99th Annual Commencement

North Carolina State University

CORRECTED COPY

Saturday, May 7
Nineteen Hundred and Eighty-Eight
Degrees Awarded 1987-88

DEGREES CONFERRED

Saturday, May 7
Nineteen Hundred and Eighty-Eight
Degrees Awarded 1987-88

This program is prepared for informational purposes only. The appearance of an individual's name does not constitute the University's acknowledgement, certification, or representation that the individual has fulfilled the requirements for a degree.

Honors listed for May 1988 candidates for degree are tentative in that they are calculated without the final semester grades.

TABLE OF CONTENTS

Musical Program

EXERCISES OF GRADUATION

May 7, 1988

Commencement Band Concert: 8:30 a.m.
Carter-Finley Stadium

Die Wachparade ..... Blankenburg
(arr.) J. R. Watson

March Juno ..... Stuart

"Seventeen Come Sunday" ..... Vaughan Williams

"Folk Songs from Somerset" ..... Vaughan Williams

America the Beautiful ..... Ward-Dragon

PROCESSIONAL: 9:00 A.M.

March Processional ..... Grundman

RECESSIONAL: (Platform Party Only)

University Grand March ..... Goldman

NORTH CAROLINA STATE UNIVERSITY COMMENCEMENT BAND
Dr. Frank M. Hammond, Conductor

EDWIN NEWMAN

Edwin Newman has been described as the only host of "Saturday Night Live" ever to moderate a presidential debate. He has also been described as the only moderator of a presidential debate ever to be host of "Saturday Night Live." In fact, he has made three appearances on "Saturday Night Live" and has moderated two presidential debates, the first Ford-Carter in 1976 and the second Reagan-Mondale in 1984.

Newman retired from NBC News early in 1984, after having been associated with the network for almost 35 years. During that time, he headed the NBC bureaus in London, Rome, and Paris, reported from three dozen countries, and anchored every kind of news program the network produced. It is said that he has taken part in more documentaries than anyone else in television history. He has also worked with the NBC Religious Programs Unit and for NBC Sports, and was the host of broadcasts from Tanglewood by the Boston Symphony Orchestra. He has taken part in the Metropolitan Opera Quiz, both as questioner and as panel member. Newman has received awards for reporting from abroad, commentary, documentary reporting, interviewing, and drama criticism, and is a Chevalier of the French Legion of Honor.

Newman's journalistic career began in Washington in 1941, after his graduation from the University of Wisconsin and a semester of graduate work at Louisiana State University. He worked first for International News Service and then for the United Press. He spent three and a half years in the Navy during World War II, and then returned to wire service and newspaper reporting until 1947, when he began two years as a news writer at CBS in Washington. He began working for NBC in London in 1949.

Newman is well-known for his views on the state of the English language. His books on the subject, *Strictly Speaking*, and *A Civil Tongue*, were best sellers. He has served as Chairman of the Usage Panel of the American Heritage Dictionary and as a consultant on a series of textbooks on grammar and composition published by Houghton Mifflin. In addition, he has written on a variety of subjects for many American, British, and Canadian publications, among them Reader's Digest, TV Guide, Harpers, Esquire, The Atlantic, the New York Times Magazine, Geo, Newsweek, Saturday Review, Psychology Today, and Punch. His comic novel, *Sunday Punch*, was published in 1979.

After his retirement from NBC, Newman became a twice-weekly columnist for King Features Syndicate. He is active on the lecture circuit, and has continued to work in television, anchoring numerous programs on PBS, including the series "Congress: We the People," and the annual conferences of former Secretaries of State. He has appeared frequently on cable television, including acting as host of two dramatic series, "Freud" and "The Borgias."

Newman and his wife, Rigel, live in New York City. Their daughter Nancy, and her husband, Henry Drucker, are members of the faculty of Edinburgh University in Scotland.

Exercises of Graduation

Carter-Finley Stadium

Chancellor Bruce R. Poulton
Presiding

May 7, 1988

PROCESSIONAL, 9:00 a.m. ..... Dr. Frank M. Hammond
Conductor, North Carolina State University Commencement Band

The Audience is requested to remain seated during the Processional.

WELCOME ..... Chancellor Bruce R. Poulton

INVOCATION ..... The Reverend Starke S. Dillard, Jr.
Assistant to the Rector
Christ Episcopal Church
Raleigh, North Carolina

NATIONAL ANTHEM ..... The Grains of Time

INTRODUCTIONS ..... Chancellor Poulton

GREETINGS ..... President C. D. Spangler, Jr.
The University of North Carolina

ADDRESS ..... Mr. Edwin Newman
Broadcast Journalist

CONFERRING OF HONORARY DEGREE ..... Chancellor Poulton

CONFERRING OF DEGREES ..... Chancellor Poulton

Candidates for Doctor of Veterinary Medicine presented by Dean of College of Veterinary Medicine. Candidates for other advanced degrees presented by Interim Dean of Graduate School. Candidates for baccalaureate degrees presented by Deans of Colleges.

ADDRESS TO FELLOW GRADUATES ..... Ms. Laura G. Lunsford
Class of 1988

RECOGNITIONS ..... Chancellor Poulton

VALEDICTORIANS—CLASS OF 1988 .....

ALMA MATER ..... The Grains of Time

RECESSIONAL (Platform Party only)

Commencement Ushers

Army ROTC Ushers

Bridges, James F.
Emmett, David L.
Evrenidis, Paul, Jr.
Garcia, Eduardo L.
Jones, Mark
Raynor, David B.
Robb, Elizabeth
Sasser, Jeffrey L.
Stokes, John R.
Troutman, Timothy C.
Wilson, Woodrow O. III
Young, James A.

Navy ROTC Ushers

Chrislip, Chris
Kirchner, Jim
Lesslie, Scott
Schadt, Mark
Syme, Scott
Womble, Thomas

Air Force ROTC Ushers

Blair, Stephen M.
Chase, Ian V.
Deal, Michael V.
Edwards, Linda R.
Farrior, Stanley M.
Haley, Jodi D.
Huber, Robert P.
Jenkins, Jeffrey J.
Kaleel, Melinda G.
Kowalske, Bryan J.
Mauro, Caroline P.
Moreno, Anthony S.
Sands, Tim
Smith, Robert G.
Thomas, James C.
Tyynismaa, Michael D.
Whitley, Charles R.
Williams, James B.
Yang, Helen

Commencement Marshals

Sheila Maureen Bennett
Paul Crenshaw Briggs
Jeffrey Franklin Cherry
Kerr Collins
Stephen Price Cook
Margaret Evelyn Cunning
David Lewis Fu
Trevor Gadson
Karen Michelle Grady
Thomas Mark Hadley, Jr.
Scott Hunter
Christopher W. Johnson
Laura Anne Lehman
Lora Ann Long
Paige Martz
Tori Marie Morhard
Brian L. Nixon
Stephanie Darrice Porter
Miriam Graham Preston
Blair Vernon Robinson
Kimberly Lynn Rowell
Cristie Anne Sealey
Victor Blaine Sitton
Steven Glen Skaggs
Anne Elizabeth Stubbins
David Keith Ward
David Lee Whiteman, Jr.
Kimberley G. Whittington
Michael Gregory Willits
John Richard Witcher, III
Leigh Ann Young

Faculty Retirements 1987-88

Alvarez, Raul Eduardo, College of Engineering, retired December 31, 1987
Amein, Michael, College of Engineering, retired December 31, 1987
Aurand, Leonard William, College of Agriculture & Life Sciences, retired December 31, 1987
Kohl, Jerome, College of Engineering, will retire June 30, 1988
Guthrie, Frank Edwin, College of Agriculture & Life Sciences, retired January 31, 1988
Konsler, Thomas Rhinehart, College of Agriculture & Life Sciences, retired December 31, 1987.
Marsland, David Boyd, College of Engineering, will retire May 15, 1988
Metzger, Robert Stephen, College of Humanities & Social Sciences, will retire May 15, 1988
Perry, Thomas Oliver, College of Forest Resources, retired December 31, 1987
Petersen, Keith Stuart, College of Humanities & Social Sciences, will retire May 15, 1988
Powell, Nathaniel Thomas, College of Agriculture & Life Sciences, will retire July 15, 1988
Register, Carolyn Crouse, College of Education and Psychology, will retire May 31, 1988
Saxe, Raymond Frederick, College of Engineering, retired December 31, 1987
Stack, Edward MacGregor, College of Humanities & Social Sciences, will retire May 15, 1988
Stannett, Vivian Thomas, College of Engineering, will retire May 15, 1988
Struble Raimond Aldrich, College of Physical & Mathematical Sciences, retired December 31, 1987

Time and Location of Distribution of Diplomas

College and Department Locations

College of Agriculture and Life Sciences—1:30 p.m.

Adult and Community College Education ... Room 1C-D, McKimmon Center, Western Boulevard
Agricultural Business Management and Agricultural Economics ..... Main Floor, Reynolds Coliseum
Agronomy, Crop Science, Soil Science and Conservation ..... 2215 and 2223 Williams Hall
Animal Science ..... Room 2, McKimmon Center
Biochemistry ..... Room 7, McKimmon Center
Biological and Agricultural Engineering ..... Weaver Laboratories Pavilion
Biological Sciences ..... 3712 Bostian Hall
- Biological Sciences Major
- Botany
- Ecology
- Entomology
- Genetics
- Microbiology
- Nutrition
- Pest Management
- Plant Pathology
- Toxicology

Food Science ..... 105 Schaub, Food Science Building
Horticultural Science ..... NCSU Arboretum, Beryl Road
Individualized Study Program ..... Location of Major Faculty Adviser
Poultry Science ..... Baptist Student Center, 2702 Hillsborough Street
Applied Sociology ..... 218 Withers Hall
Zoology ..... 222 Dabney and upper level breezeway
- Fisheries and Wildlife Sciences
- Medical Technology
- Zoology Majors

School of Design—1:30 p.m. ..... Stewart Theatre
Reception—2:30 p.m. ..... Brooks Hall Courtyard

College of Education and Psychology—1:30 p.m. except for those marked with an asterisk

Administration and Supervision ..... 220 Poe Hall
Adult and Community College Education ..... Room 1C-D McKimmon Center, Western Boulevard
Counselor Education ..... 532 Poe Hall
Curriculum and Instruction, Special Education, and Middle Grades Education ..... 412 Poe Hall
Education General Studies ..... 220 Poe Hall
*Mathematics and Science Education—2:00 p.m. ..... 216 Poe Hall
*Occupational Education: Agricultural Education, Health Occupations Education, Industrial and Technical Education, and Occupational Education —1:00 p.m. ..... 216 Poe Hall
Psychology ..... Dining Hall

College of Engineering—1:30 p.m.

Biological and Agricultural Engineering ..... Weaver Laboratories Pavilion
Chemical Engineering ..... Thompson Theater
Civil Engineering ..... Lobby of Mann Hall
Electrical and Computer
Engineering ..... Governor Holshouser Building
N.C. State Fairgrounds
Engineering Operations ..... 109 Riddick
Furniture Manufacturing and Management ..... 242 Riddick
Industrial Engineering ..... 242 Riddick
Mechanical and Aerospace
Engineering ..... University Student Center Ballroom
Materials Science and Engineering ..... McKimmon Center
Nuclear Engineering ..... North Portico, Burlington
Engineering Laboratories

College of Forest Resources—1:30 p.m. ..... Area 1A and B,
McKimmon Center, Western Boulevard

College of Humanities and Social Sciences—1:30 p.m.

Accounting, Business Management,
and Economics ..... Main Floor, Reynolds Coliseum
History ..... 100 Harrelson Hall
Multi-Disciplinary Studies Program
English, Foreign Languages and Literatures,
Philosophy and Religion ..... West Raleigh Presbyterian Church,
27 Horne Street
Political Science ..... Caldwell Hall Patio
(Rain: Caldwell Hall Lobby)
Sociology ..... 218 Withers Hall
Speech-Communication ..... Gymnastic Area,
Carmichael Gym (Rock Wall)

College of Physical and Mathematical Sciences—1:30 p.m. ..... Pullen Memorial Baptist Church
Hillsborough St. at Cox Ave.

College of Textiles—1:30 p.m. ..... Sandy Campbell Auditorium
240 Nelson Hall

ROTC COMMISSIONING CEREMONY

LIEUTENANT COLONEL HOWARD K. FISHER, JR., USA
Presiding

Stewart Theatre
May 7, 1988

PROCESSIONAL MARCH, 4:00 p.m. ..... Dr. Frank M. Hammond
Conductor, North Carolina State University Commencement Band
The audience is requested to remain seated until Processional music is completed

NATIONAL ANTHEM

INVOCATION ..... Major Van M. Jones
Chaplain, NC Army National Guard, Raleigh, NC

INTRODUCTIONS ..... Dr. Bruce R. Poulton
Chancellor, North Carolina State University

ADDRESS ..... General Maxwell R. Thurman
Commander, United States Army Training and Doctrine Command

ADMINISTRATION OF OATH
OF OFFICE ..... Lieutenant Colonel Howard K. Fisher, Jr.
Professor of Military Science
Captain Harold A. Bunch
Professor of Naval Science
Colonel Cleveland Simpson
Professor of Aerospace Studies

PRESENTATION OF CERTIFICATES ..... Dr. Bruce R. Poulton

BENEDICTION ..... Major Van M. Jones

RECESSIONAL
The audience is requested to remain seated until the Recessional music is completed.

Academic Costume

Academic gowns represent a tradition handed down from the universities of the Middle Ages. These institutions were founded by the Church; the students, being clerics, were obliged to wear the prescribed gowns at all times. Round caps later became square mortarboards; the hoods, originally cowls attached to the gowns, could be slipped over the head for warmth.

Many European universities have distinctive caps and gowns which are different from those commonly used in this country. Some of the gowns are of bright colors and some are embellished with fur. A number of these may be noted in the procession.

The usual color for academic gowns in the United States is black. The bachelor's gown is worn closed, the master's and doctor's may be worn open or closed. The shape of the sleeve is the distinguishing mark of the gown: bachelor—long pointed sleeves; master—oblong, square cut in the back with an arc cut away in front; doctor—bell shaped.

Caps are black. The tassels for the Ph.D. degree are gold and those for other graduate and professional degrees may be of the color corresponding to the trimmings on the hoods.

Of all the components of the academic costume, the hood bears the heaviest symbolic burden. The hood must make clear the level of the degree, the faculty in which it was given, and the institution which awarded it. The level of the degree is shown by the size of the hood, the width of the velvet trimming, and in the case of doctors, by the shape. The bachelor's, master's, and doctor's hoods are three feet, three and one-half feet, and four feet long, respectively. The velvet trimming in the same order is two, three, and five inches and extends all around the hood on the exposed edge. This same trimming identifies the faculty in which the degree was awarded. For each faculty there is a corresponding color; so a glance at the trimming is all that is needed to identify the faculty. A *partial* list of the colors follows: Agriculture, maize; Architecture and Art, brown; Science, golden yellow; Economics, copper; Education, light blue; Engineering, orange; Forestry, russet; Physical Education, sage green; Religion, scarlet; Speech, silver gray; Veterinary Medicine, gray; Textiles, wine red. The following faculties have the same color—dark blue: Anthropology, History, Languages, Literature, Philosophy, Political science, Sociology.

Academic Honors

Honors participants benefit from a more individualized and rigorous approach to their desired degree through special classes, seminars and individual research.

Undergraduate degree honor designations are:

Cum Laude—for GPA 3.250 through 3.499
Magna Cum Laude—for GPA 3.500 through 3.749
Summa Cum Laude—for GPA 3.750 and above.

UNDERGRADUATE DEGREES

College of Agriculture and Life Sciences

BACHELOR OF SCIENCE IN BIOLOGICAL AND GRICULTURAL ENGINEERING

Jointly administered by the College of Agriculture and Life Sciences and the College of Engineering. See page 19 under the College of Engineering for a listing of the graduate seniors in the jointly administered program.

BACHELOR OF SCIENCE IN CONSERVATION

Jointly administered by the College of Agriculture and Life Sciences and the College of Forest Resources.

Degree Conferred June 24, 1987

Mark Bruce Ethridge ..... Swansboro

Degrees Conferred December 15, 1987

Anne Elizabeth Cain ..... Hamptonville
Andrew John Johnstone ..... Garner
Stuart Scott Thompson ..... Vienna, VA

Degrees Conferred May 7, 1988

*Karol Lynn Knapp ..... Pleasant Valley, NY
***Rebecca Kay Robertson ..... Old Fort
Robert Palmer Willcox, Jr. ..... Raeford

BACHELOR OF SCIENCE IN AGRICULTURAL BUSINESS MANAGEMENT

Degree Conferred June 24, 1987

Steve Howard Herrell ..... Monroe

Degrees Conferred August 5, 1987

Robin Elise Brantley ..... Apex
Robert Delos Peterson ..... Charlotte

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Degrees Conferred December 15, 1987

Lisa Helen Davis ..... Crouse
Diana Lynne Lanier ..... Clarkton
Gail Varo Neels ..... Hydes, MD
†Andy Cade Norton ..... Whiteville

Degrees Conferred May 7, 1988

Ricardo Nedic Ashford ..... Goldsboro
Diane Mia Bateman ..... Raleigh
James Ralph Britt, Jr. ..... Mount Olive
†**Vernon Neal Cox ..... Tabor City
Alfred Forrest Denise III ..... Siler City
David Lyell Evans ..... Saint Pauls
Dallas Preston Garner ..... Newport
Beverly Joy Green ..... Gastonia
†Wesley Hiott Huffines ..... Burlington
†Margaret Mary Kozik ..... Charlotte
**Julie E. Marlatt ..... Broadus, MT
Ernest Gordon Marlette ..... Graham
Jeffrey Scott Overcash ..... Mooresville
Frederick Fleming Pollard ..... Robersonville

BACHELOR OF SCIENCE IN AGRICULTURAL ECONOMICS

Degrees Conferred August 5, 1987

Johnny Carson Barnes ..... Spring Hope
John Douglas Bunting ..... Pinetops

Degrees Conferred December 15, 1987

Charlie Leslie Manning III ..... Bethel
John Horton Wright, Jr. ..... Jamestown

BACHELOR OF SCIENCE IN AGRONOMY

Degree Conferred August 5, 1987

Kenneth Randall Ray ..... Hillsborough

Degrees Conferred December 15, 1987

Michael Robert Decker ..... Lenoxdale, MA
Kenneth David Fishback ..... Lexington
William Alfred Gardner ..... Wilson
Michael Don Harman ..... Raleigh
***James Latham Hodges, Jr. ..... Washington
Robert Edward Hyman ..... Oak City
Michael Mewborn Smith ..... Goldsboro
William Alan Ward ..... Ash

Degrees Conferred May 7, 1988

*Joseph Carroll Black ..... Seaview, VA
Darren Neal Cecil ..... Thomasville
Franklin Wyette Howey, Jr. ..... Monroe
†Douglas Clyde Lowe ..... High Point
Thomas Glen Pegram ..... Shelby

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Jon Lee Stewart ..... Buies Creek
Grace Carol Summers ..... Browns Summit
*Ralph Lloyd Warren, Jr. ..... Mount Olive
Phillip Doddridge Winslow ..... Hertford
Michael Wade Worthington ..... Greenville

BACHELOR OF SCIENCE IN ANIMAL SCIENCE

Degrees Conferred June 24, 1987

H*Mark Wakefield Hamrick ..... Mocksville
†Evander Lee McGregor, Jr. ..... Raleigh
H**Bentley Miles Stephenson ..... Pinehurst
***Wendy Jane Underwood ..... Raleigh

Degrees Conferred August 5, 1987

Douglas Gray Best ..... Dunn
Christopher Gerard McGreevy ..... Raleigh
Mary Ann Schreiber ..... Ridgefield, CT
*Patrick Alan Sustar ..... Charlotte

Degrees Conferred December 15, 1987

Edward Javier Berkhoff ..... Raleigh
H***Yvonne Diane Carter ..... Shelby
Joanne Amelia Decker ..... Durham
Diane Elizabeth Essick ..... Raleigh
Jennifer Ann Hansen ..... Charlotte
Terese Novick ..... Raleigh
Dorothy Ellen Primrose ..... Washington, DC
Kelly Neal Reep ..... Lincolnton
Christopher Carl Reeves ..... Sparta
Sylvia Lane Sullivan ..... Garner
Mark Thomas Walton ..... Mocksville

Degrees Conferred May 7, 1988

Roy Lee Abernathy ..... Morganton
*David Edgar Anderson ..... Oak Ridge
Elizabeth Scott Atwell ..... Raleigh
Danny James Bledsoe ..... Dobson
H**Cynthia Denise Burnett ..... Charlotte
Michael Darien Cain ..... Hamlet
H†Tina Marie Cecil ..... High Point
†Stephen Lane Collier ..... Zebulon
H*Johnny Dale Dellinger ..... Lincolnton
†John Joseph Euchner, Jr. ..... Gastonia
Brian Carr Griffin ..... Windsor, VA
**Robert Samuel Hanes, Jr. ..... Raleigh
Martin Roy Ingram ..... Raleigh
DeLane Marie Isley ..... Burlington
†Margaret Mary Kozik ..... Charlotte
Craig Ross Lennon ..... Bladenboro
Margaret Keesler Marshall ..... Raleigh
***Kevin Neil McKisson ..... Henderson
**Tracy Anne Meadows ..... Charlotte
H Joan Leigh Metcalf ..... Hendersonville
Sharon Murphy Nelson ..... Greensboro

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Christopher Lamar Parrish ..... Raleigh
Alison Williams Peeler ..... Durham
April Elizabeth Peters ..... Greensboro
Cindy Lee Robinson ..... Raleigh
Jeffrey Dawson Shelley ..... Laurel Hill
H***Mary Rena Smith ..... Rocky Mount
Angela Kathleen Staley ..... Rockingham
H Susan Rose Tilley ..... Oak Ridge
H*James Edward Tuck, Jr. ..... Graham
Brenda Ivy Watson-Czuwala ..... Brooklyn, NY
H Wendy Kay Welch ..... Hope Mills
H†***Sherry Lynn Wilson ..... Warrenton
Teena Wooten ..... Hookerton

BACHELOR OF SCIENCE IN APPLIED SOCIOLOGY

Degree Conferred December 15, 1987

Richard White Skinner ..... Hertford

Degree Conferred May 7, 1988

***Cynthia Bell Buzzard ..... Raleigh

BACHELOR OF SCIENCE IN BIOCHEMISTRY

Degrees Conferred June 24, 1987

Stewart Keyth Roten ..... Durham
Melissa Ann Skertich ..... Fayetteville

Degrees Conferred December 15, 1987

H***Said Ali Suleiman Al-yahyaee ..... Bahla, Oman
H†*Annamarie Klas Anderson ..... Raleigh
**David Scott Donaldson ..... Charlotte
†Lisa Elinor Eklund ..... Raleigh
†Sarah Elisabeth Glover ..... Asheboro
H†**Lisa Lynne Haney ..... Indialantic, FL
William Fuller Hunt ..... Durham
Evelyn Santos Moreno ..... Fayetteville
*Stuart Wilson Pullen ..... Raleigh
†David Ward Rusnak ..... Raleigh
†Katherin Spotswood Teer ..... Raleigh
†Nancy Graham Waff ..... Statesville
†*Lisa Eugenia Williams ..... Wilmington
H†*Rhonda Michelle Winstead ..... Nashville

Degrees Conferred May 7, 1988

H**Jill Christine Akkerman ..... Raleigh
H†**Lorrie Valentina Apple ..... Reidsville
Marietta Austin ..... Raleigh
Lance Richard Brooks ..... Fayetteville
H***Sheryl Denise Brown ..... Kinston
H*Gordon Edward Cashin ..... Richmond, VA
**Diana Lynne Crawford ..... Fayetteville
†John Paul Dekker III ..... Fayetteville
†***Shelia Crocker Hopkins ..... Selma

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

H*Leanne Kay Madre ..... Poquoson, VA
H*Erik Alexander Manring ..... Reston, VA
Michael Charles McFadden ..... Raleigh
Karen Annette Motsinger ..... Lexington
H***Donna Gail Patterson ..... Elon College
H***Lillian Hamilton Rinker ..... Burlington
Christine Lawrence Sumerel ..... Hillsborough
H***Shawn Michael Toffolo ..... Horseheads, NY
***Johnny Clayton Weeks III ..... Burlington
Nathan Dean Whitehurst ..... Burlington
Alisa Ann Windley ..... Raleigh
H†***Jennifer Rose Wood ..... Raleigh
H**Lynnette Michelle Wyatt ..... Wilmington

BACHELOR OF SCIENCE IN BIOLOGICAL AND AGRICULTURAL ENGINEERING TECHNOLOGY

Degree Conferred June 24, 1987

Elizabeth Umstead Studenberg ..... Garner

Degree Conferred August 5, 1987

Gregory Lee Hodges ..... Chocowinity

Degrees Conferred December 15, 1987

James Milton Bass II ..... Fayetteville
Joseph Phillip Garbo ..... Hope Hills
David Lawrence Godwin ..... Benson
Daniel Locke McKenzie ..... Gastonia
Randall Fred Pasley ..... Grassy Creek
**Lloyd Harrill Roberts ..... High Point
Gary Robert Scalf ..... Bath
Timothy Slade Seagroves ..... Cary

Degrees Conferred May 7, 1988

Brian Robert Bradshaw ..... Newton
†**Vernon Neal Cox ..... Tabor City
*John Martin Gann ..... Asheboro
Gregory Fielding Kirtley ..... Wilmington, DE
Eric Drew Menscer ..... Fayetteville

BACHELOR OF SCIENCE IN BIOLOGICAL SCIENCES

Degrees Conferred June 24, 1987

H*Carla Armstrong Dennis ..... Raleigh
Rana Jawdat Mohammad ..... Amman, Jordan
Jeanne Marie Salisbury ..... Saint Pauls

Degrees Conferred December 15, 1987

Sandra Louise Barber ..... Fayetteville
**Margaret Treuting Edwards ..... Clayton
†Lisa Elinor Eklund ..... Raleigh
H*Margaret Elizabeth Grau ..... Raleigh
Peter Jordan Harris ..... Raleigh
Dannie Corinne Harrison ..... New Bern
Erica Anne Headley ..... Raleigh

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Carolyn Margaret Holt ..... Summit, NJ
*Scott Allen Kirchner ..... Shelby
†Melinda Kay Lamb ..... Thomasville
William Nash McCachren, Jr. ..... Mount Airy
Sharon Fry Newman ..... Frankfort, KY
H***John David Norris ..... Havelock
Keith Alfred Peoples ..... Raleigh
†David Ward Rusnak ..... Raleigh
†Katherin Spotswood Teer ..... Raleigh
†*Lisa Eugenia Williams ..... Wilmington
Pamela Lynn Woollard ..... Gastonia
Elizabeth Ellen Young ..... Raleigh
*Frank Sherrill Young ..... Charlotte

Degrees Conferred May 7, 1988

H**Ahmed Khalfan Al-Mughtasi ..... Izki, Sultanate of Oman
H†**Elizabeth Hill Austin ..... Raleigh
H Michele Elizabeth Becker ..... Goldsboro
H***Lisa Ann Brone ..... Absecon, NJ
H***David Allen Browder ..... Weldon
**Laura Nicole Callis ..... Marshfield, MA
H*Marlana Kathryn Chapin ..... Potomac, MD
†William Lester Crowell, Jr. ..... Charlotte
†John Paul Dekker III ..... Fayetteville
**Thomas Joseph Ellis ..... Wilson
H**Angela Louise Galey ..... Fayetteville
H***Daniel Henry Johnson ..... Rocky Mount
Lynetta Michelle Johnson ..... Siler City
Jonathan Eric Lamb ..... Oak Ridge
Peter Joseph Leget ..... Vienna
**Jeanne Elaine Miller ..... Pineville
Joanna Belle Miller ..... Wilson
Christina Ruth Murchison ..... Goldston
Beverly Jean Ramsey ..... Watha
Martha Allyn Richardson ..... Greenville
H Cynthia Gineane Seal ..... Kill Devil Hills
Karen Linda Sokolove ..... Raleigh
Victor Alfred Varela ..... Winston-Salem
Leslie Ann Walrath ..... Corning, NY
John Weaver Young ..... Durham

BACHELOR OF SCIENCE IN BIOLOGICAL SCIENCES (Microbiology)

Degree Conferred June 24, 1987

H**Julie Waters Lynch ..... Raleigh

Degrees Conferred December 15, 1987

Dana Marie Agnell ..... Raleigh
Alan Clarke Buck ..... Basking Ridge, NJ
Sandra Fay McManus ..... Hamlet
Laura Anne Niver ..... Raleigh
H†*Rhonda Michelle Winstead ..... Nashville

Degrees Conferred May 7, 1988

H**Tammy Lynn Bannerman ..... Statesville
Roxanne Fletcher House ..... Franklinton

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Lourdes Maria Saap ..... San Juan, Puerto Rico
H***Laura Therese Whritenour ..... Lumberton

BACHELOR OF SCIENCE IN BOTANY

Degrees Conferred December 15, 1987

Ronald Wayne Gagliardo ..... Elizabeth, NJ
†***Andrea Michelle Herr ..... Lancaster, PA

Degree Conferred May 7, 1988

Michael Ashton Berdine ..... Parkersburg, WV

BACHELOR OF SCIENCE IN FISHERIES AND WILDLIFE SCIENCES

Degrees Conferred June 24, 1987

Tony Van Brabble ..... Plymouth
Elizabeth Jane Waldrop ..... Greensboro

Degree Conferred August 5, 1987

Sharon Lynn Briles ..... Asheboro

Degrees Conferred December 15, 1987

LaVerna Beth Davis ..... Randleman
Walter Daniel Giese ..... Jacksonville
Christopher Michael Heath ..... Commack, NY
Bradley Dean Hoyle ..... Cherryville

Degrees Conferred May 7, 1988

**Roger Darrel Bryan ..... Hudson
Kurtis Lowell Gregg ..... Morehead City
H Susan Kathleen Hansen ..... Winston-Salem
***Jennifer Ryder Howard ..... Durham
***Michael Ray Lusk ..... Wilmington
Wallace Lathan McAnulty ..... Asheboro
Medhat Mansour Hussein Mansour Mohamed ..... Raleigh
John Victor Stauber ..... Memphis, TN
***Jonathan Edward Thompson ..... Winston-Salem
Jack Lionel Todd ..... Whiteville

BACHELOR OF SCIENCE IN FOOD SCIENCE

Degrees Conferred December 15, 1987

Laura Alison Anderson ..... Hockessin, DE
Sandra Kay Metko ..... North Syracuse, NY

Degrees Conferred May 7, 1988

Mary Margaret Brake ..... Rocky Mount
Diuana Genita Davis ..... Trinity
Jennifer Ann Faris ..... Chapel Hill
Margaret Byrd Knight ..... High Point
Elizabeth Anne Martin ..... Cary
Jennifer Lynn Maruri ..... Laurel, MD
Rana Jawdat Mohammad ..... Amman, Jordan

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Whitney Anne Obrig ..... Delmar, NY
*Elizabeth Edgington Rushin ..... Raleigh
***Rabab Ahmad Saadi ..... Amman, Jordan
Joan Christine Redecker Sims ..... Raleigh
Sarah Jane Smith ..... Charlotte
Andrea Lynn Twiford ..... Rocky Mount
Francesca Vesce ..... Raleigh

BACHELOR OF SCIENCE IN HORTICULTURAL SCIENCE

Degrees Conferred August 5, 1987

Mark St. John Clapp ..... Fayetteville
Tod Jerome Williams ..... Whiteville

Degrees Conferred December 15, 1987

Ronald Eugene Dean ..... Raleigh
Charles Samuel Echerd ..... Raleigh
Mark Edward Gantt ..... Conover
John Paul Guidon ..... Powhatan, VA
Jay Dean Lang ..... Cary
James Thornton Mitchell ..... Raleigh
Randolph Walter Morgan ..... Buffalo, NY
***Thomas Benton Moss II ..... Enfield
Jodi Maria Robinson ..... Falls Church, VA
Angela Leigh Soles ..... Shallotte

Degrees Conferred May 7, 1988

Kenneth Wayne Bailey ..... Fayetteville
Robert Eugene Boyd ..... Hope Mills
David Andrew Crow, Jr. ..... Huntsville, AL
†Wesley Hiott Huffines ..... Burlington
William Ransom Johnston ..... Wilson
H John David Leford ..... Lincolnton
†Douglas Clyde Lowe ..... High Point
Robert Willard Luther III ..... Elizabeth City
Kathryn McWhorter Morgan ..... Fayetteville
Carolyn Frances Powell ..... Raleigh
Winifred Wynn Strickland ..... Charlotte
Bruce Andrew Wagoner ..... Gibsonville
Micah Kevin Weston ..... Richlands

BACHELOR OF SCIENCE IN INDIVIDUALIZED STUDY PROGRAM

Degree Conferred May 7, 1988

Susan McDermott Edmondson ..... Raleigh

BACHELOR OF SCIENCE IN MEDICAL TECHNOLOGY

Degrees Conferred August 5, 1987

Nathan Devaughan Bell, Jr. ..... Clinton
H*Elizabeth Anne Brown ..... Norristown, PA
Karen Renee Smith ..... Fayetteville
Ann Therese Winders ..... Raleigh

Degrees Conferred December 15, 1987

H**Penny Helane Wall ..... Reidsville

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

BACHELOR OF SCIENCE IN PEST MANAGEMENT FOR CROP PROTECTION

Degree Conferred May 7, 1988

Ellen Susan Blenk ..... Goldsboro

BACHELOR OF SCIENCE IN POULTRY SCIENCE

Degrees Conferred June 24, 1987

*Steven Richard Clark ..... Morganton
†Evander Lee McGregor, Jr. ..... Raleigh

Degrees Conferred May 7, 1988

Donna Kaye Carver ..... Roxboro
†Stephen Lane Collier ..... Zebulon
Wayland Thomas Davis, Jr. ..... Beulaville
David Christie Duncan III ..... Raleigh
†John Joseph Euchner, Jr. ..... Gastonia
Teddy Ray Godbey ..... High Point
William Andrew McRee ..... Raleigh

BACHELOR OF SCIENCE IN WILDLIFE BIOLOGY

Degree Conferred December 15, 1987

Russell Dwayne Branch ..... Rowland

BACHELOR OF SCIENCE IN ZOOLOGY

Degrees Conferred June 24, 1987

Clarice Bratton ..... Asheville
**Susan Marie Dermer ..... High Point
Susan Gibson Johnson ..... Greensboro
H**Lemuel Broome Kirby ..... Durham
Brent Alan Solomon ..... Raleigh
Shonna Bartlett Tompkins ..... Eureka

Degrees Conferred August 5, 1987

Charles Kendrick Cheek ..... Raleigh
Donna Marie Lindeman ..... Belair, MD
Henry Stuart Marr ..... Gastonia
Margaret Anne Parker ..... Raleigh
Raymond Jacob Sabella ..... Raleigh
William Carl Stewart ..... Pineola

Degrees Conferred December 15, 1987

H†*Annmarie Klas Anderson ..... Raleigh
Diane Elizabeth Ashby ..... Goldsboro
Cynthia Kay Baker ..... Asheville
*Patricia Diane Ballenger ..... High Point
Lesli Bernadette Barrett ..... Richmond, VA
Rosina Angela Collins ..... Fayetteville
Connie Lynn Davis ..... Elizabethtown
Robin Renee DuBois ..... Goldsboro
H*Karen Anne Grossmann ..... Raleigh
Judith Anne Heath ..... Greenville
Douglas Edward Hefner ..... Hickory

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Andrey Ann Mignacci ..... Raleigh
David Lewis Moncol ..... Garner
Tammy Lynn Moser ..... Pittsburgh, PA
Lisa Bernadine Palmer ..... Fayetteville
Steven Lee Pleasants ..... Raleigh
H**John Walton Sanders III ..... Chattanooga, TN
*Sarah Ruth Snyder ..... Monroe
William Daniel Stancil, Jr. ..... Raleigh
Jill Ann Traywick ..... Monroe
Martha Ann Tucker ..... Rockville, MD
*Kenneth McNeil Welborne ..... Charlotte

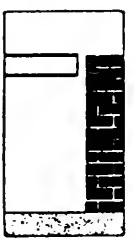
Degrees Conferred May 7, 1988

Mark Anthony Allen ..... Lumberton
H†**Lorrie Valentina Apple ..... Reidsville
Carolyn Joan Ashfield ..... Raleigh
William Quentin Best ..... Monroe
John Emerson Bisi ..... Selden, NY
H***Pamela Kay Blackburn ..... Lexington
*Brian Wayne Bozzo ..... Centerville, OH
Andrew Thomas Bruce ..... Cullowhee
Jennifer Anne Bruce ..... Fair Haven, NJ
†H Tina Marie Cecil ..... High Point
Susan Elizabeth Childers ..... Havelock
H**Kathleen Noel Christensen ..... Fairfax, VA
Susan Denise Combs ..... Burlington
†William Lester Crowell, Jr. ..... Charlotte
Catherine Michelle Daugherty ..... Winston-Salem
Kenneth Ronald Edgar ..... Hudson
Jerry Newcomb Ellington, Jr. ..... Henderson
Elizabeth Ann Fenstermacher ..... Collegeville, PA
H*Marcy Lynne Fetter ..... Raleigh
Tonya Leigh Fitts ..... Granite Falls
James Randerson Downing Flowers ..... Wilson
Allyson Ford Foster ..... Adelphi, MD
Tamera Leigh Hamilton ..... Raleigh
Lisa Robin Harmon ..... Charlotte
***Brian Keith Harris ..... Wilson
H Mark William Harris ..... Hillsborough
***Halvor Warren Hem IV ..... Raleigh
*Samuel Crawford Hill IV ..... Fayetteville
H**James Bennett Holleman, Jr. ..... Willow Springs
Delores Clara Hovey ..... New Bern
H*George VanBuren Huffmon III ..... Fayetteville
Lori Kay Illing ..... Raleigh
H John Alan Kushner ..... Fayetteville
David Earl Lennard ..... Plant City
H**Bonnie Hough Lipke ..... Charlotte
Sharon Annette Lipper ..... Raleigh
Kelley Leigh Long ..... Raleigh
**William Edward Mangano ..... Raleigh
Yvette Louise McAlister ..... Fayetteville
*Kimberly Ann McDuffie ..... Charlotte
Leslie Marie Moran ..... Raleigh
H**Jerry William Mullis, Jr. ..... Mint Hill
H*Christopher Joel Neville ..... Memphis, TN

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

***Robert Jay Nix ..... Vidalia, GA
**Kathryn Love Ormsby ..... Rockingham
†Derek James Parks ..... Goldsboro
***Armando Pizzoni-Ardemani ..... Padova, Italy
Holli Vann Poe ..... Laurinburg
John Anderson Powell, Jr. ..... Baltimore, MD
H John Flint Rhodes, Jr. ..... Raleigh
Steven Thomas Riesenberg ..... Monmouth Junction, NJ
**Bryan Eric Rodgers ..... Fayetteville
Craig Thomas Rumple ..... Statesville
Frank Lee Shealy ..... South Boston, VA
Ronald Wilson Shearon, Jr. ..... Rolesville
Denise Heather Smith ..... Raleigh
Harold Brian Stegall ..... Warrenton
Clarence Milton Stewart ..... Colerain
Vonda Lakecia Stewart ..... Colerain
Evelyn Sue Stutts ..... Charlotte
**Douglas Vance Sumerford ..... Aberdeen
Kara Michelle Utter ..... Raleigh
H**Diann Lynn Weddle ..... Eden
Rodney Preston Willis ..... Raleigh
H†***Sherry Lynn Wilson ..... Warrenton
Deborah Alise Woltersdorf ..... Birmingham, AL
H†***Jennifer Rose Wood ..... Raleigh
H Stacey Barbara Young ..... Fort Washington, MD

School of Design



BACHELOR OF ARCHITECTURE

Degrees Conferred May 7, 1988

Cynthia Louise Bandy ..... Matthews
Christopher Pemberton Bell ..... Goldsboro
*Benjamin Barry Cahoon ..... Engelhard
*Douglas Lee Hall, Jr. ..... Sanford
*Edwin Weaver Hargrave ..... Raleigh
*Nathan Charles Isley ..... Durham
Carolyn Louise Jones ..... Miami, FL
Kenneth Charles Newell ..... Lake Wylie, SC
***Katherine Ann Nielsen ..... Sanford
Danny Kerron Wayne Owens ..... Grand Cayman, Cayman Islands
*Quinn Noel Pillsworth ..... Winston-Salem
Dallas Ray Proctor ..... Rocky Mount
Donald James Rethman ..... Fort Loramie, OH
Mark Lloyd Ruetschle ..... Kettering, OH

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Leigh-Ann Freeman Stewart ..... Durham
Jeffrey Brent Yelton ..... Charlotte

BACHELOR OF ENVIRONMENTAL DESIGN

Degrees Conferred December 15, 1987

Jorge Enrique Barragan ..... Mexico City, Mexico
**Natalie Suszanne Chanin ..... Florence, AL
Robin Lynn Pelt ..... Griffin, GA

Degrees Conferred May 7, 1988

*Timothy Wendell Buie ..... Welcome
Robin Cordell Mangum ..... Sparta

BACHELOR OF ENVIRONMENTAL DESIGN IN ARCHITECTURE

Degree Conferred June 24, 1987

Katherine Belle Ponder ..... Cullowhee

Degrees Conferred August 5, 1987

William David Hardister ..... Asheville
*Rana Abdulrahim Irshaid ..... Kuwait, Kuwait
***Katherine Ann Nielsen ..... Sanford

Degrees Conferred December 15, 1987

Darryl Eugene Belton ..... Winston-Salem
John Kendall Farnum ..... Columbia, SC
Bruce Eugene Fisher ..... Goldsboro
Eugene Henry Hester ..... Liberty
Richard Covington Lambeth II ..... Thomasville
Mark Peter Melaragno ..... Charlotte
Gregory Jerome Mondin ..... Rockville, MD
Jon David Peeples ..... Lincolnton
Joseph Anthony Schneider ..... Wilton, CT
Craig Andrew Spiegel ..... Sayville, NY
**Paul Brian Tennyson ..... Greensboro
Anne Elizabeth Williams ..... Smithfield

Degrees Conferred May 7, 1988

Peter John Almasy ..... Raleigh
Brian Whitley Baker ..... Goldsboro
Quan Tinh Banh ..... Chapel Hill
Jason Edward Bell ..... Reidsville
Karl Frederick Burkheimer ..... Bahama
Kimberly Elaine Clements ..... Leesburg, FL
James Archie Courter II ..... Raleigh
Jennifer Gay DeMent ..... Richmond, VA
George Donald Dudley, Jr. ..... Greensboro
Rebecca Jo Duser ..... Largo, FL
Robert David Foster, Jr. ..... Raleigh
William Thomas Goodwin, Jr. ..... Elizabeth City
Michael Verner Greene ..... Winston-Salem
George Capers Hemingway III ..... Tarboro
*Robert Andrew Hoffman ..... Lumberton

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Michael William Huntanar ..... Fayetteville
Bessie Angelo Kortesis ..... Winston-Salem
Linda Margery Malone ..... Alexandria, VA
Nathan Glen Maune ..... Little Rock, AR
Donna Ruth Beaty McPherson ..... Raleigh
***Brian Scott O'Kelley ..... Greensboro
Nicole Anne Pillorgé ..... Baltimore, MD
**Sally Dabney Staub ..... Charlotte
***Daniel James St. Clair ..... Winston-Salem
James Bolling Sullivan IV ..... Beaufort
Krista Joan Williams ..... Sparta, NJ
David Scott Wilson ..... Fayetteville
Vernette Artherine Wattington ..... McLeansville

BACHELOR OF ENVIRONMENTAL DESIGN IN LANDSCAPE ARCHITECTURE

Degrees Conferred May 7, 1988

*Joel Haden Evans ..... Charlottesville, VA
Matthew John Ingalls ..... Fayetteville
Kimberly Lynn May ..... McLeansville
**William Lee Wilson ..... Statesville

BACHELOR OF ENVIRONMENTAL DESIGN IN PRODUCT DESIGN

Degree Conferred June 24, 1987

Emma Eastman Godfrey ..... Pound Ridge, NY

Degrees Conferred August 5, 1987

Paul Marcus Flanagan ..... Raleigh
Vincent Edward Gardner ..... Ayden
Kathryn Marie King ..... Lebannon, OH

Degrees Conferred December 15, 1987

*Jane Maria Burchard ..... Svendborg, Denmark
John Phillip Goodson ..... Raleigh

Degrees Conferred May 7, 1988

Jon Eric Anderson ..... Raleigh
Melissa Carolyn Blackmon ..... Hope Mills
*Jamie Nell Cavin ..... Landis
Amber Jo Clemons ..... Cary
Margaret Brooks Greene ..... Boone
*Amy Louise Krapp ..... Charlotte
Michael John Muscarella ..... Westhampton, NY
Scott Thomas Shankle ..... Raleigh
Vernon Frank Tolliver ..... Sanford

BACHELOR OF ENVIRONMENTAL DESIGN IN VISUAL DESIGN

Degrees Conferred June 24, 1987

*Allyson Beth Abbott ..... New Bern
*Jane O'Neal Fisher ..... Raleigh
*Vera Inez Gregory ..... Angier

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Degree Conferred August 5, 1987

**Linda McGrath Fordham ..... Raleigh

Degrees Conferred December 15, 1987

Julie Anne Harris ..... Goldsboro
Lois Ann Jensen ..... Raleigh
Nancy Crockett Miller ..... Raleigh
*Julie Lynn Purdum ..... Mobile, AL

Degrees Conferred May 7, 1988

Amy Johannah Bullard ..... Durham
Robert Adam Burns ..... Raleigh
**Douglas John Clouse ..... Pittsboro
**Tracy Lynn Dunfee ..... Raleigh
Jan Elizabeth Goodwin ..... Louisburg
Rebecca Marie Hansen ..... Charlotte
Denise Hazel Hatcher ..... Raleigh
**Beverly Robinson Murray ..... Raleigh
Sheila Lynn Nichols ..... Jamestown
**Elaine Guberman Selden ..... Raleigh
John Michael Teska ..... Raleigh
Gregory Earl West ..... Fayetteville
Janet Ross Willis ..... Durham

College of Education

BACHELOR OF ARTS IN PSYCHOLOGY

Degrees Conferred June 24, 1987

Martin Eric Lance ..... Devon, PA
William Kent Spears ..... Conover

Degrees Conferred August 5, 1987

Pauline Loring Dwight ..... Lincolnton
Alexander Otis Matthews ..... Washington, DC

Degrees Conferred December 15, 1987

Tammy Lorene Barrow ..... Summerfield
Dayna Lynn Bayles ..... Erwin
*John Lamar Edwards ..... Ayden
***Sheila Reneé Greene ..... Lenoir
Kara Suzanne Harkins ..... Cary
Lori Jean Ketring ..... Cary
Anne Hughes Mauney ..... Gastonia
Carla June Myers ..... Raeford

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Susan Rooney Myers ..... Louisburg
***Karen Paquette Parkes ..... Greensboro
Timothy Garner Stewart ..... Lexington
Eugenia Marie Tucker ..... Raleigh

Degrees Conferred May 7, 1988

***Stella Eileen Anderson ..... New Bern
Maria Andracchio ..... Rocky Mount
Angela Woolard Benson ..... Willow Springs
Kimberly Bistis ..... Millington, NJ
Belinda Faye Blackwood ..... Elon College
***Felicia Maria Bowen ..... Cary
Peggie E'Lisa Brafford ..... Raleigh
**Roger Alan Davenport ..... Raleigh
Charles Derek Dickens ..... Greenville
Dawn Marie Dillon ..... Southern Pines
Margaret Elizabeth Dixon ..... Binghamton, NY
***Mary Froese Enns ..... Raleigh
**Paula Diane Foley ..... Raleigh
Cindy Kay Fread ..... Kearney, NE
Sallie Michelle Gardner ..... Belmont
Dawn Alicia Grainger ..... Shalimar, FL
***Sharon Wolfe Hepp ..... Charlotte
Al Brenner Herr, Jr. ..... Cary
Anthony Hubert ..... Raleigh
Lillian Jeanne Jacumin ..... Shelby
*Lisa Jill Johnson ..... Knoxville, TN
**Linda Darlene Jones ..... Winston-Salem
Nancy Jean Joyner ..... Zebulon
*Charles Edward Knott, Jr. ..... Durham
*Laura Gail Lunsford ..... Durham
Ivanna Kay Mann ..... Columbus, OH
Laura Lynn Murdock ..... Columbus, OH
Bruce Duane Radcliffe ..... Cary
Lisa Ann Spruill ..... Virginia Beach, VA
Donnell Winders Taylor ..... Faison
Terri Leslie Vess ..... Old Fort
*Mary Melinda Wagoner ..... Gibsonville
Elizabeth Ann Wahl ..... Raleigh
**Gay Haley Walker ..... Cary
*Jennifer Fleming Wells ..... Greensboro

BACHELOR OF SCIENCE IN EDUCATION

Agricultural Education

Degree Conferred June 24, 1987

*Mark Thomas Dalton ..... Hendersonville

Degrees Conferred December 15, 1987

Michael Wayne Bennett ..... Oak City
Herman Edward Croom ..... Pikeville
John Ray Davis, Jr. ..... Louisburg
H***Charlie Michael Wilder ..... Bunn

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Degrees Conferred May 7, 1988

*John Burke Carpenter, Jr. ..... Bessemer City
Wayne Phillip Farrar ..... Lillington
Gregory Howard Grayson ..... Shelby
Arlen Franklin Johnson ..... Asheboro
John Patrick Jones ..... Faison
Susan Barrier McKee ..... Concord
Richard Dewitt Peed, Jr. ..... Chocowinity
Eric Thomas Powers ..... Sanford

General Studies

Degree Conferred December 15, 1987

James Douglas Howard ..... Wayne, PA

Degrees Conferred May 7, 1988

William Cardinal Cowen ..... Raleigh
George Henry Koop ..... Raleigh
David John Meyers ..... Zebulon
Ricky Rashae Morris ..... Charleston
Wilfred Lee Robbins ..... Willard
Roxanna Haunani Staton ..... Fayetteville

Health Occupations Teacher Education

Degree Conferred August 5, 1987

***Debby Roscoe Nettles ..... Hamlet

Degree Conferred December 15, 1987

*Helen Nordan Campbell ..... Cary

Degrees Conferred May 7, 1988

*Wendy Lou Aiken ..... Benson
**Vera Faulconer Barnes ..... Smithfield
***Roselyn Kouhi Egan ..... Raleigh
**Elizabeth Parrish Seitz ..... Garner

Industrial Arts Education

Degree Conferred August 5, 1987

Doyle Felton Blalock ..... Colfax

Degrees Conferred December 15, 1987

Randy Norman Lowder ..... Hamptonville
James Clarence Morgan III ..... Bath
William Hoke Page, Jr. ..... Raleigh
Kathy Sue Ussery ..... Star

Degrees Conferred May 7, 1988

Joey Silas Clemmons ..... Wilmington
Rodney Leon Whaley ..... Garner

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Marketing Education for Teachers

Degree Conferred May 7, 1988

***Christie Leigh Bradsher ..... Rolesville

Mathematics Education

Degrees Conferred December 15, 1987

Tammy Reneé Atkinson ..... Raleigh
Robert Kenneth Delmar Boone ..... Emporia, VA
Gregory Eugene Chamblee ..... Selma
Ann Marie Chapoton ..... Morehead City
Jennifer Elaine Ellington ..... Chester, VA
Valerie Ann Gade ..... Fort Pierce, FL
Donna Lynn Goodfred ..... Jacksonville
***Andrew Ralph Herr ..... Berea, OH
Julie Crafton McAlister ..... Reidsville
*Kathleen Meghan Murray ..... Raleigh
John Edward Pritchett ..... Wilmington
*Traci Lynn Roberson ..... Robersonville

Degrees Conferred May 7, 1988

Kristine Ann Balbo ..... Rutherfordton
*Jacqueline June Barnwell ..... Hendersonville
John Randall Bridges ..... Franklinton
**Billy Ray Brown, Jr. ..... Thurmond
*Rebecca Ann Brown ..... Hays
Michael Warren Byrd ..... Greensboro
†Pamela Dawn Edmondson ..... Tarboro
John Randall Goodfred ..... Jacksonville
*Tamara Rae Hatcher ..... Raleigh
Lindley Baxter Hayworth ..... High Point
Brian Stewart Hemric ..... Ronda
Lydia Truc Le ..... Goldsboro
Michael John Legeros ..... Morehead City
Julia Rebecca McGee ..... China Grove
***Ninette Yvonne Ribet ..... Rutherford College
Kimberly Paige Rogers ..... Thomasville
†Teresa Faye Rogers ..... Mebane
Christi Lynn Stikeleather ..... Waxhaw

Mathematics Education, Middle Grades Concentration

Degrees Conferred May 7, 1988

Mary Allison Bradley ..... Greensboro
Marcelle Josephine Daughtry ..... Clinton
Sidney Linn Heilig ..... Greensboro
**Brenda Gay Lee ..... Dunn
*Donna McIver Ratliff ..... Wilmington
**Jane Elizabeth Wiggs ..... Cary
Mary Alice Williams ..... Cary

Middle Grades, Language Arts and Social Studies Concentration

Degrees Conferred December 15, 1987

Samuel Todd Bailey ..... Raleigh
Kelli Amanda Bradshaw ..... Charlotte

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

*Mary Lou Critz ..... Martinsville, VA
Sharon Dawn Short ..... Oxford
***Catherine Marie Wood ..... Saratoga, CA

Degrees Conferred May 7, 1988

Faith Mary Bourbeau ..... Glastonbury, CT
Donna Louise Breniman ..... Milwaukee, WI
***Candace Hanes Knowles ..... Huntersville

Middle Grades, Mathematics and Science Concentration

Degrees Conferred December 15, 1987

Desiree Padgett Blakley ..... Raleigh
Marian Margaret Lepper ..... Fayetteville

Degrees Conferred May 7, 1988

Cosette Thompson Grant ..... Raleigh
Deborah Ann Wilusz ..... Charlotte

Science Education

Degree Conferred August 5, 1987

Robert Eugene Hester ..... Rocky Mount

Degrees Conferred December 15, 1987

William Joseph Fussell ..... Tampa, FL
LeAnder Dwaine Gray ..... Ramseur
†Melinda Kay Lamb ..... Thomasville
***Connie Jo Robinson ..... Cincinnati, OH
Jeffrey Trent Skinner ..... Wilson
Timothy Robert Skinner ..... Wilson
Jeanne Marie Salisbury Williams ..... Saint Pauls
*Melody Caroline Williams ..... Williamston

Degrees Conferred May 7, 1988

†**Elizabeth Hill Austin ..... Raleigh
Phillip Howard Cox ..... Lexington
Kimberly Diane Frazier ..... Asheboro
Deborah Lynn Hodgin ..... Graham
Rice Gwynn Strange, Jr. ..... Pelham
Matthew James Thomson ..... Cary
Richard Cromwell Walton ..... Wilmington

Science Education, Middle Grades Concentration

Degrees Conferred December 15, 1987

*Cheryl Eagle Irwin ..... Burlington
Theresa Louise Lamaze ..... Gaithersburg, MD
Brian Richard Piatt ..... Kernersville
*Ashley Goodman Whittington ..... Erwin

Degrees Conferred May 7, 1988

Sue Ann Colvin ..... Miami, FL
Amy Lynn Maynard ..... Raleigh
Donna Shuping McCallum ..... Cary
*Kathleen Margaret Murphy ..... Albany, GA

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Technical Education

Degree Conferred August 5, 1987

*Kenneth Eugene Mullis ..... Concord

Vocational Industrial Education

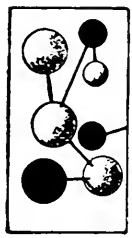
Degrees Conferred December 15, 1987

Tammy Reneé Garner ..... Asheboro
Kenneth Joseph Hill ..... Glendale, NY

Degree Conferred May 7, 1988

*Stephanie Elaine Truesdale ..... New Bern

College of Engineering



BACHELOR OF SCIENCE IN BIOLOGICAL AND AGRICULTURAL ENGINEERING

Jointly administered by the College of Agriculture and Life Sciences and the College of Engineering.

Degrees Conferred December 15, 1987

Kim Howard Colson ..... Chapel Hill
William John Lelekacs ..... Raleigh
Linda Jones Rainey ..... Raleigh

Degrees Conferred May 7, 1988

Todd Stephen Anderson ..... Raleigh
**Edward MacDonald Barnes ..... Pisgah Forest
Dana Jeffery Bolden ..... Clyde
Michael Wade Corbett ..... Fountain
Peter Edward Davis ..... Raleigh
Sidney Hunter Deck ..... Greensboro
Mark Edwin Haire ..... Creswell
Kent Pendleton Harrell ..... Plymouth
Mark Ep Hawes ..... Morganton
Brian Douglas Hinkle ..... Asheboro
John Mark Rice ..... Cary
Christopher Lee Suggs ..... La Grange

BACHELOR OF SCIENCE IN TEXTILE ENGINEERING

Jointly administered by the College of Textiles and the College of Engineering.

Degrees Conferred May 7, 1988

***Larry Charles Dickinson ..... Hickory
Elizabeth Ann Elam ..... Charlotte
Matthew Myers Thomas ..... Swannanoa

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

BACHELOR OF SCIENCE IN AEROSPACE ENGINEERING

Degree Conferred June 24, 1987

Naomi Frances Glasscock ..... Skipwith, VA

Degrees Conferred August 5, 1987

Elizabeth Ann Saunders ..... Archdale
John David Wilson ..... Columbia, SC

Degrees Conferred December 15, 1987

Shaun Michael DeAngelis ..... Durham
Timothy John Fennell ..... Havelock
Elizabeth Hiatt Jackson ..... Jefferson
**Vicki Lynn Owen ..... Smithfield
Christopher Brewer Sanders ..... Raleigh
Michael Scott Tippett ..... Newport News, VA

Degrees Conferred May 7, 1988

Teresa Sue Bass ..... Lucama
William Schoen Brinley ..... Columbia, MD
David William Cason ..... Fort White, FL
Aaron Bunnard Cozart ..... Prospect Hill
**William Bruce Davis ..... Marietta, GA
Darrell Scott Dearman ..... Kernersville
**Genevieve Anne Dellinger ..... Crouse
John Edwards Eans ..... Monrovia, MD
***Jack Ray Edwards, Jr. ..... Eden
Jonathan Casey Frye ..... Winston-Salem
***Basil Hassan ..... Raleigh
Gregory Wyman Hill ..... Indian Trail
***Douglas James Hudson ..... Raleigh
Robert Bruce Irvine ..... Delmar, NY
William Thomas Jones ..... Burlington
***Marc William Kniskern ..... Upper Marlboro, MD
Charles Louis Lehning IV ..... Jacksonville, FL
Sabrina Kim MacIntyre ..... Burlington
**Alvin Archer Mason III ..... Winston-Salem
Michael Dean McDonald ..... Clarkton
***Michael Dean Neaves ..... Lansing
James Marinus Phillips ..... Chapel Hill
Gregory Dean Pryor ..... Winston-Salem
**Graham Scott Rhodes ..... Smithfield
Herbert Paul Sakas ..... Wilson
Phillip Lee Shaw ..... Concord
†Denette Lee Sleeth ..... Novelty, OH
George Taylor Story ..... Durham
Nidak Albert Sumrean ..... Ramallah, Israel
Lora Ann Taylor ..... Abingdon, VA
Benjamin Edward Withers ..... Lillington

BACHELOR OF SCIENCE IN CHEMICAL ENGINEERING

Degree Conferred June 24, 1987

Jack Arnold Hammond II ..... Covington, VA

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Degree Conferred August 5, 1987

**Kellie Marie Ticehurst ..... Raleigh

Degrees Conferred December 15, 1987

†Janet Ann Black ..... Atlanta, GA
**Sheila Ann Clark ..... Lansing
†Susan Lee Davis ..... Palatka, FL
Victoria Lynn Fox ..... Akron, OH
Brian Charles Francois ..... Hickory
Steven Paul Geil ..... Raleigh
†*Jasdev Singh Gill ..... Augusta, GA
William Andrew Hospodar ..... Wilmington
**Patrick Allen Jones ..... Fayetteville
Jeffrey Jason Jayner ..... Farmville
*Christine Rose LaMarre ..... Monroe
Vicky Milner Landrum ..... Royal Oak, MI
Thad Parrott Leister ..... Winston-Salem
Clyde Wilburn Lollis, Jr. ..... West Point, VA
†Stephanie Riddick Miller ..... Hobbsville
James Edwin Moore, Jr. ..... Greensboro
*John Paul Morabito ..... Rockville, MD
Kim David Murphy ..... Raleigh
***Anne Naismith ..... Nyack, NY
Douglas George Parkes, Jr. ..... Greensboro
Laurie Lynn Schilling ..... Panama City, FL
George Alan Sumrell ..... Grifton
David John Svendsgaard, Jr. ..... Chapel Hill
Jerri Bea Thigpen ..... Beulaville
Richard Scott Warlick ..... Shelby
**Alan James Watters ..... Chesterfield, VA
***Robert James Weikel ..... Greensboro

Degrees Conferred May 7, 1988

Forest Wayne Adkins III ..... Raleigh
**Marty Allen Baker ..... Charlotte
*Philip Alan Block ..... Greensboro
†*Deborah Jean Bracht ..... Wilmington
Stephen Duncan Bradley III ..... Davidson
Michael David Brown ..... Wilmington
Susan Carol Byrd ..... Durham
**Philip Robert Caffrey ..... Albuquerque, NM
*Walter Stephen Cavin ..... Stanley
Donna Michelle Dannegger ..... Raleigh
Jeffrey Mark David ..... Raleigh
Elizabeth Claire Dillman ..... Clemson, SC
Laura Michelle Dwyer ..... Raleigh
Nilay Dhirajlal Gami ..... Baroda, India
***Gavin Lee Gaynor ..... Hawesville, KY
*Lisa Ann Gorsuch ..... Fayetteville
Shawn Christopher Graham ..... Knightdale
**William Andrew Gramley ..... Winston-Salem
Amy Stewart Gray ..... Raleigh
Michael Kevin Harvey ..... Pembroke

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Cynthia Michelle Helms ..... Monroe
†Alex Ray Kirby ..... Durham
*Bradford Alexander Lee ..... Raleigh
***Ernest John Lefevre, Jr. ..... Winston-Salem
***Wilford Allen Leonard ..... Greensboro
Allan Ford Lowe ..... Rockville, MD
Krista Colette Marshall ..... Winston-Salem
Wayman Bernard McLaughlin, Jr. ..... Winston-Salem
*Vincent Stephen Misiti ..... Beckley, WV
*Sandra Deanne Morgan ..... Winston-Salem
*Barbara Ann Nath ..... Raleigh
†*Paige Meredith Newland ..... Wilmington
†Robert Brian Raybon ..... Wendell
*Matthew Thomas Reboli ..... Goldsboro
†***Philip Dean Rucker ..... Lincolnton
*Elinor Susan Sartwell ..... Albion, NY
Mukul Sharma ..... Raleigh
†John Lawrence Sorrels ..... Raleigh
***Hygie Irene Starr ..... Greensboro
James Edward Swinson ..... Pink Hill
Karl Evan Taylor ..... Canandaigua, NY
***Pearl Jennifer Tejano ..... Kinston
**Vernard Ray Thomas, Jr. ..... Greensboro
Alan Brooks Urwick ..... Charlotte
Thomas Gerard von Lehmden ..... Cincinnati, OH
†Jill Carroll Watson ..... Raleigh
Lisa Suzann Whitlow ..... Greenville
Phillip Edwin Wilson ..... Asheville
*Henry Michael Woerner ..... Mount Pleasant

BACHELOR OF SCIENCE IN CIVIL ENGINEERING

Degrees Conferred June 24, 1987

John Thomas Diffee III ..... Winston-Salem
Joseph Michael Schiavone, Jr. ..... Oakhurst, NJ

Degrees Conferred August 5, 1987

*Thomas Malvia Harris ..... Raleigh
**Taha Khedro ..... Aleppo, Syria

Degrees Conferred December 15, 1987

Louis Timothy Bailey ..... Raleigh
Mark Marion Behe ..... College Park, MD
John David Bishop ..... Interlachen, FL
Walter Scott Blauch ..... Raleigh
Wayne Andrew Brunnick ..... Shelby
Joel Anders Bulluck ..... Rocky Mount
Jeffrey Charles Cole ..... Wrightsville Beach
Paul Desmond Cray ..... Cherry Hill, NJ
Paul Howard Danforth ..... Gloucester, VA
Sharon Lee Dawson ..... Tarboro
Mary Frederick-Freeman Denman ..... Fayetteville
Douglas Michael Dieter ..... Chapel Hill
James Laurence Eason ..... Raleigh

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Edwin Scott Edwards ..... Goldsboro
Lynn Watson Evans ..... Greenville
Philip Bryan Faucette ..... Mebane
George Christian Guvernator IV ..... Richmond, VA
Angela Ruth Haigh ..... Charlotte
Richard William Hancock ..... Robbins
Steven Glenn Haynie ..... Cary
Kenneth Louis Jesneck ..... Ayden
Robert Allen Jones ..... Raleigh
Ted Ashley Kallam ..... Mayodan
Jeffrey Koury Mack ..... Mooresville
Kenneth Larry Marlow, Jr. ..... Greensboro
Theodore Malcolm McDuffie, Jr. ..... West End
Doris Caroline Meyer ..... Beaufort
Sharon Annette Milstead ..... Charlotte
***Randall Bryan Moore ..... Durham
Glenda Rose Mooring ..... Snow Hill
Leon Herbert Morris III ..... Hickory
Jeffrey Scott Mosley ..... Rocky Mount
Mark Alan Mulder ..... Russellville, AR
Brian Christopher Mulholland ..... Hayesville
Erik Scott Musselman ..... Mocksville
Randy Wayne Nance ..... Salisbury
Joseph Henry Newberry III ..... Goldsboro
John Joseph Olson ..... Linwood, NJ
*Achilleas Nicolaos Parathiras ..... Ilioupolis, Greece
Jess Taylor Patterson, Jr. ..... Burlington
Brian Keith Pugh ..... Thomasville
Laura Elizabeth Rice ..... High Point
Mark Franklin Robbins ..... Union Grove
William John Shefcik ..... Charlotte
William Darwin Shehane II ..... Charlotte
Alan Louis Stone ..... Bassett, VA
Richard Thomas Thayer ..... East Bend
Robert Dale Thomas ..... Wilmington
*Phillip Gregory Tripp ..... Ash
Mark Alan Wilkes ..... Clemmons
Gregory Leigh Williams ..... Granite Falls
John Alvin Wolf, Jr. ..... Dunn
*Alex Robert Wood ..... Jacksonville
*Robert George Woodruff ..... Jensen Beach, FL
Lisa Michelle Wooten ..... Raleigh
Scott Alan Yarley ..... Durham

Degrees Conferred May 7, 1988

Richard Childs Adams ..... Columbia, SC
*Terry Lee Albrecht ..... Raleigh
Brent David Barker ..... Spencer
Mark Douglas Bartlett ..... High Point
***Douglas O'Neal Bell ..... Raleigh
Richard Leon Bollinger, Jr. ..... Lumberton
Andrew Peter Cadden ..... Saint David's, PA
Jeff Eugene Campion ..... Clemmons
Steve Derek Carpenter ..... Arden
Tracy Jeanine Clay ..... Charlotte
Christopher Todd Corriher ..... China Grove

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

**Donna Lee Costner ..... Greenville
Laura Ellen Dosser ..... Wadesboro
Edward Glenn Edens, Jr. ..... Gastonia
*Charles Norfleet Edwards, Jr. ..... Durham
***James William Edwards ..... Rocky Mount
Stuart Bevans Foard ..... Phoenix, MD
Stephen John Geiger ..... Bel Air, MD
Terry Robert Gibson ..... Huntersville
**Lisa Gonzalez ..... Charlotte
Bruce Faulkner Harrington ..... Peachland
Jane Marie Hayhoe ..... Naples, FL
Darren Zell Hennings ..... East Bend
***Stacey Lynn High ..... Bailey
Kevin Scott Holmes ..... Aydlett
James Darrin Holt ..... Sanford
Mark Joseph Hutnan ..... Raleigh
**Timothy Howard Keener ..... Highlands
William Bradley Kerr ..... Fayetteville
*Jeffrey Alan Koontz ..... Saint Albans, WV
**Michael Manuel Koutsourais ..... Clearwater, FL
Earl Randall Lewellyn ..... Walnut Cove
***Melanie Ann Mann ..... Raleigh
Yvette Michelle Massey ..... Yadkinville
Timothy Brian Matthews ..... Wilson
David Thomas McGee ..... Fuquay-Varina
John Bradley McLester ..... Statesville
Richard Dean McMillan ..... Raleigh
Stephen Eric Midkiff ..... Pilot Mountain
*Daniel DeLos Miles ..... Wake Forest
*Donald Lee Moss ..... Pilot Mountain
Richard Edwards Mullinax ..... Goldsboro
Danny Ray Mullis ..... Monroe
Glenn Wilson Mumford ..... Pleasant Hill
***Donald Thomas O'Toole ..... Raleigh
Gregory Shawn Peele ..... Greensboro
Karl Brian Peterson ..... Charlotte
Howard Justin Pickett ..... Burlington
Timothy John Plummer ..... Coral Gables, FL
Benjamin Franklin Pope III ..... Fayetteville
Carl Wilkins Ramsey ..... Roxboro
Michael Santowasso ..... Flemington, NJ
Adrian Dean Sarvis ..... Kings Mountain
Michael Warren Schrum ..... Charlotte
Thomas James Scott ..... Bethesda, MD
Anne Elizabeth Shanklin ..... Charlotte
Mark Ray Sizemore ..... King
Brian Vance Smith ..... Greensboro
*James Mark Smith ..... Roanoke Rapids
Karen Leigh Strock ..... Raleigh
Jeffrey Miles Tanner ..... Greensboro
Roger Darryl Thomas ..... North Wilkesboro
Paul Winebrener Utt ..... Frederick, MD
Flavio Vietti ..... Vienna, VA
Ellen Michelle Wagoner ..... Greensboro
Kirk David Wallace ..... Wadesboro
John Thomas Webert ..... Brownville, NY

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

**Steven Stuart Welton ..... Chesapeake, VA
Darin Noel Wilder ..... Franklinton
*Dianne Christine Wilson ..... Scotia, NY

BACHELOR OF SCIENCE IN CIVIL ENGINEERING—CONSTRUCTION OPTION

Degree Conferred August 5, 1987

David Gavin Moretz ..... Hickory

Degrees Conferred December 15, 1987

Kenneth Dale Angell, Jr. ..... Fayetteville
Stephen Wayne Coleman ..... Leasburg
Christopher Reid Glover ..... Dallas
Michael Leonard Kiser ..... Durham
**Rondal Lee Leach ..... Lake Toxaway
Brenda Loraine Moore ..... Burlington
James Whitaker Nelms ..... Newport News, VA
Sean Clancey Robey ..... Camden
*Julian Curtis Yarborough, Jr. ..... Fayetteville

Degrees Conferred May 7, 1988

Teddy Dale Baity ..... Who
Trudy Denise Brown ..... Charlotte
Donald Vance Chamblee, Jr. ..... Charlotte
Chris Lyman Champion ..... Kings Mountain
James Harry Christman, Jr. ..... Fayetteville
Javier Clawson ..... Charlotte
Mark Edward Collins ..... Raleigh
**Charles Randolph Cox ..... Dunn
Jennifer Brown Cross ..... Raleigh
*David Andrew Demick ..... Maine, NY
*Phillip Sherwood Dunston ..... Louisburg
George Franklin Ellis ..... Shelby
Richard William Ellis ..... Franklin Lakes, NJ
Roy Patrick Feser ..... Jacksonville
Paul Adam Freeman ..... State College, PA
Jeffrey Eric Getz ..... Fayetteville
***Curtis Jon Horvat ..... Irwin, PA
Allison Denise Kemp ..... Creston
Eric Simpson Lewis ..... Shannon
Ali Asghar Mahmoodi ..... Ahwaz, Iran
Scott Daniel Moore ..... Wilmington
Philip Thomas Moxley ..... Boonville
Joseph Bernard Obusek, Jr. ..... Marietta, GA
Jerry Penlton Page ..... Wilson
Jacqueline Annette Roddy ..... Wilson
Lisa Michelle Routh ..... Greensboro
**Steven Andrew Swinehart ..... North Canton, OH
Marty Craig Tillman ..... Siler City
Jeryl Anderson Williams ..... Kansas City, MO

BACHELOR OF SCIENCE IN COMPUTER ENGINEERING

Degrees Conferred June 24, 1987

Sherwood Ray Belangia ..... Summerfield
Lars Peter Mage ..... Chapel Hill

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Degrees Conferred December 15, 1987

Charles Laverne Copello II ..... Raleigh
Randall Wade Culler ..... Mount Airy
Adisorn Ermongkonchai ..... Bangkok, Thailand
Devin Lindsey Lushbaugh ..... High Point
Timothy Joseph Thomas ..... Reno, NV
***Charles Robert Yount ..... Granite Falls

Degrees Conferred May 7, 1988

**Morris Howard Arthur ..... Charlotte
Donald Dean Brickerd, Jr. ..... Glenn Dale, MD
Dennis Michael Briddell ..... Charlotte
Kevin Franklin Clayton ..... Cary
***Lori Lynn Coggins ..... Appomattox, VA
Floyd Scott Finley ..... Winchester, VA
Clinton Lane Gilbert ..... Statesville
Timothy Scott Gurganus ..... Jacksonville
Elian Hasrouni ..... North Hollywood, CA
William Edward Petty ..... Jamestown
***Tan Thanh Duy Phan ..... Fayetteville
Marwan Shaban ..... Damascus, Syria
*David Keith Smith ..... Raleigh
***Mohammed Sriti ..... Kenitra, Morocco
Peter Thomas Tola, Jr. ..... Raleigh
George Warren Wilder III ..... Winston-Salem

BACHELOR OF SCIENCE IN CONSTRUCTION MANAGEMENT

Degree Conferred May 7, 1988

John Frederick Schultze ..... Charlotte

BACHELOR OF SCIENCE IN ELECTRICAL ENGINEERING

Degrees Conferred June 24, 1987

Manal Elsayed Afify ..... Raleigh
Charlene Michelle Carter ..... Greensboro
Martin John Carter ..... Winston-Salem
**Gregory Paul Farmer ..... Goldsboro
Patrick Michael Farrell ..... Raleigh
Peter Feil ..... Raleigh
Joseph Scott Hunsucker ..... Gibsonville
***Jeffrey Hilburn Moreadith ..... Reading, PA
Keith Allen Reid ..... Linden
Daniel Henry Rouse ..... Wilmington
*Donald Bruce Spillane ..... Havelock
***Carol Louise Zanella ..... Raleigh

Degrees Conferred August 5, 1987

Michael Johann Allion ..... Charlotte
Bruce William Bennett ..... Ligonier, PA
Robert Alan Goetz ..... Middlesex, NJ
*Lisa Marie Lange ..... Raleigh
James Alan Lewis ..... Raleigh
Lowry DuRant Lewis ..... High Point
Charles James Lord ..... Asheville

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Darrell Lee Martin ..... Raleigh
**Ivan Francisco Matulic ..... Sucre, Bolivia
***Gerald James Trombley ..... Mount Clemens, MI

Degrees Conferred December 15, 1987

Robert Jeffrey Alexander ..... Raleigh
**Wael Ahmad Al-Qaq ..... Jordan, Amman
Camino Maria Andrade ..... Raleigh
Allan David Ashley ..... Shelby
†*Clinton Kesler Atkinson ..... Siler City
Robert Thomas Barfield ..... Durham
Stephen Gregory Barr ..... Wake Forest
Allen Scott Baxley ..... Saint Albans, WV
Joel Evan Benzing ..... Raleigh
*Jeffrey Odell Boger ..... Mocksville
*Daniel Sinclair Bunzey ..... Davidson
***Kara Leigh Caldwell ..... Newton
Dang Minh Cao ..... Raleigh
Michael Dean Carpenter ..... Vale
James Andrew Carros ..... Winston-Salem
Daniel Mark Carter ..... Burlington
Kendall Earl Cavender ..... Raleigh
Robert Michael Chittenden ..... Charlotte
*Joseph William Cowan ..... Dunn
Charles Mark Crampton ..... Cary
*Hien Thanh Dang ..... Greensboro
**Gregory Keith Daugherty ..... Elon College
Beverly Diane Deese ..... Monroe
Beverly Adams Dorland ..... Norfolk, VA
Pamela Kay Doughty ..... Rockledge, FL
*John Joseph Doyle ..... Bayville, NY
Taun Anh Doung ..... Raleigh
Ali Sammy Elaasar ..... Winston-Salem
Roy Thomas Ellis ..... Fayetteville
Glenn Richard Estes ..... Franklin
Matthew Lee Everett ..... Robersonville
Jesse Craig Frye ..... Cliffside
***Tracy Lawrence Fulghum ..... Wilson
**Alvin Dean Genzlinger ..... Raleigh
*Gregory Clayton Gilmore ..... Greensboro
Mark Albert Gordon ..... Wilmington
**Michael Steven Gudaitis ..... Meridan, CT
Thomas Joseph Gwynn ..... Charlotte
**Montague Ernest Hardy III ..... La Grange
Patrice Jones Hochstetler ..... North Liberty, IN
Mark Richard Hollifield ..... Summerville, SC
**John Boyce Honeycutt ..... Charlotte
Tri Huu Huynh ..... Saigon, South Vietnam
Mark Linzey Jennette ..... Monroe
Mark David Jones ..... Lillington
Thomas Orazio Joynt ..... Fort Washington, MD
Yaw Asare Karikari ..... Accra, Ghana
**Patricia Kay Key ..... Cedar Grove
David Allen Koepnick ..... Washington
**Jeffrey Todd Lawrence ..... Camden
*Karl Thomas Leinfelder ..... Chapel Hill
Cedric David Lewis ..... Annapolis, MD

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Charles Chiang Mah ..... Raleigh
Paul Leon Massengill, Jr. ..... Asheboro
*Dayn Clinton McBee ..... Greensboro
***Paul Glenn McKee ..... Raleigh
Douglas Keith Melzer ..... High Point
Michael Dean Moore ..... Havelock
*Michael Wayne Murdock ..... Denver
Terryne Felyce Murphy ..... Fayetteville
Tushar Amrut Nakhre ..... Wilson
Kathleen Frances Newberg ..... Efland
Dung Si Nguyen ..... Raleigh
***Mark Neal Nolting ..... Raleigh
Jayesh Patel ..... Franklinton
*Thanh Tien Pham ..... Raleigh
**Richard Ashley Purvis ..... Bennett
Randy Earl Quick ..... Sanford
Michael Stephen Ranieri ..... Greensboro
Janet Baldwin Raynor ..... Raleigh
Jefferson Reese, Jr. ..... Charlotte
Kenneth Wade Rich ..... Brevard
***Patrick Joseph Richardson ..... Boone
Thomas Andrew Risser ..... Charlotte
*John Douglas Roberts ..... Spring Lake
William Douglas Robertson ..... Fayetteville
William Martin Schwartz ..... Charlotte
James Christopher Sides ..... Jacksonville
Craig Lee Simmons ..... Morehead City
**Cynthia Carol Smith ..... Mount Pleasant
*Jay Archie Stancil ..... Castalia
Brett Jay Stephenson ..... Sanford
Derrick Howard Taylor ..... Charlotte
David Bryan Turner ..... Ridgecrest
Ronald Steven Turner ..... Charlotte
Mohan Gopal Unnithan ..... Kerala, India
Quang The Van ..... Rockville, MD
*Katherine Elizabeth Violette ..... Raleigh
*David Cloud Wilkins ..... Greensboro
Jeffrey Allen Wilson ..... Greenville
Barry Wayne Wood, Jr. ..... High Point
Scott Dwaine Woodard ..... Raleigh
***William Francis Yadusky ..... Fayetteville
**Lee Ann Zierenberg ..... Atlanta, GA

Degrees Conferred May 7, 1988

***Michael Eugene Adams ..... Maryville, TN
**Robin Carol Ballard ..... Durham
**Julie Ann Bauer ..... Asheville
**Bhavna Harishchandra Bhakta ..... Asheville
***Steven Langley Blake ..... Denville, NJ
Dennis Ray Blanton ..... Ellenboro
Beryl Gaye Blount ..... Greensboro
Robert Allen Bolton ..... Raleigh
Kenneth Roy Bowen ..... Raleigh
Andre Pierre Bright ..... Winston-Salem
James William Bright ..... Greenville
Robert Mark Britt ..... Goldsboro

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

John Earl Cabaniss ..... Shelby
Seavy Wesley Carroll ..... Fayetteville
Mona Nichole Carter ..... Dudley
**Suk Chu Chan ..... Greenville
Ronnie Thomas Cheek ..... Goldston
***Joydeep Chowdhury ..... Charlotte
Tai Diep Chung ..... Raleigh
†Steven Mark Clements ..... Raleigh
*Dewey Edwin Cochran ..... Waynesville
**Jill Renâ Comer ..... Concord
Brian Anthony Cox ..... Asheboro
**Alexander Berry Credle III ..... Cary
***Jeffrey William Crenshaw ..... Charlotte
Grason Pierce Curtis ..... Lenoir
Hazim Hashim Dahir ..... Ramallah, Jordan
William Bradley Davison ..... Fallston, MD
William Herbert Dean ..... Fairfax, VA
*Joseph Wayne Dodd ..... Durham
Michael Christian Dougherty ..... Matthews
**James Christopher Eason ..... Newport News, VA
Roger Lee Edwards, Jr. ..... Goldsboro
Timothy Stephen Fahey ..... Apex
*Eric Douglas Faison ..... Richmond, VA
Kenneth Allen Feldmann ..... Raleigh
Randall Lee Forester ..... Concord
John Wayne Freeze, Jr. ..... China Grove
Katherine Camille Frye ..... Garner
Randall Whitaker Fulp ..... Winston-Salem
*Garry Ray Garver ..... Garner
Thomas Joseph Gibbons ..... Cary
***John Everett Gmuender ..... Beech Mountain
*Alexander James Golian ..... Woodstock, NY
**Robey David Greene ..... Morganton
**David Charles Hall ..... Raleigh
Keith Aaron Hardt ..... Jacksonville
Benjamin Isaac Harrison, Jr. ..... Salisbury
Darren Jordan Hayes ..... Raleigh
Kevin Eugene Henderson ..... Salisbury
*Perrin Quarles Henderson, Jr. ..... Charlotte
Kay Smith Hicks ..... Charlotte
**Perrin Jay Hirshman ..... East Brunswick, NJ
Jeffrey Lamar Holley ..... Stapleton, GA
Mark Shannon Howell ..... Eden
***Andrij Walter Huryn ..... New Bern
***Wade Eric Jackson ..... Florence, SC
Ammar Numan Jadallah ..... Jerusalem, Palestine
*Kosar A. Jaff ..... Rome, Italy
Gurpreet Singh Jawa ..... Fayetteville
Ivan Edward Johnson, Jr. ..... Richmond, VA
*Kristian Marvin Johnson ..... Wake Forest
Winton Earl Kelly, Jr. ..... Durham
Steven Dale Kershaw ..... Raleigh
Kenneth Sears Kirk ..... Goldsboro
Joseph Alan Konen ..... Hope Mills
Carol Ann Lancaster ..... Maysville

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

***Richard James Lewis ..... Raleigh
*Joseph McDuffie Lytton ..... Durham
Elizabeth Anne Madry ..... Mooresville
*Timothy John Mains ..... Fayetteville
**Randall James Martin ..... Elberfeld, IN
Ronald Robert Marx ..... Raleigh
Karen Marie McCarron ..... Winston-Salem
Patrick John McCarthy ..... Fayetteville
***Mark Bradley McCoy ..... Albemarle
Kenneth Lockworth McKinney, Jr. ..... Greensboro
**Edwin Arthur Mead ..... Owego, NY
David Wesley Miller ..... Wilmington
Thomas David Mills ..... Fayetteville
†***William Kenneth Neighbors III ..... Benson
Joseph Michael Nolan ..... Centereach, NY
Peter Joseph Norton ..... Graham
Mark Palsha ..... Burlington
John Rouss Parks, Jr. ..... Burlington
Susan Angela Parks ..... Winston-Salem
Vohn Nelson Peeler, Jr. ..... Faith
Grover Calvin Perdue ..... Fayetteville
***Amir Pirzadeh ..... Tehran, Iran
Darin Andrew Pope ..... Monroe
Basil Shukri Qubain ..... Cary
Kimberly Dawn Ramseur ..... High Point
*Baeton Charles Rigsbee ..... Durham
***Charles Kenneth Robinson ..... Charlotte
Rickard Floyd Rodgers ..... Kannapolis
*Georges Farah Samaha ..... Raleigh
Tony Richard Sarno ..... Matthews
*James Frederick Schenck ..... Salisbury
***Steven Ernest Schulz ..... Charlotte
Jodie Elizabeth See ..... High Point
**Daniel Frank Selden ..... Raleigh
Kenneth Scott Shaffer ..... Greensboro
Bridget Parks Simpson ..... Hillsborough
†Colin Robert Smith ..... McLean, VA
**Donald Gregg Smith ..... Pfafftown
***Steven Mark Snider ..... Albemarle
†**Brian Kent Spiro ..... Raleigh
Ella Louise Stainback ..... Oxford
*Kenneth Ray Steele, Jr. ..... Walkertown
Glen Paul Stewart ..... Asheville
German Suarez ..... Santa Cruz, Bolivia
**Hugh Blake Svendsen ..... Jacksonville
Richard Dao Tan ..... Hickory
*John Markham Thompson ..... Durham
John Espenshade Titus ..... Raleigh
Ha Ngoc Tran ..... Raleigh
Tam Van Tran ..... Cary
Richard Meaker Trask, Jr. ..... Raleigh
John Herman Tripp ..... Greenville
Gregory Donald Turney ..... Raleigh
***Mark Stephen Viglianco ..... Winston-Salem
†Darrel Wade Vuncannon ..... Greensboro

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Michael Walsh ..... Raleigh
*Dawei Wang ..... Macau
John James Warwick ..... Madison
*Robert Louis Whatley ..... Cary
Kenneth Dwayne White ..... Mocksville
***Richard Lee Williams ..... Charlotte
Brian Drew Willoughby ..... Jacksonville
Barbara Katherine Wilson ..... Kingston, NY
**James Steven Worley ..... Greenville
*James Dudley Wright ..... Charlotte
Mark William Yalch ..... Goldsboro
***Derek Todd Young ..... Winston-Salem

BACHELOR OF SCIENCE IN ENGINEERING OPERATIONS

Degree Conferred August 5, 1987

Kevin Andrew McFalls ..... High Point

Degree Conferred December 15, 1987

Philip Leroy Culpepper ..... Charlotte

Degrees Conferred May 7, 1988

Lola Floyd Shields ..... Bennettsville, SC
Cassandra Marietta Turnbull ..... Cambria Heights, NY

BACHELOR OF SCIENCE IN FURNITURE MANUFACTURING AND MANAGEMENT

Degree Conferred June 24, 1987

Leon Scott Sartin ..... Greensboro

Degrees Conferred December 15, 1987

Herbert Lee Andrews III ..... Archdale
Carl Wayne Bundy ..... Raeford
Barry Howard Romberg ..... Macungie, PA
Kevin Eugene Ward ..... Hickory

Degrees Conferred May 7, 1988

William Carl Blackmon ..... High Point
***Stephen Todd Browning ..... Greensboro
Michael James Cavanaugh ..... Greensboro
Linda Kay Church ..... Raleigh
John Darren Duffey ..... Hudson
Larry Scott Furr ..... Sanford
Thomas Christian Hart ..... Collierville, TN
Nathan Kevin Howie ..... Fayetteville
Robin Johnston ..... Raleigh
Dawn Marie Swanson ..... Greensboro
Albert Van Dorp, Jr. ..... Jamestown

BACHELOR OF SCIENCE IN INDUSTRIAL ENGINEERING

Degrees Conferred June 24, 1987

Cynthia Gillespie ..... Elizabethtown
*Mark Everett Keesling ..... Bluefield, WV

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

June Rose Lundgren ..... Charlotte
James Robert Sills ..... Hickory
Kenneth Edwin Waegerle ..... Durham

Degrees Conferred August 5, 1987

Robert Alan Beal ..... Charlotte
James Michael Coon ..... King
Candance Sequenta Debnam ..... Raleigh
Michael Cecil Futch ..... Rocky Point
*Ted Taylor King ..... Mount Airy
Deborah Suzanne Little ..... Lenoir
Pamela Elwillie Martin ..... Union
*Pamela Ann Mazak ..... Newton
**Krista Jean Peterson ..... Hickory
Bobby Keith Puckett ..... Raleigh
Tiffany Anne Traber ..... Asheville

Degrees Conferred December 15, 1987

*Gregory Angelo Accardo ..... Selden, NY
Daniel Raymond Andolsen ..... Cleveland, OH
Kelli Jean Branson ..... Wilmington
Richard Bernard Clark ..... Fayetteville
Michael Boyd Dickenson ..... Matthews
Mark David Fuqua ..... Eden
Beverly Diane Gaskins ..... New Bern
Gary Douglas Gilbody ..... Wilmington
Breda Mary Grainger ..... Raleigh
Quanya LaJoyce Harshaw ..... Lenoir
James William Ingram, Jr. ..... Concord
Kimberly Annette Katt ..... Corning, NY
Michael Owen Kelly ..... Hendersonville
Angela Dawn Lancaster ..... Hendersonville
William Fred Lewis, Jr. ..... Belmont
Teri Michelle Loyd ..... Cary
Sylvia Denise McClain ..... Durham
*William Joseph Plunket III ..... Wahiawa, HI
Robert Shannon Riddle ..... Jacksonville
†**Andreas Iacovos Savva ..... Phterykoudhi, Cyprus
Timothy Edwin Scronce ..... Goldsboro
*Michael Lewis Singletary ..... Hamlet
***George Robert Smith ..... Raleigh
Kalyn Mia Teno ..... Charlotte
*Jamie Wrenn Wells ..... Wilson
Dawn Sullivan Whitley ..... Springfield, VA
Gena Anne Woodard ..... Graham

Degrees Conferred May 7, 1988

James Fontaine Allen, Jr. ..... Raleigh
Rodrigo Avila ..... San Salvador, El Salvador
*Vivian Diane Best ..... Pikeville
Steven Vonderlehr Boehling ..... Wilmington
Brian Martin Bridges ..... Gastonia
Jeffrey Allen Buckley ..... Endwell, NY
Gwendolyn Michele Chisholm ..... Asheville
Connie Denise Collins ..... Charlotte
*Morinee Michalle Cooper ..... Southern Pines

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Jeffrey William Ferrell ..... Greensboro
Matthew Shaw Furin ..... Fayetteville
Kelly Jean Gainer ..... Potomac, MD
Thomas Mark Geshay ..... Arden
*David William Gilbert ..... Catawba
†***Timothy Leon Grady ..... Winston-Salem
Wayne Thomas Heverly ..... Fayetteville
Janette Marie Hopkins ..... Newport Beach, CA
Christopher Eric Hultgren ..... Oak Ridge, TN
***Frederick Richard Indermaur ..... Greensboro
Debra Victoria King ..... Winston-Salem
Timothy Eugene Lash ..... Walnut Cove
Kimberly Anne Lawton ..... Summit, NJ
*Mark Anthony Lawton ..... Tobaccoville
Jacqueline Patrick Lester ..... Durham
Tasha Colette Marshall ..... Charlotte
Laura Ann Meyer ..... Charlotte
**Margaret Rose Mihalik ..... Boca Raton, FL
David James Miller ..... Bethesda, MD
Patrick James Murray ..... Richmond, VA
Mary Elizabeth Nardone ..... Lutherville, MD
Heidi Lyn Neuschwanger ..... Pinebluff
Jeffrey Todd Newmark ..... Cherry Hill, NJ
*Todd Mitchell, Reid ..... Grand Cayman, British West Indies
Peggy Johanne Remé ..... Jenkintown, PA
Sheldon Leroy Riggs ..... Clayton
Michael Brian Robinson ..... Charlotte
Kimberly Gayle Rowland ..... Durham
Vicky Ruffin ..... Kenly
*Christine Mary Sitko ..... Raleigh
†**Brian Kent Spiro ..... Raleigh
*Mary Roberta Swearingen ..... Charlotte
Samuel Lee Thomason ..... Winston-Salem
William Howard Treadaway ..... Charlotte
Donna Garris White ..... Rockingham
***Gail Lynn Whitehouse ..... Geneva, FL
Barry Dean Wilson ..... Fletcher

BACHELOR OF SCIENCE IN MATERIALS SCIENCE AND ENGINEERING

Degrees Conferred December 15, 1987

Robert Edward Dalton, Jr. ..... Lewisville
Floyd Phillip Fisher, Jr. ..... Charlotte
Dean Dwight Hackett ..... New Castle, PA
Michael Thomas McClure ..... Cary

Degrees Conferred May 7, 1988

Tammy Faye Barnes ..... Kenly
***Paul Raymond Besser ..... Dallastown, PA
William Allen Bingham ..... Raleigh
*Winston Scott Blackley ..... Wilmington
*Rebecca Joann Derro ..... Cheverly, MD

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Jay Filmore Ford ..... Lenoir
Barbara Jean Gilbert ..... Lincolnton
Joachim Gruss ..... Arden
Weaver Ballou Haney ..... Canton
Mary Luann Harmon ..... Lincolnton
Evone Faye Hartgrove ..... Greensboro
Mark William Lee ..... Kannapolis
Thomas Theodore Mabry ..... Albemarle
Michael Allen Masser ..... Cary
Gregory Edwin Mills ..... Raleigh
***Jane Felton Nally ..... Charlotte
Thomas Albert Shepard ..... Canton

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

Degrees Conferred June 24, 1987

**Jonathan Frederick DeSerres ..... Chapel Hill
Matthew Lee Hamilton ..... Raleigh
Randy Alan Hight ..... Franklinton
*LaMoyne Phillips Mix, Jr. ..... Wilmington
Jeffrey Todd Narron ..... Wilson
David Glenn Robertson ..... Roanoke Rapids

Degrees Conferred August 5, 1987

Jonathan Guy Elder ..... Claremont
Jody Michael Hartsell ..... Stanley
Jae Yung Kim ..... Greensboro
Tan Le ..... Raleigh
Robert LeVan McCollum ..... Concord
Karen Joy Miller ..... Scotia, NY
*Jeffery Stephen Plemmons ..... Waynesville

Degrees Conferred December 15, 1987

*Paul Franklin Augustitus ..... Arlington, VA
James Allen Austin III ..... High Point
*Michael Robert Austin ..... Kernersville
Lee Allen Barger ..... Hickory
**Freddie Lee Bazen, Jr. ..... Murfreesboro
Christopher Allen Beall ..... Matthews
†Surojini Meera Bhikhai ..... Cary
Kelly Lee Bishop ..... Belmont
Bonita Elizabeth Boseman ..... Goldsboro
*Robert Allen Boyette ..... Wilson
*Robert Brown, Jr. ..... Asheville
Alan Lawrence Burcham ..... Thomasville
Daniel Gilbert Burns ..... Charlotte
Michael John Chapoton ..... Morehead City
**Dimitra P Collias ..... Matthews
*Christopher Gene Cross, Jr. ..... Forest City
Aubrey Thomas Davis, Jr. ..... Winston-Salem
Robert Hamilton Dawkins, Jr. ..... Fayetteville
Joseph Lee Degraff ..... Greensboro
*Todd Franklin Denman ..... Bryson City
**Joseph Francis Xavier Doman ..... Asheboro
Steven Spence Dowdy ..... Greensboro
***Daniel Gilbert Durham ..... Dobson

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Charles Patrick Eakes ..... Greensboro
*George William Fleming III ..... Charlotte
*James Kevin Frady ..... Clyde
***Barbara Joann Gerth ..... Whispering Pines
Gary Lance Goodson ..... Monroe
Rajendra Nana Gowin ..... Raleigh
Kathy Dianne Grant ..... Taylorsville
Glenn Ray Gunter II ..... Sanford
William Theodore Harris III ..... Canandaigua, NY
*Robert Eugene Hawkins ..... Wilson
Wilson Richard Hayworth ..... Salisbury
Craig Allen Henry ..... Middletown, OH
Jason Leon Hodges ..... Dobson
Robert Larkin Hutchins ..... Siloam
*Russell Brian Jones ..... Pembroke
Kenneth Stuart Klawonn ..... Raleigh
David Alan Koukol ..... Richmond, VA
James William Lackey ..... Lenoir
**Douglas Frank LeRoy ..... Cary
Stephen Alan Lowe ..... Cincinnati, OH
**Susan Alane Lyerly ..... Denver
Jeffrey Rehr Mateer ..... Saint Davids, PA
*Richard Eugene McFarling, Jr. ..... Danville, VA
*David Brian McNeill ..... Laurinburg
Tony Earl McNeill ..... Siler City
Martin Jerome O'Connell ..... Huntington, WV
Michael Paul Oliver ..... Fort Myers, FL
William Harvey Payne III ..... Madison
Jose Ramon Perurena, Jr. ..... Panama, Panama
*Jeffrey Todd Poteat ..... Marion
William Mark Poteat ..... Raleigh
Murray Guy Rudisill ..... Winston-Salem
Jeffrey Robert Russell ..... Winston-Salem
†**Andreas Lacovos Savva ..... Phterkoudhi, Cyprus
James Glen Schwefel ..... Winnabow
Ryan Matthew Sell ..... Sanford
Fred Robert Setzer ..... Gastonia
Dwayne Eric Sloan ..... Lexington
Leonard White Thaggard ..... Clinton
**Chau Minh Tran ..... Raeford
**Scott Yonkers Utesch ..... Charlotte
Carlos Manuel Vasquez-Segura ..... La Ceiba, Honduras
John Brian Whisenant ..... Lexington
Kenneth Mark Wilhelm ..... Salisbury
Pamela Lynn Wilkins ..... Durham
*Michael Leon Woods ..... Durham

Degrees Conferred May 7, 1988

Harold Charles Albo, Jr. ..... Orangeburg, SC
Robert Carl Alridge III ..... Richmond, VA
**Jeffrey Stuart Armfield ..... Cary
William Todd Barnes ..... Rockingham
*John Andrew Bartle, Jr. ..... Raleigh
Michael John Bloser ..... Forest City
John Richard Bresko ..... Hollywood, Fl
Mitchell Andrew Brown ..... Winston-Salem
William Harry Charles ..... Spencer

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Mark Kendall Cheek ..... Clemmons
David Anthony Chester ..... Raleigh
Charles Lee Chilton ..... Winston-Salem
**David Wayne Cole ..... Lumberton
Patricia Ann Coley ..... Raleigh
Kathryn Covert ..... Roanoke, VA
Robert Todd Creekmore ..... Old Fort
Tyson Forrest Crowell ..... Spencer
John Eward Davis ..... Mount Ulla
Thomas Alexius Davis ..... Raleigh
*Erik Leonard Dixon ..... Oak Ridge
James Todd Earl ..... Lawndale
Edward Earl Evans ..... Wilmington
**Troy Allen Everhart ..... Winston-Salem
Yusef Fahmy ..... Raleigh
*Patrick Andrew Ferguson ..... High Point
John Quintin Gant ..... Burlington
**James Andrew Grant ..... Charlotte
**Kenneth Lee Greenwood ..... Mount Olive, NJ
*Mark Joseph Gross ..... Asheboro
Darwin Allen Hadley ..... Hope Mills
Bruce Ryan Hardman ..... Kinston
Dale Myrick Harward ..... Oakboro
Gary Glenn Hellard ..... Charlotte
Joseph Neil Henkel ..... Hickory
**Randy Lynn Hodge ..... Marshall
***Lysa Marie Holbrook ..... Louisville, OH
Clayton Moore House ..... Plymouth
James Wilson Hull ..... Flat Rock
*William Michael Humbles ..... Watha
Joseph Earl Hunter, Jr. ..... Kinston
**Michael Alton Hurley ..... Asheboro
Peter Daniel Hutcherson ..... Winston-Salem
**Laura Clare Jackson ..... Charlotte
Francis Augustus Jefferson III ..... Wilson
**Kazuya Kawamura ..... Albemarle
Kurtis Pierce Keller ..... Mebane
Patty Sue Knio ..... Raleigh
Craig John Kuppler ..... Youngsville
**Luis Patricio Lara ..... Raleigh
Della Rose Laviner ..... Durham
Michael Antoine Lee ..... Raleigh
Gregory I. Leifer ..... Silver Spring, MD
Mitchell Todd Lineberry ..... East Bend
Forrest Kimball London ..... Greensboro
James Jordan Long ..... Taylorsville
*Kyle Warren Loeske ..... Raleigh
Brentley Mark Lovick ..... Raleigh
Thomas Eugene Lowery ..... Tampa, FL
Michael Wayne Loy ..... Gibsonville
Robert Howell Lunney ..... Waynesboro, VA
**Mark Edward Marler ..... Charleston, SC
Kelvin Shearl Martin ..... Walkertown
Fred McIntyre ..... Troy
Jerry Richard McKeithan, Jr. ..... Forest City
Michael Philip McMahon ..... Mars Hill
James Brian Miller ..... Newark, DE

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Tyler Bruce Moore ..... Parkersbrug, WV
Glenn Junius Morgan ..... Henderson
Steven Allen Murr ..... Thomasville
*Amy Regen Myhre ..... Garner
*George Beechum O'Briant, Jr. ..... Roxboro
Alan Durand Outlaw ..... Fayetteville
Clifford Burgess Perry ..... Rocky Mount
***William Neal Pickett ..... Durham
Gerald Steven Ratchford ..... Charlotte
**George Woodliff Sanford ..... Union, SC
***Mark Daniel Schmidt ..... Greenville
Michael Glenn Schnupper ..... Columbia, SC
**Michael Craig Scott ..... Roxboro
***Robert Norman Sharpe III ..... Greensboro
†Colin Robert Smith ..... McLean, VA
Thomas Clark Smith ..... Erie, PA
*Todd Nelson Snider ..... Asheboro
Norman Punzalon Soberano ..... Cherry Hill, NJ
Walter Larry Sowers, Jr. ..... Lewisville
*Stephen Haines Speck ..... Raleigh
Ronda Diane Stamey ..... Valdese
Insil Pollock Sullivan ..... Kinston
Dennis Ray Taylor ..... Lincolnton
Gregory Scott Taylor ..... West Jefferson
Brian Howard Teague ..... Winston-Salem
*Walter Franklin Teeter ..... Mooresville
Paul Craig Thomas ..... Charlotte
June Marie Tracy ..... Albemarle
Pablo Ivan Vaca ..... Raleigh
*David Paul Van Emburg ..... Kinnelon, NJ
Paul Marcel Vinay ..... Connelly Springs
***William Ben Warren ..... Greensboro
Ronnie Clarence Watson ..... Hudson
Robert Worthington Weathers ..... Charlotte
Robin Lea Weeks ..... Morehead City
*Robin Anthony Yates ..... Winston-Salem
Alan Keith Young ..... Raleigh
***Thomas Wade Young ..... Richmond, VA
Christian Donald Zearfoss ..... Wilmington

BACHELOR OF SCIENCE IN NUCLEAR ENGINEERING

Degree Conferred June 24, 1987

Mark Ellis Metcalf ..... Cherryville

Degrees Conferred August 5, 1987

**Christa Elizabeth Boman ..... Pittsburgh, PA
Mark Randall Lewis ..... Spring Lake

Degrees Conferred May 7, 1988

*Sandra Lynn Abbey ..... Forest City
*Ala Fayez Al-Zaben ..... Haifa, Palestine
Sven Oliver Bader ..... Naarden, the Netherlands
Gregory Ross Boehling ..... Richmond, VA

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Wayne Frederick Couch ..... Wilmington
*Shawn Kent Gibby ..... Gastonia
Maria Sonia Gutierrez ..... Portugalete, Spain
*James William Kraus ..... Winston-Salem
Ronald Charles Kurtz ..... North Bellmore, NY
Billy Linwood Lee, Jr. ..... Fayetteville
Michael James Pierce ..... Troy
Edwin Duard Price ..... Lenoir
Alisa Lorraine Ramey ..... Gastonia
*Eric William Rumfelt ..... Shelby
Julie Anne Todd ..... Whitehouse Station, NJ

College of Forest Resources

BACHELOR OF SCIENCE IN CONSERVATION

Jointly administered by the College of Forest Resources and the College of Agriculture and Life Sciences.

Degree Conferred May 7, 1988

John H'earl Martindale ..... Charlotte

BACHELOR OF SCIENCE IN FORESTRY

Degrees Conferred June 24, 1987

Stephen Todd Booher ..... Farmville
***Kimala Leigh Dills ..... Durham

Degrees Conferred August 5, 1987

John William McMinn ..... Brevard
Michael Louis Spicer ..... Durham

Degrees Conferred December 15, 1987

Clare Marie Dellwo ..... Lynchburg, VA
Bradford Lee McConnell ..... Greensboro
Charles Glynn McRae ..... Kenly
Mark Vernon Pearson ..... Morganton
*Jill Theresa Power ..... Little Silver, NJ
David Michael Urgo ..... Crownsville, MD
William Austin Wright ..... Morganton

Degrees Conferred May 7, 1988

*Gwen Winifred Amick ..... Ann Arbor, MI
Thomas Sherwood Berg ..... Wilton, CT
Andrew Todd Carswell ..... Morganton
Robert Banty Chenoweth ..... Henrico

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

John Michael Cox ..... Rockville, MD
William Deems Currie, Jr. ..... Durham
Stanley Warren Hales ..... Sanford
John Phillip Howard ..... Wilmington
Frederick William Hoyt III ..... Elizabeth City
William Edward Josey ..... Charlotte
James Michael Powell ..... Hazelwood
Kevin Dale Ray ..... Nakina
*Larry Eugene Ridenhour ..... Concord
Marietta Leora Singleton ..... Wilmington
James Alan Tootle ..... Hesperia, CA
Floyd Wiley Whitley ..... Nashville

BACHELOR OF SCIENCE IN PULP AND PAPER SCIENCE AND TECHNOLOGY

Degrees Conferred June 24, 1987

Barbara Jo Gilmore ..... Raleigh
Jerry Stephen Hall, Jr. ..... Clyde

Degrees Conferred August 5, 1987

John Andrew Frazier ..... Asheboro
James Allen Stuber ..... Southern Pines
Timothy Gardner Tompkins ..... Roanoke Rapids
Benjamin Powell White ..... Conway

Degrees Conferred December 15, 1987

Mohamad Jamil Abuhasan ..... Perak, Malaysia
†Janet Ann Black ..... Atlanta, GA
†Susan Lee Davis ..... Palatko, Fl
†*Jasdev Singh Gill ..... Augusta, GA
†Stephanie Riddick Miller ..... Hobbsville
Wendi Ann Wood ..... Richmond, VA

Degrees Conferred May 7, 1988

Tony Lane Baker ..... Hope Mills
James Edward Bradbury ..... Lufkin, TX
Charles Eugene Brinkley ..... Covington, VA
†Anne Winter Callender ..... Pensacola, FL
*Barry Olin Covington ..... Canton
Scott Page Le Grand ..... Richmond, VA
Gerald Wayne Marks ..... Cameron
Timothy Alan Nuckols ..... Glen Allen, VA
†Kai Erik Simonsen ..... Raleigh
†Maureen Kaye Spears ..... Onemo, VA
Milan Kent Thomas ..... Nahunta, GA

BACHELOR OF SCIENCE IN RECREATION RESOURCES ADMINISTRATION

Degrees Conferred June 24, 1987

Kellie Lynn Beeson ..... Akron, OH
Deborah Ann George ..... Pompano Beach, FL
Martha Jacqueline Mitchell ..... Raleigh

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Degrees Conferred August 5, 1987

Charles Richard Crockford ..... Charlotte
Dianne Louise Edris ..... Raleigh
Mark Bell Franklin ..... Christiansburg, VA
Robert Joseph Harris III ..... Raleigh
Christina Lee Woodings ..... Burlington

Degrees Conferred December 15, 1987

Leslie Carol Armstrong ..... North Augusta, SC
Trina Lynne Davis ..... Welcome
Angela Demetris Daye ..... Conway
John Michael Fagala ..... Gastonia
Tina Michelle Forbes ..... Kings Mountain
Edward Burr Henriksen ..... Elkins, WV
Cynthia Ann Lee ..... Norwood
Eugene Daryl Myers ..... Willow Springs
Joseph Timothy Nesbitt ..... Asheville
Dwayne Cameron Patterson ..... Powells Point
Laura Fitzgerald Potts ..... Mount Olive
Mark Alan Ralston ..... Cary
Benjamin Douglas Simpson ..... Charlotte
*Michael Wendell Wetzel ..... Havelock
Junius Rufus Wrenn III ..... Roanoke Rapids
Michael Thomas Yonk ..... Cary

Degrees Conferred May 7, 1988

Thomas Andrew Baldridge ..... Saltville, VA
William Odie Hicks, Jr. ..... Raleigh
Chase Wescott Lassiter, Jr. ..... Greensboro
Charlynne Drucilla Todd ..... Charlotte

BACHELOR OF SCIENCE IN WOOD SCIENCE AND TECHNOLOGY

Degrees Conferred June 24, 1987

Bryan Perry Bass ..... Edenton
Mark Patrick Winter ..... Sandston, VA

Degree Conferred August 5, 1987

Ying-Ming Wu ..... Changwa, Taiwan

Degrees Conferred December 15, 1987

Craig Lloyd Forbes ..... Elizabeth City
Peter Reinhard Kolf ..... Ridgefield, CT
†Andy Cade Norton ..... Whiteville

Degrees Conferred May 7, 1988

Alex John Dean ..... Goldsboro
Bradley Charles Earnhardt ..... Gold Hill
Mary Angela Freuler ..... Candler
Kevin Douglas Griffin ..... Williamston
Warren Earl Lupton ..... Morehead City
*Kenneth Wayne Odom, Jr. ..... Severn
Norman Royce Vann, Jr. ..... Conway
Briant Albert Wilder ..... Asheboro

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

College of Humanities and Social Sciences

BACHELOR OF ARTS IN ACCOUNTING

Degrees Conferred June 24, 1987

Lisa Marie Carter ..... Omaha, NE
Dorothy Carolyn Clement ..... Charlotte
Christopher Walden Gongaware ..... Richmond, VA
**Lisa Carol Jenkins ..... Henderson
Jeffrey Hardy Pilcher ..... Beaufort
Karen Ann Spiegelberg ..... Morehead City

Degrees Conferred August 5, 1987

Bradford Morgan Brady ..... Raleigh
Sandra Faye Colson ..... South Mills
Thomas Eliot Goerke II ..... Seaford, NY
*Rebecca Garrett Hoover ..... Raleigh
**Todd Allen Rodeniser ..... Utica, OH
*June Mariash Scott ..... Raleigh
Cindy Jo Talley ..... Fuquay-Varina
James Floyd Turner III ..... Raleigh
Jennifer Leigh Walston ..... Wilson

Degrees Conferred December 15, 1987

Sherry Rita Aronson ..... Cary
Charles Latham Barker ..... Clinton
Angela Lux Blough ..... Raleigh
Nancy Lynn Brown ..... Raleigh
Dorothy Sue Burns ..... Harrells
John Adam D'Apolito ..... Far Hills, NJ
†Janet Dease ..... Baltimore, MD
Mary Robin Edge ..... Fayetteville
**Katherine Anne Fernald ..... Autryville
†Vicki Flynn Gavin ..... Raleigh
Amy Kathryn Gibbs ..... Winterville
*Lisa Gay Goolsby ..... Selma
Beverly Anne Griffin ..... Winston-Salem
***Nada Khoury Hanna ..... Raleigh
Arnette Cassandra Hawley ..... Oxford
Curtis Franklin Holshouser ..... Mount Airy
Kwame Acheampong Karikari ..... Raleigh
Lisa Burnett Keith ..... Greensboro
†Katrina Denise King ..... Hendersonville
Teresa Dawn Leonard ..... Lexington
Michael James Lord ..... Raleigh
†John Patrick McNally ..... Fayetteville

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Tracy Lynn Miller ..... Sanford
Lori Susan Mitchum ..... Matthews
James Christopher Morgan ..... Goldsboro
†Richard Wayne Musselwhite ..... China Grove
Vandinh Nguyen ..... Raleigh
**Laura Michele Nixon ..... Statesville
†David William Norby ..... Raleigh
Gregory Winston Owen ..... Fayetteville
Ellen Camille Payne ..... Wilkesboro
*Mark Andrew Pearson ..... Melrose Park, IL
John Robert Sharpe ..... Randolph, NJ
Talmage Tolly Spence III ..... Charlotte
Virginia Lisa Steele ..... Winston-Salem
Robin Elise Thomas ..... Raleigh
James Carson Welch, Jr. ..... Raleigh
Russell Eugene Zalascek ..... Fayetteville

Degrees Conferred May 7, 1988

Janet Elaine Andrews ..... Concord
Randall Charles Angel ..... Sanford
Gena Lynnette Barnes ..... Creedmoor
James Arthur Bass ..... Red Oak
†Lisa Marie Beeman ..... Chocowinity
Joel Thomas Beeson ..... Lexington
**Jeffrey Franklin Boyd ..... Gastonia
John Edward Boyle ..... Reisterstown, MD
Jennifer Layne Bracken ..... Sanford
Angela Levette Brown ..... Whiteville
*Cathy Marie Bunyard ..... Cary
†Cynthia Marie Burns ..... Fayetteville
***Kelly Moore Carter ..... Raleigh
*Daniel Ray Chappell ..... Dale, IN
Thomas Lee Churchwell, Jr. ..... Cary
Timothy Wayne Cody ..... Fuquay-Varina
David Leon Currie ..... Kannapolis
Wendy Reneé Cushman ..... Jacksonville
†Roswitha Garcia Damm ..... Raleigh
William Roy Davis, Jr. ..... Elm City
*Melanie Lynn Digeso ..... Jackson, NJ
Scott Orander Douglas ..... Winston-Salem
Linwood Corry Faulconer ..... Smithfield
Susan Turnage Ferguson ..... Siler City
**Rebecca Ann Gallagher ..... Willow Springs
Bruce Howard Garner ..... Raleigh
Thomas Gebbia, Jr. ..... Sanford
***Susan Gail Gooch ..... Creedmore
Augustus Steele Hall, Jr. ..... Asheboro
*Suanne Renee Halleen ..... Louisville, KY
**Anne Allen Handlon ..... Cary
James Harry Hayne ..... Raleigh
*Nancy Joyce Hedgepeth ..... Henderson
**Marcia Gale Hedrick ..... Harmony
Douglas Jacob Heinz ..... Hickory
*Robert Wayne Hester ..... Durham
Walter Edward Hilliard ..... Wilson

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Stacia Lynn Holt ..... Asheville
†Joseph Cameron Hughes ..... Henderson
†***Sheri Lorraine Jackson ..... Henderson
Karen Jessen ..... Mount Holly
***Sanja Sue Kennedy ..... Phoenix, AZ
†Don Blakley Leonhardt ..... Vale
†David Bryant Lucas ..... Lucama
Laketha Michelle Marley ..... Whiteville
*Michael Thomas Marshall ..... Wilson
Teresa Ann Martin ..... Fort Lauderdale, FL
Donna Carol Massengill ..... Four Oaks
†John Joseph McHugh ..... Raleigh
Craig Anderson Moss ..... Roanoke Rapids
Christine Michele Mueller ..... Raleigh
†Gregory Ray Myers ..... Thomasville
Pamela Etu O'Herrick ..... Raleigh
†*Joseph Yates Parker III ..... Raleigh
Lori Louise Peterson ..... Great Lakes, IL
†Richard Hunt Reifschneider ..... Raleigh
Sonya Carole Settlemyre ..... Newton
***Christopher Robert Simmons ..... Charlotte
James Scott Simpson ..... Burlington
*Gary Franklin Slabach ..... Lexington
*Teresa Greeson Smith ..... Gibsonnville
Charlene Annette Sorrell ..... Durham
Michele Reneé Sparrow ..... Cary
Jonathan Glen Strickland ..... Raleigh
Ann Lohr Swing ..... Lexington
Karen Lynn Thomas ..... Snow Camp
†Stephon Terrell Thompson ..... Spring Lake
†Dale Edwin Tiffany ..... Raleigh
*Michelle Marie Vaccaro ..... Princeton, NJ
Anne Taylor Walker ..... Summerfield
*Linda Carol Walters ..... Raleigh
Richard Lyle Weeks ..... Cary
†Thomas Henry Weir III ..... Winston-Salem
Harold Dwayne Whinery ..... Fayetteville
Angela Lacy White ..... Wilson
†Sherry Kay Wright ..... Gastonia
*Christine Elizabeth Wunderly ..... Virginia Beach, VA

BACHELOR OF ARTS IN BUSINESS MANAGEMENT

Degrees Conferred June 24, 1987

Elizabeth Leigh Almand ..... Winston-Salem
Pamela Jean Askey ..... Charlotte
Betty Clark Bargoil ..... Gastonia
*Ann Marie Buettner ..... West Allis, WI
†Keary Cavin IV ..... Cary
Steven Reid Citty ..... Reidsville
Bobby Thomas Dunn, Jr. ..... Nashville
Paige Allison Ellis ..... Lexington
Elaine Carol Fanjoy ..... Raleigh
Elizabeth Carol Golder ..... Wrightsville Beach
†Wendell Ray Hodge ..... Yadkinville

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

†Robert Jon Hopfenberg ..... Raleigh
Katherine Chauncey Huffine ..... Greensboro
Gary James Jaluvka ..... Pittsburg, PA
William Bartley Kennedy ..... Raleigh
Jon Miller LaMachio ..... Greensboro
Kelly Susan Long ..... Raleigh
†Todd Kendrick Minchew ..... Wallace
Eric Clayvon Nixon ..... Four Oaks
Michael John Petellin ..... Enumclaw, WA
†Hilda Marie Robinson ..... Raleigh
Teresa Powell Sessoms ..... Southern Pines
Jeffery Wayne Smith ..... Roanoke Rapids
Ray Gordon Smith, Jr. ..... Benson
*Margaret Jill Thomas ..... Moncure
†Jeri Lynn Walter ..... Greenville
†Scott Eric Weiser ..... Mooresville
Gordon Rawlings White III ..... New Bern

Degrees Conferred August 5, 1987

†Anthony Mark Allen ..... Wake Forest
Jonathan Porter Babb ..... Greenville
Hector Currie Batchelor ..... Red Springs
†Sheryl Yvette Briscoe ..... Charlotte
†Nicole Marlisa Chatman ..... Orange, NJ
†Ashley Annette Collins ..... Warsaw
Angie Cotten ..... Angier
†Katheryn Lynn Felton ..... Rocky Mount
Tammy Lynn Frazier ..... Raleigh
Betsy Deanna Gentry ..... King
†Robert Benton Brightwell Glasgow IV ..... Raleigh
Sheila Anita Godfrey ..... Elizabeth City
Robert Walker Hazell ..... Richmond, VA
Judith Ginsberg Hiatt ..... Raleigh
†Mary Lloyd Hodges ..... Henderson
†Aldwyn Christopher Isley ..... Louisberg
Charles Shelby Jones ..... Cary
†Jackson Marie Jordan ..... Rocky Mount
†Mark Jon Marrocco ..... McClean, VA
Ernest Edward Mason III ..... Charlotte
John Edgar Maynard ..... Greensboro
Tammy Lavonne Mayo ..... Raleigh
*Leigh Ann McClure ..... Raleigh
Kimberly White McGlohon ..... Greenville
Scott Thomas McGuinn ..... Greensboro
William Jack Medford ..... Lake Junaluska
Vera Elaine Miller ..... Fayetteville
Michael Edward Mooney ..... Somerville, NJ
†Terri Lynn Pruitt ..... Wilson
†Sandra Kay Reid ..... Winston-Salem
Charles Lindsey Richardson ..... Tabor City
†Susan Elizabeth Roeber ..... Boca Raton, Fl
†*William Kevin Swartz ..... Sanford
Bradley Scott Underdal ..... Winston-Salem
†Kevin Michael Wade ..... Raleigh
Kimberly Kersey Watson ..... Durham
†John Charles Welch ..... Pfafftown
Melissa Ann Williamson ..... Charlotte

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

†Carleton Scott Andrew ..... Asheville
†John Casey Andrews ..... Rockville, MD
Anthony Gene Barefoot ..... Raeford
Harvey Craig Barefoot ..... Raleigh
Robert Marshall Blackmon ..... Greensboro
†Eric Scott Blumenthal ..... Chatham, NJ
Todd Warner Bone ..... Raleigh
Andrea Antoinette Breazeale ..... Winston-Salem
Lisa Faye Briggs ..... Roanoke Rapids
†***Ralph Timothy Bryan ..... Roanoke, VA
†*Dawn Marie Burnett ..... Rockville, MD
†Kimberly Lynn Cagle ..... Claremont
Linda Sue Canaday ..... Four Oaks
Selvan Thirumalaiswamy Chettiar ..... Durham
Michael Anthony Cillo ..... Raleigh
*Jody Lynn Cloninger ..... Gastonia
John Nicholas Cokinos ..... Chevy Chase, MD
†Jacqwendlyn Marlene Coleman ..... Fayetteville
Gary Douglas Cook ..... Hickory
Eric Steven Corbett ..... Raleigh
†Norman Edward Corkhill ..... Manassas, VA
Jeffrey Lee Curtis ..... Charlotte
James Edwin Dale ..... Raleigh
†William Thomas Daughtrey III ..... Medford, NJ
Kristi Michelle Davis ..... Asheboro
†Janet Dease ..... Baltimore, MD
†Eric Todd Denham ..... Salisbury
†Tamara Leigh Dooley ..... Carolina Beach
Blake Carlisle Doty ..... Winston-Salem
†Anthony Lee Downs ..... Thomasville
†Chibuzor Emmanuel Ehilegbu ..... Aba, Nigeria
Lisa Ann Elium ..... Salisbury
†Kimberly Ann Evans ..... Charlotte
Matthew David Evans ..... Charlotte
**Tena James Fabrizio ..... Cary
Torin Lane Fury ..... Raleigh
Bruce Howard Garner ..... Wake Forest
†Vicki Flynn Gavin ..... Raleigh
Richard Gray Gentry ..... Durham
†Brandon Keith Gerringer ..... Raleigh
Kurt Graham Gibson ..... Knightdale
†Anthony Joseph Giuli ..... Raleigh
†Cheryl Denise Goodman ..... Wilson
Elizabeth Ann Granger ..... Southern Pines
Bonita Denise Greene ..... Greensboro
Sandra Black Grey ..... Winston-Salem
Susan Carolyn Harriss ..... Henderson
Paul Robert Heide ..... Norfolk, VA
†Kimberly Ann Heisey ..... Charlotte
†Michael John Hickey ..... Richardson, TX
†Johnnie Dewey Hodges III ..... Topsail Beach
†Floyd Lofton Howell, Jr. ..... Raleigh
Gartha Ingram III ..... Fayetteville
David Henry Johnson ..... Fayetteville
†Timothy Lee Joines ..... Clemmons
†Robert Joseph Kearney ..... Raleigh

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

†*Walter Richard Kelly III ..... Charlotte
†Katrina Denise King ..... Hendersonville
Cooper Dave Kunkel IV ..... New Bern
Perry Joseph Leblond ..... Jacksonville
Tracy Lynn Legrand ..... Fayetteville
David Jonathan Levy ..... Newtown, PA
Matthew Frank Lewis ..... Wilmington
†Pamela Letitia Lindsey ..... Lumberton
Barry Scott Lingafelt ..... Winston-Salem
†***Catherine Helen Lloyd ..... Cary
Sharon Mayers ..... Charlotte
Maureen Elizabeth McCain ..... Milton
Abbot Henderson McClintic ..... Raleigh
†Thomas Dean McGhee ..... Yadkinville
†John Patrick McNally ..... Fayetteville
†Macon Warfield Michaux, Jr. ..... Goldsboro
†Claudia Renate Mitchell ..... Arlington, VA
Michael Brown Mizelle ..... Raleigh
*Edward Dale Moolenaar ..... Arden
Kevin Hill Moore ..... Monroe
†Richard Wayne Musselwhite ..... China Grove
†David William Norby ..... Raleigh
Karen Marie Oglesby ..... Williamston
Debra Lynn Ondrus ..... Wheaton, IL
Melissa Jane Owens ..... Jacksonville
Jerry Wayne Parrish, Jr. ..... Gastonia
Stephen Douglas Pindell ..... Raleigh
†Mary Hope Poole ..... Raleigh
Charles Franklin Potts, Jr. ..... Manassas, VA
Kim Spach Powell ..... Raleigh
†Nahida Lea Price ..... Raleigh
†Ritchie Wynne Ray ..... Albuquerque, NM
*Marcia Beverly Resnick ..... Raleigh
Gary Michael Ruess ..... Raleigh
†David Graig Salmon ..... Raleigh
***William Carl Shaver ..... Grand Island, NE
James Kendall Shaw ..... Roxboro
†Jonathan Andrew Shelton ..... Winston-Salem
†***Stacey Lynn Smith ..... Cary
John Louis Spirek ..... Springfield, VA
Scott Roland Strong ..... Charlotte
Robert Baxter Thompson, Jr. ..... Jacksonville
Tammy Ollie Tillman ..... Bonlee
Cynthia Rae Todd ..... Charlotte
Daniel Edward Todd ..... Annandale, NJ
Kathleen Ann Unterberger ..... Tucson, AZ
†Vonda Kaye Villines ..... Hurdle Mills
Mark Steven Vollinger ..... Pittsfield, MA
Gregory Guy Walker ..... Raleigh
Selena Ann Wall ..... Greensboro
†*Brooks Lee Warren ..... Spruce Pine
†Steven Kent Whitfield ..... Cary
Caryl Ruth Williams ..... Cary
†Michael Kirk Wilson ..... Raleigh
Troy Donnell Wright ..... Edenton
Louise Brinson Yelle ..... Raleigh

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

James Everette Abernethy ..... Marion
Kimberly Rene Anderson ..... Cary
†**Sharon Sullivan Aspden ..... Raleigh
Whitney Louisa Barnes ..... Durham
†James Alexander Barnwell III ..... Burlington
Stephanie Baron ..... Raleigh
†Frances Denise Bass ..... Roseboro
†Carolyn Carmontry Bates ..... Fort Bragg
**Lisa Rose Baumgartner ..... Rockville, MD
†Lisa Marie Beeman ..... Chocowinity
†Ashlea Ennis Benner ..... Fayetteville
Chris Anthony Benson ..... Toms River, NJ
†Richard David Benson ..... Leland
**Larry Bernstein ..... Raleigh
Michael Anthony Bierman ..... Washington
Laure Malosky Bowen ..... Raleigh
Daniel Lewis Bramlett ..... Charlotte
†**Brian Phillip Brauns ..... Pleasant Garden
†Brian Karl Brenner ..... Chapel Hill
Jeffrey Edward Bross ..... Hartford
†Gary Neville Buchanan ..... Franklin
Ken Thomas Buchanan ..... Brevard
Martha Joe Buffaloe ..... Garner
Andrew Ike Bullard ..... Raleigh
Julie Alice Bumgarner ..... Newton
†Cynthia Marie Burns ..... Fayetteville
Lisa Christine Cabler ..... Highlands
Kelly Anne Carlyle ..... Fayetteville
William Robert Cauley III ..... Holly Ridge
Melody Yvonne Cherry ..... Bethel
Carole Ann Cochran ..... Pineville
*Barbara Sue Coffin ..... Durham
Stephen Peter Conger ..... Kensington
†Andrew Malcolm Cooper ..... High Point
*Jennifer Lynn Cotten ..... Oxford
Ann Ivey Crumpler ..... Fayetteville
Russell Clay Curtis ..... Charlotte
Elizabeth Donleycott Dale ..... Raleigh
Frank Payne Davis IV ..... Rumson
†Thomas Hilton Deadmore ..... Richmond, VA
†Louis Scott Dettman ..... Rocky Mount
Terri Lynn Diemer ..... Burlington
†Robert Franklin Dixon ..... Matthews
†Pamela Tuck Dunn ..... Timberlake
†David Victor Dupont ..... Raleigh
†Kyle Andrew Edwards ..... Iron Station
†Thomas Fain Eller, Jr. ..... Asheville
Angela Sue Featherston ..... Charlotte
†Margaret Dare Fogleman ..... Burlington
†Karen Luanne Fowler ..... Winston-Salem
***Todd Branton Gaines ..... Raleigh

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Richard Anthony Gallo ..... Cary
Jeffrey David Gans ..... Charlotte
†Patricia Tran Garrett ..... Fayetteville
†Robert Earl Garris, Jr. ..... Roanoke Rapids
Jacqueline Prior Gibbons ..... Charlotte
†Myron Shawn Godette ..... New Bern
Jane Kathryn Goellner ..... Vienna, VA
†*Karen Rene Gray ..... Knightdale
Blair Meta Gunter ..... Raleigh
Richard Brian Hall ..... Denton
Arnette Cassandra Hawley ..... Oxford
†Mary Elizabeth Hayes ..... Charleston, SC
†Charles Heath Helms ..... Peachland
Frederick Raymond Hemphill ..... Charlotte
†Christopher Aaron Hill ..... Cary
†Lisa Ann Hodnett ..... Raleigh
Allen Wade Holmes ..... Franklinton
†Joseph Cameron Hughes ..... Henderson
Gregory Alan Hunter ..... Brevard
†*Cathy Annette Hurlocker ..... Raleigh
†Daniel Joseph Jacobs ..... Raleigh
†Donna Caroline Jobe ..... Matthews
†George Jones ..... Kenly
James Hilbert Jones, Jr. ..... Lumberton
†Mack Davis Jones ..... Greensboro
†Marwan Salah Juma ..... Rome, Italy
Maria Kanos ..... Raleigh
†Christal Ladeanne Kelly ..... Asheville
Scott Douglas Kimble ..... Marietta, OH
***Kimberley Laine King ..... Raleigh
†***Shari Elizabeth Kirk ..... Cary
Julie Lynn Knell ..... Gastonia
Thomas Noss Kyle, Jr. ..... Rockville, MD
Tamara Lynette Lail ..... Granite Falls
Kay Lynn Lane ..... Tavares, FL
†Roxanne Marie Langdon ..... Garner
Paul Lyndon Lanier ..... Jacksonville
†William Vandeventer Leaming, Jr. ..... Durham
†Don Blakley Leonhardt II ..... Vale
Laura Jill Lewis ..... Eagle Springs
*Pamela Roxanne Lewis ..... Fallston
†David Edwin Lineback ..... Winston-Salem
Ingrid Elizabeth Lium ..... Atlanta, GA
Ella Mae Logan ..... Lake Lure
†David Bryant Lucas ..... Lucama
†Alexander Cox Mackenzie ..... Matthews
Robert Keith Manning ..... Greensboro
†**Victoria Lee Marden ..... Spartansburg
†Christopher Grey Martin ..... Burlington
Myrna Martia McCaskill ..... Gastonia
†Janice Louise McDonald ..... Erwin
†John Joseph McHugh ..... Raleigh
†Sophia Kathry McIlwain ..... Red Springs
Gregory Scott McLean ..... Apex
David Timothy McQueen ..... Raleigh

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Michael Lawton McQueen ..... Raleigh
†Mark Charles Meissner ..... Charlotte
James Davis Metzler ..... Greensboro
Tracy Lynn Miller ..... Sanford
†Anthony Scott Monfrado ..... Raleigh
Paul Merritt Moore, Jr. ..... Raleigh
Leigh Ann Morris ..... Asheville
†Kenneth Rick Morrow ..... Forest City
Cassandra Dale Mudd ..... Fayetteville
†Gregory Ray Myers ..... Thomasville
†Stacey Jean Najarano ..... Cranston, RI
†David Allen Nettesheim ..... Raleigh
Kelly Elizabeth Newton ..... Morresville
Patricia Erin Nolan ..... Annapolis
Timothy John O'Connor ..... Raleigh
†*Joseph Yates Parker III ..... Raleigh
**Patricia Karen Parker ..... Morehead City
Melissa Ann Patrick ..... Ashland, VA
†Michael Carlos Peace ..... Henderson
†Kimberly Dawn Pearce ..... Raleigh
**Moira Skea Pearson ..... Raleigh
Erik Clay Peterson ..... Cherry Hill, NJ
Metalone Phongsavath ..... Raleigh
*†Therence Osatti Pickett ..... Philadelphia, PA
Stephen McDavid Powell ..... Roanoke, VA
†Jeffrey Wayne Pratt ..... Eden
Eileen Ann Reap ..... Charlotte
†Richard Hunt Reifschneider ..... Raleigh
Brian Forrest Riggins ..... Charlotte
Christophe Frank Roach ..... Goldsboro
Jeri Lynne Roberts ..... Greensboro
†Joseph Christy Rodri, Jr. ..... Wilson
Carl Linwood Rogers III ..... Cary
Todd Anthony Rollins ..... King George, VA
†Leslie Jane Rothenberg ..... Lake Wylie, SC
†Stephen Eric Russell ..... Raleigh
Elizabeth Stone Rutland ..... Hopkinsville
Jodi Lynn Schneider ..... Raleigh
David Anthony Scott ..... Raleigh
†John Russell Shattuck ..... Raleigh
Melissa Ann Sills ..... Bunnlevel
†*Bradley Allen Smith ..... Greensboro
Claudia Lee Smith ..... Raleigh
Craig J. Smith III ..... Winston-Salem
Gary Dwayne Smith ..... Reidsville
John Alan Sneeden ..... Wilmington
Mark David Sobotkin ..... Hickory
Jonathan Thomas Speaks ..... Kannapolis
†Johnnie Craig Speight ..... Rocky Mount
†Angela Jo Stainback ..... Wilson
Shannon Rae Stamey ..... Forest City
Edward James Stanley ..... Greenville

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

†Natalie LaTrecia Stewart ..... Raleigh
Kelly Anne Stryker ..... Lincoln, NE
†Eric Kin-Son Tang ..... Petaling, Jaya
†Susan Dabney Templeton ..... Lynchburg, VA
Michael Latif Thomas ..... State College, PA
†Stephon Terrell Thompson ..... Spring Lake
Janet Blaire Tidwell ..... Cary
†Dale Edwin Tiffany ..... Raleigh
†Robert Justin Timbers, Jr. ..... Spring Lake
*Donna Lynn Torrence ..... Lenoir
Annemarie Treadway ..... Greensboro
Bondilyn Van Etten ..... Hickory
†Ann Marie Wagner ..... High Point
†Mark Daniel Walker ..... Roxboro
†Thomas Henry Weir III ..... Winston-Salem
Carrie Elizabeth Wenner ..... Greensboro
†Jeffrey Thomas Williams ..... Raleigh
†**Stuart Allan Williams ..... Raleigh
†Robert Wesley Willingham ..... Chapel Hill
Regina Rhae Wilson ..... Winston-Salem
†Tanya Ann Womble ..... Clinton
Timothy Earle Woodberry ..... Virginia Beach, VA
David Ray Worsley, Jr. ..... Wallace
†Sherry Kay Wright ..... Gaston
Margaret Marie Zangerle ..... Jacksonville, FL

BACHELOR OF ARTS IN ECONOMICS

Degrees Conferred June 24, 1987

John Christopher Allen ..... Jamestown
†Keary Cavin IV ..... Cary
†Wendell Ray Hodge ..... Yadkinville
†Robert Jon Hopfenberg ..... Raleigh
†Todd Kendrick Minchew ..... Wallace
Kristi Michelle Murray ..... Winston-Salem
†Hilda Marie Robinson ..... Raleigh
Susan Elizabeth Walker ..... Cary
†Jeri Lynn Walter ..... Greenville
†Scott Eric Weiser ..... Mooresville

Degrees Conferred August 5, 1987

†Anthony Mark Allen ..... Wake Forest
†Sheryl Yvette Briscoe ..... Charlotte
†Nicole Marlisa Chatman ..... Orange, NJ
†Kathryn Lynn Felton ..... Rocky Mount
†Robert Benton Brightwell Glasgow IV ..... Raleigh
†Mary Lloyd Hodges ..... Henderson
†Aldwyn Christopher Isley ..... Louisburg
†Jackson Marie Jordan ..... Rocky Mount
†Robert Joseph Kearney ..... Raleigh
†Mark Jon Marrocco ..... McClean, VA
†Terri Lynn Pruitt ..... Wilson
†Sandra Kay Reid ..... Winston-Salem
†Susan Elizabeth Roeber ..... Boca Raton, FL.
†*William Kevin Swartz ..... Sanford
†Kevin Michael Wade ..... Raleigh
†John Charles Welch ..... Pfafftown

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Degrees Conferred December 15, 1987

†Carleton Scott Andrew ..... Asheville
†John Casey Andrews ..... Rockville, MD
†Eric Scott Blumenthal ..... Chatham, NJ
†***Ralph Timothy Bryan ..... Roanoke, VA
†*Dawn Marie Burnett ..... Rockville, MD
†Kimberly Lynn Cagle ..... Claremont
†Jacqwendlyn Marlene Coleman ..... Fayetteville
Simon Keith Cooper ..... Cheltenham, England
†Norman Edward Corkhill ..... Manassas, VA
†William Thomas Daughtrey III ..... Medford, NJ
†Eric Todd Denham ..... Salisbury
†Tamara Leigh Dooley ..... Carolina Beach
†Anthony Lee Downs ..... Thomasville
Michael Gregory Dunn ..... Raleigh
†Chibuzor Emmanuel Ehilegbu ..... Aba, Nigeria
†Kimberly Ann Evans ..... Charlotte
†Brandon Keith Gerringer ..... Raleigh
†Anthony Joseph Giuli ..... Raleigh
†Cheryl Denise Goodman ..... Wilson
†Kimberly Ann Heisey ..... Charlotte
†Michael John Hickey ..... Richardson, TX
†Johnnie Dewey Hodges III ..... Topsail Beach
†Floyd Lofton Howell, Jr. ..... Raleigh
†Timothy Lee Joines ..... Clemmons
†Robert Joseph Kearney ..... Raleigh
†*Walter Richard Kelly III ..... Charlotte
†Pamela Letitia Lindsey ..... Lumberton
Thomas Dean McGhee ..... Yadkinville
Scott Thomas McGuinn ..... Greensboro
David Anthony Parker, Jr. ..... Denton
†Mary Hope Poole ..... Raleigh
†Nahida Lea Price ..... Raleigh
†Ritchie Wynne Ray ..... Albuquerque, NM
Mark Allen Reid ..... Raleigh
†David Craig Salmon ..... Raleigh
Scott Matthew Teel ..... Raleigh
*Rebecca Rose Thompson ..... Fayetteville
†Vonda Kaye Villines ..... Hurdle Mills
†*Brooks Lee Warren ..... Spruce Pine
†Steven Kent Whitfield ..... Cary
†Michael Kirk Wilson ..... Raleigh
Scott Jeffrey Wilson ..... Northampton, MA

Degrees Conferred May 7, 1988

†**Sharon Sullivan Aspden ..... Raleigh
†James Alexander Barnwell III ..... Burlington
†Frances Denise Bass ..... Roseboro
†Carolyn Carmontry Bates ..... Fort Bragg
†Ashlea Ennis Benner ..... Fayetteville
†Richard David Benson ..... Leland
†**Brian Phillip Brauns ..... Pleasant Garden
†Brian Karl Brenner ..... Chapel Hill

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

†Gary Neville Buchanan ..... Franklin
Rebecca Lynn Buchanan ..... Sanford
†Cynthia Marie Burns ..... Fayetteville
†Andrew Malcolm Cooper ..... High Point
†Roswitha Garcia Damm ..... Raleigh
†Thomas Hilton Deadmore ..... Richmond, VA
†Louis Scott Dettman ..... Rocky Mount
†Robert Franklin Dixon ..... Matthews
†Pamela Tuck Dunn ..... Timberlake
†David Victor Dupont ..... Raleigh
†Kyle Andrew Edwards ..... Iron Station
†Thomas Fain Eller, Jr. ..... Asheville
†Margaret Dare Fogleman ..... Burlington
†Karen Luanne Fowler ..... Winston-Salem
†Patricia Tran Garrett ..... Fayetteville
†Robert Earl Garris, Jr. ..... Roanoke Rapids
Sarah Lesley Gee ..... Charlotte
†Myron Shawn Godette ..... New Bern
†*Karen Rene Gray ..... Knightdale
Andrew Peter Greene ..... High Point
†Mary Elizabeth Hayes ..... Charleston, SC
†Charles Heath Helms ..... Peachland
†Christopher Aaron Hill ..... Cary
†Lisa Ann Hodnett ..... Raleigh
†*Cathy Annette Hurlocker ..... Raleigh
†***Sheri Lorraine Jackson ..... Henderson
†Daniel Joseph Jacobs ..... Raleigh
†Donna Caroline Jobe ..... Matthews
†George Jones ..... Kenly
†Mack Davis Jones ..... Greensboro
†Marwan Salah Juma ..... Rome, Italy
†Christal Ladeanne Kelly ..... Asheville
†***Shari Elizabeth Kirk ..... Cary
†Roxanne Marie Langdon ..... Gardner
Carl Eric Lasley ..... Greensboro
†William Vandeventer Leaming, Jr. ..... Durham
†David Edwin Lineback ..... Winston-Salem
***Catherine Helen Lloyd ..... Cary
†Alexander Cox Mackenzie ..... Matthews
†**Victoria Lee Marden ..... Spartanburg, SC
†Christopher Grey Martin ..... Fayetteville
Harry Shaw McDonald, Jr. ..... Raleigh
†Janice Louise McDonald ..... Erwin
†Sophia Kathry McIlwan ..... Red Springs
†Mark Charles Meissner ..... Charlotte
†Anthony Scott Monfrado ..... Raleigh
†Kenneth Rick Morrow ..... Forest City
Wade Lee Murdock ..... Cary
†Stacey Jean Najarano ..... Cranston, RI
†David Allen Nettesheim ..... Raleigh
†Michael Carlos Peace ..... Henderson
†Kimberly Dawn Pearce ..... Raleigh
†*Therence Osatti Pickett ..... Philadelphia, PA
†Jeffrey Wayne Pratt ..... Eden
†Joseph Christy Rodri, Jr. ..... Wilson
†Leslie Jane Rothenberg ..... Lake Wylie, SC

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

†Stephen Eric Russell ..... Raleigh
†John Russell Shattuck ..... Raleigh
†*Bradley Allen Smith ..... Greensboro
†Johnnie Craig Speight ..... Rocky Mount
†Angela Jo Stainback ..... Wilson
†Natalie LaTrecia Stewart ..... Raleigh
†Eric Kin-Song Tang ..... Petaling, Jaya
†Susan Dabney Templeton ..... Lynchburg, VA
†Robert Justin Timbers, Jr. ..... Spring Lake
†Ann Marie Wagner ..... High Point
†Mark Daniel Walker ..... Roxboro
†Jeffery Thomas Williams ..... Raleigh
†**Stuart Allan Williams ..... Raleigh
†Robert Wesley Willingham ..... Chapel Hill
†Tanya Ann Womble ..... Clinton
Troy Donnell Wright ..... Edenton

BACHELOR OF SCIENCE IN ECONOMICS

Degrees Conferred June 24, 1987

Kemp Jerome Chalmers ..... Cameron
Kevin Patrick Muldowney ..... Gastonia

Degrees Conferred August 5, 1987

†Barry Keith Bowden ..... Henderson
Wilson Henry Brown ..... Cary
Jay Michael Cowder ..... Raleigh
Randall Edmon King ..... Rural Hall

Degrees Conferred December 15, 1987

Warren Benjamin Chapman ..... Charlotte
Stephen Gregory Howard ..... Hope Mills
Neill McCauley Laney, Jr. ..... Wilmington
Angela Michele Long ..... Mebane
Fredric Todd Macholz ..... Charlotte
*Claven Curtis Williams, Jr. ..... Faison

Degrees Conferred May 7, 1988

Timothy Marvin Bivens ..... Forest City
Aaron Edward Bryant ..... Winston-Salem
Norwood Bennett Chestnutt ..... Gastonia
Garry Pike Copeland ..... Tyner
Anthea Palliet Jones ..... Lexington
Joo Hwan Kim ..... Fayetteville
James Vanty Lamb II ..... Lumberton
Lynne Suzanne Moose ..... Maiden
James Michael Pardue ..... Sanford
H†John Lawrence Sorrels ..... Raleigh
†***Sheila Jane Stone ..... Cary
Ricardo Velasquez ..... Goldsboro

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

BACHELOR OF ARTS IN ENGLISH

Degrees Conferred June 24, 1987

Carol Christian Brewer ..... Raleigh
***Patricia Riddle Johnson ..... Raleigh
***Kenneth Richard Rose ..... North Reading, MA
Teresa Gayle Royal ..... Millers Creek
Kimberly Michelle Sivills ..... Rocky Mount

Degrees Conferred August 5, 1987

Pauline Finney ..... Shelby
Marguerite Tucker Joyner ..... Raleigh
Robert Brooks Lester ..... Chapel Hill
Jeany Lynn Sapp ..... Tobaccoville
James Coburn Shell, Jr. ..... Kinston

Degrees Conferred December 15, 1987

Tracey Leigh Baines ..... Raleigh
Samuel David Carson, Jr. ..... Kenbridge, VA
Michael Standfield Cheek ..... Chapel Hill
Susan Kay Coble ..... Raleigh
Amy Elese Elliott ..... Lewisville
Robin Stephanie Falls ..... Raleigh
Carver Sapp Faucette ..... Raleigh
Ellen Adair Griffin ..... Clinton
Billie Ann Hinton ..... Clayton
Stephen Milton Holloman ..... Greenville
Peter Morgan Holman ..... Raleigh
Deron Leslie Johnson ..... Durham
Joan Taylor Loftin ..... Vanceboro
Carol Ann Madre ..... Hertford
Linda Elizabeth Mahnen ..... Scarsdale, NY
Allison Cannon McArthur ..... Fayetteville
Grover John McKay, Jr. ..... Knightdale
†Macon Warfield Michaux, Jr. ..... Goldsboro
Denise Manning Monck ..... Raleigh
Patricia Rose O'Grady ..... Wheaton, IL
Eric David Olson ..... Eden
Timothy Michael Peeler ..... Vale
William Netherton Wiechmann ..... Guilford, CT

Degrees Conferred May 7, 1988

***Amy Elizabeth Adams ..... Wilson
Lynne Denise Basden ..... Rutherfordton
**Vicki Ricks Bishop ..... Cary
Anna Lucille Carson ..... Rutherfordton
**Terri Marie Clerico ..... Flemington, NJ
Catherine Ludwig Donleycott ..... Raleigh
Donna Jeanne Edwards ..... Raleigh
Jill Ann Fortner ..... Goldsboro
***Wanda Bullock Gilchrist ..... Raleigh
Margaret Anne Hale ..... Raleigh
Stephanie Renee Harris ..... Sanford

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

***Betty June Havens ..... Louisburg
Sheree Long Hester ..... Raleigh
Daphne Holden ..... Raleigh
Archibald Robinson Hoxton IV ..... Shepherdstown, WV
Erica Lynn Hughes ..... Lancaster, PA
Lisa Kay Hunt ..... Durham
John Bruce Jones ..... Raleigh
Marcy Lyn Kuhns ..... Pfafftown
Patrick Charles Lee ..... Camden, SC
Crystal Leigh Leonard ..... Thomasville
Kari Susan Mathisen ..... Sparta, NJ
Lois Ann McDaniel ..... Cherryville
Julia Esperanza Morin McKnight ..... Detroit, MI
*John Howard McWilliam ..... Raleigh
Rachel Lynae Meldrom ..... Roanoke Rapids
Penny Pendergraft Miller ..... Marion
Ellen Christina Neville ..... Linden
**Lauren Elizabeth Nuckolls ..... Cary
*Mary Joan Opyr ..... Raleigh
Robert Kevin Padovano ..... Short Hills, NJ
Leslie Ann Painter ..... Gastonia
Valerie Anita Pearson ..... Henderson
Frederick Daniel Perry ..... Raleigh
H Melinda Ann Pfeiffer ..... Columbia, SC
Jennifer Martin Raisig ..... Durham
Robert Duane Richards ..... Raleigh
Lisa Marie Strong ..... Carolina Beach
Gina Marguerite Thompson ..... Wilmington
**Crystal Dawn Walser ..... Lexington
Daniel Adam Williams ..... Goldsboro
Pamela Rae Williams ..... Wilmington

BACHELOR OF SCIENCE IN ENGLISH

Degrees Conferred May 7, 1988

Stephen Jeffrey Brandon ..... High Point
Paul Joseph McKenzie ..... Bethania

BACHELOR OF ARTS IN FRENCH LANGUAGE AND LITERATURE

Degrees Conferred December 15, 1987

*Kimberly Bryant Bruff ..... Raleigh
†***Catherine Helen Lloyd ..... Cary
**Sara Frances McClure ..... Rutherfordton
†Claudia Renate Mitchell ..... Arlington, VA

Degree Conferred May 7, 1988

*Lisa Gayle Vogel ..... Fort Lauderdale, FL

BACHELOR OF ARTS IN HISTORY

Degrees Conferred August 5, 1987

*Robert Daniel Murray ..... Winston-Salem
Daryl Freeman Russell ..... Suffolk, VA

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Degrees Conferred December 15, 1987

Dace Allen Bergen ..... Durham
**Mark Daniel Chapman ..... Junction City, OR
William Todd Dunnagan ..... Charlotte
Jeffrey Wilson Ferrell ..... Knightdale
Michael Thomas Gaddy ..... Fayetteville
Robert Arthur Goyette ..... Charlotte
James Evan Horton ..... Whitakers
Delmous Roy Ingram, Jr. ..... Raleigh
Pamela Faye Jackson ..... Raleigh
Lisa Lynn Levine ..... Black Mountain
*Jane Cole O'Brien ..... Raleigh
Samuel Omayenwa Okpodu ..... Warri, Nigeria
Richard Shirley Proctor III ..... Goldsboro
David Melvin Williams, Jr. ..... Denver, CO
James Ronald Wilson ..... Raleigh
Anthony Derek Zehia ..... Cary

Degrees Conferred May 7, 1988

Christine Marie Carroll ..... Danbury, CT
Gregory Brent Chappell ..... Rockingham
Jeffrey Thomas Coppley ..... Lexington
Stephanie Laine Denmark ..... LaGrange
Timothy Myles Dolan ..... Charlotte
Allison Eva Donnan ..... Oakland, NJ
Francesca Renee Dorsch ..... Winston-Salem
John Harrison Harvel ..... Southern Pines
Virginia Elizabeth Jonson ..... Cary
Nathan Bryant Karnes ..... Storrs, CT
Stephanie Paige Maready ..... Wilmington
William Ernest Maxwell ..... Pink Hill
*John Mark Sweat ..... Apex

BACHELOR OF SCIENCE IN HISTORY

Degrees Conferred December 15, 1987

Leonard Paul Harrison ..... Goldsboro
Jennifer Karches ..... Cary
Susan Hope Lee ..... Asheboro
Neil William Morgan ..... Vass
Mark Haviland Tandy ..... Holden Beach

Degrees Conferred May 7, 1988

*Daniel DeLos Miles ..... Wake Forest
John Russell Taylor ..... Rocky Mount

BACHELOR OF ARTS IN MULTI-DISCIPLINARY STUDIES

Degree Conferred June 24, 1987

Carol Ann Meister ..... Basking Ridge, NJ

Degrees Conferred August 5, 1987

Jeffrey Scott Austin ..... Kernersville
Suzette Gail Bradham ..... Wagram

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

**Danny Lee Gray, Jr. ..... Concord
William Joseph Ladd ..... Raleigh

Degrees Conferred December 15, 1987

Emily Lois Carnes ..... Chapel Hill
†Lisa Dawn Harrison ..... Raleigh
†Janet Dean Hoskins ..... Everetts
†Jennifer Jeanne Love ..... Greensboro
Maureen Ann Murray ..... Merrimack, NH
Stephanie Denise Paradeses ..... Raleigh
Joseph Dante Saccio ..... Charlotte

Degrees Conferred May 7, 1988

*†April Beverly Adams ..... Robbinsville
†David Michael Barnett ..... Raleigh
Ronald Kurt Edmark ..... Hibbing, MN
Cheryl Ann Gancos ..... Thomaston, CT
†*Laura Jean Gray ..... Raleigh
Nora Jane Grimbergen ..... Flanders, NJ
†Kimberly Anne Hancock ..... Raleigh
Steven Charles Josephson ..... Cary
†Elizabeth Lindsay McCoy ..... Fayetteville
**Julia Richardson McIver ..... Fuquay Varina
†Amy Kathryn Pettyjohn ..... Winston-Salem
†Deborah Kathleen Reedy ..... Clinton
†Ruthan Mary Singleton ..... Charlotte
†*Dana Ann Watson ..... Gastonia
†Donna Kay Weavil ..... Whiteville
Wallace Benjamin Wolverton ..... Raleigh

BACHELOR OF ARTS IN PHILOSOPHY

Degrees Conferred December 15, 1987

H†***Andrea Michelle Herr ..... Lancaster, PA
Arun Kumar Prasad ..... Raleigh

Degrees Conferred May 7, 1988

**Daniel John O'Herrick ..... Raleigh
*Mark David Prather II ..... Wilmington

BACHELOR OF ARTS IN POLITICAL SCIENCE

Degrees Conferred June 24, 1987

James Michael Cofer ..... Charlotte
Diane Edwards ..... Nashville
**Michael Ernest Hayhurst ..... Medina, OH
Michael Lamonte Hunter ..... Goldsboro
Malissia Agnes Moore ..... Red Oak
Kenneth Isaac Poe ..... Durham
Dawn Anne Weaver ..... Plantation, FL
Adrian ZaCharuss Williams ..... Fayetteville

Degrees Conferred August 5, 1987

Donald James Faggart, Jr. ..... Concord
Lena Claudine Ford ..... Charlotte
John Raydean Kivett, Jr. ..... Asheboro

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Michael Addison Knight ..... Raleigh
Joseph George Marshall ..... Winston-Salem
Isaac Gregory Medlin ..... Raleigh
Sandra Alice Ray ..... Warsaw
William Edward Tourtellot ..... Charlotte
Henry John Waters, Jr. ..... Raleigh

Degrees Conferred December 15, 1987

Jeffery Lewis Barger ..... Hickory
John Richard Best ..... Goldsboro
John Kenneth Carlisle, Jr. ..... Cary
Anthony Scott Chesnutt ..... Salemburg
Robert Ansel Clark ..... Marion
Howard Lee Clyburn ..... Raleigh
William Fleming Courts ..... Greensboro
Virginia Coleman Creech ..... Wilson
Scott Howell Dannenberg ..... Raleigh
David Terrell Dellinger ..... Durham
Alan Wade Eatmon ..... Rocky Mount
William Kinglsey Goldfarb ..... Charlotte
John Frederick Doyle Hartwell ..... Closter, NJ
Scott Edward Hildebran ..... Hickory
**Marjorie Wetherbee Hodges ..... Linville
Robin Lynn Holt ..... Sanford
Jeffrey Glenn Horton ..... Roxboro
*Kimberly Dawn Krawiec ..... Kernersville
Tallemeko Lewis ..... Goldsboro
Kelly Susan McInnis ..... Fayetteville
*Barbara Piver Moore ..... Garner
Kirkland Haughton Rice ..... Greensboro
Cynthia Louise Royals ..... Kernersville
Ricky Lee Sapp ..... Winston-Salem
†Jonathan Andrew Shelton ..... Winston-Salem
Steven Allen Sloan ..... Sanford
Timothy Steven Smith ..... Kinston
Marcanthony Sodano ..... Warrington, PA
Scott Vincent Stuart ..... Charlotte
Michael Lauritz Sweeney ..... Durham
David Dirk Tharpe ..... Statesville
Jan Renea Tharrington ..... Garner
Mary Dell Weeks ..... Winston-Salem
James Barrett Wilson ..... Winston-Salem

Degrees Conferred May 7, 1988

Rodney Lance Baker ..... Cary
Abigail Denise Ballard ..... Raleigh
Lisa Stone Barnes ..... Middlesex
Jeffrey Charles Barnhardt ..... Mocksville
Justine Andrea Carpenter ..... Gastonia
Jeffrey Glenn Causey ..... Cary
Robert Booker Coats II ..... Raleigh
Phillip Cohn Craig ..... Durham
Kassie Herb Creekmore ..... Raleigh
Sherman Lee Criner ..... Raleigh
*Ann Elizabeth Dixon ..... Cary
H***William Murray Downs ..... Raleigh
Mekella Sedonia Dunlap ..... Coinjock

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Kimberly Kay Engle ..... Banner Elk
William Clayton Faulk ..... Fayetteville
Anthony Michael Fields ..... Goldston
Suzanne Annette Marie Gallant ..... Raleigh
Janet Renee Grisdale ..... Charlotte
Steven Frank Hamlin ..... Cherry Hill, NJ
Eric Gregory Hansen ..... Fayetteville
David Clay Houston ..... Grifton
Jeffrey William Huber ..... Fuquay Varina
†Richard Dalton Huber II ..... Canton
Mitchell Wright Kernstine ..... Warsaw
*Lorna Marie Massey ..... Raleigh
**Michael Joseph McCann ..... Raleigh
Samuel Norman McKenzie, Jr. ..... Wrightsville Beach
Indira Savannah Moses ..... Williamston
Stacy Lynn Myrick ..... Greensboro
Joseph Thomas Neville ..... Dunn
John Marshall Nunnally ..... Raleigh
Michael Irvin Outlaw ..... Kenansville
Richard Howard Pajerski ..... Raleigh
Elizabeth Anne Pfuetze ..... Athens, OH
*Frederic William Powers ..... Mukwonago, WI
Davina Pujari ..... Bluefield, WV
Charles Exum Rambeau, Jr. ..... Fuquay-Varina
Hector Neill Ray ..... Fayetteville
Jean Carol Smith ..... Winston-Salem
Pamela Suzanne Utter ..... Greensboro
**Kristy Weathers ..... Southern Pines
Charles Horace Weaver ..... Raleigh
Leonard Lamont Wiggins ..... Rocky Mount
Steven Cameron Wright ..... Charlotte
Lorie Michelle Yoos ..... Wilson

BACHELOR OF SCIENCE IN POLITICAL SCIENCE

Degree Conferred December 15, 1987

Frank Gereon Mittag ..... Raleigh

Degrees Conferred May 7, 1988

William Jonathan Compton ..... Raleigh
William Carroll Elliott ..... West Jefferson
Keith Alexander Hawkins ..... Durham
*Stewart Todd Morgan ..... Boone

BACHELOR OF ARTS IN SOCIOLOGY

Degrees Conferred June 24, 1987

Robert Thomas Johnson ..... Mount Olive
Ann Marie O'Donohue ..... Durham

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Degrees Conferred August 5, 1987

Charles Harris Bates ..... Greensboro
Jill Louise Kabala ..... Raleigh
Gina Marie Pratola ..... Verona, NJ
*Clint Ryan Tillerson ..... Apex
Sherie Ann Yorkovich ..... Charlotte

Degrees Conferred December 15, 1987

Wade Lloyd Britt ..... Cary
Michael Craig Brittain ..... Hendersonville
Dora Lee Dunston ..... Raleigh
Wanda Yvette Floyd ..... Henderson
Carla Thomasine Hillman ..... Cheaspeake, VA
Paul Albert Koop ..... Raleigh
David Benjamin Stone ..... Sanford

Degrees Conferred May 7, 1988

Sandra Lee Bannerman ..... Springfield, VA
Deborah Leigh Brittsan ..... Greensboro
Karen Leigh Cartner ..... Clemmons
Richard Bryant Culler ..... Kernersville
Brian Scott Davis ..... High Point
Vonnie Lucile Dawson ..... Stantonsburg
Eugene Owen Gallagher, Jr. ..... Raleigh
Lisa Carol Harmon ..... Raleigh
Mary Susan Indelicato ..... Alexandria, VA
*Virginia Wilson Jeffers ..... Raleigh
***Carol Rose Jernigan ..... Dunn
Mary Katherine Keating ..... Kinston
**Jeffrey Lance Lasater ..... Knightdale
Lorenzo Steven Melton ..... Raleigh
Joseph Lawrence Page ..... Wilson
Anna Corinne Peel ..... Durham
Meigan Marie Sullivan ..... Potomac, MD
William Edward Tillman ..... Butner
Linda Brown Wheeler ..... Durham

BACHELOR OF ARTS IN SPANISH LANGUAGE AND LITERATURE

Degree Conferred August 5, 1987

†Ashley Annette Collins ..... Warsaw

Degree Conferred December 15, 1987

Charles Reagan Purser ..... Brevard

Degrees Conferred May 7, 1988

Martha Joe Buffaloe ..... Garner
Tim McCoy Duke, Jr. ..... Louisburg
†Richard Dalton Huber II ..... Canton
**Patricia Diane Metzler ..... North Jackson, OH
Martha Ann Tucker ..... Rockville, MD

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

BACHELOR OF ARTS IN SPEECH COMMUNICATION

Degrees Conferred June 24, 1987

Thellena Pearl Brown ..... Jamaica, NY
Susan Elizabeth Crouch ..... Rocky Mount
Roberta Kay Harger ..... Fayetteville
Belinda Marie Haselrig ..... Greenville
Suzanne Ware Scott ..... Raleigh
Patrena Yvette Trice ..... Chesapeake, VA
Ann Kathleen Vrba ..... Convent Station, NJ

Degrees Conferred August 5, 1987

*John McNair Bell ..... Raleigh
Donna Elizabeth Biglin ..... Stewart Manor, NY
Patricia Lee Brown ..... Chapel Hill
Carolyn Jane Teeter Chappell ..... Raleigh
Kathy Ann Frye ..... Kannapolis
Joe Ellison McIntosh, Jr. ..... Lexington
Melinda Jean Morris ..... Hendersonville
Lisa Anne Natoli ..... Chevy Chase, MD
Robyn Lin Richardson ..... Raleigh
Elizabeth Michaele Riley ..... Parkersburg, WV
Stuart Scott Sanderson ..... Wendell
Angela Renee Shackelford ..... Dillon
Deborah Ann Sheppard ..... Monroe
Marva Denise Williams ..... Baltimore, MD

Degrees Conferred December 15, 1987

Jeffrey Michael Aiken ..... Durham
Nancy Margaret Bailey ..... Raleigh
Lynn East Barber ..... Turonza, AR
David Lawrence Barron ..... Raleigh
Julia Meredith Brady ..... Reidsville
David Addison Brooks ..... Fayetteville
Anita Dawn Campbell ..... Randleman
Susan Elizabeth Campbell ..... King of Prussia, PA
Karen Ruth Clark ..... Garner
Ashley Brailsford Crawford ..... Lexington
Peri Hope Dunefsky ..... Huntington, NY
Alan Jeffrey Furno ..... Cary
Suzanne Grandbois ..... Montreal, Canada
Abbie Leigh Gray ..... High Point
Todd Lee Green ..... Kannapolis
*Bruce Bailey Ham ..... Fayetteville
†Lisa Dawn Harrison ..... Raleigh
Linda Marie Hazeltine ..... Matthews
Kenneth Hooper Helms ..... Cherryville
†Janet Dean Hoskins ..... Everetts
Thomas McNeal James ..... Leland
David Harrison Kellis ..... Candor
Elizabeth Ann Kemper ..... Ballston Spa, NY
**Samuel Timothy Kent ..... Marion
Jacqueline Kibler ..... Cary
Darren John Ley ..... Sanford
Michael Levon Long ..... Greenville
†Jennifer Jeanne Love ..... Greensboro

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Jill Katherine Lundgren ..... Charlotte
**Angela Marie Mason ..... Washington
Richard Anderson Meadows ..... Sanford
Paul Herbert Noblin, Jr. ..... Raleigh
Mary Annette Petty ..... Charlotte
Jamie Rae Schofield ..... Titusville, FL
Paige Elizabeth Siner ..... Morehead City
†***Stacey Lynn Smith ..... Cary
Allen Lawrence Sofley ..... Cary
Nicolette Marie Sorger ..... Havertown, PA
Raymond Gerald Spencer, Jr. ..... Southport
Anne Marie Storey ..... Vincentown, NJ
Kenneth Todd Williamson ..... Wilson

Degrees Conferred May 7, 1988

†*April Beverly Adams ..... Robbinsville
Marlon Walton Archey ..... Los Angles, CA
†David Michael Barnett ..... Raleigh
Mary Elizabeth Baroody ..... Winston-Salem
*Rima Veronika Barzdukas ..... Falls Church, VA
Jewell Henriette Ball ..... Fayetteville
Amy Lynn Boiselle ..... Fayetteville
*Dianne Creech ..... Kenly
Cynthia Lucille Davis ..... Rowland
Kevin Dunston ..... Newark, NJ
Cherry Lynn Escherich ..... Burlington
Stacy Lariannette Evans ..... Oxford
Jackie Dean Farmer II ..... Apex
Sonja Joyce Gill ..... Silver Spring, MD
Danielle Monee Glenn ..... Winston-Salem
†*Laura Jean Gray ..... Raleigh
Mary Kathryn Gregg ..... Saint Davids, PA
Anne Lawrence Griffin ..... Charlotte
Timothy Oliver Haas ..... Boone
John Denning Hall ..... Clinton
†Kimberly Anne Hancock ..... Raleigh
Ronald Guyle Hesmer ..... Wilson
Valerie Lynn Hocutt ..... Manteo
*Jill Marie Holmes ..... Stockton, CA
John Stuart Inman ..... Elizabethtown
David Sean Johnston ..... Coral Gables, FL
Robin Michelle Jones ..... Winston-Salem
Matthew Adams Kelley ..... Raleigh
Christie Lynne Knittel ..... Fairvield, CT
Stephanie Dawn Lamb ..... Hendersonville
Daniel Robert Lee ..... Garner
***Julia Williams Lee ..... Raleigh
†Elizabeth Lindsay McCoy ..... Fayetteville
Molly Ann Miller ..... High Point
Stephen Christopher Morrison ..... Marion, SC
Lori Wade Nance ..... Raleigh
Hugh Reavis Nelson III ..... Durham

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Christopher Harvey Nichols ..... Winston-Salem
Stephen Edward Nixon, Jr. ..... High Point
Sharon Page O'Dell ..... Raleigh
Scharina Farranzel Oliver ..... Winston-Salem
Elizabeth Darlene Owen ..... Oak Ridge
William Scott Parton ..... Rutherfordton
Wendy Lea Patterson ..... Kenbridge, VA
Seth Jones Perkinson III ..... Charlotte
†Amy Kathryn Pettyjohn ..... Winston-Salem
**Amy Lee Pfeiffer ..... Columbia, SC
Phillip Marvin Pitchford ..... Fayetteville
David James Purvis ..... Winston-Salem
Jutta LaTeppar Reed ..... Columbia
Deborah Kathleen Reedy ..... Clinton
Thomas Coleman Richardson III ..... Henderson
Susan Freeman Riddle ..... Sanford
Deward Reginald Robinson, Jr. ..... Mount Holly
Divakar Kirit Shukla ..... Charlotte
Philip Silverstein ..... Simsbury, CT
†Ruthan Mary Singleton ..... Charlotte
Amy Christine Smith ..... Charlotte
Dawn Lee Snavely ..... Alexandria, VA
Angela McQueen Thompson ..... Lumberton
Cassandra Lee Tomes ..... Rockville, MD
Susan Elisabeth Tutza ..... Point Pleasant, NJ
Monique Velasquez ..... Amarillo, TX
†*Dana Ann Watson ..... Gastonia
†Donna Kay Weavil ..... Whiteville
Sharon Helene Wilensky ..... Raleigh
Jane Michele Wilkins ..... Hampton, VA
Timothy Ross Wilkins ..... Garner
Mary Beth Williams ..... Autryville
Jane Hunter Wilson ..... Salisbury
Jeffrey Todd Wimberley ..... Durham
James Philip Wylie ..... Charlotte

BACHELOR OF SOCIAL WORK

Degrees Conferred June 24, 1987

**Jacqueline Stevens Conord ..... Peterborough, NH
William Albert Leverenz, Jr. ..... Kingston, NY
*Jeannette Lewis ..... Newton Grove

Degrees Conferred December 15, 1987

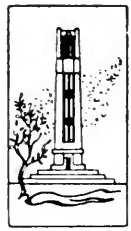
*Susan Roswell Godfrey ..... Columbia, SC
Kristy Leigh Jennette ..... Goldsboro
*Beverly Inez Pike ..... Raleigh
**Tammy Van Buren Stamper ..... Winston-Salem

Degrees Conferred May 7, 1988

Sheila Clayton Crews ..... Greensboro
Molly Caroline Michael ..... Lexington
Craig William Smith ..... Marshville
Terry Leonard Thomas ..... Wilmington, DE
Sherry Denise Windham ..... Raleigh

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

College of Physical and Mathematical Sciences



BACHELOR OF ARTS IN CHEMISTRY

Degrees Conferred June 24, 1987

Frank Scott Arnold ..... Charlotte
James Darren Martin ..... Mount Airy

Degrees Conferred August 5, 1987

†Barry Keith Bowden ..... Henderson
Allen Bobby Ingle ..... Marshall
Ann Hyunwon Kim ..... Elizabeth City

Degrees Conferred December 15, 1987

†Surojini Meera Bhikhai ..... Cary
†Norwood Bennett Chesnutt ..... Gastonia
†Sarah Elisabeth Glover ..... Asheboro
†Dean Edward Gokel ..... Raleigh
Glenn Athur Graham ..... Henderson
†**Lisa Lynne Haney ..... Indialantic, FL
Doris Kim Johnson ..... Burlington
Bradley Lee ..... Wilson
Barbara Christine Marrujo ..... Winston-Salem
Clarence Arthur Rupard ..... Mocksville
†Nancy Graham Waff ..... Statesville
†*Lisa Eugenia Williams ..... Wilmington
Billie Leigh Woosley ..... Granite Falls

Degrees Conferred May 7, 1988

**Kimberly Griffith Atkins ..... Pilot Mountain
David Goad Brintle ..... Mount Airy
Donald Bigham Cochran ..... Stamford, CT
John Steven Crook ..... Monroe
Angela LeAnn Diggs ..... China Grove
William Bradley Griffin ..... Zebulon
†***Shelia Crocker Hopkins ..... Selma
Thomas Bernard Kenney ..... Raleigh
†Alex Ray Kirby ..... Durham
Lisa Richey Padgett ..... Charlotte
†Derek James Parks ..... Goldsboro
Carolyn Patricia Pearsall ..... Greenville
†Robert Brian Raybon ..... Wendell
*Susan Marie Rhodes ..... Hendersonville
Dennis Eugene Ross ..... Carthage
Frenchie Janlean Simpson ..... Winston-Salem
*Garry Michael Summer ..... Cherryville
†***Johnny Clayton Weeks III ..... Burlington
Jamie Kaye Whitfield ..... Durham

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

BACHELOR OF SCIENCE IN CHEMISTRY

Degrees Conferred June 24, 1987

Kimberly Barbour Perry ..... Clayton

Degrees Conferred December 15, 1987

Curtis Kent Barnhardt ..... Winston-Salem
Christopher Thomas Kochanowicz ..... Lexington
Laura Anne Torres ..... Statesville

Degrees Conferred May 7, 1988

George McKinley Adams, Jr. ..... Zebulon
**Rima Salin Al-Awar ..... Raleigh
John Edmond Baur ..... Wayne, PA
*Edward Paul Bowman ..... Hendersonville
Carolyn Ann Bruce ..... Wilmington
†Steven Mark Clements ..... Raleigh
Paru Kishore Desai ..... Collegeville, PA
**William Paul Hudson, Jr. ..... Burlington
***Paula Blackman Huffman ..... Goldsboro
Kenneth Alan Krebs ..... Winston-Salem
Cathleen Dawn Roberts ..... Greensboro
Edith Marie Simpson ..... Winston-Salem
†Maureen Kaye Spears ..... Matthews City, VA
†**Timothy George Strein ..... Montoursville, PA
†**Eric Leonard Tart ..... Browns Summit
Karen Christine Traylor ..... Fayetteville
†Jill Carroll Watson ..... Raleigh

BACHELOR OF SCIENCE IN COMPUTER SCIENCE

Degrees Conferred June 24, 1987

*Marck Chadwick Barker ..... Cary
**Margaret Anne Hinson ..... Nashville
**Eileen Elizabeth Kupstas ..... Kinston
Tammy Virginia Martin ..... Raleigh

Degrees Conferred August 5, 1987

Isaac Reginald Allen ..... Wade
Harry Asmura Barber ..... Raleigh
*William Robert Bireley ..... Vero Beach, FL
Tamela Luann Boger ..... Clemmons
Cynthia Watson Bowman ..... Winston-Salem
*Stephanie Mullen Davis ..... Rolesville
John Stephen Dorsett ..... Raleigh
Dennis Wade Elledge ..... Millens Creek
Mark Harold Fletcher ..... Nashville, TN
Richard Earl Harrison ..... Troutman
Daniel Vincent Lucas ..... Cary
**Myrene Elizabeth Martin ..... Lawsonville
Brian Keith McCuiston ..... Winston-Salem
Christopher Roscoe Obie ..... Roxboro
Himesh Gajendra Patel ..... Raleigh
Alok Sharma ..... Ajmer, India
**John William Snyder ..... Cary
Julianne Elizabeth Staub ..... Southern Pines

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

**Anna Beth Taylor ..... Harrellsville
Harriet Jones Watts ..... Raleigh
Alissa Renee Wilhelm ..... Morrisville

Degrees Conferred December 15, 1987

Walter Enos Allen ..... Reidsville
Robert Emerson Allison, Jr. ..... Cleveland
**Jenny Crenshaw Beal ..... Jacksonville, FL
Rodney Blake Blackwell ..... Reidsville
Kimberly Dawn Boone ..... Rocky Mount
Robert Elwood Brady, Jr. ..... Statesville
Scott Anderson Cheek ..... Pineville
Elizabeth Ann Chermak ..... Raleigh
David John Christofaro ..... Raleigh
David Wade Cloninger ..... Dallas
Carrie Wren Combs ..... Rural Hall
Walker Ragland Crump III ..... Raleigh
***Blain Alan Dillard ..... Charlotte
*James Patrick Eberwein ..... Durham
***Arleen Dorothy Ebinger ..... Elon College
Mark William Enloe ..... Raleigh
Paula Marie Hemric ..... Ronda
Annette Horne ..... Fayetteville
Tina Lynn Hudnell ..... Melbourne, FL
**Angie Eve Jacobs ..... Jelenia Gora, Poland
*James Christoph Jones ..... Advance
Katherine Altavia Justice ..... Greenville
Bradley William Klenz ..... Charlotte
*Anne Marie Lach ..... Raleigh
***Menahem Levanon ..... Bat Yam, Israel
*Martin Leon Loy, Jr. ..... Burlington
Paul Cooper Lunceford ..... Silver Springs, MD
Gregory Scott Luther ..... Rocky Mount
William David Marseilles ..... Pinehurst
**Kevin John McCloskey ..... Jacksonville
Milton Edison McCoy, Jr. ..... New Bern
Darryl Dana McGraw ..... Whiteville
Vicki Leigh Merricks ..... Charlotte
James Jefferson Millard ..... High Point
Carlotta Gretchen Miller ..... Winston-Salem
Larry Douglas Miller, Jr. ..... Salisbury
***Gabriel Gaby Mizrahie ..... Ramat-Gan, Israel
Jeffrey Mukamal ..... Whiteville
Roy Clyde Owens ..... Mebane
Snehal Harivadan Parikh ..... Bombay, India
Mark Curtis Park ..... Elkin
Pranav Kanti Patel ..... Vasad, India
Dat Tien Pham ..... Greensboro
Richard Alan Ragland ..... Raleigh
**Mickey Donald Sartin ..... Roxboro
Ernest Perry Sharpe III ..... Chapel Hill
Thomas Edward Sherron ..... Sanford
**Marianne VanLeeuwen Sisson ..... Wake Forest
Cynthia Plain Sliwa ..... Raleigh
Joseph Matthew Smith ..... Pleasant Garden
*Mary Beth Smith ..... Charlotte

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Travis Casey Stephenson ..... Smithfield
Mark Benjamin Terry ..... Henderson
Paul Andrew Thomas ..... Charlotte
Craig Anthony Tripp ..... Charlotte
**Paul Duncan Walukewicz ..... Garner
Michael Stephen Whitcher ..... Troy
*Ronald Day Young ..... Oxford
***Van Austin Zimmerman ..... Cary

Degrees Conferred May 7, 1988

Stuart Allen Austin ..... Hickory
Allen Bernard Bailey ..... Drewery
*David Jonathan Bailey ..... Raleigh
***William Spencer Boswell ..... Wilson
Randall Craig Buckland ..... Raleigh
**Gary Neal Bundy ..... Kinston
†**Richard Allen Bynum ..... Goldsboro
John Michael Carroll ..... Goldsboro
Stephen Craig Chapman ..... Cary
Janet Marie Charbonneau ..... Goldsboro
Tresa Lyn Stone Chastain ..... Whitehall, MI
Dawn Renae Cherry ..... Wilson
Siddharth Chopra ..... Greensboro
*Randy Boyd Cleary ..... Lexington
**Maya Ruthanne Codelli ..... Atlanta, GA
Joan Carmel Cooney ..... Cary
*Andree Charlotte Corbin ..... Wake Forest
Phillip Walter Crowson ..... Charlotte
Robert S. Culpepper ..... Nags Head
John Wentzle DeBoskey ..... Raleigh
Kimberly Theresa Donleycott ..... Cary
**Jeffrey Mark Estroff ..... Charlotte
Ircil Nathaniel Gentry, Jr. ..... Raleigh
*Nancy Elizabeth Gibbs ..... Reidsville
Donald George Gordon ..... Coral Springs, FL
Walter William Gould ..... Raleigh
**Rodney Ray Green ..... Oxford
Jeffrey Alan Hallman ..... Lincolnton
Samuel Leonard Hayes ..... Cameron
†Joseph Tracy Hester ..... Kernersville
Scott McDowell Hester ..... Charlotte
Barry Fitzgerald Hicks ..... Burlington
*Jimmie Banks Hicks, Jr. ..... New Bern
Rebecca Dale Holder ..... Dunn
William Lyndon Hoopper ..... Franklin
Katherine Estelle Kalish ..... Charlotte
*Elizabeth Ann Koonts ..... Charlestown, SC
Shawn Dickey Lackey ..... Concord
***Kathleen Davis Lee ..... Raleigh
Kenneth Gerald Lee ..... Whiteville
Jeanette Denise Long ..... Yanceyville
Kerry Antwan Long ..... High Point
*Karen Lynn Mahoney ..... Wilson
**Timothy Allen Malone ..... Cary
Carol Ann Marion ..... Atlanta, GA
Juan Christopher McIver ..... Sanford

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

**Stephen Derrick McNeill ..... Asheboro
*Todd Wilson Medlin ..... Monroe
***Elizabeth Anne Middleton ..... Raleigh
***Elizabeth Diane Mynatt ..... Knoxville, TN
†***William Kenneth Neighbors III ..... Benson
**Matthew Douglas Palmer ..... Palmer
Richard Levonte Palmer ..... Stratford, CT
Tonya Deneen Palmer ..... Fayetteville
***Lynn Paige Perkinson ..... Roanoke Rapids
Sarah Lois Peters ..... Roanoke, VA
***Daniel Scott Petersen ..... Raleigh
Frank Wiley Pittenger ..... Raleigh
Robert Allen Powell ..... Lowgap
**Keith Douglas Raker ..... Winston-Salem
Walter Samuel Rogers, Jr. ..... Roxboro
***Randolph Rollins Rowell ..... Holly Springs
Bryan Keith Shuler ..... Fort Worth, Tx
*Sook-Cheng Sim ..... Malaysia, Penang
Jeffrey Alan Simpson ..... Reidsville
Dwayne Allen Sorrell ..... Durham
*Brian Scott Stewart ..... Midland, PA
Bryan Keith Stewart ..... Winston-Salem
Brian Joseph Summy ..... Raleigh
Tong Kok Tang ..... Hendersonville
**Tuyet Dien Tran ..... Greensboro
Stephen Anthon Vincent ..... Lynchburg, VA
**Nho Thi Vo ..... Cary
*Gregory Mark Vulopas ..... Succasunna, NJ
†Darrel Wade Vuncannon ..... Greensboro
Milton James Westmoreland, Jr. ..... Charlotte
Lisa Regina Wharton ..... East Bend
**Thomas Wolf ..... Fayetteville

BACHELOR OF ARTS IN GEOLOGY

Degrees Conferred December 15, 1987

Matthew Nicholas Gikas ..... Rochester, MN
James Cecil Izzell, Jr. ..... Greensboro

Degree Conferred May 7, 1988

Amy Leslie Eason ..... Raleigh

BACHELOR OF SCIENCE IN GEOLOGY

Degree Conferred August 5, 1987

Craig William Kiley ..... Raleigh

Degrees Conferred December 15, 1987

†Dean Edward Gokel ..... Raleigh
Kenneth Chad Leinbach ..... Pfafftown

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

BACHELOR OF SCIENCE IN MATHEMATICS

Degrees Conferred June 24, 1987

Elaine Sue Futris ..... Fayetteville
**Richard Craig Johnson ..... Raleigh
Scott Dillon Pleasants ..... Greensboro
Susan Duff Hosie Smith ..... Apex

Degrees Conferred August 5, 1987

Jocelyn Edwina Bethel ..... Kinston
Karen Marie De Vol ..... Washington, DC
Kenneth Allen Howard ..... Raleigh
***Susan Edith Liles ..... Raleigh
*Neil Phillip Sigman ..... Newton
Lorna Clarice Withrow ..... Shelby

Degrees Conferred December 15, 1987

Scott Edward Arnold ..... Jacksonville
†Kaushik Banerjee ..... San Jose, CA
Larry Dean Bolick ..... Hickory
Gerald Zachary Bray ..... Elizabeth City
Christine Marie DeKraker ..... Greensboro
Curtis Maurice Hamilton ..... Dudley
Barbara Darlene Hargett ..... Matthews
Alison Lynne Johnson ..... Boone
Mathew Cole Martin, Jr. ..... Jacksonville
*Jerri Renee Wells ..... Goldsboro
Kimberly Anne Whitaker ..... Thiells, NY
Randolph Stanton Wright ..... Raleigh

Degrees Conferred May 7, 1988

*Maria Michelle Andrews ..... Greensboro
Mark Joseph Bumgardner ..... Durham
Lekim Banh ..... Chapel Hill
***Pirkko Palonen Barber ..... Raleigh
**James William Brantley ..... Selma
*James Anthony Burgess ..... Brevard
†***Timothy Michael Del Sole ..... Winston-Salem
†Pamela Dawn Edmondson ..... Tarboro
***Tonya Lynn Etchison ..... Siler City
*Robin Mary Finnerty ..... Apex
Annette Fogg ..... Louisburg
Wanda Louise Freeman ..... Liberty
*Karen Leigh Godwin ..... Wilson
†David Wilson Justice ..... Kernersville
Phillip Lee Lewis ..... Reidsville
**Robin Rutledge Moore ..... Thomasville
**Bruce Wayne Perry ..... Statesville
†Teresa Faye Rogers ..... Mebane
*David William Sheppard ..... Deer Park, NY
†Denette Lee Sleeth ..... Novelty, OH
†***Sheila Jane Stone ..... Cary
†John Russell Taylor ..... Rocky Mount
Kenneth Allen Wetherington ..... New Bern

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

BACHELOR OF SCIENCE IN METEOROLOGY

Degrees Conferred December 15, 1987

***Steven Rice Chiswell ..... Derwood, MD
Richard Wilkins Fisher ..... Sun Prairie, WI

Degrees Conferred May 7, 1988

Phillip Wayne Badgett ..... Dobson
Charles Lowell Begley, Jr. ..... Winston-Salem
Daniel Scott Connell ..... Salisbury, MD
Stuart Pierce Creighton ..... Dunn
Michael Robert Dennis ..... Raeford
*Susan Whitson Hallyburton ..... Marion
Kathryn Joanne Hoxsie ..... Burbank, CA
Thomas Clark Moore ..... Belmont
Elizabeth Tamsin Toler ..... Nashville, IN

BACHELOR OF SCIENCE IN PHYSICS

Degree Conferred June 24, 1987

Stephen Max Tussey ..... Asheboro

Degree Conferred December 15, 1987

†Kaushik Banerjee ..... San Jose, CA

Degrees Conferred May 7, 1988

Carson Lee Bennett II ..... Halifax, VA
**Stuart Jay Berkowitz ..... Raleigh
Jeffrey Alexander Cantrell ..... Clayton
Lowell Grady Dallas ..... Cary
†***Timothy Michael Del Sole ..... Winston-Salem
Matthew Jack Freeman ..... Charlotte
Thomas Harriman Jevon ..... Pittsburgh, PA
Mark Anderson Miller ..... Spring Hope
*David Allen Moffett ..... Dallas
*Denys Laurent Proteau ..... Raleigh
***Jerry Michael Reid ..... Winston-Salem
Robert Michael Tidwell ..... Pleasant Garden
James Edward Vogel, Jr. ..... Jacksonville
***Kimberly Gay Wade ..... Madisonville, KY

BACHELOR OF SCIENCE IN STATISTICS

Degree Conferred August 5, 1987

Craig Stephen Hansen ..... Akron, OH

Degrees Conferred December 15, 1987

Melissa Ann Conner ..... Chadbourn
*Kecia Dawn Hancock ..... Seagrove
***Mary Amelia Woessner ..... Cary

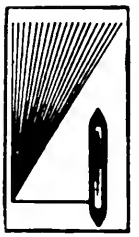
Degrees Conferred May 7, 1988

Vickie Lynn Booth ..... Eden
†**Richard Allen Bynum ..... Goldsboro
Virginia Diane James ..... Raleigh

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

†David Wilson Justice ..... Kernersville
*Gregory Bryan Russell ..... Summerfield
Barbara Suzanne Simmons ..... Seven Springs
*Melodie Annette Waitman ..... Trinity

College of Textiles



BACHELOR OF SCIENCE IN TEXTILE ENGINEERING

Jointly administered by the College of Textiles and the College of Engineering. See page 19 under College of Engineering for a listing of the graduate seniors in the jointly administered department.

BACHELOR OF SCIENCE IN TEXTILE CHEMISTRY

Degree Conferred June 24, 1987

Edwin Russell Smith ..... Jamestown

Degrees Conferred August 5, 1987

Steven Maurice Mosley ..... Raleigh
Laura Ann Trollinger ..... Burlington
Frederick Eugene Wilson III ..... High Point

Degrees Conferred December 15, 1987

*Kenneth Ray Butts ..... Charlotte
Peter Graham Christian ..... Fayetteville
Richard Bryan Torrence ..... Salisbury
David Richard Vlaservich, Jr. ..... Gastonia
Kenneth Wayne Witherell, Jr. ..... Conover

Degrees Conferred May 7, 1988

*Janet Bliss Absher ..... Greensboro
Curtis Jack Bare, Jr. ..... Havelock
David Carson Benson ..... Greensboro
†*Deborah Jean Bracht ..... Wilmington
Donald Andrew Buckner, Jr. ..... Gastonia
Samira Williams Collins ..... Greensboro

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

*Thomas Worth Coltrane, Jr. ..... Asheboro
William Elvin Hopkins, Jr. ..... Bishopville, SC
Sylvie Christine Hudgins ..... Fayetteville
Virgil Lynn Lippard ..... Salisbury
Douglas Vincent Matre ..... Charlotte
*Frances Darlene McDonald ..... Hamlet
*Randy Lee Mumford ..... Charlotte
†*Paige Meredith Newland ..... Wilmington
Rona Levetta Reid ..... Charlotte
**Adrian Arthur Roberson ..... Zebulon
*Carol Lynn Shay ..... Charlotte
**Elizabeth Lanier Smith ..... Wilmington
Thomas Jefferson Smith, Jr. ..... Lincolnton
H†**Timothy George Strein ..... Montoursville, PA
†**Eric Leonard Tart ..... Browns Summit
Russell Douglas Walls ..... Goldsboro
Tammy Lynn Wise ..... Charlotte

BACHELOR OF SCIENCE IN TEXTILE AND APPAREL MANAGEMENT

Degrees Conferred June 24, 1987

Terry Wayne Stroud ..... Denver
Garlon Jerome Stuart, Jr. ..... Fuquay-Varina

Degrees Conferred August 5, 1987

Mark Ray Arrowood ..... Lebo
*David Thomas Ballenger ..... Charlotte
Charlotte Denise Sutton ..... Warsaw

Degrees Conferred December 15, 1987

James Alexander Baldecchi ..... Henderson
Nasir Mohammed Bandukda ..... Karachi, Pakiston
James Addison Barnhardt ..... Charlotte
Michael Shannon Beck ..... Thomasville
Gregory Mitchell Byrd ..... Angier
Gina Carol Edwards ..... Newton Grove
Mark Allen Eudy ..... Concord
Carla Lea Gallimore ..... Ellerbe
Wanda Gail Harris ..... Goldsboro
Allyson Anne Johnson ..... Shelby
Timothy Darrell Koonts ..... Lexington
Daniel Weston Long ..... Bladenboro
Michelle Louise Mauney ..... Gastonia
Radovan Fitzgerald Moss ..... Charlotte
Suzanne O'Donnell ..... Greensboro
Timothy Ephraim Pittman ..... Valdese
James Thomson Potter III ..... Kings Mountain
Andrew John Southwell ..... Wilkesboro
Gary Daniel Steppling ..... Pittsburgh, PA
Larry Randall Stroud ..... Jamestown
Stafford McKee Swearingen ..... Sedalia, MO
Lee Krista Timmerman ..... Traverse City, MI
Karen Lynn Wilhelm ..... Hickory
Barron Anthony Womble ..... Kings Mountain
Leslie Gale Woodburn ..... Greensboro

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

Degrees Conferred May 7, 1988

Peggy Moore Anderson ..... Henderson
George Lovick Ballard, Jr. ..... Lumberton
Keith Phillip Brubaker ..... Callaway, VA
Mark Lynn Brummitt ..... Henderson
*Richard Thomas Capel ..... Troy
Jason Leon Carter ..... Hickory
*Sara McDuffie Current ..... Gastonia
Anthony Perry Ervin, Jr. ..... Henderson
Alan Todd Fleming ..... Lexington
Steven Charles Gamlin ..... Selma
*Tracy Lynn Haley ..... Kannapolis
Brian Kevin Hooker ..... Thomasville
***Martha Craig Lambeth ..... Greensboro
*Robert Eric Lowder ..... Albemarle
Perry Michael Luisi ..... Plainview, NY
David Scott McLaughlin ..... China Grove
Walter Currin Montgomery ..... Roxboro
**Michael Scott Phillips ..... High Point
Steven Mark Pruitt ..... Providence
Robert Gregory Rabon ..... Lexington
*Mary Beth Sabio ..... Oakland, NJ
Martin Karl Schreiner ..... Raleigh
*Stephanie Ann Sigmon ..... Newton
James Howard Styles, Jr. ..... Statesville
*Benjamin Wesley Swain ..... Charlotte
Catherine Ann Thompson ..... Goldsboro
Cheryl Ann Yvars ..... Valhalla, NY

BACHELOR OF SCIENCE IN TEXTILE SCIENCE

Degree Conferred August 5, 1987

Charles Christian Hertwig III ..... Macon, GA

Degrees Conferred December 15, 1987

†**Clinton Kesler Atkinson ..... Siler City
James Marion Edmonds ..... Greensboro
William Henry Garrett, Jr. ..... Edenton
John Gregory Lemelin ..... Matthews
James Bruce Malpass, Jr. ..... Goldsboro
Michael Glenn Pilkington ..... Selma
Jonathan LeAllen Rhoades ..... Raleigh
Alex Sylvester Whitley ..... Oakboro

Degrees Conferred May 7, 1988

Tonia Jeanine Ashburn ..... Wilson
Anthony Hunter Durham, Jr. ..... Greensboro
Paul Darin Gilbert ..... Conover
H†***Timothy Leon Grady ..... Winston-Salem
Derek Michael Gunn ..... Madison
George Loren Hamilton ..... Pikeville
Van Alex Johnson ..... Stoneville
Sharon Kay McCraw ..... Hendersonville
†***Philip Dean Rucker ..... Lincolnton
Jerry Edsel Sanderson ..... Charlotte

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

***Jacqueline Crawford Wentz ..... Arden
La Shurya Marie Wise ..... Vanceboro

BACHELOR OF SCIENCE IN TEXTILES

Degrees Conferred December 15, 1987

Sandra Beatriz Cameron ..... Lima, Peru
Allison Leer Cowles ..... Charlottesville, VA
Margaret Ellen Cozort ..... Valdese
David Mitchell Crowder ..... Huntersville
Derek Todd Hanes ..... Lexington
Richard Allen Jones ..... Hickory
Sherry Machell McCourry ..... Conover
Jamie Lynn Stumpf ..... Bear Creek
Sabra Simone Sweitzer ..... Raleigh
H Marjorie Deanne Williams ..... Raleigh

Degrees Conferred May 7, 1988

Thomas Michael Barbee ..... Huston, TX
*Florence Chepkoech Morogo ..... Kenya
Martha Wambui Mwangi ..... Karatima, Kenya
Luby Clifton Rose ..... Fremont
Douglas John Salway ..... Raleigh
Michael Darron Staton ..... Archdale

Professional Degrees

CIVIL ENGINEER

Degree Conferred December 15, 1987

Asaad Ahmed Shamsi ..... Kaychi, Pakistan

Degree Conferred May 7, 1988

Karl Kar-Yue Lin ..... Hong Kong

† Co-major * Cum Laude ** Magna Cum Laude *** Summa Cum Laude H Honors Program

GRADUATE DEGREES

Master's Degrees

MASTER OF AGRICULTURE

Degrees Conferred August 5, 1987

Charlie Wayne Batten ..... Wendell
Robert Stanley Hayter ..... Southern Pines
Cedric Kindell Jones ..... Elizabethtown
James Franklin Miller, Jr. ..... Watkinsville, GA

Degrees Conferred December 15, 1987

David Christian Berle ..... Danbury
Benedict M. Bhembe ..... Lobamba, Swaziland
Momodou Balancang Sainy Canteh ..... Sallikenye, Gambia
James Homer Norris ..... Tabor City
Lyson Mulongoti Phiri ..... Kitwe, Zambia
Purna Man Shakya ..... Pokhara, Nepal

Degrees Conferred May 7, 1988

Keith Doyle Clay ..... Murphy
Timothy Sears Hall ..... Pineville
Franklin Daniel Shaw ..... Richlands

MASTER OF ARCHITECTURE

Degrees Conferred December 15, 1987

Edward Alexander Gerster ..... Raleigh
Lynn Cesaro Lacy ..... Halifax, VA
Marianne Cherene Mansour ..... Jefferson Township, NJ
John Lester Rose ..... Arlington, VA
Dominic Joseph Sarica ..... North Brunswick, NJ
Paul Albert Taylor ..... Cohoes, NY
Jeffrey Lynn Trussler ..... Raleigh

Degrees Conferred May 7, 1988

Fida Sadak Abdulkhalek ..... Raleigh
Azza A. Arif ..... Cairo, Egypt
Aenne Maria Feil Barchowsky ..... Asheville
Kwan-Young Chung ..... Seoul, Korea
Samuel R. Cooper ..... Atlanta, GA
John Kevin Huelster ..... Indianapolis, IN
Lisa Keskinen ..... Raleigh
Signe Jeanne LeFever ..... Plainfield, NJ
Chun Wing Edward Lui ..... Hong Kong
Steven Andrew Odams ..... Weston, CT

Ann Ellen Ruthsdottir ..... Battle Creek, MI
Wendy Suzanne Schmitthenner ..... Barnesville, OH
William Merritt Singer ..... Durham
Chalermpol Sriprapattha ..... Bangkok, Thailand
Dennis Edward Stallings ..... Satellite Beach, FL

MASTER OF BIOMATHEMATICS

Degree Conferred August 5, 1987

Yanan Yu ..... Ochen, People's Republic of China

MASTER OF CIVIL ENGINEERING

Degrees Conferred August 5, 1987

Victor Kenneth Angell ..... Mocksville
Susan Violette Brain ..... Somerset, MA
Mohamed Kamal Jamaluddin ..... Bentong, Phang, Malaysia
Weichen Lien ..... Taipei, Taiwan, Republic of China
Edward Ignatius Matthews ..... Raleigh
Alfred Gerald Strickland ..... Bunn
Brian David Wright ..... Chicago, IL
Shiuh-Liang Yan ..... Taipei, Taiwan, Republic of China

Degrees Conferred December 15, 1987

Robert Alfredo Nunez ..... Quito, Ecuador
Jingyuan Wang ..... Taipei, Taiwan, Republic of China

Degrees Conferred May 7, 1988

Ladson Montgomery Brearley, Jr. ..... Hamlet
Han-Chieh Chiu ..... Taipei, Taiwan, Republic of China
Joanne Cherin Eder ..... Virginia Beach, VA
*Gregory Gene Emanuel ..... North Bend, NE
Kenneth Jeffery Greene ..... Lenoir
Rosli Bin Hamir ..... Kuala Lumpur, Malaysia
Jing-Jong Jang ..... Raleigh
Martha Alicia Laverde ..... Barranquilla, Colombia
Mauricio Rodrigo Ledesma ..... Quito, Ecuador
Yuchi Liu ..... Taipei, Taiwan, Republic of China
Jenghwa Lyan ..... Taipei, Taiwan, Republic of China
David Andrew Nailor ..... Durham
Steven Kent Rogers ..... Asheville
Bruce Samuel Surface ..... Warsaw, IN
Wen Wang ..... Taipei, Taiwan, Republic of China
Erwin Thompson William III ..... Lumberton

MASTER OF COMPUTER STUDIES

Degrees Conferred August 5, 1987

Yu-Chung Chou ..... Raleigh
David Alfred Dodd ..... Durham
Anita Louise Hogans ..... Jacksonville, FL
Thomas Joseph Loos ..... Ralston, NE
Santanagopalan Surya ..... Bombay, India

*Co-major in Public Affairs

Degrees Conferred December 15, 1987

Shirley Hwang Chao ..... Raleigh
Tzyy-Yi Chen ..... Taipei, Taiwan, Republic of China
Tzau-Jin Chung ..... Singapore
Kai-Ling Duh ..... Kaoshung, Taiwan, Republic of China
Usha Konakanchi Kotamarti ..... Vijayawada, India
Tsung-Ying Lee ..... Austin, TX
Jiing-Kae Wu ..... Taipei, Taiwan, Republic of China
Yen-Shin Yeh ..... Taipei, Taiwan, Republic of China
Fu-Shin Yen ..... Taipei, Taiwan, Republic of China

Degrees Conferred May 7, 1988

Suck Won Hong ..... Seoul, Korea
Hong-Jyeh Huan ..... Singapore
Terrence Allen Kanka ..... Omaha, NE
Melinda Ann Kellum ..... Jacksonville
Charles Ray Kirk ..... Raleigh
Karen Downer Mitchell ..... Columbia, MD
Mary Elizabeth O'Connor ..... Raleigh
Jack Joseph Rouse ..... Kinston
Danny Ira Wellisch ..... Asheville
Tzung-Hsing Wong ..... Taipei, Taiwan, Republic of China

MASTER OF ECONOMICS

Degrees Conferred August 5, 1987

Bruce Louis Ahrendsen ..... Oxford Junction, IA
Aleta Catamora Domdom ..... Raleigh
Marcelle Benrimokh Thomas ..... Raleigh

Degrees Conferred December 15, 1987

Antonios Evangelos Agatsas ..... Theves, Greece
David Shelton Brown, Jr. ..... Raleigh
Lesli Liliana Castillo-Sierra ..... Comayaguela, Honduras
Belin Chang ..... Taipei, Taiwan, Republic of China
Young Sook Eom ..... Jeon Je, Korea
Ayse Canan Karayalcin ..... Ankara, Turkey
Kalliope S. Magoula ..... Athens, Greece
Mark Sigel Mather ..... Cincinnati, OH
Laura Jean Norwood ..... Raleigh
Jose Augusto Sierra ..... Tegucigalpa, Honduras
Jeffery Lee Ward ..... Asheville

Degrees Conferred May 7, 1988

Rangachari Arvind ..... New Delhi, India
Melissa Bell Cox ..... Wake Forest
Dennis Royce Davis ..... Marion
Annette Carlyle Holt ..... Raleigh
Abdul Latif Fakhruddin Hossain ..... Durham
Connie Beth Parnell Ivey ..... Lumberton
Stephen Lindblad MacDonald ..... Durham
Allen Warren McDowell ..... Wilmington
Guido Phillip Pfuhl ..... Raleigh
Samuel Lewis Robinson ..... Marshville
Edward Bruce Teachey ..... Greensboro
Ping Zhang ..... Tai'an, People's Republic of China

MASTER OF EDUCATION

Adult and Community College Education

Degrees Conferred August 5, 1987

Fred Wallace Bayley ..... Morganton
James Keith Letchworth ..... Raleigh
Sujata Acharya Maitra ..... Cary
George Wallace Stancil ..... Newton

Degrees Conferred December 15, 1987

Margaret Elaine McEwen ..... Raleigh
Claus Monrad Spliid ..... Aarn, Denmark

Degrees Conferred May 7, 1988

William Wright Baggett ..... Clinton
William George Bickel ..... Raleigh
Susan Louise Hollenbach ..... Raleigh
Mark Cooke Joyner ..... Statesville
Sriprakash Sriram Mayasandra ..... Bombay, India
Mary Ruth Lewis Russ ..... Bolivia
Tracey Sumner Thompson ..... Raleigh
Martha Warren Warner ..... Newton Grove

Agricultural Education

Degree Conferred August 5, 1987

Samuel Eugene Groce ..... Siler City

Degrees Conferred December 15, 1987

Robert Woolard Clark, Jr. ..... Williamston
Michael Ward Shaw ..... Chadbourn
Sylvia Jean White Smith ..... Kinston

Degrees Conferred May 7, 1988

Dale Scott Cochran ..... Concord
Weldon Wright Faircloth ..... Autryville
James Thomas Parsons ..... Fuquay-Varina
Michele Grady Spence ..... Hookerton
Paul Wesley Wilson ..... Sanford

Curriculum and Instruction

Degree Conferred August 5, 1987

Deborah Ann Wilson Holland ..... Raleigh

Degrees Conferred December 15, 1987

Jacqueline Devon Dove ..... Kinston
Patsy Carroll Gentry ..... Cary
Susan Winslow Mastro ..... Raleigh

Degrees Conferred May 7, 1988

Becky Lynn Gerber ..... Raleigh
Karen Chaney Kauffman ..... Joliet, IL
Deborah Spragins Maness ..... Roanoke Rapids
Heidi Maria Nuttle ..... Raleigh
Regina Kay Oakes ..... Boone

Educational Administration and Supervision

Degree Conferred December 15, 1987

Lina McCullers Sanders ..... Smithfield

Degrees Conferred May 7, 1988

Eddie Bernard Clinton ..... High Point
Mary Nell Lee Ferguson ..... Raleigh

Guidance and Personnel Services

Degrees Conferred August 5, 1987

Barbara Ann Briggs ..... Raleigh
Bonita Tyndall Cooley ..... Goldsboro
Susan Ellen Gorman ..... Cincinnati, OH
Ronald Wayne Hardison ..... Jacksonville
Claude Alan Lee ..... Raleigh

Degrees Conferred December 15, 1987

Virgilia Moore ..... Raleigh
Elgina Demetrius Reaves ..... Bear Creek

Degrees Conferred May 7, 1988

Sonia Melton Barnes ..... Wilson
Ann Louise Brooks ..... Raleigh
Velma Jeffers Bullock ..... Raleigh
Mary Elsie Daisey ..... Raleigh
Carolyn McLean Fox ..... Raleigh
Elizabeth Leigh Gainor ..... Charlotte
Barbara Jean Gegg-Harrison ..... Raleigh
Suzanne McMillen Goerger ..... Garner
Mary Pleasants Hogg ..... Garner
Patricia Thompson Laniak ..... Durham
Marian Bridget Lawhorn ..... Jacksonville
Eddie Wayne Lawrence ..... Rocky Mount
Mary Deaton Love ..... Raleigh
Walter Manuel III ..... Fair Bluff
Carol Ginn Nobles ..... Raleigh
Robert Murray Parker ..... Chapel Hill
Andrea Dobson Vest ..... Raleigh
John Arrington Williams II ..... Oxford

Mathematics Education

Degrees Conferred August 5, 1987

Melissa Ann Best ..... Fayetteville
Jesse Louis Capps ..... Raleigh
Timothy Wayne Tucker ..... Rocky Mount

Degrees Conferred December 15, 1987

Lezlie Duncan Covington ..... Raleigh
Julia Starr ..... Garner

Degree Conferred May 7, 1988

Dara Faye Royal ..... Fayetteville

Middle Grades Education

Degree Conferred May 7, 1988

Suzanne Marie Downs ..... Raleigh

Occupational Education

Degree Conferred December 15, 1987

Susan Jane Lamb ..... Raleigh

Degrees Conferred May 7, 1988

Ronald Glenn Grady ..... Mount Olive
Ruth Dupree Petrea ..... Durham

Science Education

Degrees Conferred August 5, 1987

Eira Marie Longstreth McDaniel ..... Manchester, TN
Martha Glenn Bradshaw Ramsey ..... Wendell
Janet Lynch Sullivan ..... Cary
Daniel Leonard West ..... Garner

Special Education

Degree Conferred August 5, 1987

Olivia Green Day ..... Summit, NJ

Degrees Conferred December 15, 1987

Nafisa Rene Keels ..... Cary
Deveney Tucker Sweetser ..... Raleigh

Degrees Conferred May 7, 1988

Kim Kauffman Battaglia ..... Durham
Susan Warren Gilbert ..... Salisbury
Gloria Hines Jones ..... Bailey
Robin Mills Overcash ..... Concord
Beverley Mary Williams ..... Raleigh

MASTER OF ENGINEERING

Degree Conferred August 5, 1987

Henry Powell Dozier ..... Wilmington

Degree Conferred May 7, 1988

Nancy Ellen Joyner ..... Black Mountain

MASTER OF FORESTRY

Degrees Conferred August 5, 1987

Kalutantri Patabendi Ariyadasa ..... Barapola, Sri Lanka
Jerry Lamont Bettis, Sr. ..... Raleigh
Charles Corson Bolton, Jr. ..... Winston-Salem

Degree Conferred December 15, 1987

Gery Allan Glover ..... Temple Hills, MD

Degrees Conferred May 7, 1988

Michael Elmo Drilling ..... Amherst, NY
Daniel Fairley McInnis, Jr. ..... Raleigh
Kyung-Whan Pak ..... Seoul, Korea
David Thompson Tew ..... Thomasville

MASTER OF INTEGRATED MANUFACTURING SYSTEMS ENGINEERING

Degree Conferred August 5, 1987

Bruce Raymond ..... Cary

Degrees Conferred December 15, 1987

Pai-Chou Chen ..... Panchiao, Taiwan, Republic of China
Paul James Guidry, Jr. ..... Gainesville, FL
Herman Heung ..... Modesto, CA
Michael Francis Hitchcock ..... Louisville, KY
Roderick Bao-Buo Ma ..... Raleigh
Russell Raymond Mann ..... Valparaiso, IN
John Frederick McKirachan, Jr. ..... Columbia, MD
Ibrahim Mounib Richani ..... Raleigh
Chao-Hsin Sun ..... South Amboy, NJ
Kun-Hui Tsai ..... Taipei, Taiwan, Republic of China

Degrees Conferred May 7, 1988

Tony Lee Hudson ..... Goldsboro
Bobby Kent Potts, Jr. ..... High Point
Tibebu Senbetta ..... Addis Ababa, Ethiopia

MASTER OF LANDSCAPE ARCHITECTURE

Degrees Conferred August 5, 1987

Michael Joseph Gibbons ..... Raleigh
Pamela Holley Granade ..... Raleigh
Wendy Caye Moses ..... Raleigh
Kenneth Joseph Natoli ..... Virginia Beach, VA
Daphne Evelyn Souder ..... Rockville, MD
Teikhoe Wong ..... Saint Louis, MO

Degrees Conferred December 15, 1987

Chester William Hunter ..... Youngstown, OH
John Frederick Wettstein ..... Winter Park, FL

Degrees Conferred May 7, 1988

Harold Hoyt Bangs III ..... Raleigh
Nancy Jill Coleman ..... Chapel Hill
Marlys Ann de Alba ..... Raleigh
Robert Joseph Harned, Jr. ..... Madison
David Glenn Heiser ..... Raleigh
Bradford Charles Houk ..... Bloomsburg, PA
Elizabeth Ann Kirkland ..... Raleigh
Paul Joseph Klens ..... Mill Hall, PA
Yi-in Lin ..... Taipei, Taiwan, Republic of China
Mary Catherine Mattocks ..... Raleigh
Kathryn Ruth McPherson ..... Raleigh
John David Penkacik ..... Orlando, FL

Elizabeth Ballard Simons ..... Wilmington
Rachel Marie Therrien ..... Raleigh
Peter Ryan Williamson ..... Raleigh

MASTER OF LIFE SCIENCES

Degrees Conferred August 5, 1987

Wilson Douglas Brame ..... Durham
Barry Reid Keith ..... Marion, IN
Jenny Grace Smith ..... Raleigh

Degree Conferred May 7, 1988

Annette Denise Dickens ..... Erie, PA

MASTER OF MATERIALS SCIENCE AND ENGINEERING

Degree Conferred December 15, 1987

Yu David Chen ..... Tanshui, Taiwan, Republic of China

Degree Conferred May 7, 1988

Kirsten Petersen Kunz ..... Amherst, NH

MASTER OF MECHANICAL ENGINEERING

Degrees Conferred August 5, 1987

Dimitri Athanasios Keranis ..... Athens, Greece
Jong-Huei Lin ..... Taipei, Taiwan, Republic of China
Gwa-Guang Tan ..... Taipei, Taiwan, Republic of China
Juhchin Angus Yang ..... Fengshen, Taiwan, Republic of China

Degrees Conferred December 15, 1987

Kuang-Chung Chao ..... Taipei, Taiwan, Republic of China
Fereydoon Souresrafil ..... Wilmington
Mark Jerome Weber ..... Wake Forest

Degrees Conferred May 7, 1988

Yung-Pyng Chang ..... Taipei, Taiwan, Republic of China
Shin-Yuh Chern ..... Taipei, Taiwan, Republic of China
Hsiang-Chen Hsu ..... Taipei, Taiwan, Republic of China
Shanghsu Liao ..... Taipei, Taiwan, Republic of China
Richard Achidi Mofor ..... N. W. Province, Cameroon
Charles Joyce Moore, Jr. ..... Tempe, AZ
Hosein Zadafshar ..... Isfahan, Iran

MASTER OF NUCLEAR ENGINEERING

Degrees Conferred December 15, 1987

Brett Ward Carlsen ..... Pocatello, ID
John Norman Miller, Jr. ..... Fayetteville, AR

MASTER OF PRODUCT DESIGN

Degrees Conferred August 5, 1987

Joselyn Margaret Berry ..... Durham
Sherry Fresia Blankenship ..... Raleigh
Barbara Loucas Conrad ..... Raleigh
Jeffrey Wilson Grubbs ..... Black Mountain
Eric Nathan Wiebe ..... Durham

Degrees Conferred December 15, 1987

Susan Jean Bukowski ..... Union Mills, IN
Ding-Bang Luh ..... Taipei, Taiwan, Republic of China
Hao Pin Pu ..... Taipei, Taiwan, Republic of China
David Justino Urena ..... Bristol, TN

Degrees Conferred May 7, 1988

Dana Alexandra Bartelt ..... Raleigh
David Andrew Brown ..... Manhattan, KS
Hui-Jin Chuang ..... Chungli, Taiwan, Republic of China
Linda Carol Dallas ..... Raleigh
John Edward Fels ..... Saint Louis, MO
Ellen Rosalind Hood ..... Mebane
Larry Frederick James ..... Raleigh
Obelia Johnson ..... Goldsboro
John Francis Kasper ..... Plattsburgh, NY
Maria Roxana Maksymowych ..... Willow Grove, PA
Ann Carter Sprinkle, Jr. ..... Raleigh
Roopa Sunil Sreedharan ..... Daly City, CA
William Bouknight Tyler ..... Richmond, VA

MASTER OF PUBLIC AFFAIRS

Degrees Conferred August 5, 1987

Thomas Lee Bennett ..... Apex
Elisha Thomas Bert ..... Raleigh
Anne Sharpe Cochrane ..... Raleigh
Hyacinth Chinedum Ezeamii ..... Nimo, Anambra, Nigeria
Linda Polaski Honeycutt ..... Johnsonburg, PA
Mary Elisa Keech ..... Raleigh
Zeph J. Putnam ..... Angier
Carla Janell Hobbs Stephens ..... Fayetteville
Scott Kevin Townsend ..... Raleigh

Degrees Conferred December 15, 1987

Nancy Carol Collins ..... High Point
Eleanor Arey Cornish ..... Raleigh
George Stuart Crockett ..... Alexandria, VA
Miles Melvin Hamby ..... Raleigh
Deborah Kay Lamm ..... Wilson
Cheryl Joan McIlquham ..... Fond du Lac, WI
Oladipo Adelakun Oluwole ..... Lagos, Nigeria
John Joseph Salengo ..... Raleigh

Degrees Conferred May 7, 1988

Saul Abreu ..... Bonao, Dominican Republic
Jimmie Gray Armstrong, Jr. ..... Rocky Mount
Leslie Annette Brown ..... Charlotte
Kevin Jerome Gergely ..... Welch, WV
Lorna Ellen Gerome-Crowder ..... Harrisonburg, VA
Robert Otis Jenkins ..... Ellenboro
Michael Roberts Lloyd ..... Raleigh
Sylvia Douglas Nygard ..... Cary
Anne Morgan Williams ..... Raleigh

MASTER OF RECREATION RESOURCES ADMINISTRATION

Degrees Conferred August 5, 1987

Cheng-I Chen ..... Taipei, Taiwan, Republic of China
Deborah Ying Harrison ..... Framington, MO
**Roy Eric Jensen ..... Durham

Degrees Conferred December 15, 1987

Michael Garrett Kent ..... Raleigh
Sheryl Ann Rudd ..... Wilson
***Laura Valerius ..... Shreveport, LA

Degree Conferred May 7, 1988

Curtis Todd Sinclair ..... Mahomet, IL

MASTER OF SOCIOLOGY

Degree Conferred August 5, 1987

Cyd Shauneille Buck ..... New Bern

MASTER OF STATISTICS

Degrees Conferred December 15, 1987

Joan Fiorello Barrett ..... Cary
Adam Paul Holtzman ..... Raleigh
Shigeo Kawahata ..... Nishinomiya, Hyogo, Japan
Heungsun Park ..... Seoul, Korea
Fouad Gabriel Younan ..... Baghdad, Iraq

MASTER OF TEXTILES

Degrees Conferred August 5, 1987

Wayne Donald Magerl ..... North Wales, PA
Bharat Patel ..... Charlotte
Baruch Porath ..... Raleigh

Degrees Conferred May 7, 1988

Judson Wade Carter ..... Raleigh
Ingrid Johnson ..... New York, NY

MASTER OF TOXICOLOGY

Degree Conferred May 7, 1988

Michael John Kohan ..... Dayton, OH

MASTER OF WOOD AND PAPER SCIENCE

Degree Conferred December 15, 1987

Jerry Van Midyette ..... Engelhard

Degrees Conferred May 7, 1988

Rokiah Hashim ..... Selangor, Malaysia
Othman Sulaiman ..... Selangor, Malaysia

** and *** Co-major: Public Affairs

Master of Arts Degrees

Archival Management

Degree Conferred December 15, 1987

Anita Denise Haynes ..... Raleigh

Degrees Conferred May 7, 1988

Donna Kelly Flowers ..... Raleigh
Ann Patterson Renegar ..... Monroe
Tyler Otto Walters .....Chapel Hill

English

Degrees Conferred August 5, 1987

Virginia Herren Connell ..... Douglasville, GA
Melissa Ann Moore ..... Houston, TX
Daniel Nolan Neil ..... Raleigh
Muri-lyn Bearfield Pugh ..... Cary
Belinda Marsha Bulla Shaaban .....Charlotte

Degrees Conferred December 15, 1987

Keith Joseph Faivre ..... Tenafly, NJ
Judith Stone Ghoneim ..... Fayetteville

Degrees Conferred May 7, 1988

Winifred DeGray Cherry ..... Raleigh
Robanna Sumrell Knott ..... Raleigh
Damienne Palazzola Real ..... Ann Arbor, MI
Peggy Carol Williamson Wiggins ..... Raleigh

History

Degree Conferred December 15, 1987

Mary Frances Morrow ..... Raleigh

Degrees Conferred May 7, 1988

Philip Chumley Cope .....Montreat
Michelle Scott Ivey .....Wilson
Jacqueline Suzanne Yang ..... Raleigh

Political Science

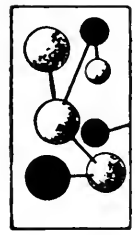
Degrees Conferred December 15, 1987

Stephen Richard Aylward ..... Portland, ME
Alan Charles Sanger ..... Coolidge, AZ
Mark Anthony Swaringen ..... North Fort Myers, FL

Degrees Conferred May 7, 1988

Lee Franklin Duffy ..... Vicksburg, MS

Master of Science Degrees



Adult and Community College Education

Degrees Conferred December 15, 1987

Edna Johnson Black ..... Williamsville, NY
Victor Carlyle Scott ..... Pulaski, VA

Degree Conferred May 7, 1988

John Mark Pettitt ..... Greensboro

Aerospace Engineering

Degrees Conferred August 5, 1987

Paul Dexter Frymier, Jr. ..... Plymouth
Edgar North Rudisill, Jr. ..... Hendersonville

Degrees Conferred December 15, 1987

Jassim Abbass Al-Saadi ..... Bryson City
Armin Martin Moerz ..... Pfronten, West Germany

Degrees Conferred May 7, 1988

Charles Cochran Fenno, Jr. ..... Raleigh
Christopher Joseph Riley ..... Newton
Chad Joseph Yetka ..... Goldsboro

Agricultural Economics

Degree Conferred December 15, 1987

Dale Clayton Miller ..... Apex

Degree Conferred May 7, 1988

Kevin Edward Jack ..... Loudonville, NY

Animal Science

Degree Conferred August 5, 1987

Lennie June Samsell ..... Morganton, WV

Degree Conferred December 15, 1987

Margaret Ann Lamb ..... Tigard, OR

Degrees Conferred May 7, 1988

Marjorie Alice Faust ..... Kempton, PA
Thomas William Powel ..... Union Bridge, MD

Biochemistry

Degree Conferred December 15, 1987

Inga Chalet Brandon ..... Greensboro

Biological and Agricultural Engineering

Degree Conferred August 5, 1987

Eric Todd Weatherly ..... Columbia

Degrees Conferred December 15, 1987

Matthew Scott Howarth ..... Athens, GA
Mark Michael Wilsnack ..... Dover, DE

Degrees Conferred May 7, 1988

Gerald Lee Cain, Jr. ..... Raleigh
Ping Liang ..... Guangxi, People's Republic of China

Biomathematics

Degree Conferred December 15, 1987

Jennifer Marie Webb ..... Marion

Botany

Degrees Conferred December 15, 1987

Tracie Lynn Bradshaw ..... Morganton
Lynne Alese Dengler ..... Pottstown, PA
David Wilson Freshwater ..... Morehead City
James John Polashock ..... Saddle Brook, NJ
Dora Liverman Som-Pimpong ..... Greensboro
Richard Hulse Stickney, Jr. ..... Raleigh

Degrees Conferred May 7, 1988

Stephanie Jane Horton ..... Burnsville
Sharon Brown Settlage ..... Sharpsburg, GA

Chemical Engineering

Degrees Conferred August 5, 1987

Timothy John Bauer ..... Madison, NJ
Theodore Andrew Walter ..... Durham

Degrees Conferred December 15, 1987

Sylvia Mizelle Hardison ..... Jamesville
William Preston Wright, Jr. ..... Burlington

Degrees Conferred May 7, 1988

Daniel Robert Brouns ..... Rockville, MD
Shelley Elizabeth Peters ..... Omaha, NE
Jeffrey Gerard Sczechowski ..... Troy, MI
Christian Louis Traynelis ..... Morgantown, WV

Chemistry

Degree Conferred August 5, 1987

Sholeh Jabarzadeh-Azar ..... Isfahan, Iran

Degrees Conferred December 15, 1987

David Gray Anderson ..... Southern Pines
Hanna Assefa ..... Addis Ababa, Ethiopia

Civil Engineering

Degrees Conferred August 5, 1987

Frank Michael Altimore ..... Raleigh
Joseph Allen Wolhar ..... Charlotte

Degrees Conferred December 15, 1987

Frank Kyunghwan Park ..... Raleigh
Hilal Abdallah Saadi ..... Acre, Palestine
Thomas Eliot Tallman ..... Bethesda, MD
Pamela Beth Townsend ..... Raleigh

Degrees Conferred May 7, 1988

Fouad Kamal Abu-Arbid ..... Beirut, Lebanon
Bashar Suleiman Rihani ..... Amman, Jordan

Computer Studies

Degrees Conferred August 5, 1987

Kelvin Sebron Bryant ..... Fayetteville
Elizabeth Spangler ..... Lewisburg, WV

Degrees Conferred December 15, 1987

Carole Lee English ..... Raleigh
Anwer Zuheir Kotob ..... Damascus, Syria
David Brown McNeill ..... Sanford
Manoj Ramchandra Patwardhan ..... Bombay, India

Crop Science

Degrees Conferred August 5, 1987

Brenda Carol Gwynn ..... Oxford
Thomas Mekontchou ..... Maroua, Cameroon
Inigo Pfeiffer ..... Madrid, Spain
Mark Allan Tucker ..... Madison
Randall H. White ..... Clymer

Degrees Conferred December 15, 1987

Jean Louise Dowty ..... Bakersfield, CA
Ziya Gizlice ..... Adana, Turkey
Irwin Lee Goldman ..... Skokie, IL
Victoria Erasga Matalog ..... Los Banos, Laguna, Philippines
Timothy Dale Phillips ..... Raleigh
Richard Jay Sloane ..... Los Angeles, CA
Tirtoboma ..... Jakarta, Indonesia

Degrees Conferred May 7, 1988

Robert Parsons Ewing ..... Chapel Hill
David Lindley Jordan ..... Edenton
David Ronald Lawson ..... Saint Charles, MO
Kenneth Neil McCaskill ..... Sylva
Wan Zaki Bin Wan Mamat ..... Kuala Trengganu, Malaysia
Daniel Roy Wendt ..... Whiteland, IN

Curriculum and Instruction

Degree Conferred May 7, 1988

Joy Matheson Collins ..... Cary

Ecology

Degree Conferred May 7, 1988

Jeffrey Griffin Bruton ..... Fayetteville

Electrical and Computer Engineering

Degrees Conferred August 5, 1987

Susan Marie Alexander ..... Greenville, SC
Mark Steven Basel ..... Cary
Andrew Thomas Brown ..... Huntsville, AL
Lawrence William Cook ..... Palm Bay, FL
Everett Jackson Dunning, Jr. ..... Charlotte
Kenneth Wilson Fernald ..... Autryville
Wen Jenq Derek Hwang ..... Kaohsiung, Taiwan, Republic of China
Mark Joel Lanzo ..... Durham
Yihong Liao ..... Quingdao, People's Republic of China
Li-Hsin David Lu ..... Taipei, Taiwan, Republic of China
Randy Grey Martinez ..... Raleigh
Mark Devere Strickland ..... Raleigh
Jean Elizabeth Van Well ..... Dallas, TX
Simon Verghese ..... Cary
Guor-Jang Wur ..... Taipei, Taiwan, Republic of China

Degrees Conferred December 15, 1987

Denis Aulagnier ..... Marseille, France
Sheila Benfield Banks ..... Asheville
William Edward Batchelor ..... Raleigh
Mark Edward Boduch ..... Lenoir
Darol Chamberlain ..... Raleigh
Far-Yung Chen ..... Chu-Tung, Taiwan, Republic of China
John Randall Cooper ..... Greenville
Edward Robert Deak ..... Mechanicsburg, PA
Richard Washington Flatow ..... Mexico City, Mexico
Avinash Laxman Ghirnikar ..... Bombay, India
Michael Dennis Haynes ..... Morganton
Yaw-Ting Ho ..... Chiayi, Taiwan, Republic of China
Wendy Kay Hodgin ..... Wilmington
Wen-Chau Hou ..... Chia-Yi City, Taiwan, Republic of China
David Charles Jarman ..... Jacksonville
Richard Lewis Johnson, Jr. ..... Charlotte
Danny Jonathan ..... Winston-Salem
Yun Sun Kang ..... Seoul, Korea
Yungsik Kim ..... Incheon, Korea
Rajan Vasudev Kuruppillai ..... Bombay, India
Jong Keuk Lee ..... Taegu, Korea
Nai-Hui Liao ..... Taipei, Taiwan, Republic of China
Kailih David Lin ..... Taipei, Taiwan, Republic of China
Sanjay Nayak ..... Raipur, M.P., India
Jaideep Prakash ..... Raleigh
John Claassen Roberts ..... Chapel Hill
Tasneem Saleh ..... Dhaka, Bangladesh
John Dai-Lun Sun ..... Melbourne Beach, FL
Paul David Thieken ..... Raleigh
Kalavathy Venkataramana ..... Raleigh

Degrees Conferred May 7, 1988

Robert Francis Allan ..... Cary
Gregory Thomas Brauns ..... Pleasant Garden

Ming Pin Chang ..... Taipei, Taiwan, Republic of China
Chih-Fu Edward Chen ..... Taichung, Taiwan, Republic of China
Tyan-Far Chen ..... San Jose, CA
Woei-Kae Chen ..... Taipei, Taiwan, Republic of China
Jae-Ho Choi ..... Seoul, Korea
Stephen Samuel Crutchfield ..... Milton
Paramesh Sampatrai Desai ..... Cary
Timothy Lee Droz ..... Raleigh
Bonnie Louise Franke ..... West Caldwell, NJ
Milind Shrikant Gadekar ..... Bombay, India
Jeffery Scott Hines ..... Raleigh
Jun-Shong Huang ..... Taipei, Taiwan, Republic of China
Thomas Ashford Hughes, Jr. ..... Raleigh
George Chih Wen Hwa ..... Beijing, People's Republic of China
Jzan-Ching Jerry Jeen ..... Hsin-Chu City, Taiwan, Republic of China
Fuyung Lai ..... Taipei, Taiwan, Republic of China
Hsin-Chang Sanko Lan ..... Elmhurst, NY
Mao-Shen Lin ..... Kaohsung, Taiwan, Republic of China
Jin-Kun Lin ..... Taipei, Taiwan, Republic of China
Wu Sho-Zu Lin ..... Taichung, Taiwan, Republic of China
Hsiao-Cheng J. Liu ..... Taipei, Taiwan, Republic of China
Richard Gary Minor ..... Raleigh
Hyunmin Park ..... Seoul, Korea
James Clarence Parker ..... Asheville
Pankaj Rasiklal Parmar ..... Raleigh
Prayson Will Pate ..... Durham
Mark Paul Peters ..... Raleigh
Kenneth Eugene Polleck ..... Raleigh
Mark Glenn Powell ..... Ellenboro
****Mark Roger Promislow ..... Charlotte
Roberto Salama ..... Cochabamba, Bolivia
Saurin Bharatkumar Shroff ..... Bombay, India
Kwee Teng Soh ..... Cirebon, Indonesia
Mark Harold Van Horn ..... Raleigh
Shiuh-Chong Louis Wang ..... San Jose, CA
Yih-Jiahn Wang ..... Taipei, Taiwan, Republic of China
Joel Mark Yarborough ..... Winston-Salem
Tong-Fei Yeh ..... Tainan, Taiwan, Republic of China
Edward William Yohon, Jr. ..... Rochester, NY
Ichiro Yoshida ..... Yokohama, Japan
Shiming Zhan ..... Urumqi, People's Republic of China

Entomology

Degrees Conferred December 15, 1987

James Dale Barbour ..... Lafayette, IN
Thomas Patrick Keeley ..... Raleigh
Sergio Orduz ..... Bucaramanga, Colombia
Marla Robin Share ..... Howard Beach, NY
Hung-Wen Shen ..... Taipei, Taiwan, Republic of China

Degrees Conferred May 7, 1988

Joseph Arthur Browde, Jr. ..... Durham
Gwen Ann Pearson ..... Conroe, TX
Lanionel Leodegario Tromp ..... Curacao, Netherlands Antilles

****(Co-major in Integrated Manufacturing Systems Engineering)

Food Science

Degrees Conferred December 15, 1987

Judith Ann Dudziak ..... Minneapolis, MN
Melissa LuAnn Fulp ..... Winston-Salem
Donald Lewis Higgins ..... Raleigh
Michele Davis Keziah ..... Charlotte
Karen Hoff Myers ..... Atlanta, GA
*****Debora Varon ..... Raleigh
Ruth Hamrick Watkins ..... Cary

Degrees Conferred May 7, 1988

Vivian Marie Higgins ..... Raleigh
Ruth Price McGuire ..... Lancaster, SC
Jianqing Wu ..... Zhejiang, People's Republic of China

Forestry

Degrees Conferred August 5, 1987

Gordon McKee Cressman ..... Cary
Ruy Teixeira Lima ..... Cach. de Itapemirim, Brazil
Mark Tonry Senior ..... Bernardsville, NJ

Degrees Conferred December 15, 1987

Claudio Emilio Balocchi ..... Valdivia, Chile
Charles John McCormick, Jr. ..... Cohasset, MA
B. Dipak Upadhyay ..... Goushala, Kathmandu, Nepal

Degree Conferred May 7, 1988

Doreen Alana Liner ..... Danbury, CT

Genetics

Degree Conferred August 5, 1987

Susan Elmore Stamper ..... Raleigh

Degree Conferred December 15, 1987

Leslie Ann Bethards ..... Okemos, MI

Degree Conferred May 7, 1988

David Franklin McCarn ..... Badin

Guidance and Personnel Services

Degrees Conferred August 5, 1987

Harriet Platts Adams ..... Kinston
Trudi Mildred Crozier ..... Raleigh
Cecil Harold McManus ..... Waxhaw

Degree Conferred May 7, 1988

Linda Carol Greene ..... Stanley

*****Co-major in Horticultural Science. See page 92.

Horticultural Science

Degrees Conferred December 15, 1987

Robert Davey Belding ..... Little Falls, NJ
Mary Anne Depa ..... Sterling Heights, MI
*****Debora Varon ..... Raleigh
Mark Herlong Yonce ..... Moncks Corner, SC

Degree Conferred May 7, 1988

Steven Glynn Russell ..... Cabot, AR

Industrial Engineering

Degrees Conferred August 5, 1987

Michael Anthony Boggi ..... Stratford, NJ
Christina Unrein King ..... Cary
Steve King Monteith ..... Raleigh

Degree Conferred December 15, 1987

Damodar Anand Ramanuj ..... Bangalore, India

Degrees Conferred May 7, 1988

William Clifford Burton ..... Baldwinsville, NY
Nathan Charles Claridy ..... Lakeland, FL
Edward Steven Henkler ..... Durham
Sumant Mehta ..... New Delhi, India
Theodore Marcel Reymann ..... Hartville, OH
Dann George Salami ..... South Charleston, WV

Management

Degrees Conferred August 5, 1987

Ann Rutledge Bowen ..... Raleigh
Patricia Lynn Colelli ..... Cary
Gary Lynn Davis ..... Raleigh
Mohammad Innamur Razzak ..... Dhaka, Bangladesh
Pierre Nocolas Van Peteghem ..... Brussels, Belgium

Degrees Conferred December 15, 1987

Karan Melinda Bunn ..... Raleigh
Kenneth Alan Davis ..... Raleigh
Glenn Richard Matteson ..... Raleigh
Kevin Ike Pait ..... Raleigh
Amit Lal Patra ..... Durham
Bobby Lee Pellegrini ..... Winston-Salem
William Clint Weathers ..... Southern Pines

Degrees Conferred May 7, 1988

William Pitt Isley ..... Wilmington
Sean Quinn McClellan ..... Durham
Suha Ahmad Sabi ..... Qalqilya, Palestine

*****Co-major in Food Science. See page 91.

Marine, Earth and Atmospheric Sciences

Degrees Conferred August 5, 1987

Nizar Shabib Abu-Jaber ..... Amman, Jordan
Katherine Anne Brehme ..... Winston-Salem
John David Pickle ..... Lancaster, PA
Robin Raible Reynolds ..... Ozark, AK
Frank Harrison Ruggiero ..... Lyndhurst, NJ
Donna Marie Wojtak ..... Tappan, NY

Degrees Conferred May 7, 1988

Anto Francis Akkarappuram ..... Raleigh
Kirankumar Venkata Alapati ..... Raleigh
Gregory Matthew Cambareri ..... Greensboro
David Lee Epperson ..... Columbus, IN
John Edward Nelsen, Jr. ..... Erie, PA
Thomas Mac Nelson ..... Perryville, MO
Edward Harrison Stephens ..... Raleigh
Kim Margaret Talbert ..... California, MD

Marine Sciences

Degree Conferred August 5, 1987

Frank Marcus Gupton ..... Raleigh

Materials Science and Engineering

Degrees Conferred August 5, 1987

Robert Mark Davis ..... Fayetteville
Edward Roy Myers ..... Springfield, IL
Stephen John Wrinn ..... Cary

Degrees Conferred December 15, 1987

Atul C. Ajmera ..... Calcutta, India
Jong Keun Jung ..... Seoul, Korea
Tracy Elizabeth Rothwell ..... Cary
Sujit Sharan ..... Ranchi, India
Rajiv Kumar Singh ..... Howrah, India

Degrees Conferred May 7, 1988

Amit Chandravadan Gami ..... Raleigh
Eric Lee Gaylord ..... Matthews
James Bruce White ..... Durham

Mathematics

Degree Conferred August 5, 1987

Nur Azlina Bt Abd Aziz ..... Seremban, N. Sembilan, Malaysia

Degree Conferred December 15, 1987

Chul Kim ..... Seoul, Korea

Mathematics (Applied)

Degrees Conferred August 5, 1987

John Grady Collinsworth ..... Newport
James Dean Creasman ..... Andrews

Ahmad Basel Kanawati ..... Damascus, Syria
Jung-Soon Kim Lee ..... Daegu, Korea
Aminah Bt Nik Taib ..... Petaling Jaya, Selangor, Malaysia
Aziah Shamsuddin ..... Perak, Malaysia
Suzanne Sumner ..... Greensboro

Degrees Conferred December 15, 1987

Wan Ainun Mior-Othman ..... Perak, Malaysia
Sophfronia Germaine Tucker ..... Ridgeville, SC
Saundra Denice Wall ..... Rockingham
Kevin Dean Yeomans ..... Lumber City, GA

Degrees Conferred May 7, 1988

Keith Eugene Crowe ..... Morganton
Donna Lyn Guarino ..... Wilmington
Ismail Bin Kamis ..... Johor, Malaysia
Sarina Bt. Md. Jam ..... Bayan Lepas, Penang, West Malaysia
Ming-Ching Diana Shyu ..... Moscow, ID

Mechanical Engineering

Degrees Conferred August 5, 1987

Gregory Everett Smith ..... Mount Holly
James Myron Smith ..... Raleigh

Degrees Conferred December 15, 1987

Myungjin Choi ..... Seoul, Korea
Karen Lynn Core ..... Raleigh
Adnan Ertay ..... Limasol, Cyprus
Thomas W. Groot ..... Chapel Hill
Michael William Hiller ..... New York City, NY
Cheng-Hung Huang ..... Tainan, Taiwan, Republic of China
Fariba Jabbarzadegan ..... Tehran, Iran
Jennifer Lynn Rhatigan ..... Jacksonville, FL
Jeffrey Thomas Warfford ..... Lexington
Grant Howell Williard ..... Winston-Salem

Degrees Conferred May 7, 1988

Charles Kelly Allred ..... Mebane
Richard Kendrick Coryell ..... Rose Hill, KS
Brian Arthur FitzGerald ..... Parma Heights, OH
Shang-Shyan Liao ..... Taipei, Taiwan, Republic of China
Derrick Yale Promislow ..... Raleigh

Microbiology

Degrees Conferred August 5, 1987

Michael Alfonse DeGuglielmo ..... Rocky Mount
Anne Wendy Shrago ..... Rocky Mount

Degrees Conferred December 15, 1987

Michael Leroy Bruin ..... Walnut Creek, CA
David Andrew Winters ..... Pittsburgh, PA

Nuclear Engineering

Degrees Conferred August 5, 1987

Waheedul Haq ..... Islamabad, Pakistan
Woojune Yi ..... Seoul, Korea

Degree Conferred May 7, 1988

Khalid Mohamed Al-Otaibi ..... Jeddah, Saudi Arabia

Nutrition

Degrees Conferred December 15, 1987

Ann Elizabeth Petro ..... Raleigh
Pamela Long Spurlin ..... Elizabeth City

Occupational Education

Degree Conferred December 15, 1987

Deborah Wheeler Tiffany ..... Durham

Degree Conferred May 7, 1988

Deborah Powers Hoy ..... Cookeville, TN

Operations Research

Degrees Conferred December 15, 1987

Mary Aldridge Follas ..... Apex
Hilal Yousif Putrus ..... Baghdad, Iraq
Steven John Rawlick ..... New Haven, CT

Degrees Conferred May 7, 1988

Ricardo Jose Gomez ..... Charlotte
Ramzi Moufid Ziade ..... Hammana, Lebanon

Physics

Degree Conferred August 5, 1987

Christopher James Roddy ..... Wilmington

Degrees Conferred December 15, 1987

Brian Neal Davidson ..... Raleigh
Lindsey Neal Yadon ..... Charlotte

Physiology

Degree Conferred August 5, 1987

Kirstin Lise Pauling ..... Raleigh

Degrees Conferred December 15, 1987

Lisa Andrews Dozier ..... Wilmington
Maura G. Will Klinge ..... Durham
Mary Ann Tillett McBride ..... Raleigh

Degree Conferred May 7, 1988

Sandra Karen Johnson ..... Asheville

Plant Pathology

Degrees Conferred December 15, 1987

Alberto Raul Escande ..... Mar del Plata, Argentina
Stephanie Anne Fore ..... Chapel Hill
Theresa Ann Frisina ..... Wappingers Falls, NY
Brent Steven Sipes ..... Bolingbrook, IL

Degrees Conferred May 7, 1988

Vermando Masinsin Aquino ..... Laguna, Philippines
Tsega Berecket ..... Addis Ababa, Ethiopia
Marcus Dixon Law ..... Harrisville, WV
Michael Joseph Munster ..... LaCrosse, WI

Psychology

Degrees Conferred August 5, 1987

Leslie Elizabeth Carter ..... Lynchburg, VA
Patrick Lawrence McMurtry ..... Waverly, TN
Sherry Lynn Turner ..... Memphis, TN

Degrees Conferred December 15, 1987

Julia Malaea King ..... Monroe
Anne Bittinger White ..... Raleigh

Degrees Conferred May 7, 1988

Elizabeth Doughton Greulich ..... Pittsburgh, PA
Nancy Helen Koester ..... Raleigh
Victoria Lee Reardin ..... Bloomsburg, PA
Maureen Odilia Vandermaas ..... Charlotte

Recreation Resources Administration

Degree Conferred August 5, 1987

Carter Joseph Betz ..... Denver, CO

Degree Conferred May 7, 1988

George Nevin Lipscomb ..... Rockville, MD

Rural Sociology

Degrees Conferred August 5, 1987

Christina Margaret Klaas ..... Poughkeepsie, NY
Taehong Sohn ..... Pusan, Korea

Degree Conferred December 15, 1987

Mary Frances McKenzie ..... Winston-Salem

Degrees Conferred May 7, 1988

Jon Lee Wiggs ..... Wendell
Maria Winchell ..... Rochester, NY

Soil Science

Degree Conferred August 5, 1987

Richard Eric Gauger ..... Waseca, MN

Degree Conferred December 15, 1987

Sarah Jane Lein ..... Arlington, IA

Degrees Conferred May 7, 1988

Sheunesu Mpepereki Mpofu ..... Harare, Zimbabwe
Eleazar Rafael Salazar ..... Caracas, Venezuela

Textile Chemistry

Degree Conferred August 5, 1987

Aida Vinent Garrard ..... Fayetteville

Degrees Conferred May 7, 1988

Herbert Mathole Lulube ..... Plumtree, Zimbabwe
Sherri Antoinette Satterwhite .....Hebron, IN
Wrennie Naomi Sommerville ..... Raleigh

Textiles

Degree Conferred December 15, 1987

Robert Warren Fontaine .....Gettysburg, PA

Degrees Conferred May 7, 1988

Anne Long Crews .....Butner
John Victor Gournas ..... Raleigh
Kerri Alexis Kolehma ..... Rocky Mount
Barbara Ann Matthews ..... Raleigh
Amitkumar Manoharrao Paradkar ..... Badlapur, India
Al-Karim Janmohamed Thawer .....Dar-Es-Salaam, Tanzania

Toxicology

Degrees Conferred December 15, 1987

Kevin Eugene Powell ..... Apex
Garry Wong ..... Sacramento, CA

Degrees Conferred May 7, 1988

Johnny Michael Sanders .....Franklin
Hala Tayel Shehata-Karam ..... Raleigh
Jane Kay Smollinger ..... Bethlehem, PA

Degree Conferred December 15, 1987

Robert Alan Bullis ..... Morgantown, WV

Degrees Conferred May 7, 1988

Hans Walter Heidner ..... Santa Barbara, CA
Marsha Dean Wilburn Ward ..... Cary

Zoology

Degree Conferred December 15, 1987

John Joseph Fried .....New Hyde Park, NY

Degrees Conferred May 7, 1988

Cresada Angela Buchanan .....Greensboro
Lisa Dawn Gates ..... Raleigh
Steven Howard Neptun ..... Cherry Hill, NJ

DOCTOR OF VETERINARY MEDICINE

SCHOOL OF VETERINARY MEDICINE

Degrees Conferred May 7, 1988

Wendy Jo Alphin ..... Durham
Deborah Karen Anderson ..... Carrboro
Margaret Ann Anderson ..... Enka-Candler
Kenneth Raymond Brodie ..... Hendersonville
Laurel Denise Brooks ..... Clayton
David Hugh Close ..... Trenton, NJ
Patrick Michael Comyn ..... Mill Spring
Elizabeth Anne Daughtry ..... Gaithersburg, MD
James Wilson DeBell ..... Winston-Salem
Julie L. Doub ..... Winston-Salem
Amy Feher Edwards ..... Ahoskie
David Powell Elliott ..... Raleigh
Linda Ellen Erday ..... Garner
Lora Elizabeth Evans ..... Salisbury
Richard Thomas Evans, Jr. ..... Greensboro
Bernard Martin Fischer ..... Chapel Hill
Jennifer Susan Foshee ..... Cary
Randolph Cochrane Frantz ..... Southern Pines
Michael Patrick Gallup ..... Raleigh
Ginny Lou Grant ..... Hendersonville
James Mark Hammer ..... Ayden
Hope Laura House ..... West Covina, CA
Ronald Earl Johnson, Jr. ..... Pink Hill
Holly Lynn Jordan ..... Durham
James Stanley Kittrell ..... Greenville
Adrian Matthews Kreeger ..... Pfafftown
Dina Michele Lawrence ..... Kannapolis
Cynthia Judson Lees ..... Winston-Salem
Edward Maris Lineberger ..... Belmont
William Charles Marlatt II ..... Garner
Donna Ontene Matthews ..... Winston-Salem
Donna Jan McLamb ..... Benson
John Thomas McLean IV ..... Lincolnton
Mark Allen McMahon ..... Morganton
Gerald Scott Melton ..... Rutherfordton
Christine Lee Merrill ..... Raleigh
Angela Adams Mitchell ..... Asheville
Teresa Clark Moazed ..... Charlotte
Mary Belle Myers ..... Union Grove
John Norman Norton II ..... Thomasville
Linton Bertram Palmer ..... Waynesville
Cheryl Lane Parker ..... Smithfield
Barbara Ann Pollard ..... Greensboro
Kathy Ann Rash ..... Statesville
Ann Robin Ratchford ..... Dallas

Douglas Leonard Reece ..... Winston-Salem
Joseph Keith Reid ..... Carrboro
Karen Unger Rosenthal ..... Raleigh
Irene Mary Rusnak ..... Raleigh
John Joseph Santilli ..... Cary
James Eugene Schacht ..... Charlotte
Susan Frieda Schopler ..... Chapel Hill
David Franklin Scotton ..... Siler City
Suzanne Riley Sewell ..... Charlotte
Carolyn Harrison Smoak ..... Chapel Hill
John Patrick Soles ..... Whiteville
Daniel James Stack ..... Raleigh
Catherine Muir Starkweather ..... Wilmington, DE
Suzanne Zoé Sulka ..... Winston-Salem
Carole Ann Thomas ..... Wilson
Heath Carl Thomas ..... Greenville
Joanne Thompson ..... Aurora
David Michael Tillson ..... Jamestown
Clayton Charles Watkins ..... Lexington
Paul Edward Whippo ..... Dallas
Doby Wren Whited ..... Mebane
Annette Joyce Wilson ..... Durham
Vivian Anne Winstead ..... Rocky Mount
Cindy Joy Yetka ..... Goldsboro

Doctor of Education Degrees

Degrees Conferred August 5, 1987

Charles Lincoln Barton, Educational Administration and Supervision
Raleigh, North Carolina
Dissertation: Industrial Image: North Carolina High School Seniors' Perception of the Textile Industry. (Under the direction of William B. Harvey.)

Pamela Uremovich Grey, Adult and Community College Education
Raleigh North Carolina
Dissertation: An Analysis of Levels of Self-efficacy and Associated Factors for the Career-related Competencies of Top Administrators in Two-year Colleges. (Under the direction of R. David Mustian.)

Joyce Leslie MacKinnon, Educational Administration and Supervision
Carrboro, North Carolina
Dissertation: Relations among Patient Management Problems, Critical Thinking Abilities and Professional Knowledge Levels Attained by Physical Therapy Students. (Under the direction of Bruce B. Beezer.)

Sandra Raiford McCullen, Guidance and Personnel Services
Dudley, North Carolina
Dissertation: The Cognitive-Moral Development of Counselors-in-training. (Under the direction of Don C. Locke.)

Elizabeth Anna Swainson Weir, Curriculum and Instruction
Raleigh, North Carolina
Dissertation: Levels of Phonemic Awareness in Early Readers. (Under the direction of Barbara J. Fox.)

Degrees Conferred December 15, 1987

Jerry William Barker, Adult and Community College Education
Danville, Virginia
Dissertation: Perceived Wellness Needs of University Employees and Variations in Relation to Personal and Employment Characteristics. (Under the direction of J. Conrad Glass, Jr.)

Brian Christopher Findsen, Adult and Community College Education
Hamilton, New Zealand
Dissertation: The Process of International Graduate Student Adjustment. (Under the direction of Edgar J. Boone.)

Lorraine Adams Gail, Guidance and Personnel Services
Greensboro, North Carolina
Dissertation: Group Career Peer Counseling as an Intervention for the Development of Moral Judgment and Career Planfulness among Senior High School Learning Disabled Students. (Under the direction of Don C. Locke.)

John Thomas German, Adult and Community College Education
Boomer, North Carolina
Dissertation: Factors Related to Supervisors' Perceptions of Job Performance of Industrial Maintenance Personnel in Northwest North Carolina. (Under the direction of Edgar J. Boone and R. David Mustian.)

Bobbie Kearns Reddick, Curriculum and Instruction
Durham, North Carolina
Dissertation: The Relationship between Psychological Types and Expressed Job Satisfaction of Nurse Educators. (Under the direction of Barbara M. Parramore and Judith A. Davis.)

John Gilbert Richardson, Adult and Community College Education
Nakina, North Carolina
Dissertation: Capacity of the North Carolina Agricultural Extension Service to Deliver Technological Information: Perceptions of Agricultural Producers Who Are Users of Its Services. (Under the direction of Edgar J. Boone.)

Jacqueline Rogers Scott, Guidance and Personnel Services
Fair Bluff, North Carolina
Dissertation: Cognitive Developmental Learning Theory Applied to Cross-age Tutoring of Elementary School Females in Mathematics. (Under the direction of Norman A. Sprinthall and Lawrence K. Jones.)

Degrees Conferred May 7, 1988

Kenneth Arnold Boham, Adult and Community College Education
Jackson, North Carolina
Dissertation: An Analysis of the Career Paths of Mid-Atlantic Community College Presidents. (Under the direction of Edgar J. Boone.)

Richard Wallace Bohannon, Adult and Community College Education
Fayetteville, North Carolina
Dissertation: Information Accessing Behavior of Physical Therapists. (Under the direction of R. David Mustian.)

Harold David Bryant, Educational Administration and Supervision
Raleigh, North Carolina
Dissertation: Descriptive Study of Hemispheric Preferences, Attribute Variables and Environmental Characteristics among School Administrators. (Under the direction of Elizabeth MacPhail-Wilcox and Jon C. Marshall.)

Anna Carelli, Adult and Community College Education
Raleigh, North Carolina
Dissertation: Factors Associated with Adult Education Administrators' Perception of Needed Competencies in Performing in the Six Role Areas Encompassed in Their Administrative Position. (Under the direction of J. Conrad Glass, Jr. and Edgar J. Boone.)

Georgene Gaskill Eakes, Adult and Community College Education
Greenville, North Carolina
Dissertation: Grief Resolution in Hospice Nurses: An Exploration of Effective Methods. (Under the direction of Arlene Fingeret.)

Felix Yao Mensa Fiadjoe, Adult and Community College Education
Anyako, Ghana
Dissertation: Socio-cultural Factors That Farmers with Limited Resources Consider in Making Choices When Faced with Problematic Situations in Their Farming Activities. (Under the direction of George L. Carter, Jr.)

Denis Sherald Jackson, Occupational Education
Newton Grove, North Carolina
Dissertation: The Academic Performance of Students Entering North Carolina State University between 1974 and 1984 through Traditional and Nontraditional Undergraduate Admissions Procedures. (Under the direction of Joseph R. Clary and Farmer S. Smith.)

Georgianna Smevog Langley, Adult and Community College Education
Shelby, North Carolina
Dissertation: A Needs Assessment of Staff Development Activities within the North Carolina Community College Systems. (Under the direction of R. David Mustian.)

Charles Rupert McAdams III, Guidance and Personnel Services
Charlotte, North Carolina
Dissertation: Promoting the Development of High-risk College Students through a Deliberate Psychological Education-based Freshman Orientation Course. (Under the direction of Don C. Locke.)

James Goodlet McDaniel, Occupational Education
Wilmington, North Carolina
Dissertation: Comparison of Collaborative Components between Diploma Schools of Nursing That Are Open and Those That Have Closed. (Under the direction of Judith A. Davis and Linda S. Dillon.)

Mazanah Muhamad, Adult and Community College Education
Kuala Lumpur, Malaysia
Dissertation: Ralph W. Tyler's Perspectives on Designing and Facilitating Adult Learning. (Under the direction of George L. Carter, Jr.)

Othman Bin Haji Omar, Adult and Community College Education
Kota Kinabalu, Sabah, Malaysia
Dissertation: Relationship between Organizational Context and Mission from the Perspective of a County Agricultural Extension Service. (Under the direction of George L. Carter, Jr.)

Ronald Julian Plummer, Adult and Community College Education
Randleman, North Carolina
Dissertation: The Conceptual Programming Model and the Integration of Telecommunications into the Instructional Program of North Carolina Community Colleges: Perceptions of Chief Academic Officers and Telecommunications Coordinators. (Under the direction of Edgar J. Boone.)

Robert Earl Powell, Guidance and Personnel Services
Raleigh, North Carolina
Dissertation: Moral and Ego Development among Female Criminal Offenders. (Under the direction of Don C. Locke.)

Helena Mask Steene, Adult and Community College Education
Raleigh, North Carolina
Dissertation: Illiteracy Then and Now: North Carolina and Wake County, 1900-1980. (Under the direction of R. David Mustian.)

Philip Andrew Watkins, Occupational Education
Raleigh, North Carolina
Dissertation: The Relationship of Person-Environment Congruence and Measured Satisfaction and Achievement of Students Enrolled in High School Automotive Mechanics Courses. (Under the direction of V. William DeLuca and Richard E. Peterson.)

Doctor of Philosophy Degrees

Degrees Conferred August 5, 1987

K. Anand, Materials Science and Engineering
Madras, India
Dissertation: Effect of Microstructure on Local Impact Damage and Erosion of Cemented Carbides. (Under the direction of Hans Conrad.)

Carrie Lillie Baker, Psychology
Garner, North Carolina
Dissertation: The Relationship between K-ABC Factors and Woodcock-Johnson Achievement Scores for Reading Disabled Children. (Under the direction of Rachel F. Rawls and William P. Erchul.)

Marcia Yowell Bingham, Psychology
Cary, North Carolina
Dissertation: The Relationship of Subject, Task and Stimulus Characteristics to Holistic versus Analytic Processing on a Constrained Classification Task: Consideration of Three Models. (Under the direction of Patricia F. Horan.)

Molly McElrath Bland, Genetics
Winston-Salem, North Carolina
Dissertation: DNA Sequence Analysis of Mitochondrial Genes from *Nicotiana tabacum*. (Under the direction of Dale F. Matzinger and Charles S. Levings III.)

Clinton Lee Brown, Jr., Science Education
Raleigh, North Carolina
Dissertation: The Development and Evaluation of a Model Course in Advanced Biology for Secondary Education. (Under the direction of Norman D. Anderson.)

Raymond Todd Brown, Psychology
Hopewell, Virginia
Dissertation: The Combined Effects of Noise and Interpersonal Distance on Human Information Processing Efficiency. (Under the direction of Richard G. Pearson.)

Dae Won Byun, Marine, Earth and Atmospheric Sciences
Andong, Korea
Dissertation: A Two-dimensional Mesoscale Numerical Model of St. Louis Urban Mixed Layer. (Under the direction of S. Pal Arya.)

Humberto Enrique Cabanillas, Plant Pathology
Lambayeque, Peru
Dissertation: Factors Influencing the Efficacy of *Paecilomyces lilacinus* in Biocontrol of *Meloidogyne incognita* on Tomato. (Under the direction of Kenneth R. Barker.)

Fernando Castillo-Gonzalez, Crop Science
Chapingo, Mexico
Dissertation: Agronomic Evaluation of Latin American Maize Populations. (Under the direction of Major M. Goodman.)

Charles Edouard Chassaing, Mechanical Engineering
Asheville, North Carolina
Dissertation: Acoustic Wave Propagation by Finite Elements and Time-step Integration. (Under the direction of Allen C. Eberhardt.)

Chao-Lung Chen, Statistics
Taipei, Taiwan, Republic of China
Dissertation: Estimation Problems in Group Testing. (Under the direction of William H. Swallow.)

Chwen-Jinq Chen, Civil Engineering
Kaoshiang, Taiwan, Republic of China
Dissertation: Bridge Management under a Level of Service Concept Providing Optimum Improvement Action, Time and Budget Prediction. (Under the direction of David W. Johnston.)

Lynn Farnam Dickey, Biochemistry
Asheville, North Carolina
Dissertation: Characterization of a Third Distinct Ferritin Subunit cDNA, the Corresponding Processed Pseudogene in Bullfrog Tadpole and Its Use in the Study of Translational Control. (Under the direction of Elizabeth C. Theil.)

Brian James Eastwood, Statistics
London, Ontario, Canada
Dissertation: Confidence Interval Construction in Semi-nonparametric Regression Estimation. (Under the direction of A. Ronald Gallant.)

Dennis Lee Eggett, Statistics
American Fork, Utah
Dissertation: A Comparative Evaluation of Some Statistics for Determining the Limits of Applicability of a Linear Regression Model. (Under the direction of William H. Swallow.)

Tushar Kanti Ghosh, Fiber and Polymer Science
Habra, India
Dissertation: Computational Model for the Bending Behavior of Plain Woven Fabrics. (Under the direction of Roger L. Barker and Subhash K. Batra.)

Nancy Catherine Giles, Physics
Raleigh, North Carolina
Dissertation: Optical Properties of Novel II-VI Semiconductor Films and Quantum Well Structures. (Under the direction of Jan F. Schetzina.)

Tom C. Granato, Soil Science
Chicago, Illinois
Dissertation: Effects of Exogenous Nitrate and Processes That Produce Proliferation of Corn Roots. (Under the direction of Charles D. Raper.)

Stewart M. Gray, Plant Pathology
East Longmeadow, Massachusetts
Dissertation: Resistance in *Cucumis melo* to Watermelon Mosaic Virus 2: The Effect on the Epidemiology and Pathogenesis of the Virus. (Under the direction of James W. Moyer and George G. Kennedy.)

Delores Miller Hayes, Sociology
Fayetteville, North Carolina
Dissertation: An Ecological Model for the Study of Social Mobility of Population Segments. (Under the direction of A. Clarke Davis.)

Rhonda Dayle Helms, Psychology
Monroe, North Carolina
Dissertation: The Relations of Intelligence, Cognitive Level and Social Perspective Taking: A Developmental Stage Analysis of Juvenile Delinquency. (Under the direction of Samuel S. Snyder.)

Marty Ray Jacobson, Microbiology
Viroqua, Wisconsin
Dissertation: Transcriptional Regulation of Nitrogen Fixation in *Azotobacter vinelandii* by Molybdenum. (Under the direction of Paul E. Bishop.)

Roy Donald Jaquette, Nutrition
Elkton, Maryland
Dissertation: Effects of Dietary Protein Level on Milk Fat Depression in Dairy Cattle during Early Lactation. (Under the direction of Allen H. Rakes.)

Chwen-Jye Ju, Electrical Engineering
Taipei, Taiwan, Republic of China
Dissertation: Block Realization of Multidimensional Recursive Digital Filters. (Under the direction of Winser E. Alexander.)

Soojoon Kang, Mechanical Engineering
Seoul, Korea
Dissertation: Variational Modal Identification of Self-adjoint Distributed-parameter Systems. (Under the direction of Larry M. Silverberg and Richard F. Keltie.)

William Charles Kauffman, Entomology
Lancaster, Pennsylvania
Dissertation: Influence of 2-Tridecanone-based Resistance of a Wild Tomato on Parasitoids and Predators of the Tomato Fruitworm, *Heliothis zea* (Boddie). (Under the direction of George G. Kennedy.)

Myung-Sun Kim, Materials Science and Engineering
Seoul, Korea
Dissertation: The Structure and Properties of Nb-Ge and Nb-Sn Alloys Synthesized by Mechanical Alloying. (Under the direction of Carl C. Koch.)

Philip Museve Kutima, Food Science
Kabras, Kakamega, Kenya
Dissertation: Characterization of the Spore Coat Involved in the Germination of *Bacillus cereus* T Spores. (Under the direction of Peggy M. Foegeding.)

June Taeg Lim, Biomathematics
Seoul, Korea
Dissertation: A Dynamic Growth Model of Vegetative Soybean Plants under Variations of Root Temperature and Nitrogen Concentration in Nutrient Solution. (Under the direction of Harvey J. Gold and Gail G. Wilkerson.)

Ibere Delmar Gondim Lins, Soil Science
Campo Grande, M.S., Brazil
Dissertation: Improvement of Soil Text Interpretations for Phosphorus and Zinc. (Under the direction of Fred R. Cox.)

Mushtaq Ahmad Mian, Nutrition
Ziarat Kaka Sahib, Pakistan
Dissertation: Nutritional Evaluation of Soybean Meal Varying in Urease and Trypsin Inhibitor Activity. (Under the direction of Jim D. Garlich.)

Mark Harrison Morton, Aerospace Engineering
Albemarle, North Carolina
Dissertation: Natural Control of Flexible Space Structures. (Under the direction of Larry M. Silverberg and Richard F. Keltie.)

Magdi Sami Moustafa, Operations Research
Raleigh, North Carolina
Dissertation: Optimal Scheduling in Networks of Queues. (Under the direction of Shaler Stidham, Jr.)

Michael David Mullen, Soil Science
Fort Wayne, Indiana
Dissertation: Effects of Phosphorus Nutrition on the *Glycine max-Bradyrhizobium japonicum*. (Under the direction of Arthur G. Wollum.)

Raif Oruc Onvural, Operations Research
Ankara, Turkey
Dissertation: Closed Queueing Networks with Finite Buffers. (Under the direction of Harry G. Perros.)

Mark Edwin Oxley, Applied Mathematics
Harrison, Ohio
Dissertation: Moving Boundaries in Reaction-Diffusion Systems with Absorption. (Under the direction of Robert H. Martin, Jr.)

Edna Cachola Pableo, Plant Pathology
Kabacan, North Cotabato, Philippines
Dissertation: DNA Characterization and Relationship of the Genomes of Some *Meloidogyne* Species. (Under the direction of Anastasios C. Triantaphyllou.)

John Edward Parsons, Biological and Agricultural Engineering
Salisbury, Maryland
Dissertation: Development and Application of a Three-dimensional Water Management Model for Drainage Districts. (Under the direction of R. Wayne Skaggs.)

Charlotte Longacre Phillips, Biochemistry
Orlando, Florida
Dissertation: The Regulation of Beta Follicle Stimulating Hormone Subunit RNA by 17-Beta Estradiol, Progesterone and Inhibin in Ovine Pituitary Cells in Culture. (Under the direction of William L. Miller.)

Joanne Rebbeck, Botany
Trenton, New Jersey
Dissertation: The Effects of Ozone and Soil Moisture on the Growth and Energy Reserves of Ladino Clover and Tall Fescue. (Under the direction of Udo Blum.)

Nancy Suzanne Robbins, Horticultural Science
Raleigh, North Carolina
Dissertation: Influences of Environmental Factors on Carbohydrate Metabolism in Cucumber. (Under the direction of D. Mason Pharr.)

Clara Lee Schreiner, Biochemistry
Lancaster, New York
Dissertation: Metabolism of 2-Hydroxy-4-methylthiobutanoic Acid (the Methionine Hydroxy Analogue) by Cultured Porcine Kidney Fibroblasts. (Under the direction of Evan E. Jones.)

Vincent Hugh Smith, Economics
Croydon, England
Dissertation: An Econometric Model of Maintenance, Utilization, Scrapping and Capital Use in the U. S. Electric Power Industry: Implications for the Consequences of Air Quality Regulation. (Under the direction of Duncan M. Holthausen, Jr. and Raymond B. Palmquist.)

Larry David Stephenson, Materials Science and Engineering
Champaign, Illinois
Dissertation: An Investigation of Microstructures in Aluminum Implanted with Molybdenum Ions. (Under the direction of Ray B. Benson, Jr.)

Eddie Stuart Tessnear, Psychology
Wilson, North Carolina
Dissertation: A Self-instructional Training Strategy for Remediation of Cognitive Impulsivity in Hearing Impaired Children. (Under the direction of Rachel F. Rawls and N. William Walker.)

Mariann Weiler Tillery, Psychology
High Point, North Carolina
Dissertation: School Psychological Consultation: Effects on Parents during Intervention. (Under the direction of N. William Walker.)

Juan Luis Torres, Biochemistry and Toxicology
Rio Piedras, Puerto Rico
Dissertation: Physical and Chemical Characterization of Horse Serum Carboxylesterase. (Under the direction of H. Robert Horton and Frank E. Guthrie.)

Antonio Amilcar Ubiera, Soil Science
Santo Domingo, Dominican Republic
Dissertation: The Occurrence and Properties of Hydroxy-interlayered Silicate Clays in Some Soil of the Dominican Republic. (Under the direction of Sterling B. Weed.)

John Stephen Usher, Industrial Engineering
Louisville, Kentucky
Dissertation: Estimating Component Reliabilities from Incomplete Accelerated Life Test Data. (Under the direction of Thom J. Hodgson.)

David Eugene Van den Bout, Electrical and Computer Engineering
Pinehurst, North Carolina
Dissertation: A Digital Signal Processor and Programming System for Parallel Signal Processing. (Under the direction of J. Benjamin O'Neal, Jr. and Thomas K. Miller III.)

James Matthew Vose, Forestry
Aurora, Illinois
Dissertation: Effects of Increased Nutrient Supply on Loblolly Pine Stand Leaf Area, Stemwood Growth and Crown Architecture. (Under the direction of Arthur W. Cooper and H. Lee Allen.)

Susan Elaine Wells, Genetics and Microbiology
Raleigh, North Carolina
Dissertation: Characterization of Tetracycline Resistance Plasmids in Staphylococci. (Under the direction of Wesley E. Kloos.)

Marsha Hurst Winston, Wood and Paper Science
Raleigh, North Carolina
Dissertation: Characterization of the Lignin Residue from Hydrolysis of Sweetgum Wood with Superconcentrated Hydrochloric Acid. (Under the direction of Irving S. Goldstein.)

Lisa Ann Wisniewski, Forestry
Chicago, Illinois
Dissertation: The Effect of Cytokinins and Root System Parameter on the Maturation of Loblolly Pine (*Pinus taeda* L.). (Under the direction of Henry V. Amerson and Steven E. McKeand.)

Horng-Tsann Yang, Mechanical Engineering
Taipei, Taiwan, Republic of China
Dissertation: Three-dimensional Flow Fields Past Reentry Vehicles. (Under the direction of Hassan A. Hassan.)

Doctor of Philosophy Degrees

Degrees Conferred December 15, 1987

Dulasiri Dayananda Amarasiriwardena, Chemistry
Galle, Sri Lanka
Dissertation: Qualitative and Quantitative Analysis of Iron Oxides and Oxyhydroxides by Mossbauer Spectroscopy. (Under the direction of Lawrence H. Bowen.)

Susan Arrendell, Crop Science
Raleigh, North Carolina
Dissertation: Breeding for Increased Nitrogen Fixation in Peanut (*Arachis hypogaea* L.). (Under the direction of Johnny C. Wynne.)

Gary Lewis Benzon, Entomology
Raleigh, North Carolina
Dissertation: Oviposition Attraction and Stimulation in *Aedes aegypti* (L.) and in a Predator of Mosquito Larvae, *Toxorhynchites splendes* (Wiedemann). (Under the direction of Charles A. Apperson and George G. Kennedy.)

Bharat Laxmidas Bhuva, Electrical and Computer Engineering
Rajkot, India
Dissertation: The Simulation of Worst-case Operating Conditions for Integrated Circuits Operating in a Total Dose Environment. (Under the direction of Sherra E. Kerns.)

Mary Pat Bonner, Chemistry
Hazleton, Pennsylvania
Dissertation: Intermolecular Cyclization Reactions of Optically Active Epoxides. (Under the direction of Samuel G. Levine.)

Christopher Scott Brown, Botany
Columbia, Missouri
Dissertation: The Control of Reserve Mobilization and Photosynthesis in Cotyledons of Soybean (*Glycine max* L. [merr]). (Under the direction of Steven C. Huber.)

John Michael Brown, Horticultural Science
Clark's Summit, Pennsylvania
Dissertation: Computed Tomography and Magnetic Resonance Imaging of Water Distribution in Plants and Solids. (Under the direction of Eric Young.)

Hyo Ihl Chang, Food Science
Seoul, Korea
Dissertation: Protein Digestibility of Alkali- and Fructose-treated Protein by Rat Assay and by an Immobilized Digestive Enzyme Assay (IDEA) System. (Under the direction of George L. Catignani.)

Jyhyeong Chang, Electrical and Computer Engineering
Hsinchu, Taiwan, Republic of China
Dissertation: Stability Analysis and Stabilization of Multidimensional Digital Recursive Filters with Applications to Adaptive Image Coding. (Under the direction of Winser E. Alexander.)

Ping-Chu Chu, Biomathematics
Taichung, Taiwan, Republic of China
Dissertation: Modeling Water Balance in Larval Mexican Bean Beetles, *Epilachna varivestis* Mulsant. (Under the direction of Ronald E. Stinner.)

Thomas Charles Corbin, Crop Science
Nashville, Tennessee
Dissertation: Evaluation of a Doubled Haploid Breeding Procedure for Simultaneous Recurrent Selection and Inbred Line Development. (Under the direction of Earl A. Wernsman.)

Paulo Roberto Rio da Cunha, Industrial Engineering
Recife, Pernambuco, Brazil
Dissertation: An Interactive Compromising Method for Policy Selection in Multipurpose Reservoir Management Problems. (Under the direction of Thom J. Hodgson and William S. Galler.)

Deborah Lynn Cutter, Microbiology
Norfolk, Virginia
Dissertation: Antibiotic Resistance Plamids of *Bordetella avium*. (Under the direction of Geraldine H. Luginbuhl.)

Karen Ann Dassel, Statistics
Evansville, Indiana
Dissertation: Experimental Design for the Weibull Function as a Dose Response Model. (Under the direction of John O. Rawlings.)

Ralph Earl Dewey, Crop Science
Logan, Utah
Dissertation: Expression of Chimeric Mitochondrial Genes Associated with Cytoplasmic Male Sterility in Maize. (Under the direction of David H. Timothy.)

Joseph George Doolan, Fiber and Polymer Science
Trenton, New Jesery
Dissertation: A Study of the Molecular Motions in Poly(ethylene terephthalate) Films by the Electron Spin Resonance Spin Probe Technique. (Under the direction of Ralph McGregor and Richard D. Gilbert.)

John Adam Edmond, Materials Science and Engineering
Cohocton, New York
Dissertation: Ion Implantation, Annealing and Simple Device Fabrication in Monocrystalline Beta-Silicon Carbide Thin Films. (Under the direction of Robert F. Davis.)

Mohamed Kamal El Ghor, Materials Science and Engineering
Cairo, Egypt
Dissertation: Characterization and Optimization of Structural Defects in Buried Oxide Materials Formed by High Dose Oxygen Implantation in Silicon. (Under the direction of Jagdish Narayan.)

Yeh-Chin Fey, Mechanical Engineering
Taichung, Taiwan, Republic of China
Dissertation: Analytical Studies of the Vacuum-sublimation in the Frozen Porous Media. (Under the direction of Michael A. Boles and Mehmet N. Ozisik.)

Donita Lynn Frazier, Veterinary Medical Sciences
Raleigh, North Carolina
Dissertation: Gentamicin Nephrotoxicity in Subclinical Renal Disease. (Under the direction of Jim E. Riviere.)

Mohammed Awad Gabr, Civil Engineering
Raleigh, North Carolina
Dissertation: Load-deflection Analysis of Laterally Loaded Piers. (Under the direction of Roy H. Borden and Harvey E. Wahls.)

Marian Brinkley Gardner, Genetics
Atlanta, Georgia
Dissertation: The Effects of Selection for Grain Yield and Ear Number on Nitrogen Use Efficiency and Prolificacy in Maize. (Under the direction of Robert H. Moll.)

Earl Brent Godshalk, Crop Science
Blooming Glen, Pennsylvania
Dissertation: Evaluation of Heritability of Cell Wall Carbohydrates, Index Selection and Multivariate Analysis for Switchgrass Improvement. (Under the direction of David H. Timothy.)

Daniel Thomas Grimm, Microbiology
Memphis, Tennessee
Dissertation: Influence of *Bradyrhizobium* sp. on Nodule and Seed Composition in Peanut (*Arachis hypogaea* L.). (Under the direction of Gerald H. Elkan.)

Salih Abdul Hakeen, Economics
Goldsboro, North Carolina
Dissertation: A Dynamic Supply Model of the United States Broiler Industry. (Under the direction of Walter N. Thurman and Gerald A. Carlson.)

Karl Andrew Harris, Physics
Cary, North Carolina
Dissertation: Growth of Mercury-based Films and Quantum Well Structures by Molecular Beam Epitaxy. (Under the direction of Jan F. Schetzina and James W. Cook, Jr.)

Kitty Brown Herrin, Sociology
Birmingham, Alabama
Dissertation: Effects of Economic and Technological Development on Structural Inequalities for Females: An Examination of Education, Occupation and Income in North Carolina, 1970 and 1980. (Under the direction of Robert L. Moxley.)

Ann Barbara Herriott, Horticultural Science
Morristown, New Jersey
Dissertation: The Heritability of Resistance to Early Blight Disease in Tetraploid X Diploid Crosses of Potatoes. (Under the direction of Frank L. Haynes.)

Sherief Abdelmoneim Hussein, Nuclear Engineering
Alexandria, Egypt
Dissertation: Crystallographic Texture and Mechanical Anisotropy of Zircaloys. (Under the direction of K. Linga Murty.)

Muhammad Nadeem Iqbal, Nuclear Engineering
Karachi, Pakistan
Dissertation: Radiosotope Tracer Methods for the Dynamic Measurement of the In-process Inventory of Dissolved Materials. (Under the direction of Robin P. Gardner.)

William Steed Irby, Entomology
Lexington, Virginia
Dissertation: Hosts and Resting Distribution of Female Mosquitoes in the Coastal Plain of North Carolina and Immunoblot Analysis of Blood Digestion by *Aedes aegypti* (Diptera: Culicidae). (Under the direction of Charles S. Apperson and Wayne M. Brooks.)

Rahmad Binit Ismail, Economics
Trengganu, Malaysia
Dissertation: The Effect of Human Capital on Earnings Differentials in Malaysia. (Under the direction of Steven G. Allen and Daniel S. Sumner.)

Idris Bin Jajri, Economics
Kuala Lumpur, Malaysia
Dissertation: The Impact of Petroleum Prices on the Natural Rubber Industry. (Under the direction of Michael K. Wohlgenant.)

Changjian Jiang, Statistics
Yangzhou, People's Republic of China
Dissertation: Estimation of F-statistics in Subdivided Genetic Populations. (Under the direction of C. Clark Cockerham.)

Rolf Dieter Joerger, Microbiology
Raleigh, North Carolina
Dissertation: Characterization of Tn*5*-induced Nif$^-$ Mutants of *Azotobacter vinelandii* and Determination of the Sequence of the *nifB-nifQ* Genomic Region. (Under the direction of Paul E. Bishop.)

Melissa Gail Jones, Science Education
Cary, North Carolina
Dissertation: Gender Differences in Student-Teacher Interactions in Physical Science and Chemistry Classes. (Under the direction of Jack H. Wheatley and John F. Roberts.)

Bradford Maurice Kard, Entomology
San Rafael, California
Dissertation: Seasonal History, Effects and Control of White Grubs (Coleoptera: Scarabaeidae) in a Fraser Fir Christmas Tree Plantation in the Southern Appalachians. (Under the direction of Fred P. Hain.)

Tsukuru Katsuyama, Electrical Engineering
Kawasaki, Japan
Dissertation: Growth, Characterization and Device Applications of Strained Layer Superlattices. (Under the direction of Salah M. Bedair.)

Mohammad Ali Khatibzadeh, Electrical and Computer Engineering
Raleigh, North Carolina
Dissertation: Large-signal Modeling of Gallium Arsenide Field-effect Transistors. (Under the direction of Robert J. Trew and Nino A. Masnari.)

William Albert Kiele, Mathematics
Stuart, Florida
Dissertation: The Classification Problem of Finite Rings by Computable Means. (Under the direction of Kwangil Koh.)

Byung Yong Kim, Food Science
Seoul, Korea
Dissertation: Rheological Investigation of Gel Structure Formation by Fish Proteins during Setting and Heat Processing. (Under the direction of Donald D. Hamann.)

Sunil Shrinkrishna Kulkarni, Mechanical Engineering
Pune, Maharashtra, India
Dissertation: Automatic Feedback Control of Rigid Body for Finite Displacements. (Under the direction of Clarence J. Maday.)

Jay Edgar Lane, Materials Science and Engineering
Pittsburgh, Pennsylvania
Dissertation: Kinetics and Mechanisms of Primary and Steady-state Creep in Sintered Alpha Silicon Carbide. (Under the direction of Robert F. Davis.)

Ambrish Lavania, Mechanical Engineering
Varanasi, U.P., India
Dissertation: Condensation of a Vapor Bubble in an Immiscible Liquid. (Under the direction of Richard R. Johnson.)

Gil Sik Lee, Electrical and Computer Engineering
Taegu, Korea
Dissertation: Electrical Properties and Materials Growth of Strained Layer Heterostructures. (Under the direction of Robert M. Kolbas.)

Ja-Song Leu, Electrical and Computer Engineering
Yun-Lin, Taiwan, Republic of China
Dissertation: Strategies for Retargeting of Existing Sequential Programs for Parallel Processing. (Under the direction of Dharma P. Agrawal.)

Jen-Hsiang Lin, Economics
Taipei, Taiwan, Republic of China
Dissertation: Retirement Decisions and Food Expenditure Patterns for Older Households in United States. (Under the direction of Ronald A. Schrimper.)

Kuanlian Liou, Industrial Engineering
Puli, Nantou, Taiwan, Republic of China
Dissertation: Path Generation for Welding Robot: An Application of Geometric Modeling System. (Under the direction of Thom J. Hodgson and Han Bao.)

Jiann Liu, Electrical and Computer Engineering
Taipei, Taiwan, Republic of China
Dissertation: A Study of Techniques Which Can Be Used in the Fabrication of Submicron MOSFET Devices. (Under the direction of Jimmie J. Wortman.)

Kate King-Yu Luk, Chemistry
Raleigh, North Carolina
Dissertation: Vaporized Analyte Introduction into a Low-power Plasma for Atomic Emission Spectrometry. (Under the direction of Charles B. Boss.)

Lloyd Wilson Massengill, Electrical and Computer Engineering
Raleigh, North Carolina
Dissertation: The Simulation of Pulsed-ionizing Radiation-induced Errors in CMOS Memory Circuits. (Under the direction of Sarah E. Kerns.)

Alexander David McDonald, Economics
Adelaide, S.A., Australia
Dissertation: An Empirical Model of the Economics of Resource Extraction with Output Price and Reserve Level Stochastic. (Under the direction of Edward W. Erickson and Thomas Johnson.)

Joseph McGuire, Chemical Engineering
Wilmington, Delaware
Dissertation: The Influence of Solid Surface Energetics on Macromolecular Adsorption from Milk. (Under the direction of David E. Guinnup and Kenneth R. Swartzel.)

Tony L. Mitchell, Electrical and Computer Engineering
Lumberton, North Carolina
Dissertation: A Fault Tolerant Self-routing Computer Network Topology. (Under the direction of Arne A. Nilsson and Wushow Chou.)

Manjoo Mittal, Psychology
Raleigh, North Carolina
Dissertation: An Experimental Evaluation of Community/Industry Growth Strategies. (Under the direction of Frank J. Smith.)

Harold George Monbouquette, Chemical Engineering
Norwood, Massachusetts
Dissertation: Kinetics of Immobilized Cells. (Under the direction of David F. Ollis.)

Mary Lynn Moser, Zoology
Decatur, Illinois
Dissertation: Effects of Salinity Fluctuations on Juvenile Estuarine Fish. (Under the direction of John M. Miller.)

Larry Eugene Mosley, Physics
Raleigh, North Carolina
Dissertation: Phenomena Involving Reversible Metastable Configurations and Defects in Amorphous Silicon. (Under the direction of Michael A. Paesler.)

Jane Mt. Pleasant, Soil Science
Syracuse, New York
Dissertation: Weed Control Measures for Short-cycle Food Crops under Humid-Tropical Environments in Developing Countries. (Under the direction of Robert E. McCollum.)

Abdelfatah Abdelmutti Mohammed, Operations Research
Madani, Sudan
Dissertation: Information Theory and Queueing Theory via Generalized Geometric Programming. (Under the direction of Elmor L. Peterson.)

Eduardo Manuel Munoz-Morales, Mathematics
Antofagasta, Chile
Dissertation: Bifurcation Analysis of a Coevolutionary Model with Interspecific Competition. (Under the direction of James F. Selgrade.)

Christine Ann Nalepa, Entomology
Detroit, Michigan
Dissertation: Life History Studies of the Woodroach *Cryptocercus punctualatus* Scudder (Dictyoptera:Cryptocercidae) and Their Implications for the Evolution of Termite Eusociality. (Under the direction of John T. Ambrose and Fred Gould.)

Ahmed-Naguib Hassan Nassar, Biological and Agricultural Engineering
Cairo, Egypt
Dissertation: Solar Energy Utilization and Microcomputer Control in the Greenhouse Bulk Curing and Drying Solar System. (Under the direction of Barney K. Huang.)

Thomas Patrick Oscar, Animal Science
Wilmington, Delaware
Dissertation: Role of Nickel in Ruminal Fermentation. (Under the direction of Jerry W. Spears.)

Bonnie Hope Ownley, Plant Pathology
Elizabeth City, North Carolina
Dissertation: Physical and Biological Approaches to Control of Phytophthora Root Rot of Container Grown Ornamentals. (Under the direction of David M. Benson.)

Ching-Tsuan Pan, Applied Mathematics
Shanghai, People's Republic of China
Dissertation: Hyperbolic Rotations for Downdating the Cholesky Factorization with Application to Signal Processing. (Under the direction of Robert J. Plemmons.)

Jan Elizabeth Pegram, Fiber and Polymer Science
Spindale, North Carolina
Dissertation: Dye Diffusion in Solvent-treated Polyester. (Under the direction of David M. Cates.)

Hong Peng, Mechanical Engineering
Shanghai, People's Republic of China
Dissertation: Acoustic Radiation from Plates Driven by Multi-point Random Forces. (Under the direction of Richard F. Keltie.)

Zongmyung Rhee, Electrical and Computing Engineering
Seoul, Korea
Dissertation: Finite Precision Arithmetic Effects for Fixed and Adaptive Lattice Filters. (Under the direction of S. Thomas Alexander and H. Joel Trussell.)

Billy Warren Roberts, Soil Science
Marshall, North Carolina
Dissertation: Plant Growth and Soil Microorganism Responses to SO_2, NO_2 and Ozone as Affected by Soils. (Under the direction of Arthur G. Wollum II.)

George Brett Runion, Plant Pathology
Washington, North Carolina
Dissertation: The Epidemiology and Control of Pitch Canker of Southern Pines. (Under the direction of Robert I. Bruck.)

Farid Sadeghi, Food Science
Tehran, Iran
Dissertation: Kinetic Studies of Calibration Materials for Thermal Evaluation of Food Systems. (Under the direction of Kenneth R. Swartzel.)

Michele Meyer Schoeneberger, Forestry
Saint Louis, Missouri
Dissertation: The Mycorrhizal Fungus-Rhizobium-Leguminous Plant Symbiosis in *Lotus pendunculatus* Cav. and *Trifolium subterraneum* L. (Under the direction of Charles B. Davey.)

Sally Hamilton Spetz, Psychology
Meadville, Pennsylvania
Dissertation: Work-related Interests and Their Relationships to Career Choice, Satisfaction and Decisiveness. (Under the direction of Joseph W. Cunningham.)

Lawrence Thomas Szott, Soil Science
Chicago, Illinois
Dissertation: Improving the Productivity of Shifting Agriculture in the Amazon Basin of Peru through the Use of Leguminous Vegetation. (Under the direction of Charles B. Davey.)

Douglas Waters VanOsdell, Chemical Engineering
Apex, North Carolina
Dissertation: Flow Resistance of Filter Dust Deposits Formed under the Influence of a Surface Electric Field. (Under the direction of Richard M. Felder.)

Kilmer Von Chong, Plant Pathology
Anton, Panama
Dissertation: Epidemiology of Alfalfa Leafspot Diseases: Pathogen Occurrence and the Relationship among Environmental Factors, Inoculum Density and Disease Progress. (Under the direction of C. Lee Campbell and Eddie Echandi.)

Sharon May Wallsten, Psychology
Chapel Hill, North Carolina
Dissertation: Interactive Factors in Stress: Differences between Caregivers' and Noncaregivers' Perception of Stress in Daily Experiences. (Under the direction of Samuel S. Snyder.)

Philip Terrell Weinbrecht, Biochemistry and Physiology
Elberton, Georgia
Dissertation: The Application of Light Reflectance Studies of Red Blood Cell Number to Cerebral Microvascular Responses to Hypoxia. (Under the direction of Ian S. Longmuir and J. Paul Thaxton.)

John Charles Welker, Economics and Forestry
Jacksonville, Florida
Dissertation: Application of a Dynamic Investment Scheduling Model to Import Substitution of Softwood Lumber in Jamaica. (Under the direction of Jan G. Laarman and Duncan M. Holthausen, Jr.)

Robert Reid Whiteside, Jr., Psychology
Spartanburg, South Carolina
Dissertation: Development and Validation of an Illustrated Multiple-choice Test of Social Skills Knowledge of Adolescents. (Under the direction of Rachel F. Rawls and William P. Erchul.)

Yong-Sun Wie, Aerospace Engineering
Seoul, Korea
Dissertation: Numerical Investigation of Three-dimensional Flow Separation. (Under the direction of Fred R. DeJarnette.)

Carol Ann Wilkinson, Crop Science
Fitchburg, Massachusetts
Dissertation: Studies on *Septoria nodorum* Causal Agent of Glume Blotch of Wheat. (Under the direction of Donald A. Emery and J. Paul Murphy.)

Chen-Yui Yang, Physics
Panchaio, Taiwan, Republic of China
Dissertation: An X-ray Study of Amorphous Arsenic and Arsenic Chalcogenide Semiconductors. (Under the direction of Dale E. Sayers.)

Sung-Kyun Zee, Nuclear Engineering
Seoul, Korea
Dissertation: Numerical Algorithms for Parallel Processors Computer Architectures with Applications to the Few-group Neutron Diffusion Equations. (Under the direction of Paul J. Turinsky.)

Ronald Craig Zumstein, Chemical Engineering
Knoxville, Tennessee
Dissertation: 1. Modeling, Determination and Measurement of Growth Rate Dispersion in Crystallization. 2. The Crystallization of L-Isoleucine in Aqueous Solutions. (Under the direction of Ronald W. Rousseau.)

Degrees Conferred May 7, 1988

Wan Omar Abdullah, Veterinary Medical Sciences
Kuala Lumpur, Malaysia
Dissertation: Immune Complexed and Free Forms of Antigens in the Sera of *B. pahangi* Infected Dogs and Characterization of Excretory-Secretory Antigens in Filarial Infection. (Under the direction of Eduard V. DeBuysscher and Bruce Hammerberg.)

Jon Alan Arnold, Civil Engineering
Beaver Falls, Pennsylvania
Dissertation: Rotary Distributors: A Field Study and Ground Water Flow Model. (Under the direction of William S. Galler.)

Owusu Atiba Bandele, Horticultural Science
Baltimore, Maryland
Dissertation: Plant Density, N Fertilizer and Previous Crop Effects within Several Sequential Vegetable Cropping Systems. (Under the direction of Conrad H. Miller and Douglas C. Sanders.)

William Mark Barbour, Microbiology
Collinsville, Virginia
Dissertation: Effects of Plasmid Curing and a Plasmid Copy-number Mutant on Symbiotic and Physiological Properties of *Rhizobium fredii* USDA 206. (Under the direction of Gerald H. Elkan.)

Michael John Beggs, Biochemistry
Pittsburgh, Pennsylvania
Dissertation: Action of Gonadotrophin-releasing Hormone in Cultured Ovine Pituitary Cells Is Separate from Protein Kinase C Activation and Is Potentiated by Purified Inhibin. (Under the direction of William L. Miller.)

Barry Hamilton Beith, Psychology
Fullerton, California
Dissertation: A Study Investigating the Subjective Workload of Individuals and Teams of a Cognitive Task. (Under the direction of Richard G. Pearson.)

Thomas Gary Bifano, Mechanical Engineering
Brookline, Massachusetts
Dissertation: Ductile-Regime Grinding of Brittle Materials. (Under the direction of Thomas D. Dow.)

Fitzgerald Lewis Booker, Botany
Dayton, Ohio
Dissertation: Physiological Responses of *Spartina alterniflora* Loisel. and *Limonium carolinianum* (Walt.) Britt. to Weathered Fuel Oil. (Under the direction of Ernest D. Seneca.)

Philip Allen Brown, Chemistry
East Islip, New York
Dissertation: The Regioselective Synthesis of Terminal Ring Disubstituted Benz[f]indenes and s-Hydrindacenes. (Under the direction of Samuel G. Levine.)

Michael Paul Carver, Toxicology
Richmond, Indiana
Dissertation: Development of the Isolated Perfused Porcine Skin Flap for *In vitro* Studies of Percutaneous Absorption Pharmacokinetics and Cutaneous Biotransformation. (Under the direction of Frank E. Guthrie and Jim E. Riviere.)

Servio Alves Cassini, Microbiology
Belo Horizonte, M.G., Brazil
Dissertation: Variation in Symbiotic Effectiveness of *Bradyrhizobium sp.* through Plant Passage in Peanut (*Arachis hypogaea* L.). (Under the direction of Gerald H. Elkan.)

Dureseti Chidambarrao, Civil Engineering
Visakhapatnam, India
Dissertation: Comparative Analyses and Assessment of Different Hardening Rules in Channel Die Compression of F.C.C. Crystals. (Under the direction of Kerry S. Havner.)

Robert Dennis Ciskowski, Mechanical Engineering
Chicago, Illinois
Dissertation: Boundary Element Solution for a Coupled Elastodynamic and Wave Equation System to Predict Forced Response of a Plugged Acoustic Cavity. (Under the direction of Larry H. Royster.)

Patricia Walton Collins, Psychology
Raleigh, North Carolina
Dissertation: An Information Processing Investigation of Individual Strategy Differences on a Spatial Visualization Task. (Under the direction of Patricia F. Horan.)

James Andrew Cooke, Mechanical Engineering
Raleigh, North Carolina
Dissertation: Determination of the Impulse Response of a Viscoelastic Bean Using a Fractional Derivative Constitutive Model. (Under the direction of Richard F. Keltie.)

James Burr Cunningham, Psychology
Sacramento, California
Dissertation: Performance of a Visual Search Task as a Function of Directional Noise Stress and Target Location. (Under the direction of Richard G. Pearson.)

William Layne Daugherty, Nuclear Engineering
Raleigh, North Carolina
Dissertation: Biaxial Creep of Zircaloy: Texture and Temperature Effects. (Under the direction of K. Linga Murty.)

Gary Sherman Davis, Physiology
Raleigh, North Carolina
Dissertation: Factors Influencing Plasma Corticosterone in Posthatch and Adolescent Turkeys. (Under the direction of Thomas D. Siopes.)

Claudia Thompson Dickerson, Psychology
Atlanta, Georgia
Dissertation: The Effects of Adjunct Questions on Learning from Text Inconsistent with Prior Knowledge. (Under the direction of Patricia F. Horan and Slater E. Newman.)

Yehia El-Badrawy El-Mogahzy, Fiber and Polymer Science
Auburn, Alabama
Dissertation: A Study of the Nature of Friction in Fibrous Materials. (Under the direction of Bhupender S. Gupta.)

Taher Ali Fenaish, Civil Engineering
Raleigh, North Carolina
Dissertation: Numerical Modeling of Wave Uprush and Induced Dune Erosion. (Under the direction of John S. Fisher and Margery F. Overton.)

Catherine Ingram Fogel, Sociology
Durham, North Carolina
Dissertation: Health Status of Incarcerated Women. (Under the direction of Maxine P. Atkinson and William B. Clifford.)

Ali Gooya, Mechanical Engineering
Raleigh, North Carolina
Dissertation: Velocity Distribution and Particle Deposition in a Baboon Nose Cast. (Under the direction of Elsayed M. Afify.)

Karen Ann Grosser, Chemical Engineering
Media, Pennsylvania
Dissertation: Hydrodynamics and Lateral Thermal Dispersion in Trickle Bed Reactors. (Under the direction of Ruben G. Carbonell.)

David Joseph Halchin, Electrical and Computer Engineering
Punxsutawney, Pennsylvania
Dissertation: Characterization of Thin Ferrite Films Using Microwave Propagation. (Under the direction of Daniel D. Stancil and Robert J. Trew.)

Michael Lynn Hall, Nuclear Engineering
Greensboro, North Carolina
Dissertation: Numerical Modeling of the Transient Thermohydraulic Behavior of High Temperature Heat Pipes for Space Reactor Applications. (Under the direction of J. Michael Doster.)

Budi Haryanto, Animal Science
Semarang, Indonesia
Dissertation: Fiber Utilization by Indonesian Kacang Goats Fed Mixed Native Grass Forage Supplemented with Zinc and Nitrogen. (Under the direction of William L. Johnson and Jerry W. Spears.)

Paul Francis Hemler, Electrical and Computer Engineering
Raleigh, North Carolina
Dissertation: A Procedural Approach to View Independent Three Dimensional Object Recognition and Pose Determination. (Under the direction of Wesley E. Snyder.)

Chih-Hong Ho, Mechanical Engineering
Taipei, Taiwan, Republic of China
Dissertation: Direct and Inverse Radiation in Participating Media with Constant and Variable Albedo. (Under the direction of Mehmet N. Ozisik and F. Yates Sorrell.)

Alexander Owens Hobbs, Civil Engineering
Aiken, South Carolina
Dissertation: An Investigation of the Use of Coal-fired Power Plant Ash Ponds for Treatment of Boiler Acid Cleaning Waste. (Under the direction of William S. Galler.)

David Marshall Holland, Statistics and Forestry
Timonium, Maryland
Dissertation: Evaluation of a Bounded Frequency Distribution Generated by a Transformed Logistic Variable. (Under the direction of Thomas M. Gerig and William L. Hafley.)

Dorothy Gallon Holmes, Sociology
Fayetteville, North Carolina
Dissertation: A Path Analytic Model of Attitudes toward Discretionary and Medical/Rape Abortions. (Under the direction of Maxine P. Atkinson and Odell Uzzell.)

Alan Henry Huber, Marine, Earth and Atmospheric Sciences
Millersville, Pennsylvania
Dissertation: Distribution of Pollutant Concentrations Downwind of a Point-source in the Near Wake of a Building. (Under the direction of S. Pal Arya.)

Todd Harvey Hubing, Electrical and Computer Engineering
Raleigh, North Carolina
Dissertation: Modeling the Electromagnetic Radiation from Electrically Small Sources with Attached Wires. (Under the direction of J. Frank Kauffman.)

Walid Yousef Jaber, Civil Engineering
Jenin, Jordan
Dissertation: Probabilistic Analyses for Wave-induced Instability of Sea Bed. (Under the direction of Mohammed S. Rahman and Chi C. Tung.)

Sally Elizabeth Treharne John, Genetics and Forestry
Victoria, British Columbia, Canada
Dissertation: Early Genotype by Environmental Interactions and Genetic Variances of Douglas-fir. (Under the direction of Gene Namkoong.)

Michael Evan Kazmierszak, Fiber and Polymer Science
Atlantic Beach, Florida
Dissertation: Morphological Studies of the PPDI-based Polyurethane Block Copolymer System. (Under the direction of David R. Buchanan and Raymond E. Fornes.)

James Thomas Kroll, Marine, Earth and Atmospheric Sciences
Warren, New Jersey
Dissertation: An Analysis of the Error Characteristics of Atlantic Tropical Cyclone Track Prediction Models. (Under the direction of Jerry M. Davis and Mark DeMaria.)

Georgia Stallings Lawrence, Mathematics Education
Hertford, North Carolina
Dissertation: An Analysis of the Algebraic Competencies and Other Characteristics Which Affect Success in Developmental Mathematics Courses on the College Level. (Under the direction of Lawrence M. Clark and William M. Waters, Jr.)

Susan Carter Laws, Biochemistry
Rose Hill, North Carolina
Dissertation: Regulation of GnRH Receptors by Progesterone and Inhibin in Ovine Pituitary Cell Culture. (Under the direction of William L. Miller.)

Pee-Yew Lee, Materials Science and Engineering
Taichung, Taiwan, Republic of China
Dissertation: The Amorphization of Nickel-Niobium and Nickel-Zirconium Alloys by Mechanical Alloying. (Under the direction of Charles C. Koch.)

Yun-Cheng Liu, Electrical and Computer Engineering
Raleigh, North Carolina
Dissertation: Performance Modeling of Distributed and Parallel Processing Systems. (Under the direction of Arne A. Nilsson and Harry G. Perros.)

David Langdon Loftis, Forestry
Brevard, North Carolina
Dissertation: Regenerating Red Oak in the Southern Appalachians: Predictive Models and Practical Applications. (Under the direction of Arthur W. Cooper.)

Jean-Marie Luginbuhl, Nutrition
Neuchatel, Switzerland
Dissertation: The Effect of Hay Intake on Chewing Behavior, Transit of Digesta and Particle Size Breakdown in Cattle. (Under the direction of Joseph C. Burns and Kevin R. Pond.)

Robert Ping-Chung Ma, Chemical Engineering
Taipei, Taiwan, Republic of China
Dissertation: Modeling a Fluidized Bed Coal Gasification Reactor. (Under the direction of Richard M. Felder.)

Taryn Smith Moody, Industrial Engineering
Severna Park, Maryland
Dissertation: The Effects of Restricted Vocabulary Size on Voice Interactive Discourse Structure. (Under the direction of Thomas J. Hodgson, Michael G. Joost and Robert D. Rodman.)

David Mark Naylor, Chemical Engineering
Raleigh, North Carolina
Dissertation: A Study of the Radiation-induced Polymerization of Vinyl Ethers and Ring-opening Polymerization of Cyclic Siloxanes. (Under the direction of Vivian T. Stannett.)

Russell Steven Nelson, Zoology
Tallahassee, Florida
Dissertation: A Study of the Life History, Ecology and Population Dynamics of Four Sympatric Reef Predators (*Rhomboplites aurorubens*, *Lutjanus campechanus*, Lutjanidae; *Haemulon melanurum*, Haemulidae; and *Pagrus pagrus*, Sparidae on the East and West Flower Garden Banks, Northwestern Gulf of Mexico. (Under the direction of William W. Hassler and Charles S. Manooch III.)

James Irvin Northrup, Applied Mathematics
Chapel Hill, North Carolina
Dissertation: Pointwise Quasi-Newton Methods and Integral Equations. (Under the direction of Carl T. Kelley.)

Mehmet Cevdet Ozturk, Electrical and Computer Engineering
Ankara, Turkey
Dissertation: Formulation of Shallow Junctions for VLSI by Ion Implantation and Rapid Thermal Annealing. (Under the direction of Jimmie J. Wortman.)

John William Palmour, Materials Science and Engineering
Raleigh, North Carolina
Dissertation: Characterization of Oxidation, Dry Etching and Device Performance of Monocrystalline Beta-Silicon Carbide Thin Films. (Under the direction of Robert F. Davis.)

Jong Shin Park, Fiber and Polymer Science
Raleigh, North Carolina
Dissertation: Experimental and Theoretical Studies on the Interlaminar Shear Strength of Graphite Fiber/Epoxy Composites Exposed to Ionizing Radiation. (Under the direction of Raymond E. Fornes and Richard D. Gilbert.)

No Gill Park, Mechanical Engineering
Pusan, Korea
Dissertation: An Analytical Investigation of Geared System Dynamics Containing Spur and Helical Gears. (Under the direction of Joseph W. David and Richard F. Keltie.)

George Joseph Pesacreta, Zoology
Beacon, New York
Dissertation: Water Chemistry from North Carolina Piedmont Impoundments with Hydrilla, (*Hydrilla verticillata* L.f. Royle). (Under the direction of Ronald G. Hodson and Melvin T. Huish.)

Dale Nelson Rachmeler, Crop Science
Huntsville, Alabama
Dissertation: Inheritance of Early Maturity and Fatty Acid Composition in Peanut (*Arachis hypogaea* L.). (Under the direction of Johnny C. Wynne.)

Alice Anna Wood Reese, Animal Science
Los Angeles, California
Dissertation: Effect of Energy Supplementation on Indonesian Sheep. (Under the direction of Raymond W. Harvey and William L. Johnson.)

Jonathan Lloyd Schaeffer, Toxicology
Smithfield, North Carolina
Dissertation: Mycotoxins and Carotenoid Metabolism in Poultry. (Under the direction of Pat B. Hamilton.)

Herbert Ernst Schellhorn, Microbiology
Guelph, Ontario, Canada
Dissertation: Response of Catalase- and Superoxide Dismutase-deficient Mutants of *Escherichia coli* to Oxidative Stress. (Under the direction of Hosni M. Hassan.)

Joan Rivers Schiavone, Microbiology
Columbus, Georgia
Dissertation: The Regulation of Superoxide Dismutase Biosynthesis in *Escherichia coli* and Other Prokaryotic Systems. (Under the direction of Hosni M. Hassan.)

Seyedjavad Seyedghasemipour, Operations Research
Greenville, North Carolina
Dissertation: Petroleum Resource Estimation in a Partially Explored Region with a Sequential Land Release Scheme. (Under the direction of Bibhuti B. Bhattacharyya and Peter Bloomfield.)

Jill Renee Sidebottom, Plant Pathology
Urbana, Illinois
Dissertation: Use of Cultural Practices to Enhance Partial-resistance in Peanut Cultivars to *Cylindrocladium crotalariae*. (Under the direction of Marvin K. Beute.)

Prem Singh, Biological and Agricultural Engineering
Raleigh, North Carolina
Dissertation: Simulation of Root Growth and Soil Moisture in a Peanut Growth Model. (Under the direction of James H. Young.)

Thomas John Stabel, Biochemistry
Virginia Beach, Virginia
Dissertation: Investigation of the Distribution of Sulfhydryl Oxidase in Mammalian Tissues and Its Relationship to Milk Proteins. (Under the direction of H. Robert Horton.)

Shari Jill Stowers, Toxicology
Rougemont, North Carolina
Dissertation: Role of Activated Proto-oncogenes in Chemically Induced Rodent Tumors. (Under the direction of Ernest Hodgson.)

Ming-Shiuan Su, Chemistry
Tainan, Taiwan, Republic of China
Dissertation: The Electrorefinement of Group IIIA Elements through Metal Alkyl Complex Electrolytes. (Under the direction of Klaus J. Bachmann.)

Harold Mathijs van Es, Soil Science
Amsterdam, Netherlands
Dissertation: Field-scale Water Relations for an Eroded Hapludult. (Under the direction of D. Keith Cassel.)

Andrew Clayton Vinal, Veterinary Medical Sciences
Cary, North Carolina
Dissertation: The Association of Congo Red Binding and Virulence in *Escherichia coli* Pathogenic for Poultry. (Under the direction of Herman A. Berkhoff and Thoyd Melton.)

Joseph Andrew White, Genetics
Kendall Park, New Jersey
Dissertation: Compartmentalization of the Maize Mitochondrial Superoxide Dismutase. (Under the direction of John G. Scandalios.)

Richard Scott Winder, Botany
New Castle, Pennsylvania
Dissertation: Evaluation, Optimization and Screening of Potential Mycoherbicides. (Under the direction of W. Scott Chilton and C. Gerald Van Dyke.)

John Francis Witzig, Zoology
Vienna, Virginia
Dissertation: The Visual Assessment of Reef Fish Communities. (Under the direction of Gene R. Huntsman and Kenneth H. Pollock.)

Shawn Harold Woodson, Aerospace Engineering
China Grove, North Carolina
Dissertation: An Interactive Three-dimensional Laminar and Turbulent Boundary-layer Method for Compressible Flow over Swept Wings. (Under the direction of Fred R. DeJarnette.)

Kap Seung Yang, Fiber and Polymer Science
Junlabook-Do, Korea
Dissertation: Lyotropic Mesophases of Cellulose in the Ammonia/Ammonium Thiocyanate Solvent System. (Under the direction of John A. Cuculo and Michael H. Theil.)

Ying Jay Yang, Electrical and Computer Engineering
I-Lan, Taiwan, Republic of China
Dissertation: Quantum Well Transverse Junction Stripe Laser. (Under the direction of Robert M. Kolbas.)

ALUMNI DISTINGUISHED PROFESSORS

Name	*College and Department*	*Date*
Richard R. Braham	College of Forest Resources Department of Forestry	1988-91
Chandra D. Cox	School of Design Department of Design	1988-91
William T. Fike	College of Agriculture and Life Sciences Department of Crop Science	1988-91
Donald H. Mershon	College of Education and Psychology Department of Psychology	1988-91

GRADUATE ALUMNI DISTINGUISHED PROFESSOR

Name	*College and Department*	*Date*
Josef S. Gratzl	College of Forest Resources Department of Wood and Paper Science	1988-91

OUTSTANDING TEACHER AWARDS FOR 1987-88

Name	*School and Department*
Roger L. Barker	Textiles Textile Engineering and Science
Mary Frances Castro	Humanities and Social Sciences Foreign Languages and Literatures
Kenneth L. Esbenshade	Agriculture and Life Sciences Animal Science
Abdel-Aziz Fahmy	Engineering Materials Science and Engineering
Lola C. Hudson	Veterinary Medicine Anatomy, Physiology, and Radiology
John P. Huggard	Humanities and Social Sciences Economics and Business
Karen L. Johnston	Physical and Mathematical Sciences Physics
H. Joseph Kleiss	Agriculture and Life Sciences Soil Science
Bryce H. Lane	Agriculture and Life Sciences Horticultural Science
N. F. J. Matthews	Engineering Electrical and Computer Engineering
Vernon C. Matzen	Engineering Civil Engineering
Robert P. Patterson	Agriculture and Life Sciences Crop Science
Michael Pause	Design Design
Phillip S. Rea	Forest Resources Recreation Resources Administration
Norman A. Sprinthall	Education and Psychology Counselor Education
William H. Swallow	Physical and Mathematical Sciences Statistics
Deborah B. Wyrick	Humanities and Social Sciences English

Awards for Achievement 1987-1988

COLLEGE OF AGRICULTURE AND LIFE SCIENCES

Agri-Life Council Outstanding Club Member Awards:
Agronomy: Benjamin R. Smith, Matthews
Animal Science: Teena Wooten, Hookerton
Biochemistry: Michael Willits, Raleigh
Biological and Agricultural Engineering: Science Curriculum—Daphne M. Cartner, Mocksville; Technology Curriculum—John M. Gann, Asheboro
Biology: Alice L. Lewis, Raleigh
Agricultural Economics: Vernon N. Cox, Tabor City
Food Science: Michael N. Chesson, Raleigh
Horticultural Science: Christopher G. Berrier, Thomasville
Medical Technology: Samantha William, Hookerton
National Agri-Marketing Association: Mia Bateman, Raleigh
Pest Management: Ellen S. Blenk, Goldsboro
Poultry Science: John D. McDanel, Hiddenite
Pre-Medical and Pre-Dental: Jerry W. Mullis, Jr., Charlotte
Pre-Professional Health Society: Charles D. Dickens, Greenville
Pre-Veterinary: David W. Linzey, Raleigh
Wildlife Biology: Jonathan E. Thompson, Lilburn, GA

Agronomy
Senior Highest Scholastic Average in Agronomy: Joseph C. Black, Seaview, VA
American Society of Agronomy Award, Most Outstanding Senior: Joseph C. Black, Seaview, VA
Agronomy Club Leadership Award: Joseph C. Black, Seaview, VA

Animal Science
Most Outstanding Club Member: William K. Lytle, Old Fort
Most Outstanding Senior: Kevin N. McKisson, Henderson
American Society of Animal Science Undergraduate Awards: Cynthia D. Burnett, Charlotte; Johnny D. Dellinger, Lincolnton; Mark G. Ladd, Rougemont; Tracy A. Meadows, Raleigh; Kevin N. McKisson, Henderson; Mary R. Smith, Rocky Mount; James E. Tuck, Jr., Graham; Jenna L. Blackwell, Matthews; Stephen H. Brenn, New Providence, NJ; Lisa G. Britt, Goldsboro; Fred G. Brown, Traphill; Geri S. Davidson, Hinsdale, HN; Kelly J. Driggins, Conway; Jaime Mullerat, Raleigh; Chesley D. Overby, Reidsville; Sharon K. Williams, Morrisville; David A. Dominquez, Cary; Brenda G. Jordan, Belhaven; Laura H. Phillips, Mocksville; Denna M. Rhein, Raleigh; Kristal P. Velazquez, Knightdale; Cynthia L. Warner, Raleigh; Alexandra M. Willie, Stedman

Biochemistry
Outstanding Biochemistry Student Award: Lillian H. Rinker, Burlington

Biological and Agricultural Engineering
American Society of Agricultural Engineers, Student Honor Awards—North Carolina Student Engineering Branch of the American Society of Agricultural Engineers: Randall K. Page, Elon College
North Carolina Student Mechanization Branch of the American Society of Agricultural Engineers: Mark E. Langdon, Coats

Botany
Most Outstanding Student: Andrea M. Herr, Lancaster, PA

Food Science
B. M. Newell Award: Andrea L. Twiford, Rocky Mount
Forbes Leadership Award: Jennifer A. Faris, Chapel Hill
Ambrosia Chocolate Top Scholar Award: Rabab A. Saadi, Amman, Jordan
Crouch Scholastic Achievement Award: Reem S. Sidahmed, Durham

Horticultural Science
Outstanding Senior Horticulturist Award: Thomas B. Moss, II, Enfield

Microbiology
Most Outstanding Student: Laura T. Whritenour, Lumberton

Poultry Science
T. T. Brown Poultry Science Club Award: Angela Conner, Cary

Zoology
Most Outstanding Student: Jennifer R. Wood, Raleigh

SCHOOL OF DESIGN

The American Institute of Architects School Medal: Dennis Edward Stallings, Satellite, FL
The American Institute of Architects Certificate of Merit: John Lester Rose, Arlington, VA
Alpha Rho Chi Medal: Robert Andrew Hoffman, Lumberton
North Carolina Chapter of The American Institute of Architects Book Award: John Kevin Huelster, Indianapolis, IN
Richard Green Prize for Design Achievement: Benjamin Barry Cahoon, Engelhard
Architecture Faculty Book Award: Robert Andrew Hoffman, Lumberton
Walter Hook Book Award: Kwan Young Chung, Seoul, Korea
The American Society of Landscape Architects Certificate of Honor: Joel Haden Evans, Charlottesville, VA; Elizabeth Ballard Simons, Wilmington
The American Society of Landscape Architects Certificate of Merit: Harold Hoyt Bangs, Raleigh; John David Penkacik, Orlando, FL
North Carolina Chapter of The American Society of Landscape Architects Book Award: Paul J. Klens, Mill Hall, PA
Landscape Architecture Faculty Honor Award: Matthew John Ingalls, Fayetteville
Landscape Architecture Faculty Service Award: Kathryn Ruth McPherson, Pittsburgh, PA
Product Design Book Award: Jamie Nell Cavin, Landis
Visual Design Book Award: Beverly Robinson Murray
Design Faculty Book Award: Timothy Wendell Buie, Welcome; Natalie Suszanne Chanin, Florence, AL
Orton A. Boren Service Award: Bruce Eugene Fisher, Goldsboro

COLLEGE OF EDUCATION AND PSYCHOLOGY

Education Council Outstanding Senior Awards:

Agricultural Education: Charlie Michael Wilder, Louisburg, NC
Health Occupations Teacher Education: Roselyn Kouhi Egan, Raleigh, NC
Industrial Arts Education: Kathy Sue Ussery, Star, NC
Industrial and Technical Education: Stephanie Elaine Truesdale, New Bern, NC
Marketing Education for Teachers: Christie Leigh Bradsher, Rolesville, NC
Mathematics Education: Ninette Yvonne Ribet, Rutherford College, NC
Psychology (outstanding graduating senior): Stella Eileen Anderson, New Bern, NC
Psychology (general option): Karen Paquette Parkes, Greensboro, NC
Psychology (human resource development option): Felicia Maria Bowen, Cary, NC
Science Education: Kathleen Margaret Murphy, Albany, Georgia

Agricultural Education Awards to Most Outstanding Seniors:

Fall 1987: Herman Edward Croom, Pikeville, NC
Spring 1988: Arlen Franklin Johnson, Asheboro, NC
Durwin M. Hanson Achievement Award: Charlie Michael Wilder, Louisburg, NC
Vocational Industrial Clubs of America Collegiate Leadership Award: Stephanie Elaine Truesdale, New Bern, NC

Psychology Department for Academic Achievement: Sheila Renee Greene, Lenoir, NC
Psychology Department Award for Service to the Department: Jennifer Fleming Wells, Greensboro, NC

Science Education Service Award to Outstanding Teacher: Martha Ramsey, Garner Senior High
Mathematics Education Service Award to Outstanding Teacher: Donna Buchan, Athens Drive Senior High School

COLLEGE OF ENGINEERING

Electrical Engineering
Outstanding Electrical Engineering Senior: December 1987: Paul Glenn McKee; May 1988: Mark Bradley McCoy, Richard Lee Williams

Engineering Senior Award for Scholarly Achievement: Frederick Richard Indermaur, Greensboro (Industrial Engineering); Ellen Miller West, Cary (Mechanical and Aerospace Engineering); Richard Lee Williams, Matthews (Electrical and Computer Engineering)
Engineering Senior Award for Citizenship and Service: Edward MacDonald Barnes, Pisgah Forest (Biological and Agricultural Engineering)
Engineering Senior Award for Leadership: Mark Ray Sizemore, King (Civil Engineering)
Engineering Senior Award for the Humanities: Ju Peng, Alhambra, CA (Electrical and Computer Engineering)

Biological and Agricultural Engineering
Agri-Life Council Outstanding Club Member Award for Biological and Agricultural Engineering—Science Curriculum: Daphne Mae Cartner, Mocksville
American Society of Agricultural Engineers Student Honor Award: North Carolina Student Engineering Branch of ASAE: Randall Keith Page, Elon College
Civil Engineering
Associated General Contractors Award to Outstanding Senior in Civil Engineering/Construction Option: Curtis Jon Horvat, Irwin, PA
Civil Engineering Outstanding Teaching Assistant Awards: Hisham Ibrahim Abdelfattah, Egypt; Mohamed Khairy Sorour, Egypt; James Harvey Trogdon III, Hope Mills

Computer Engineering
Outstanding Computer Engineering Senior: December 1987: Charles Robert Yount; May 1988: Tan Thanh Duy Phan

Furniture Manufacturing and Management
Rudolph Willard Award, Outstanding Senior in Furniture Manufacturing and Management: Stephen Todd Browning, Greensboro

Industrial Engineering
Outstanding Industrial Engineering Student: Bhavna Harishandra Bhakta

Materials Engineering
Outstanding Senior Award: Paul Besser, Red Lion, PA

Nuclear Engineering
Outstanding Nuclear Engineering Senior Award: Ala Fayez Alzaben, Raleigh

Textile Engineering
Lawrence Iason Honor Award: Larry Dickinson, Hickory

COLLEGE OF FOREST RESOURCES

Forestry

Biltmore Work Scholarships: David G. Cole, Raleigh; Clare M. Dellwo, Raleigh; Timothy R. Eudy, Albemarle; Robert B. Kidd, Siler City; Mark V. Pearson, Morganton; Edward W. Sontag, Raleigh; Michelle L. Spersrud, Raleigh

Ralph C. Bryant Scholarship Award: Forrest H. Teague, Jr., Goldsboro

E. F. Conger Scholarship: Christopher F. Dumas, Wilmington; Jerold M. Bryant, Durham

James L. Goodwin Awards: Gwen W. Amick, Ann Arbor, MI; Russell A. Anderson, Raleigh; Barbara A. Boothroyd, Asheville; Paul T. Eriksson, Ledgewood, NJ; Timothy R. Eudy, Albemarle; Eduardo L. Garcia, Old San Juan, PR; John H. Grogan, III, Raleigh; Thomas J. Margo, Stokesdale; Deborah L. Nahikian, Asheville; Ian C. Shannon, Sharon, MA; Forrest H. Teague, Jr., Goldsboro; T. Dale Thrash, Pisgah Forest; Paula S. Troxell, Pittsburgh, PA; Randall F. West, Jr., Andrews

Jonathan Wainhouse Memorial Scholarship Awards: James W. Hauser, Raleigh; David Bruce Powell, Jr., Franklin, VA; James F. Shern, Derwood, MD

George C. Slocum Award: Larry E. Ridenhour, Raleigh

John M. and Sally Blalock Beard Forestry Scholarship: Jonathan M. Bograd, Charlotte; Rodney B. Buchanan, Bakersville; Bradley C. Duckworth, Rocky Mount; Matthew B. Vincett, Raleigh

N.C. Forestry Foundation (Minority): Thomas M. Alston, Georgetown, SC; Brenda L. Anderson, Bethel; Fagin G. Fisher, New Bern; Gisele R. Letlough, Greensboro; Eric Logan, Greensboro; Paul A. Meggett, Charlotte

Xi Sigma Pi Scholarship: Dennis S. Detar, Concord

Garden Club of North Carolina: Clare M. Dellwo, Raleigh; Matthew B. Vincett, Raleigh

Wood Science and Technology

Pulp and Paper Technology

Alonzo Aldrich Scholarship: Robert Glenn McRee, Rome, GA

Dietrich V. Asten Scholarship: Jeffrey Wilson Thornton, Charlotte

Betz Laboratories, Inc. Scholarship: Scott Page LeGrand, Richmond, VA

M. Lebby Boinest, Jr. Scholarship: David Alston Chesnutt, Turkey

William E. Caldwell Scholarship: John William Graves, Pensacola, FL

Lawrence H. Camp Scholarship: Larry Scott Jackson, Ashland, VA

Caraustar Industries Scholarship: Scott Alexander Hamilton, Waynesville

J. Robert Carpenter Scholarship: Matthew Wilson Barbour, Raleigh

Terri P. Charbonnier Scholarship: Christopher Andrew Mastro, Chester, VA

Drs. Li-Sho & Lee-Fun Chang Scholarship: Albert Keith Williams, Roanoke Rapids

Charles W. Coker, Sr. Scholarship: Patrick Wayne Low, Rock Hill, SC

Continental Forest Industries Scholarship: John Charles Single, Atlanta, GA

Salesmen's Society to the Dixie Pulp and Paper Mills Scholarship: Kai Simonsen, Raleigh

Eugene E. Ellis Scholarship: William Gregory Fullenwider, Lewisport, KY

Robert G. Hitchings Scholarship: Richard Arthur Venditti, Monroe, CT

International Paper Company Scholarship: Jack Leonard Robinson, Elkin

James River Corporation Scholarship: W. McClinton Lipscomb, Jr., West Point, VA

John R. Kennedy Scholarship: Jasdev Singh Gill, Augusta, GA

John Milton May, Jr. Scholarship: Robert Shean Cumbee, Supply

Nalco Scholarship: Barbara Ann Ludwig, Tell City, IN

George E. Oakley Scholarship: Ronald Bowman Tucker, Browns Summit

Sture G. Olsson Scholarship: Kevin Jerome Gramelspacher, Tell City, IN

Paper Chase Scholarship: Stacy Ray Lee, Vanceboro

C. Cline Peters Scholarship: Gerald Wayne Marks, Cameron

Harry H. Saunders Scholarship: Gavin Lee Gaynor, Hawesville, KY

Dr. Fred B. Schelhorn Scholarship: Julie Lynn Goffinet, Tell City, IN

Shouvlin Family Scholarship: John Gerhard Michael, Warner Robins, GA

Ray Smith Scholarship: Mitchell Alan Malcolm, Centerville, GA

Southeastern PIMA Scholarship: Kathleen Carrell French, Raleigh

Southern PIMA Scholarship: James Edward Bradbury, Lufkin, TX
Stone Container Corporation Scholarship: Joseph William Johnson, Mauldin, SC
Dwight J. Thomson Scholarship: Robert Wade Harris, Vidor, TX
Union Camp Corporation Scholarship: Christopher William Blenk, Savannah, GA
Vinings Chemical Scholarship: Melinda Joyce McDaniel, Warner Robins, GA
Weyerhaeuser Company Scholarship: Andrea L. Nelson, Macon, GA

Wood Science & Technology
Carolina Canadian Lumber Sales Scholarship: Gregory R. Kasten, Edwardsville, IL
The Roy Carter Scholarship: Kenneth W. Odom, Jr., Severn
Weyerhaeuser Company Scholarship: Eugene W. Brown III, Rich Square; Leonard E. Byrd, Wilmington; Kevin D. Griffin, Williamston; Roger G. Poindexter, Troy; James A. Snyder, Monroe; Stephen M. Strand, Greensboro; Reynolds A. Trull, Henderson

COLLEGE OF HUMANITIES AND SOCIAL SCIENCES

Highest Scholastic Achievement Awards

College of Humanities and Social Sciences: Kenneth Richard Rose
Department of Economics and Business: Kelly Moore Carter, Raleigh (Accounting); Shari Elizabeth Kirk, Cary (Business Management); Sheila Jane Stone, Raleigh (Economics)
Department of English: Kenneth Richard Rose, Pittsburgh, PA
Department of Foreign Language and Literatures: Catherine Helen Lloyd, Cary
Department of History: Mark Daniel Chapman, Raleigh
Department of Political Science & Public Administration: William Murray Downs, Raleigh
Department of Philosophy and Religion: Andrea Michelle Herr, Lancaster, PA
Department of Sociology and Anthropology: Carol Rose Jernigan, Dunn (Sociology); Jacqueline Stevens Conord, New Bern (Social Work)
Department of Speech Communication: Stacy Lynn Smith, Cary
Outstanding Senior Awards: Male: Brian Phillip Brauns, Pleasant Garden; Female: Lisa Marie Beeman, Chocowinity

COLLEGE OF PHYSICAL AND MATHEMATICAL SCIENCES

School Awards to Outstanding Seniors
Scholarship: Sheila Jane Stone, Raleigh; Mary Amelia Woessner, Cary
Citizenship and Service: Kathryn Joanne Hoxsie, Raleigh
Humanities: John Taylor, Rocky Mount
Leadership: Cathleen Dawn Roberts, Greensboro

Departmental Awards
Chemistry
The North Carolina Institute of Chemists' Outstanding Student Award: Rima Salim Al-Awar, Raleigh
The Merck Index Awards for Scholastic Achievement in Chemistry: Paula Blackman Huffman, Goldsboro
The CRC Press Freshman Chemistry Achievement Award: John Edward Davis, Forest City
The 1988 Undergraduate Award in Analytical Chemistry: Ho Sung Cho, Chapel Hill

Physics
Outstanding Graduating Senior in Physics: Timothy Michael Delsole, Winston-Salem
Hubert L. Owen Scholarship: Adam Lyon, Cary

Statistics
Outstanding Graduating Senior in Statistics: Richard Allen Bynum, Goldsboro

Mathematics
Outstanding Graduating Senior in Mathematics: Sheila Stone, Raleigh
John Cell Scholarships: Tonya Lynn Etchinson, Raleigh
Mary Alice and Hubert V. Park Scholarship: Donald Carver, Hudson
Jack Levine-Charles Anderson Award: Randolph Rowell, Holly Springs
Charles Anderson Award: Scott Gray, Raleigh
Charles F. Lewis Scholarship: James Brantley, Salem

Marine, Earth and Atmospheric Sciences
Outstanding Graduating Senior in Geology/Geophysics: James Nathan Johnston, Raleigh
Outstanding Graduating Senior in Meteorology: Steven Rice Chiswell, Derwood, MD

COLLEGE OF TEXTILES

Joseph D. Moore Honor Award: Benjamin W. Swain, Charlotte
Harry Ball Honor Award: Elizabeth L. Smith, Wilmington
Lawrence Iason Honor Award: Larry C. Dickinson, Hickory
Chester H. Roth Honor Award: S. Machell McCourry, Conover
John M. Reeves Scholarship: Paul L. Latten, Pineville
Murray Frumkin Honor Award: Sylvie C. Hudgins, Cary
Textile Veterans Association Honor Award: Stephanie A. Sigmon, Newton
John E. Reeves Award: Mary Beth Sabio, Oakland, NJ
Donald F. McCullough Award: A. Art Roberson, Zebulon
John N. Gregg Award: Rona L. Reid, Charlotte
American Association of Textile Chemists & Colorists Award: Carol L. Shay, Charlotte
Phi Psi Textile Fraternity Award: Jacqueline C. Wentz, Arden
American Association for Textile Technology Award: Leslie G. Woodburn, Greensboro
Sigma Tau Sigma Scholarship Fraternity Award: To be announced
Kappa Tau Beta Student Leadership Award: Martha C. Lambeth, Greensboro
Delta Kappa Phi Textile Fraternity: Tracy L. Haley, Kannapolis
Henry A. Rutherford Honorary Award: Jonathan A. Childress, Gibsonville
AAMA-Apparel Student of the Year: Jean Duval Mozier, Medford, NJ
The Dean's Award: Martha C. Lambeth, Greensboro

ALUMNI ATHLETIC AWARD

Vincent J. DelNegro, Springfield, MA

THE HONOR SOCIETY OF PHI KAPPA PHI, GRADUATING SENIOR MEMBERS

Amy Elizabeth Adams
Michael Eugene Adams
Rima Salim Al-Awar
Wendy Jo Alphin
Stella Eileen Anderson
Marty Allen Baker
John Daniel Beasley
Douglas O'Neal Bell
Steven Langley Blake
William S. Boswell
Felicia Maria Bowen
Lisa Ann Brone
David Allen Browder
Sheryl Denise Brown
Stephen Todd Browning
Cynthia Bell Buzzard
Kelly Moore Carter
Suk Chu Chan
Lori Lynn Coggins
Patrick M. Comyn
Donna Lee Costner
Timothy M. Delsole
Larry C. Dickinson
William Murray Downs
Georgene M. Eakes
Jack Ray Edwards, Jr.
James William Edwards
Roselyn Kouhi Egan
Mary Froese Enns
Tonya Lynn Etchison
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Gavin Lee Gaynor
B.J. Gegg-Harrison
Wanda B. Gilchrist
Susan Gail Gooch
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Robey David Greene
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Basil Hassan
Halvor Warren Hem, IV
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Shelia Crocker Hopkins
Curtis Jon Horvat
Jennifer Rider Howard
Douglas James Hudson
Paula Blackman Huffman
Andrij Walter Huryn
Frederick R. Indermaur
Sheri Lorraine Jackson
Wade Eric Jackson
Robert Otis Jenkins

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Karen Downer Mitchell
Taryn Leigh Moody
Stewart Todd Morgan
Elizabeth Diane Mynatt
David Andrew Nailor
Jane Felton Nally
W.K. Neighbors, III
Paige Meredith Newland
Barbara Ann Newman
Robert Jay Nix
Brian Scott O'Kelley
Kathryn Love Ormsby
Donald Thomas O'Tool
Amitkumar M. Paradkar
Jong Shin Park
Donna Gail Patterson
James Russell Peeler
Lynn Page Perkinson
Tan Thanh Duy Phan
Amir Pirzadeh
A. Pizzoni-Ardemani
Ronald Julian Plummer
Victoria Lee Reardin
Alan Jerome Reiman
Pablo Reiter
Ninette Yvonne Ribet
Rebecca Kay Robertson
Charles K. Robinson
Bryan Eric Rodgers
Rabab Ahmad Saadi
Mark Daniel Schmidt
Steven Ernest Schultz
Sharon Brown Settlage
Suzanne R. Sewell
Christopher R. Simmons
Carolyn H. Smoak
Steven Mark Snider
Mohammed Sriti
Dennis E. Stallings
Hygie Irene Starr
Daniel James St. Clair
Sheila Jane Stone
Hugh Blake Svendsen
Pearl Jennifer Tejano
Matthew T. Terribile
Jonathan E. Thompson
William Cline Tolley
Maureen O. Vandermaas
Mark Stephen Viglanco
Kimberly Gay Wade
Johnny C. Weeks, III
James R. Westmoreland
Gail Lynn Whitehouse
Jane Elizabeth Wiggs
Richard Lee Williams
Paul Wesley Wilson
Sherry Lynn Wilson
Jennifer Rose Wood
James Steven Worley
Cindy J. Yetka
Derek Todd Young
Thomas Wade Young

PHI KAPPA PHI ACHIEVEMENT AWARDS

Seniors

Kelly L. Berkstresser
Cynthia Bell Buzzard
Frederick R. Indermaur
Sanja Sue Kennedy
Mark Bradley McCoy
Elizabeth A. Middleton
Michael Dean Neaves
Tan Thanh Duy Phan
Armando Pizzoni-Ardemani
Ninette Yvonne Ribet
Amy Kennett Stout
Shawn Michael Toffolo
Richard Lee Williams

Juniors

Jeffrey Gordon Crater
Roselyn Kouhi Egan
James William Hauser
Ronald Leo Meggison, Jr.
Kimberly Ann Monroe
Charles Allan Morse
Leslie Gail Wehe
Leigh Ann Young

Nominee for National Society Fellowship:
Lisa Ann Brone
Dr. Debra W. Stewart

GOLDEN CHAIN HONOR SOCIETY MEMBERS FOR 1987-88

Jeffrey Franklin Cherry
Jeffrey Gordon Crater
David Lewis Fu
Tamara Yvette Jackson
Christopher Walker Johnson
Tori Marie Morhard
Donn Christopher Mueller
Pamela Ann Rose
Jane Elizabeth Stover
Leigh Ann Young

ARMY ROTC AWARDS

Department of the Army Superior Cadet Award: MS I, George L. Coppit; MS II, John W. Brennan; MS III, Steven T. McGugan; MS IV, Robert L. Mickey

Association of the United States Army Award: Matthew B. Vincett

Reserve Officers Association Award: MS II, Kyle R. Harper; MS III, Michelle L. Mincey; MS IV, Gregory N. Washington

Society of American Military Engineers Award: Phillip D. Chelf

American Legion Award for Military Excellence: MS III, Todd A. Grubb; MS IV, George B. Spence III

American Legion Award for Scholastic Excellence: MS III, David L. Emmett; MS IV, Brian K. Harris

American Veterans of World War II, Korea and Vietnam Award: Christian Popa

National Sojourners Award: Sarah M. Small

Military Order of World Wars: MS I, Michael W. Brennan II; MS II, Karen E. Schroeder; MS III, David B. Slaughter

Daughters of the American Revolution: Jeffrey S. Kulp

Daughters of Founders and Patriots of America: Barry E. Ginn

George C. Marshall Award: Barry F. Huggins

American Defense Preparedness Association: Richard C. Dyer

Retired Officers Association Award: Jeffrey A. Bhe

Braxton Bragg Chapter of the Association of the United States Army (AUSA) Award: John D. Harrison

Veterans of Foreign Wars Award: Georges J. Sawyer IV

Sons of the American Revolution Award: George L. Fattal

General Dynamics Corporation Award for Outstanding Achievement: Kenneth R. Riggsbee II

Army ROTC Commissionees

DECEMBER 1987

William D. Thurmond ..... Cary

MAY 1988

Robert C. Alridge III ..... Richmond, VA
Allen B. Bailey ..... Manson
James A. Barnwell III ..... Burlington
Jeffrey A. Bhe ..... Fayetteville
George H. Bourgeois, Jr. ..... Hamlet
Elsbeth J. Chapman ..... Rougemont
Clarence E. Cherry, Jr. ..... Kelford
Jennifer B. Cross ..... Forest City
William G. Eades ..... Goldsboro
Robin A. Ellerbe ..... Fayetteville
Terrence E. Evans ..... Philadelphia, PA
Rodney E. Frazier ..... Morehead City
Brian K. Harris ..... Wilson
John D. Harrison ..... Rockingham
Blair L. Hawkins ..... Charlottesville, VA
Jeffrey S. Kulp ..... Charlotte
Kervo F. Locklear ..... Rowland
David J. Lubinski ..... Fayetteville
David A. Markowski ..... Havelock
William E. Maxwell ..... Pink Hill
Robert L. Mickey ..... Winston-Salem
Calvin R. Moore ..... Ahoskie
Juphenia L. Parker ..... Wilmington
Howard J. Pickett ..... Burlington
Kenneth R. Riggsbee II ..... Chapel Hill
George B. Spence III ..... Owings, MD
Christopher E. Verwoerdt ..... Durham
Gregory N. Washington ..... Durham

TO BE COMMISSIONED IN JULY 1988

Alicia G. Bridgeman ..... Fayetteville
Ellen D. Loy ..... Martinsburg, WV

Navy ROTC Commissionees

John E. Eans ..... Raleigh
Mark Hutnam ..... Raleigh
Eric S. Lewis ..... Shannon
Joseph T. Neville ..... Dunn
William C. Elliott ..... West Jefferson
Richard W. Ellis ..... Wyckoff, NJ
Scott D. Moore ..... Wilmington, DE

Air Force ROTC Commissionees

DECEMBER 1987

*Kimberly D. Boone ..... Elm City
Robert K.D. Boone ..... Emporia, VA
Roy T. Ellis ..... Fayetteville
Lynn W. Evans ..... Greenville
Timothy J. Fennell ..... Cherry Point
Leonard P. Harrison ..... Goldsboro
Kenneth S. Klawonn ..... Conway, SC
*David A. Koukol ..... Richmond, VA
James E. Moore ..... Greensboro
Joseph H. Newberry ..... Hickory
Leon H. Morris ..... Goldsboro
*Scott M. Teel ..... Raleigh

MAY 1988

Kathryn Covert ..... Roanoke, VA
Deborah A. Crawford ..... Pine Knoll Shores
Jeffrey E. Getz ..... Fayetteville
Denette L. Sleeth ..... Novelty, OH
Teresa S. Bass ..... Lucama
Aaron T. Blocker ..... Winston-Salem
William S. Brinley ..... Columbia, MD
Andrew P. Cadden ..... St Davids, PA
William J. Compton ..... Raleigh
Michael R. Dennis ..... Raeford
Eric G. Hansen ..... Fayetteville
*Thomas C. Moore ..... Belmont
Grover C. Perdue ..... Fayetteville
James M. Phillips ..... Chapel Hill
Christophe F. Roach ..... Goldsboro

AUGUST 1988

Richard A. Gibson ..... Salisbury
James C. Thomas ..... Greenville
*Kevin H. Van Hall ..... Raleigh

*Distinguished Graduate.

1988 COMMENCEMENT

ACKNOWLEDGEMENTS

The following non-University organizations have contributed significantly to the success of our commencement.

Mr. Frank Greathouse, Owner
Realizations, Inc., Raleigh, N.C.

Design and Implementation
of Stage Backdrop

Mr. Wade C. Miller, Jr., Owner
Sound Engineering, Asheboro, N.C.

Sound Systems

Mr. Graham Rouse, Balloon Master
ABC Creations, Raleigh, N.C.

Visual Effects


NORTH CAROLINA STATE UNIVERSITY
FOUNDED MARCH 7, 1887

NORTH CAROLINA

Agricultural Institute

TWENTY-SEVENTH COMMENCEMENT

University Student Center

North Carolina State University

May 6, 1988

TWENTY-SEVENTH
AGRICULTURAL INSTITUTE
EXERCISES OF GRADUATION

School of Agriculture and Life Sciences
Durward F. Bateman, Dean
Presiding

May 6, 1988
3:00 p.m.

*PROCESSIONAL

*INVOCATION.....C. Grady Long
Pastor
Salem Baptist Church
Apex, North Carolina

ADDRESS.....Charles L. Tomlinson
Landscape Engineer
North Carolina Department of Transportation
Greenville, North Carolina

AWARDING OF DIPLOMAS.....Durward F. Bateman, Dean

James L. Oblinger, Associate Dean and
Director of Academic Affairs

H. Bradford Craig, Associate Director
of Academic Affairs and Director of
the Agricultural Institute
College of Agriculture and Life Sciences

STUDENT COMMENCEMENT SPEAKER.....Charles W. Herlocker

REMARKS.....Bruce R. Poulton
Chancellor
North Carolina State University

RECOGNITION OF MARSHALS.....Durward F. Bateman, Dean

*BENEDICTION.....C. Grady Long

*RECESSIONAL

Reception Immediately Following the Graduation Ceremony

*Please Stand

AGRICULTURAL INSTITUTE GRADUATES

May 6, 1988

AGRIBUSINESS MANAGEMENT

Paul Gregory Amburn
\+ ‡ John Edward Ashe, Jr.
\+ ‡ Mel Alan Ferrell
\+ Larry Steven Martin
‡ Todd Marshall-Raymond Meyer
Thomas Worth Smith
\+ Reginald Howard Strickland
★ Joseph Shane Varnell

AGRICULTURAL PEST CONTROL

• Kevin Blackwell Weeks

FIELD CROPS TECHNOLOGY

Jerry Wendell Griffin
★★ Charles Wayne Herlocker
Larry Josephus Jones
Samuel Frank Keziah, III
★ Joel Reece Poindexter

FOOD PROCESSING, DISTRIBUTION, AND SERVICE

Allen Ward Bell
Elizabeth Irene Blum
• Johnny Ray Hayes
• Rodney Ray Lewis
★★ + ‡ Stephen Ek Teong Loo
• Darrick Maurice Rodgers
★ • Darrell Edwin Smith
• B. Elaine Wheeler
\+ William Gerald Wilson

GENERAL AGRICULTURE

\+ Ronald David Alcorn
Edward Scott Sewell

LIVESTOCK MANAGEMENT AND TECHNOLOGY

Kevin Dale Cadigan
★★ Mark Timothy Clark
★ Merrie Beth Flynn
Brian Edward Page
Jean Meredith Phifer
★ • Kevin Duane Powell
William Barrett Sadler
Kurt Moore Wagoner
★ • William Russell Wagoner

ORNAMENTALS AND LANDSCAPE TECHNOLOGY

		+	‡	Tony Ray Arnold
★★		+	‡	Gary Anthony Cooper
★★		+	‡	Katherine Henderson Humphries
		+	‡	Barry Raymond Kelly
				Ronald Eugene Leonard
★★	•			Cheryl Ann Lindsay
				William Fred McClure, Jr.
		+	‡	Bruce Lane Myers
★				Calvin Larkin Peed
★				Jake Lee Phillips, Jr.
★			‡	Jeffrey Oliver Preddy
★★				Karen Marie Steele
★				Susan MacKinnis Sutton

TURFGRASS MANAGEMENT

		+		Duane Everette Dawes
				Mark Hamilton Dowd
★★				Alan Crowder Erwin
				John Eric Feagans
★★	•	+	‡	Michael Ernest Hayes
				Mark Allan Kriews
				Douglas Thompson Morris
★★	•	+	‡	Richard Lawson Oldenburg
		+	‡	Christopher Kent Randall
		+	‡	Gregory Lewis Robertson
★★				William Eugene Smith
				James Christopher Wood

DOUBLE MAJORS

★★				Martin Joseph Acker
★★				Ashley Aderson Betts
★				Robert Collins Blades, Jr.
★		+	‡	William Everett Bryant
	•			Stephen Mark Buchanan
★				Bonnie Haynes Dickerson
				Jerome Lee Dodson
★★				Robert Stephen Hearn
★				Christopher Wright Hunt
		+	‡	Jeffrey Lynn Lassiter
		+	‡	John Gregory Little
		+		Donald Gene Madre, Jr.
		+	‡	Timothy Reid Parker
	•			Michael Joseph Paul
★★	•			Jeffrey Kevin Sloan
★★		+	‡	Randall Allen Smith
★★				James Bryan Turner
★				Gary Wayne Watson, Jr.
		+	‡	John Newton Young

★★High Honors

★ Honors

• Agribusiness Concentration

+ Graduated December, 1987

‡ In Absentia

MARSHALS

Margaret Piner Langston

William Thomas Lawrence

Christopher Douglas Pace

Jefferson Chandler Sadler

Mark Sellers

Warren Lee Cloer


NORTH CAROLINA STATE UNIVERSITY
FOUNDED MARCH 7, 1887

North Carolina State University Bulletin

summer sessions 1988

February 1988

NORTH CAROLINA STATE UNIVERSITY

VOLUME 88 FEBRUARY 1988 NUMBER 1

Published four times a year in February, June, August and December by North Carolina State University, Department of Admissions, Peele Hall, Box 7103, Raleigh, N. C. 27695-7103.

Bulletin Editors: John F. Cudd, Jr., Director, Summer Sessions; Nancy E. Polk, Assistant Director, Summer Sessions; Barbara Fraser, Secretary.

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DEFINITIONS OF ETHNIC GROUPS

White (not of Hispanic origin). Persons having origins in any of the original peoples of Europe, North Africa, or the Middle East.

American Indian or Alaskan Native. Persons having origins in any of the original peoples of North America, and who maintain cultural identification through tribal affiliation or community recognition.

Black (not of Hispanic origin). Persons having origins in any of the black racial groups.

Asian or Pacific Islander. Persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands. This includes for example, China, Japan, Korea, the Philippine Islands, American Samoa.

Hispanic. Persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race.

SUMMER SESSIONS 1988

North Carolina State University

Raleigh, North Carolina

SUMMER SESSIONS 1988 REGISTRATION APPLICATION INFORMATION

STUDENTS ELIGIBLE TO USE THE ENCLOSED SUMMER SESSIONS REGISTRATION APPLICATION:

Only Lifelong Education students are eligible to use the enclosed Summer Sessions Registration Application.

The Registration Application form *must* be used by all visiting students from other colleges or universities who will be classified as *Lifelong Education students* and by all students who are currently classified as Lifelong Education students at North Carolina State University.

A *Lifelong Education student* is one who has not been formally admitted as a degree candidate to North Carolina State University and does not wish regular classification of any kind at the University. See page 10, Lifelong Education Students, for additional information.

NOTE: All Lifelong Education students (including those from other universities and colleges) are advised that NCSU degree students are always given priority for Summer Sessions classes. *Acceptance of the Registration Application for Lifelong Education students by the Summer Sessions Office in no way constitutes a guarantee that class space will be available.*

STUDENTS *NOT* ELIGIBLE TO USE THE ENCLOSED SUMMER SESSIONS REGISTRATION APPLICATION:

1. The Registration Application form is *not* to be used by any classified degree candidate, undergraduate or graduate, now attending North Carolina State University. Such students must preregister through their advisers (see page 13).
2. The Registration Application form is *not* to be used by any student who has previously enrolled as a degree candidate at North Carolina State University. Such students (former students returning) must apply for readmission to the University by writing to the Department of Registration and Records, North Carolina State University, Box 7313, Raleigh, North Carolina 27695-7313 (see page 13).

INFORMATION:

For additional information about the Summer Sessions write to:

The Director of Summer Sessions
North Carolina State University
Box 7401
Raleigh, N.C. 27695-7401

or call (919) 737-2265.

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NORTH CAROLINA STATE UNIVERSITY

ADMINISTRATION

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Nash N. Winstead, *Provost and Vice Chancellor*
Debra W. Stewart, *Interim Vice Provost and Dean of Graduate School*
Franklin D. Hart, *Vice Chancellor for Research*
George L. Worsley, *Vice Chancellor for Finance and Business*
William L. Turner, *Vice Chancellor for Extension and Public Service*
Thomas H. Stafford Jr., *Vice Chancellor of Student Affairs*
John T. Kanipe Jr., *Vice Chancellor for Foundations and University Relations*

DEANS OF THE COLLEGES AND SCHOOLS

Durward F. Bateman, *College of Agriculture and Life Sciences*
Claude E. McKinney, *School of Design*
Carl J. Dolce, *College of Education and Psychology*
Larry K. Monteith, *College of Engineering*
Eric L. Ellwood, *College of Forest Resources*
William B. Toole, III, *College of Humanities and Social Sciences*
Garrett Briggs, *College of Physical and Mathematical Sciences*
Robert A. Barnhardt, *College of Textiles*
Terrence M. Curtin, *College of Veterinary Medicine*

SUMMER SESSIONS

William L. Turner, *Vice Chancellor for Extension and Public Service*
John F. Cudd Jr., *Director*
Nancy E. Polk, *Assistant Director*

ADMISSIONS

George R. Dixon, *Director*

REGISTRATION

James H. Bundy, *University Registrar*

SUMMER SESSIONS CALENDARS
1988

FIRST SESSION (MAY 23-JUNE 28)

March 31	Thursday	Last day to preregister
May 23	Monday	Registration/Change Day
May 24	Tuesday	First day of classes
May 25	Wednesday	Last day to add a course without permission of instructor
May 30	Monday	Last day to add a course; last day to withdraw or drop a course with a refund (NOTE: The tuition and fees charge is based on the number of hours and courses officially carried as of this date.)
June 3	Friday	Last day to withdraw or drop a course at the 400 level or below without a grade, last day to change from credit to audit at the 400 level or below, last day for all students to change from letter grade to credit only.
June 10	Friday	Last day to withdraw or drop a course at the 500 or 600 level without a grade
June 24	Friday	Last day of classes
June 27, 28	Monday, Tuesday	Final examinations

FIRST SESSION FINAL EXAMINATION SCHEDULE

Examination Times	0800-1100	1300-1600	1800-2100
	Hour Class Actually Begins During the Session		
Monday, June 27	0730, 0800, 0910	1140	1745
Tuesday, June 28	0950, 1020	1300, 1340	1915, 1945

SECOND SESSION (JULY 5-AUGUST 10)

May 19	Thursday	Last day to preregister
July 5	Tuesday	Registration/Change Day
July 6	Wednesday	First day of classes
July 7	Thursday	Last day to add a course without permission of instructor
July 11	Monday	Last day to add a course; last day to withdraw or drop a course with a refund (NOTE: The tuition and fees charge is based on the number of hours and courses officially carried as of this date.)
July 15	Friday	Last day to withdraw or drop a course at the 400 level or below without a grade, last day to change from credit to audit at the 400 level or below, last day for all students to change from letter grade to credit only.
July 22	Friday	Last day to withdraw or drop a course at the 500 or 600 level without a grade
August 8	Monday	Last day of classes
August 9, 10	Tuesday, Wednesday	Final examinations

SECOND SESSION FINAL EXAMINATION SCHEDULE

Examination Times	0800-1100	1300-1600	1800-2100
	Hour Class Actually Begins During the Session		
Tuesday, August 9	0730, 0800, 0910	1140	1745
Wednesday, August 10	0950, 1020	1300, 1340	1915, 1945

TEN-WEEK SESSION (MAY 23-AUGUST 10)

March 31	Thursday	Last day to preregister
May 23	Monday	Registration/Change Day
May 24 (25)*	Tuesday (Wednesday)	First day of classes
May 26 (30)*	Thursday (Monday)	Last day to add a course without permission of instructor
May 30	Monday	Last day to add a course; last day to withdraw or drop a course with a refund (NOTE: The tuition and fees charge is based on the number of hours and courses officially carried as of this date.)
June 14 (15)*	Tuesday (Wednesday)	Last day to withdraw or drop a course at the 400 level or below without a grade, last day to change from credit to audit at the 400 level or below, last day for all students to change from letter grade to credit only.
June 21 (22)*	Tuesday (Wednesday)	Last day to withdraw or drop a course at the 500 or 600 level without a grade
July 4	Monday	Holiday
July 28	Thursday	Last day of classes for Tuesday/Thursday classes
August 2	Tuesday	Final examinations for 1745 Tuesday/Thursday classes
August 3	Wednesday	Last day of classes for Monday/Wednesday classes
August 4	Thursday	Final examinations for 1915, 1945 Tuesday/Thursday classes
August 8	Monday	Final examinations for 1745, Monday/Wednesday classes
August 10	Wednesday	Final examinations for 1915, 1945 Monday/Wednesday classes

*First date for Tuesday/Thursday classes. Date in parentheses for Monday/Wednesday classes.

TEN-WEEK SESSION FINAL EXAMINATION SCHEDULE

(As noted in the calendar above)

Prominent in the above aerial of the central North Carolina State University campus are three high-rise residence halls (foreground), the circular Harrelson Hall with the adjacent towers of Cox and Dabney Halls, and in the upper left, the tower of the D. H. Hill Library. The central campus encompasses some 623 acres.

North Carolina State University

North Carolina State University is one of the nation's major public research universities. As a Land-Grant state university it shares the distinctive characteristics of these institutions nationally—broad academic offerings, extensive public service, national and international activities, and large-scale extension and research programs.

The University is organized in eight colleges, the School of Design and the Graduate School. The eight colleges are Agriculture and Life Sciences, Education and Psychology, Engineering, Forest Resources, Humanities and Social Sciences, Physical and Mathematical Sciences, Textiles, and Veterinary Medicine. In addition, a complex of divisions, institutes, and centers provides for a wide range of special academic, research, and extension programs.

NCSU's rich and varied academic programs include 86 undergraduate degree programs spanning 82 fields of study, 105 master's degree programs spanning 75

fields of study, 48 doctoral degree programs and the doctor of veterinary medicine program.

Research activities cover a broad spectrum of about 1,400 scientific, technological and scholarly endeavors supported by an annual budget of approximately $110 million.

Extension work on a statewide basis in each of the 100 counties and the Cherokee Indian Reservation carries the University's activities throughout the state.

The University has approximately 5,600 employees. Faculty and other academic personnel total 2,900, a number which includes 1,400 graduate faculty and 250 adjunct faculty.

NCSU's campus totals 1700 acres—a figure which includes the Central Campus, the College of Veterinary Medicine, and the new Centennial Campus. In addition, NCSU has 88,000 acres on a statewide basis, including one research and endowment forest of 78,000 acres. Near the campus are 2,500 University acres which include research farms; biology and ecology sites; genetics, horticulture and floriculture nurseries; teaching and research forests; and areas such as Carter-Finley Stadium.

The University's Wolfpack athletic teams are well-known nationally. The basketball team was national champion in 1974 and 1983. The football team has been the Atlantic Coast Conference champion five times and co-champion twice and has won five bowl games. Numerous NCSU athletes have won NCAA, national and international honors, including medals in the last five Olympics. The intercollegiate cross-country men's and women's teams have won many titles in recent years.

North Carolina State University (along with Duke University and the University of North Carolina at Chapel Hill) is one of three Research Triangle Universities forming the points of a 30-mile triangle encompassing the Research Triangle Park where numerous major U.S. corporations have located research divisions. Also within the park are the Research Triangle Institute, a contract research organization, and the Triangle Universities Computation Center, a central facility for the extensive computing activities of the institutions.

NCSU's total enrollment is more than 24,000, including approximately 16,700 undergraduate students, 3,500 graduate students, 3,300 Lifelong Education students and 500 students in other, special categories. The student population consists of approximately 14,850 men and 9,100 women and includes 2,290 black and 789 other minority students. Students come to NCSU from nearly every state in the union and at least 92 foreign countries are represented by 1,107 international students.

North Carolina State University is committed to equality of educational opportunity and does not discriminate against applicants, students or employees based on race, color, national origin, religion, sex, age or handicap. Moreover, NCSU is open to people of all races and actively seeks to promote racial integration by recruiting and enrolling a larger number of black students.

NCSU is a member of the National Association of State Universities and Land-Grant Colleges, the American Council on Education, and the American Council of Learned Societies.

THE SUMMER SESSIONS

The Summer Sessions at North Carolina State University offer an extensive educational program planned to meet the varied needs and interests of approximately 13,000 students. Sixty departments offer instruction in more than 700 courses, approximately 90% of which are at the undergraduate level.

Each of the University's nine colleges and schools, with a combined faculty of more than 500, participates in the Summer Sessions. The schedule includes two "regular" five-week sessions and a ten-week session, as well as several dozen evening courses scheduled for the convenience of working adults.

Summer courses and special programs are designed for the new student, the undergraduate wanting to advance his or her academic standing at State, the graduate desiring to continue study and research during the summer months and for visiting students pursuing degrees at other institutions. Teachers who need to earn credit toward renewal of teaching certificates or advanced degrees in education and persons in professional fields who wish to keep abreast of new developments and trends also take advantage of State's summer programs.

ADMISSIONS

North Carolina State University is committed to equality of educational opportunity and does not discriminate against applicants, students, or employees based on race, color, national origin, religion, sex, age, or handicap. Moreover, North Carolina State University is open to people of all races and actively seeks to promote racial integration by recruiting and enrolling a larger number of black students.

Students are admitted to the summer sessions in one of seven categories: 1) new freshmen, 2) new undergraduate transfer students, 3) new graduate students, 4) Lifelong Education students, 5) continuing North Carolina State University students, 6) former North Carolina State University students, and 7) suspended North Carolina State University students.

NEW FRESHMEN

Application forms for new freshmen should be obtained from the Director of Admissions, NCSU, Box 7103, Raleigh, North Carolina 27695-7103. The Summer Sessions application form in this bulletin should *not* be completed. Applications should be submitted in the fall of the senior year in high school. The application deadline is May 1. Based on past experience, applications and credentials received in the fall and early winter have received full consideration while those applications received later may be subject to a waiting list. A freshman applicant should be a graduate of an accredited secondary school. Nongraduates should have a high school equivalency certificate. The following high school preparation, or its equivalent, is necessary: English, 4 units; history or social studies, 2 units including U.S. history; mathematics, 2 units in algebra, 1 unit in geometry, 1 unit in advanced math is strongly recommended; science, 2 units, preferably biology, chemistry, or physics (one unit must be a laboratory science); foreign language, 2 units recommended but not required.

Freshman applicants must take the Scholastic Aptitude Test. These scores, together with the high school record, will be considered in determining admissibility. Information as to the time and place at which the Scholastic Aptitude Test will be given may be obtained from high school guidance counselors, or by writing directly to the College Board, Box 592, Princeton, New Jersey 08540 for

the *Bulletin of Information*. The *Bulletin* includes an application form and is available without charge.

Additional information concerning Admissions may be obtained by contacting the Undergraduate Admissions Office, 112 Peele Hall, Box 7103, Raleigh, N.C. 27695-7103 (919-737-2434).

NEW TRANSFER STUDENTS

Students seeking transfer admission into a degree program should obtain an application from the Office of Undergraduate Admissions and submit it before May 1. These students should not complete the Summer Sessions application in this bulletin.

Priority will be given to students presenting 60 or more semester hours of "C" or better work on courses which are applicable to the degree program to which they are applying. The minimum overall grade point average required for transfer admission is 2.0; programs which are experiencing space limitations require a higher GPA.

Individual official transcripts must be submitted from each institution attended. Students must be eligible to return to the last institution attended. College credits must have been earned at an accredited institution and should include a college-level math or the high school record must be submitted to show proper background.

NEW GRADUATE STUDENTS

All students working towards advanced degrees are enrolled in the Graduate School. An application for admission may be obtained from the Dean of the Graduate School, Box 7102, NCSU, Raleigh, North Carolina 27695-7102.

STUDENTS ADMITTED TO THE FALL SEMESTER

Any student accepted for regular admission for the fall semester wishing to attend either summer session should notify the Admissions Office, to change the date of entrance. He or she should *not* complete a Summer Sessions application.

LIFELONG EDUCATION STUDENTS

Lifelong Education students must complete the Summer Sessions Registration Application in the front of this bulletin. A Lifelong Education student is one who has never been formally admitted as a degree candidate at North Carolina State University. All students visiting from other schools will be classified as Lifelong Education students.

Lifelong Education Students—Undergraduate Studies (UGS)—This classification is used for individuals who have not obtained a baccalaureate degree and who wish to take courses but who are not currently admitted to a degree program. To be eligible for acceptance as an Undergraduate Lifelong Education Student, for the Summer Sessions an individual should:

a. have acquired a high school diploma or GED certificate; and
b. not be a degree candidate at North Carolina State University; or
c. be a high school student who has been recommended by his/her school and approved by the Office of Admissions to take lower level courses.

Post-Baccalaureate Studies (PBS)—The Post-Baccalaureate Studies (PBS) classification is designed for U.S. citizens who wish to undertake academic work beyond the baccalaureate degree but who are not currently admitted to a degree program. This classification is not open to international students with the exception of the spouse of a regularly enrolled NCSU student. In special cases where students are sponsored by an agency of the U. S. Government for specialized, non-degree study, approval may be given by the Graduate School for registration in the Post-Baccalaureate Studies classification. The following policies apply to students who wish to register for PBS:

1. All must have baccalaureate degrees from accredited institutions of higher education.
2. All classes taken for credit by PBS students will be graded in the usual manner that applies for the particular course (A, B, C, D, NC or S, U). All courses taken at NCSU will show on the student's transcript. If the student is admitted as a graduate student, a maximum of nine hours may apply toward the minimum requirements of the degree for which the student is enrolled, including hours approved for graduate credit while classified as a senior, unclassified undergraduate or professional engineering student. Only the *first* nine hours of course work taken at the graduate level in the PBS category can be accepted toward degree requirements unless a request for some other combination of nine hours is made by the student's advisory committee and approved both by the College or School Dean and the Graduate Dean.
3. The Grade Point Average (GPA) of a graduate student who has credits in the PBS category will be based on all courses taken at the 400-600 level. However, no course taken six (6) years prior to enrollment into a program will be considered in the GPA calculation.
4. Registration is limited to a maximum of two courses per session. Individuals who are employed fulltime should limit their PBS registration to one course per session.
5. The PBS classification carries with it no implication that the student will be admitted to the Graduate School in any degree classification.
6. All course work accepted for degree credit must be approved by the student's advisory committee as being germane to the program. Requests for degree credit for courses completed in the PBS classification are considered after admission to a graduate degree program when the student's Plan of Graduate Work is filed with the Graduate School.
7. PBS students are expected to familiarize themselves with Graduate School policies and to seek further advice or clarification as needed.

Limitations—Persons found eligible to study as Lifelong Education students are not to assume that they have received formal admission to the University as either undergraduate or graduate degree candidates. To become a degree candidate, formal application must be made through the Undergraduate Admissions Office or the Graduate School. Undergraduate Lifelong Education students may not register for more than two courses plus one physical education course per summer session.

Course Availability—Persons found eligible may register for any course offered by the University, provided they satisfy the required course prerequisites and classroom space is available.

Academic Standards—The academic standards applicable to undergraduate students at the University also apply to Lifelong Education students.

CONTINUING NCSU DEGREE STUDENTS

Any regular NCSU degree candidate may attend the Summer Sessions. The *Summer Sessions application in this bulletin must not be completed*, but registration procedures as listed on page 13 must be followed.

READMISSION OF FORMER NCSU DEGREE STUDENTS

Former NCSU degree students who wish to attend the Summer Sessions must apply for readmission through Registration and Records at least 30 days prior to the intended date of return. The readmission application may be obtained by writing to the Department of Registration and Records, NCSU, Box 7313, Raleigh, N.C. 27695-7313. *The Summer Sessions application in this bulletin must not be completed*, but registration procedures as listed on page 13 must be followed.

SUSPENDED NCSU DEGREE STUDENTS

NCSU degree students suspended at the end of the spring semester, 1988, may attend one or both sessions of the Summer Sessions to become eligible to continue in the fall. *The Summer Sessions application in this bulletin must not be completed*, but registration procedures as listed on page 13 must be followed. Students suspended prior to the spring semester, 1988, may attend one or both sessions of the Summer Sessions but should follow readmission procedures. The readmission application may be obtained by writing the Department of Registration and Records, NCSU, Box 7313, Raleigh, N.C. 27695-7313.

REGISTRATION PROCEDURES

PREREGISTRATION

All students who plan to attend the Summer Sessions must preregister. Preregistration consists of selecting the courses to be taken during the Summer Sessions and filing a Preregistration Schedule Request Form with Registration and Records. Each student who preregisters will be allowed to *complete registration by mail* if tuition and fees have been paid by the deadline. The preregistration period for all students will begin on Monday, March 21, 1988. The deadlines for preregistration will be:

First Summer Session and the Ten-Week Session—Thursday, March 31, 1988
Second Summer Session—Thursday, May 19, 1988

Currently enrolled degree students will preregister for the Summer Sessions at the time they preregister for the 1988 fall semester.

Former degree students returning may preregister for the Summer Sessions after they have filed an application for readmission and have received their letters of approval.

New freshmen and new transfer degree students may preregister for the Summer Sessions after they have received their letter of approval. New students who desire to attend the Summer Sessions should contact the Admissions Office.

Lifelong Education (non-degree) students will preregister for the Summer Sessions by completing the Summer Sessions Registration Application in the front of the Summer Sessions Bulletin and filing this with the Summer Sessions Office by mail or in person.

REGISTRATION BY MAIL FOR ALL PREREGISTERED STUDENTS

All students (undergraduate degree, graduate degree, and Lifelong Education (non-degree) students) who have preregistered will complete registration by mail if tuition and fees have been paid by the deadlines:

First Summer Session and the Ten-Week Session—Monday, May 9, 1988
Second Summer Session—Monday, June 20, 1988

No class schedule will be mailed if tuition and fees are not paid in full by these deadlines. Class schedules will be mailed approximately one week prior to the beginning of classes to the student's mailing address. It is *very important* that all students notify the Department of Registration and Records of any address changes. Class schedules returned by the U.S. Postal Service because of an improper address should be picked up in 100 Harris Hall by Registration/-Change Day:

First Summer Session and the Ten-Week Session—Monday, May 23, 1988
Second Summer Session—Tuesday, July 5, 1988

Degree Students should check with the Department of Registration and Records, telephone (919) 737-2572.

Lifelong Education students (non-degree) should check with the Division for Lifelong Education, McKimmon Center; telephone (919) 737-2265

If a student fails to pick up a returned class schedule, the University will assume that the student does not wish to complete registration and the student's schedule will be CANCELLED.

Remember

There are three IMPORTANT steps required for a student to complete registration:

1) Preregister by the deadline:
   First Summer Session and Ten-Week Session—Thursday, March 31, 1988
   Second Summer Session—Thursday, May 19, 1988

2) Pay tuition and fees and *all* other debts to the University by the deadline:
   First Summer Session and Ten-Week Session—Monday, May 9, 1988
   Second Summer Session—Monday, June 20, 1988

   NOTE: Holds placed on class schedules could be a result of parking fines, library fines, gym clothes not returned to the PE department, or other outstanding fees owed to departments that the student has not paid. Students are encouraged to check with the Cashiers Office (Student Accounts) if they believe that a hold on their class schedules could exist. It is the student's responsibility to clear all obligations to the University.

3) Obtain a class schedule and AllCampus Card (see page 15). *Class schedules will be mailed* to the student's Permanent Address approximately one week prior to Registration/Change Day.

Cancellation Policy

All class schedules not mailed because of a University Hold will be automatically cancelled.

PAYMENT DEADLINES

First Summer Session and the Ten-Week Session—May 9, 1988
Second Summer Session—June 20, 1988

REGISTRATION FOR NON-PREREGISTERED STUDENTS

All students will report to Reynolds Coliseum with a "Permit to Register." The "Permit to Register" may be obtained at the appropriate office according to the following categories:

Continuing Degree Students (students who were registered or withdrew during the 1988 spring semester)—Report to Room 100, Harris Hall, and request a "Permit."

Re-entering Degree Students (students who previously attended NCSU but were not enrolled during the 1988 spring semester)—Report to Room 100, Harris Hall, complete a Readmission Application, and obtain a "Permit."

New Undergraduate Degree Students (never attended NCSU)—Report to the Admissions Office, 107 Peele Hall and obtain a "Permit."

New Graduate Degree Students (never attended NCSU)—Report to the Graduate Office, 104 Peele Hall and obtain a "Permit."

Lifelong Education Students (non-degree)—Report to the Division for Lifelong Education, McKimmon Center, complete a Lifelong Education Student Application Form, and obtain a "Permit."

All students will be admitted to the Coliseum from 8:30 a.m. to 12:00 noon on the Registration dates indicated below:

First Summer Session and the Ten-Week Session—May 23, 1988
Second Summer Session—July 5, 1988

ALLCAMPUS CARDS

North Carolina State University has implemented a permanent photo I.D./registration card program called the AllCampus Card. The AllCampus card is used to gain access to various campus activities including: D. H. Hill Library, Clark Infirmary, physical education activities, Student Accounts, athletic events, and University Dining's meal plan program. The AllCampus card is also the card used by Money Card depositors to access their funds at University Dining locations, the NCSU Bookstore, the Laundry, Parking Services and Health Services.

Students continuing their studies during the Summer Sessions will use the card they currently possess. New students can have their pictures taken and AllCampus cards made on Summer Session Registration/Change days, May 23 and July 5, at Reynolds Coliseum from 8:30 a.m.-12:00 noon. Photographing of new students will take place throughout each session in Room 217 Harris Hall.

Office hours will be extended until 7:00 p.m. on May 23-24 and July 5-6.

Lost/stolen AllCampus cards can be replaced any regular business day at 217 Harris Hall from 8:00 a.m.-5:00 p.m. There is a nonrefundable $15.00 service charge for this replacement card.

WITHDRAWAL FROM THE UNIVERSITY

A regularly enrolled student who finds it necessary to drop all courses will initiate withdrawal from the University at the Counseling Center, 200 Harris Hall. A Lifelong Education student in the same circumstance initiates withdrawal from the University at the Summer Sessions Office, McKimmon Center, Gorman Street and Western Boulevard. A student who withdraws will not have any grades recorded. A student who discontinues attending classes without officially withdrawing will receive all "NC" grades.

After a short period (four days) during which it is possible to withdraw with a refund of fees (less a registration fee), there is a period during which a student may withdraw but without refund. The withdrawal deadline for undergraduates (regularly classified and Undergraduate Lifelong Education students) corresponds to the last day to drop a course at the 400-level or below; for graduate students (including Post-Baccalureate students) the deadline for withdrawal corresponds to the last day to drop 500- or 600-level courses. (See the appropriate Summer Sessions Calendar for dates.) After the published deadlines, there is no withdrawal except for unusual circumstances which can be documented as, for example, extended illness. Under these circumstances a student may petition the *Fee Appeals Committee* for a prorated refund of tuition and fees.

SPECIAL NOTES

1. Tuition and fees are payable by check or cash before or on the day of registration. Advanced billing of tuition and fees will be made *only* for those students who preregister. Payment is requested by May 9, 1988 for the First Summer Session and Ten-Week Session and June 20, 1988 for the Second Summer Session.
2. Students planning to take courses in both the First and Second Sessions should plan their sequences well in advance. Offerings in the Second Session are often substantially less in number than in the First Session, and in some instances, departments do not offer courses in both summer sessions.
3. Everything possible will be done to insure that the courses listed in this bulletin will be given at the time indicated. *However, the Director of Summer Sessions reserves the right to cancel courses in which enrollment is deemed insufficient.*
4. The maximum load for either session of the Summer Sessions is two courses plus a PE course for undergraduates and six hours for graduates. Any student may carry less. Regularly enrolled students who desire to carry *more* than seven hours must obtain the approval of the dean of the college or school in which they are enrolled. Students visiting from other institutions who wish to take more than the maximum must obtain the approval of the Director of Summer Sessions.
5. *All Lifelong Education students (including those from other universities and colleges) are advised that* NCSU *degree students are always given priority for Summer Sessions classes. Acceptance of the Registration Application for Lifelong Education students by the Summer Sessions Office in no way constitutes a guarantee that class space will be available.*

NONDISCRIMINATION POLICY

North Carolina State University is dedicated to equality of opportunity within its community. Accordingly, North Carolina State University does not practice

or condone discrimination, in any form, against students, employees, or applicants on the ground of race, color, national origin, religion, sex, age, or handicap. North Carolina State University commits itself to positive action to secure equal opportunity regardless of those characteristics.

North Carolina State University supports the protection available to members of its community under all applicable Federal laws, including Titles VI and VII of the Civil Rights Act of 1964, Title IX of the Education Amendments of 1972, Sections 799A and 845 of the Public Health Service Act, the Equal Pay and Age Discrimination Acts, the Rehabilitation Act of 1973, Vietnam Veteran's Readjustment Assistance Act of 1974, and Executive Order 11246. For information concerning these provisions, contact:

Dr. Lawrence M. Clark
Associate Provost and University Affirmative Action Officer
Box 7101
North Carolina State University
Raleigh, North Carolina 27695-7101
Phone: (919) 737-3148

PLANNING TO GRADUATE. . . .

If you plan to graduate at the end of the Summer Sessions, there are a number of items that should be of interest to you.

1. You should submit an Application for Degree card for *each* degree you are to receive. This should be turned in to your department within two weeks after the beginning of the Session. If for any reason you submitted an Application for Degree card last semester, but did not graduate, it is necessary that you submit *another Application* for the Summer Sessions. Remember: If you are to receive two degrees, you must submit a separate application for each degree.

2. Your local address and your official University correspondence address should be kept up-to-date. Also, the address you show on your Application for Degree card will be the address to which your diploma is mailed and also the address to which any further correspondence from the University will be sent. Any changes should be made by reporting your new address to the Department of Registration and Records, 100 Harris Hall, Box 7313, Raleigh, NC 27695-7313.

3. If you are transferring hours from another university in order to graduate, this should be done before the end of the Summer Sessions. If you are enrolled at another institution and that institution is unable to furnish an official transcript by the end of this Session, you must have that university's Registrar send to the Department of Registration and Records a letter showing the course and grade with an official school seal and Registrar's signature. This letter must be received by the end of the Summer Session.

4. Correspondence course grades must be received, all "incompletes" and "late grades" cleared, and all fines and fees paid by the end of the Summer Session.

5. If you are eligible to take reexamination, it must be taken no later than 30 days after the date of the intended graduation.

6. If you would like to participate in the May, 1989 commencement exercises, contact your Dean's office at your earliest convenience. You will be placed on a mailing list to receive all necessary information about the graduation activities. Graduation exercises are scheduled for May 6, 1989.

If you have any questions concerning the above information, please call Loretta Massenburg, Supervisor of Records, Department of Registration and Records, 100 Harris Hall, telephone (919) 737-2572.

ACADEMIC REGULATIONS

North Carolina State University's grading system for recording academic achievement is:

DEFINITION OF LETTER GRADES AND GRADE POINTS

Grade	*Definition*	*Grade Points Per Credit Hour*
A	Excellent	4
B	Good	3
C	Satisfactory ("Passing" for graduate students)	2
D	Marginal	1
NC	No Credit	0

(The following grades are not used in the calculation of grade point averages.)

S	Satisfactory (Credit-only and certain other courses)
U	Unsatisfactory (Credit-only and certain other courses)
CR	Credit by Examination or Advanced Placement
IN	Incomplete
LA	Temporarily Late
AU	Audit
NR	No Recognition Given for Audit
W	Withdrawal or Late Drop

Questions concerning this grading system should be directed to James H. Bundy, University Registrar, NCSU, Box 7313, Raleigh, N.C. 27695-7313.

EXPENSES

TUITION AND FEES RATE SCHEDULE—1988 SUMMER SESSIONS

Undergraduates

Residents of North Carolina				**Nonresidents**			
		Required				*Required*	
Hours	*Tuition*	*Fees*	*Total*	*Hours*	*Tuition*	*Fees*	*Total*
0-5	$ 63	$65	$128	0-5	$ 513	$65	$ 578
6-8	126	65	191	6-8	1,027	65	1,092
9-11	189	65	254	9-11	1,540	65	1,605
12+	252	65	317	12+	2,053	65	2,118

Graduate Students

Residents of North Carolina

Hours	*Tuition*	*Required Fees*	*Total*
0-Thesis	$116	$ 7	$123
0-2	63	65	128
3-5	126	65	191
6-8	189	65	254
9+	252	65	317

Nonresidents

Hours	*Tuition*	*Required Fees*	*Total*
0-Thesis	$ 366	$ 7	$ 373
0-2	513	65	578
3-5	1,027	65	1,092
6-8	1,540	65	1,605
9+	2,053	65	2,118

School of Veterinary Medicine

Residents of North Carolina

Hours	*Tuition*	*Required Fees*	*Total*
0-2	$141	$65	$206
3-5	281	65	346
6-8	422	65	487
9+	562	65	627

Nonresidents

Hours	*Tuition*	*Required Fees*	*Total*
0-2	$ 811	$65	$ 876
3-5	1,622	65	1,687
6-8	2,432	65	2,497
9+	3,243	65	3,308

A. Thesis Preparation (GR 598 or GR 698), Dissertation Research (GR 697), Examination Only (GR 597), and Summer Research (GR 596S or GR 696S) are all charged the 0-Thesis rate.

B. Cooperative Education Fee $130
C. Audits ..... Rates same as for credit

Note: The tuition and fees charge is assessed according to the total hours and courses carried as of 5:00 p.m. on:

—Monday, May 30, 1988, for the First Summer Session and Ten-Week Session.
—Monday, July 11, 1988 for the Second Summer Session.

* Tuition and fees for the 1988 Summer Sessions are tentative rates and are subject to change.

NOTICES

1. A statement of tuition and fees is mailed to each preregistered student around 20-30 days before the beginning of each Summer Session. The statement must be returned with full payment or complete financial assistance information by May 9, 1988 for the First Summer Session and the Ten-Week Session and by June 20, 1988 for the Second Summer Session. Nonpreregistered students are required to pay tuition and fees at registration. Deferred payments will not be allowed during the Summer Sessions.

2. Required fees are included in the rates listed above and must be paid by all students. Students are entitled to the services, facilities, and programs offered by the Student Center, Health Services, Physical Education Department, and Athletics Department. An itemization of required fees will be provided upon request.

3. Upon adding course work that results in an increased fee, students should pay at Reynolds Coliseum on Registration/Change Day and at Suite 1105 Student Services Center thereafter. Refunds resulting from courses dropped can be obtained by presenting the official drop form at Suite 1105 Student Services Center.

4. All students enrolled in courses designated as requiring student use of University, College/School, or Departmental computing resources during class or laboratory sessions or as homework assignments will be charged a computer course fee of $15 per Summer Session. Similarly, all students enrolled in courses designated as requiring student use of University, College/School, or Departmental laboratory resources will be charged a laboratory course fee of $15 per Summer Session. The maximum course fee to be charged to any student will be $30 per Summer Session regardless of the computer and/or laboratory courses taken. This fee will *not* be waived when a designated lab or computer fee course is dropped *after the official enrollment date.* (Official enrollment dates are stated at the end of the following listing of designated courses.)

COURSES REQUIRING COMPUTER OR LABORATORY COURSE FEES SUMMER SESSIONS, 1988

ARC	400	CSC	202E	FLS	102	MB	401
		CSC	302	FLS	201		
BCH	554	CSC	311	FLS	201E	MEA	110
		CSC	311E				
BO	200	CSC	312	FOR	111	NE	202
BO(ZO)	365	CSC	417	FOR	204		
		CSC	431E	FOR	261	PP	503
BS	100	CSC	461	FOR	264		
		CSC	461E	FOR	274	PS	471
CE	382	CSC	499	FOR(FW)	310		
						PY	205
CH	101	CSE	452	FW(FOR)	310	PY	208
CH	103	CSE	452E			PY	211
CH	104	CSE	453	HS	400	PY	212
CH	107	CSE	453E			PY	231
CH	221	CSE	699	IA	115		
CH	223			IA	122	SOC	416
CH	315	ECE	213	IA	351		
CH	499	ECE	214			ST	516
		ECE	301	IE	361		
CHE	205	ECE	302	IE	452	T	220
CHE	225			IE	453	T	250
		FLF	101			T	301
CSC	101E	FLF	101E	LAR	698		
CSC	102	FLF	102			VD	400
CSC	102E	FLF	102E	MAE	305		
CSC	111			MAE	306	WPS	205
CSC	200X	FLG	101				
CSC	200Y	FLG	102	MAT	200	ZO	201
CSC	201			MAT	210	ZO	305
CSC	201E	FLS	101			ZO(BO)	365

Course fees will be assessed for courses officially carried at 5:00 p.m. on Monday, May 30 for the First and Ten-Week Sessions; Monday, July 11 for the Second Session.

RESIDENCE STATUS CLASSIFICATION FOR TUITION PURPOSES

To qualify as a resident for tuition purposes, a person must have established legal residence (domicile) in North Carolina and maintained that legal residence for at least twelve months immediately prior to his or her classification as a resident for tuition purposes. To be eligible for classification as a resident for tuition purposes a person must establish that his or her presence in the State is, and during the requisite twelve month qualifying period was, for purposes of maintaining a bona fide domicile *rather than of maintaining a mere temporary residence or abode incident to enrollment in an institution of higher education.*

North Carolina General Statute (G. S.) 116-143.1 is the governing law concerning resident status classification and sets forth statutory definitions, rules and special provisions for determining resident status for tuition purposes. Copies of the law and implementing regulations are found in *A Manual to Assist the Public Higher Education Institutions of North Carolina in the Matter of Student Residence Classification for Tuition Purposes* which is available for inspection in the Office of Undergraduate Admissions, 112 Peele Hall. Special situations concerning minors, the military, and marriage as they relate to residence status classification are addressed in *The Manual*. It is the student's responsibility to initiate a review of their situation when classification or re-classification as a resident for tuition purposes is sought.

Active military personnel assigned to North Carolina and their military dependents may be eligible to receive the benefit of the in-state tuition rate under G.S. 116-143.3. A student who qualifies for the in-state tuition rate under this statute is not considered a resident, but merely eligible for the benefit of the in-state tuition rate. Application for eligibility to be charged the in-state tuition rate under G.S. 116-143.3 must be made prior to initial enrollment or re-enrollment for which the student claims the benefit. Further application for such eligibility must similarly be made prior to the outset of each successive academic year of enrollment.

Questions concerning residence status classification should be addressed to the Director of Undergraduate Admissions, North Carolina State University, Box 7103, Raleigh, North Carolina 27695-7103, (919) 737-2434

REFUND OF TUITION AND FEES

A student who withdraws from school on or before May 30 for the First and Ten-Week Sessions or July 11 for the Second Session will receive a refund of the full amount paid, less a $15 registration fee. After the dates specified, no refunds will be made.

In some instances, circumstances justify waiving rules regarding refunds. An example might be withdrawal from the University because of illness. Students have the privilege of appeal to the Fee Appeals Committee when they feel special consideration is merited. Application for such appeals may be secured from the Department of Registration and Records (100 Harris Hall), Summer Sessions Office (McKimmon Center), or University Cashier's Office (Suite 1105 Student Services Center).

FINANCIAL AID

The financial aid available to regular students attending the Summer Sessions is ordinarily limited to loans and work-study jobs. Students who wish to be considered for financial aid should make application to the Financial Aid Office as far in advance as possible, preferably no later than March 31. Summer applications will be available in early March.

The University has no financial aid for summer visitor students. However, these students may have access to the part-time job listings on the bulletin board outside the Financial Aid Office, 2005 Harris Hall.

COUNSELING CENTER

The Counseling Center provides services designed to assist individuals in gaining a better understanding of themselves and their opportunities. Psycholo-

gists, professional counselors, and psychiatrists are available to evaluate and to work with students who have concerns such as: choosing a career; academic planning; identifying and overcoming educational difficulties; developing greater self-understanding; drug and alcohol problems; developing more satisfying personal relations; and coping with stress or emotional crisis. All counseling is strictly confidential.

In addition to one-to-one and group counseling for individuals and couples, workshops are offered throughout the year in a variety of areas, including vocational exploration, test anxiety-reduction, and assertive behavior.

Counseling services are available without cost to all enrolled NCSU students, and some services are available to prospective students. Appointments may be scheduled over the telephone by calling 737-2424 or in person by coming to 200 Harris Hall. Some evening appointments are available, and a counselor is on call 24 hours a day through Health Services, 737-2563.

HOUSING

RESIDENCE HALLS

During the 1988 Summer Sessions, housing will be provided in the residence halls on a first-come, first-served basis for men and women who are enrolled for one or more courses.

Assignment to a room for a Summer Session does not guarantee that a room will be available for the Fall Semester. A student must be accepted by NCSU for Fall enrollment as a full-time student to be eligible to apply for University housing.

ROOM RENTALS AND APPLICATIONS

The rental rate for a five-week Session is $160.00 per person in a double room on main campus. *If space is available*, a single room may be reserved for $220.00 each Session. Watauga Hall (air-conditioned) is primarily for graduate students (juniors and seniors on space available basis). The rental rate is $255.00 for a double room and $280.00 for a single room. Contact the Housing Assignments Office in Suite 1112J Student Services Center or telephone 737-2440 for further housing reservation information.

Residents will be permitted to change rooms after the first week of classes with the approval of the Housing Assignments Office. The room change fee is $5.00. *Opening days of the residence halls will be as follows:*

FIRST SESSION—Noon, Sunday, May 22, 1988
SECOND SESSION—Noon, Tuesday, July 5, 1988

HOUSING REFUND POLICY

Cancellation of a room reservation must be made in writing as follows:

(a) In person at the Housing Assignments Office in Suite 1112J, Student Services Center, Monday through Friday, between 8:00 a.m. and 5:00 p.m., on the cancellation form provided; or
(b) By mail addressed to the Housing Assignments Office, Box 7315, NCSU, Raleigh, N.C., 27695-7315.

The effective date of cancellation is the date notification is received at the Housing Assignments Office or the date the room is vacated, whichever is later. Residents who have moved out of their rooms must return their Check-Out Card to the Housing Assignments Office to avoid a charge for an improper check-out.

If the housing agreement is cancelled on or before Registration/Change Day, the rental fee paid will be refunded less a $25 processing fee. *If the housing agreement is cancelled AFTER 5:00 p.m. on Registration/Change Day, NO REFUND of room rent will be made.* In cases of medical withdrawals, however, a $25 processing fee will be charged plus a daily charge from date of occupancy.

If a student fails to check in and secure his/her keys by 5:00 p.m. on Registration/Change Day, the housing agreement will be cancelled and NO REFUND will be made except as stated above.

STUDENT FAMILY HOUSING

The University operates E.S. King Village as an apartment complex for students with families. This complex consists of 300 apartments (120 efficiency, 148 one-bedroom, and 32 two-bedroom). Interested students should write to Student Family Housing, NCSU, Box 7315, Raleigh, N.C., 27695-7315, for family housing applications and information.

FRATERNITY HOUSES

Several of the 20 fraternity houses located on or adjacent to the campus provide housing for Summer Sessions students. Twelve of the 20 houses are fully air-conditioned and all provide furnished rooms and living areas. In addition, some houses offer board plans during the summer months. Any student interested in further details should write to the Office of Student Development, Box 7314, NCSU, Raleigh, N.C., 27695-7314 or telephone (919) 737-2441.

D. H. HILL LIBRARY

The libraries of North Carolina State University contain more than 1,200,000 volumes of books and bound journals, 620,000 federal government publications, and 2,500,000 microforms. The collection is especially strong in the physical and biological sciences, agriculture, textiles, architecture and design. The D. H. Hill Library houses the vast majority of these publications and subscribes to over 9,400 periodicals. Five branch libraries—the College of Textiles Library in Nelson Hall, the Design School Library in Brooks Hall, the College of Forest Resources Library in Biltmore Hall, Veterinary Medical Library in the College of Veterinary Medicine, and the Curriculum Materials Center in Poe Hall—serve the special needs of their colleges/schools.

The D. H. Hill Library has been a depository for U. S. government publications since 1924 and receives over 97% of these publications. The library also receives the microfiche research reports published by the Department of Energy (DOE), the National Aeronautical and Space Administration (NASA), the Educational Resources Information Center (ERIC), and the National Technical Information Service (NTIS).

On-line computer-based literature searching is offered by the library from a number of data bases such as ERIC, AGRICOLA (Bibliography of Agriculture), Psychological Abstracts, Sociological Abstracts, BIOSIS (Biological Abstracts), and Nuclear Science Abstracts. Only direct costs are charged to the user.

Facilities and equipment are also available for both individual and group use of audiovisual media. The library's theater can be scheduled for group media presentations, and films in the State Library's film collection can be borrowed by the D. H. Hill Library's Media Center for academic use by faculty and students.

The scholar, student, and browser will each discover the materials and services of the library to be useful and enjoyable additions to his or her Summer Sessions program. All areas of the library complex are air-conditioned and open to students and faculty.

Library hours for the Summer Sessions are as follows:

Monday-Thursday	7:45 a.m.-12:00 midnight
Friday	7:45 a.m.- 9:30 p.m.
Saturday	9:30 a.m.- 6:00 p.m.
Sunday	1:00 p.m.-12:00 midnight

SUMMER ACTIVITIES

Through many curricular and extracurricular activities, the Summer Sessions provide special opportunities to those students engaged in summer study. Interesting, informative and entertaining programs and activities are scheduled for each session.

A few of the more popular activities and special features include the Carmichael Gym athletic and recreation programs and the varied activities sponsored by the University Student Center.

The University's regular program of student personnel services is available to summer students. It includes the Counseling Center for educational, career and personal counseling; the Career Planning and Placement Center for career planning and placement; the Residence Life and Residence Facilities offices for residence quarters; the Financial Aid Office for financial assistance; and the Student Health Service for medical care.

Beyond the campus, the city of Raleigh offers cultural and recreational opportunities of interest to students. The Raleigh Little Theater presents several productions during the summer, the North Carolina Museum of Art sponsors gallery concerts and exhibits, and there are several swimming pools and city and state parks located in and around Raleigh.

UNIVERSITY STUDENT CENTER

The hub of campus summer activity is the University Student Center. The Center is supported in part by student fees, and all Summer Sessions students are invited to attend the programs and activities sponsored by the Summer Programs Board. These programs include movies and a variety of social and recreational events.

The air-conditioned Center offers many facilities, including a television lounge, an art gallery, offices for student organizations, a game room, snack bar, theater and meeting rooms. The Craft Center in the Thompson Building has a full range of crafts programs.

University Student Center hours during the summer are:

Monday-Friday	7:00 a.m.-11:00 p.m.
Saturday-Sunday	9:00 a.m.-11:00 p.m.

SPECIAL COURSES AND INSTITUTES

NCSU MIDDLE SCHOOL WORKSHOP—"ALTERNATIVES FOR THE MIDDLE YEARS"

(Listed as ED 598-F)
June 20-July 1

This ninth annual activity-oriented workshop is designed to help teachers and administrators develop humane and imaginative programs for students ages 10-15. It will focus upon (a) the developmental needs, interests, and abilities of emerging adolescents; (b) curriculum ideas and teaching methods; and (c) school organization strategies.

Participants will be involved in whole group activities and mini-courses which explore topics such as:

Adolescence and contemporary society
Team organization
Advisor/advisee programs
Learning styles
Interdisciplinary inquiry
Arts and the adolescent
Learning environment/classroom design
Creativity and the right side of the brain
Competition and cooperation
Case studies of outstanding schools
Outdoor education
Adolescent sexuality
Moral development and values clarification
Adolescence and authority
Cognitive and social development in adolescence
All school activities
Learning games and simulations
The principal as educational leader

In addition, special electives will be offered in math, science, language arts, and social studies.

Emphasis in most sessions will be placed on activity, involvement and sharing. Films, slides, simulations, small group discussions, working with classroom materials, and a variety of other learning techniques will be utilized.

The workshop will be directed by John Arnold, Coordinator of Middle Years Education at NCSU, and Chris Stevenson, Curriculum Specialist, University of Vermont. Consultants from the State Department of Public Instruction and from area schools will serve on a part-time basis.

Sessions will meet Monday through Friday from 8:30 a.m. to 3:00 p.m. Three graduate credits will be granted to those who participate satisfactorily and complete a curriculum project. Also, 5.5 CEU credits will be awarded by the State Department of Public Instruction.

Dormitory rooms (for approximately $15 per night per person, double occupancy), will be available for out-of-town participants. Rooms may be reserved by contacting the Housing Assignments Office, NCSU, Box 7315, Raleigh, NC 27695-7315.

To register, contact Dr. John Arnold, Department of Curriculum and Instruction, NCSU, Box 7801, Raleigh, NC 27695-7801, for special registration forms. Or, you may call (919)737-3221 and request forms from the secretary. Registration must be completed no later than May 23, 1988.

REGIONAL SUMMER SCHOOL FOR ADULT, EXTENSION, AND COMMUNITY COLLEGE EDUCATORS
June 6-June 24, 1988

The Department of Adult and Community College Education offers a special three-week program of instruction designed to provide graduate study and professional improvement opportunities for educators. This intensive session assists extension workers, community college instructors, administrators, and other adults to increase their understanding of topics such as current issues in community colleges, use of microcomputers, designing and producing educational materials, and coping with decline. It also offers opportunities for keeping up-to-date in areas of agricultural and home economics technology.

The program is interdisciplinary; it enlists the professional competence of visiting and resident faculty. Courses meet daily in block schedule for morning and afternoon. Each participant may take a maximum of six semester hours.

Students enrolling for the special three-week session will complete registration by mail. In order to register for the 1988 Regional Summer School, students must complete the application form and submit the tuition by *May 23, 1988*. The form may be obtained from Bernadette G. Watts, Department of Adult and Community College Education, NCSU, Box 7607, Raleigh, NC 27695-7607.

Course offerings are listed below:

ANS 500 Advanced Ruminant Nutrition
CS 591G Crop Stress Relations
EB 403 Economics of Consumer Decisions
EB 433 U. S. Agricultural Policy
ED 596C Instructional Leadership in the Community College
ED 596D Extension Education Methods
ED 596I Emerging Issues in Adult Education
ED 596J Leading and Working with People
ED 596K Developing Supervisory Skills
ED 596M Improving Administrative Skills
ED 696 Leadership Strategies
HS 595A Production Maintenance and Marketing of Quality Horticultural Crops
PP 595A Plant Diseases—Principles, Diagnoses and Management
SSC 560 Advanced Soil Management

INSTITUTE FOR TEACHERS OF GIFTED AND TALENTED
June 20-July 10

This institute will consist of two courses:

ED 598-I Special Problems in Curriculum and Instruction: Intelligence
&
ED 598-J Special Problems in Curriculum and Instruction: Counseling the Gifted Individual

Registration for this three-week workshop must be completed during the regularly scheduled Preregistration and Registration times for the University's Second Summer Session. For further information, contact: Dr. Lyn Aubrecht, Department of Curriculum and Instruction, NCSU, Box 7801, Raleigh, NC 27695-7801. Phone (919) 737-3221.

SPECIAL WORKSHOPS FOR MATHEMATICS AND SCIENCE TEACHERS

North Carolina State University's Center for Research in Mathematics and Science Education (CRMSE) will offer five workshops during the summer of 1988. Tuition, stipends and materials will be furnished to participating teachers.

These workshops are not included in the Summer Sessions Program described in this catalog. Special registration procedures are required. **To apply, contact Dr. Sarah B. Berenson, Center for Research in Mathematics and Science Education, NCSU, Box 7801, Raleigh, NC 27695-7801 (telephone: 919/737-2013) for special application forms. APPLICATION DEADLINE IS APRIL 16, 1988.**

• NSF WORKSHOP FOR HIGH SCHOOL MATHEMATICS TEACHERS—"Tool Software and the Impact on the High School Mathematics Curriculum"

This National Science Foundation workshop is planned to update high school mathematics teachers' knowledge and skills in the use of computer tools that manipulate symbols, perform calculations, plot functions, and draw geometric constructions. The two main components of the workshop are to become familiar with operating the software and how to use the software to improve instruction.

Teachers will develop instructional materials for one class using a tool of their choice. Emphasis in most sessions will be placed on hands-on learning, sharing, and cooperation in a computer laboratory setting. Materials for teachers to use as demonstration lessons and laboratory lessons and some public domain software will be given to teachers attending.

Schedule: 8:00 a.m.-12:30 p.m., weekdays—June 20-July 1
Credit: Two semester hours graduate credit
Instructor: CRMSE Staff

• TITLE II WORKSHOP FOR HIGH SCHOOL ADVANCED ALGEBRA AND ADVANCED MATHEMATICS TEACHERS—"Problems, Solutions, and Strategies for High School Advanced Mathematics (PS^2)"

This workshop will provide high school teachers of Advanced Algebra and Advanced Mathematics an opportunity to: enhance their problem-solving skills, improve the way they teach their students to solve problems, and learn how to generate non-routine, real-world problems. The class format will encourage cooperation and sharing of ideas. The last week will be spent developing problems and solutions which will be published and distributed to high school teachers across the State.

Schedule: 4:00-7:00 p.m. Tuesday and Thursday—May 24-June 17; and
all day, Monday through Friday—June 20-June 30
Credit: Six semester hours graduate credit
Instructor: Dr. William Waters

• SUMMER INSTITUTE FOR MIDDLE GRADES MATH TEACHERS —"LOGO and BASIC as Mathematics Tools"

This Mathematics Summer Institute, supported in part by the State Department of Public Instruction and the Mathematics and Science Education Network, is designed for Middle School mathematics teachers who have had little or no computer programming in LOGO and BASIC. The emphasis is to integrate

the use of these languages into the middle school math curriculum, especially in the areas of Informal Geometry, Number Theory, and Probability. The instructional approach will be hands-on with the computer and concrete materials that will enhance instruction.
Schedule: 8:00 a.m.-12:00 noon, weekdays—July 23-August 3
Credit: Two semester hours graduate credit
Instructor: Dr. Sarah Berenson

• SUMMER INSTITUTE FOR MIDDLE GRADES SCIENCE TEACHERS—"Physical Science for Middle Grades Teachers"

This Science Summer Institute, supported in part by the State Department of Public Instruction and the Mathematics and Science Education Network, is designed for Middle School science teachers who wish to improve their understanding of physic concepts taught in the middle grades. Through lectures, discussion, and appropriate activities, teachers will deepen their understanding of science concepts and learn how to increase their pupils' interest in and understanding of physical science.
Schedule: 8:00 a.m.-1:00 p.m., weekdays—July 5-July 18
Credit: Three semester hours graduate credit
Instructor: CRMSE Staff

• SUMMER INSTITUTE FOR ELEMENTARY TEACHERS OF GRADES 4-6—"Measurement and Arithmetic for Upper Elementary Teachers"

This course will assist teachers in using concrete materials to teach whole number, fraction, and decimal algorithms to their students. It will also develop the theory of measurement and present the measurement concepts that elementary students should understand before pre-Algebra. The instruction will be presented in a hands-on format with teachers working cooperatively in a laboratory setting.
Schedule: 8:00 a.m.-12:00 noon, weekdays—July 5-July 18
Credit: Two semester hours graduate credit
Instructor: Dr. John R. Kolb

TEACHING OF WRITING INSTITUTE
(Listed as ED 598-D)
June 27-July 26

The Capital Area Writing Project (CAWP) at N. C. State University is modeled after the highly successful National Writing Project and is one of eight sites of the North Carolina Writing Project network.

Experienced elementary and secondary teachers of English and **other content areas** are eligible for the 25 Fellowships available. Applicants should have a marked interest in improving effectiveness in teaching writing and in sharing new knowledge with their colleagues. Participants will agree to conduct inservice programs as Teacher/Consultants within the Region. Applicants from private schools and colleges within Region Three can be considered only if public school applicants do not fill available openings. Application deadline is March 31, 1988.

Fellows will receive (at no cost) six hours of graduate credit from NCSU in the teaching of writing, a $400 stipend, and a text of numerous writing activities and successful teaching strategies developed during the four weeks of the project.

Workshop sessions will be held five days per week, Monday through Friday. Mornings will be spent in journal writing, group response and editing. Because of the intensive nature of the workshop and occasional evening activities, dormitory residence during the week is recommended, though not required. Participants will be expected to attend an all-day orientation on Saturday, June 11.

Registration for this Institute must be completed during the regularly scheduled Preregistration and Registration times for the University's Second Summer Session. For further information about the Capital Area Writing Project at NCSU, please contact either Dr. Ruie Pritchard (NCSU) at (919) 737-3221 or Dr. Sally Buckner (Peace College) at (919) 832-2881.

HIGHLANDS BIOLOGICAL STATION

The Highlands Biological Station is a regional field station for biological research and education in the Southern Appalachian Mountains. Its facilities are available for use by qualified scientists and graduate students who are engaged in research on the biota and environments of the Southern Appalachian region. The Station is an interinstitutional facility of the University of North Carolina. It is administered by Western Carolina University, located in nearby Cullowhee, a constituent institution of the University of North Carolina. Responsibility for the Station's programs is held by a nine-member Board of Directors that includes representatives from the biology faculties of several southeastern universities. Twenty-one colleges and universities support the Station through institutional memberships. The USDA Forest Service is a cooperating agency.

The Station offers several courses each summer at the advanced undergraduate-graduate level dealing with the special biological features of the southern Appalachians and with areas of study that are appropriate for investigation at a mountain field station. Students have the option of receiving credit for courses through either Western Carolina University or UNC-Chapel Hill. The following courses are being offered in 1988:

Amphibian Larval Biology. June 6-17. Three semester hours. Team taught by Drs. Richard Wassersug (Dalhousie University), H. Bradley Shaffer (University of California, Davis), and James Hanken (University of Colorado). This is a lecture, laboratory, and field course addressing a variety of topics on the biology of amphibian larvae. Among the topics to be covered are: the identification of local larvae, the evolution of complex life cycles and metamorphosis, and the feeding behavior of tadpoles and salamander larvae. Assorted aspects of the morphology, ecology, behavior, and population genetics of amphibian larvae that reflect the special interests and expertise of the instructors will be emphasized. Students will conduct individual 2½ day projects of their own design and execution. Prerequisite: General Zoology.

Forestry and Wildlife Concepts for Biologists. June 20-25. Two semester hours. Dr. Stephen G. Boyce (Duke). A field study of how biological knowledge is used to manage forests for enhanced biological diversity, game, timber, recreation, wilderness, and other values. Current resource management practices and the biological effects of these practices are examined on both public and private lands. Trips include: forests recently harvested and regenerated, forest cultured for game and nongame habitats, a tree nursery, forest cultured for recreation, a wilderness, and a fish hatchery for producing game and endangered fish. Managers and biologists explain current forestry and wildlife concepts. Each student participates in daily seminars on the biological significance of the findings and on opportunities for research to support management concepts. Prerequisites: University training in biology and ecology, or permission of the instructor.

Flora of the Southern Blue Ridge. July 4-15. Three semester hours. Dr. J. R. Massey (UNC-Chapel Hill). A survey of the ferns, gymnosperms, and flowering plants characteristic of the southern Blue Ridge Mountains. This two-week intensive field course will involve the identification, recognition, and characterization of local plants. Most days will be spent studying and collecting in the field, with lectures and discussions in the evening. Prerequisite: General Botany.

Biology of Spiders. July 18-29. Three semester hours. Team taught by Drs. Fred A. Coyle (Western Carolina University) and William A. Shear (Hampden-Sydney College). This course will focus on all aspects of the biology of spiders. Lectures and discussions will be held daily, in the mornings and/or evenings. Discussions will be based on recent research articles. Afternoons will be devoted to field work. The main objective of the field work will be the assemblage of a significant collection of the local spider fauna, which is extraordinarily rich; in the course of collecting attention will inevitably be drawn to ecology and behavior. Most evenings will be available for students to work on identification. Prerequisite: General Zoology.

Scientific Illustration. July 10-16. Two semester hours. George Venable (Smithsonian Institution) and Lewis Sadler (University of Illinois at Chicago). An intensive course in basic through advanced techniques for rendering plant and animal specimens. This course makes widespread use of the biological resources of the Highlands region. The course is designed for both field biologists and artists. Prerequisite: Permission of the instructor.

Photography for the Field Biologist. July 18-23. Two semester hours. Gilbert Leebrick (Appalachian Environmental Arts Center) and A. Murray Evans (University of Tennessee). A course designed for the amateur or professional biologist covering both field and laboratory applications. Photographic equipment, techniques, software, close-up work, laboratory still-lifes, composition, and design will be covered, all in the context of the southern Appalachian flora and fauna. Prerequisite: Permission of the instructor.

Registration fees: Western Carolina University, $15 application fee and $40 registration fee. UNC-Chapel Hill, $50 registration fee.

Tuition: $65/semester hour

Housing: $25-$35/week

The Highlands Biological Foundation, Inc. offers limited financial aid to qualified students. Further information on specific courses, financial aid, and application forms can be obtained by writing the Executive Director, Highlands Biological Station, P.O. Drawer 580, Highlands, North Carolina 28741 or by contacting Dr. A. W. Cooper, Department of Forestry, N. C. State University. Telephone (919) 737-2891.

EVENING SUMMER SESSIONS

Late afternoon and evening classes are scheduled during the First Session (May 23-June 28), Second Session (July 5-August 10), and the Ten-Week Session (May 23-August 10) for the convenience of Evening Degree students, Lifelong Education students and "traditional" day students who have summer jobs but who would like to remain academically active. Many of the evening courses offered in the 1988 Summer Sessions may be used toward fulfilling the basic requirements for a B.A. degree from the College of Humanities and Social Sciences.

The following departments are offering late afternoon and evening classes during the 1988 Summer Sessions: Accounting, Adult and Community College Education, Anthropology, Computer Science, Computer Studies, Counselor

Education, Curriculum and Instruction, Economics and Business, English, Electrical and Computer Engineering, French, Health Occupations, Industrial Arts, Mathematics, Occupational Education, Physical Education, Political Science, Public Administration, Social Work, Sociology, Spanish, and Zoology. Please refer to the Course Listings beginning on page 116 for specific details.

For information concerning the evening degree and certificate programs in the College of Humanities and Social Sciences, contact Ms. Lynda Hambourger, Coordinator of Evening Programs, Room 106 Caldwell Building, or call (919) 737-2467. Ms. Hambourger's office is open until 7:30 p.m. Monday through Thursday and until 5:00 p.m. Fridays.

SUMMER INSTITUTE IN ENGLISH FOR SPEAKERS OF OTHER LANGUAGES

June 27-July 30

The Summer Institute in English for Speakers of Other Languages at North Carolina State University is a five-week, noncredit course of study of the English language and American culture. It is designed for individuals from other countries who intend to pursue university studies or specialized training programs in the United States. With an emphasis on developing competence in all aspects of English language usage, the program includes classroom instruction, use of language laboratories, and extensive opportunities for practicing English in actual communication situations. In addition, opportunities are available for students to become acquainted with life in the U.S. with weekend trips to places of historic, artistic and scenic interest.

Any student who has a score of 400 on the TOEFL (Test of English as a Foreign Language) or an equivalent facility in the use of spoken English may attend the Institute. (Information about taking the test at one of the centers located in the students' home countries may be obtained by writing to: Test of English as a Foreign Language, Educational Testing Service, Princeton, New Jersey.)

Admission to the Institute does not imply admission as a degree candidate at North Carolina State University or any other campus of The University of North Carolina.

The Institute, which is sponsored by the Division for Lifelong Education in cooperation with the Summer Sessions and the Department of Foreign Languages and Literatures, is under the direction of Mrs. Claire A. Drehmel of the Department of Foreign Languages and Literatures. All classroom work is conducted on the campus. Classes, including language laboratory practice sessions, are held six hours a day, Monday through Friday, from 8:00 a.m. to 12:30 p.m. and 1:30 p.m. to 3:10 p.m. (Attendance at the Institute does not carry academic credit, although students who complete the program receive a certificate of attendance.)

The total cost of the five-week program is approximately $1,775. The cost of the Institute is estimated on the basis of campus dormitory accommodations and meals at the campus cafeterias. Incidental expenses, such as laundry, dry cleaning, entertainment, etc., are not included. (Room rent includes sheets and towels.)

Course and Books/Materials Fees	$775.00
Room in Campus Dormitory (Estimated)	$500.00
Food (Estimated)	$500.00

For further information about the Institute, write to Nancy E. Polk or Gwen Hobby, Division for Lifelong Education, NCSU, Box 7401, Raleigh, North Carolina 27695-7401. Telephone (919) 737-2265.

INDEPENDENT STUDY BY EXTENSION

In addition to the classes listed in this schedule, many undergraduate courses are available through independent study (correspondence instruction). This program allows students to enroll at any time, to work at their own pace, and to take up to thirteen months to complete a course. For further information about independent study, including a complete listing of courses, contact Independent Study by Extension, 201 Abernethy Hall 002A, University of North Carolina, Chapel Hill, North Carolina 27514. Telephone (919) 962-1106.

COURSE LISTINGS

Courses are listed by department, departmental abbreviation and numerical designator. Semester hour credits for each course are given following the name of the course. Classes meet daily, Monday through Friday, except where specified to the contrary. The symbols "LR", "LB" and "PR" before the clock hours refer to "lecture-recitation," "laboratory" and "problem-solving session," respectively. If there is no symbol before the clock hours, lecture-recitation is implied.

The number in parentheses to the right of the class meeting time is the "Call Number." This number must be indicated on the Preregistration Schedule Request Form by students who are preregistering for Summer Sessions courses.

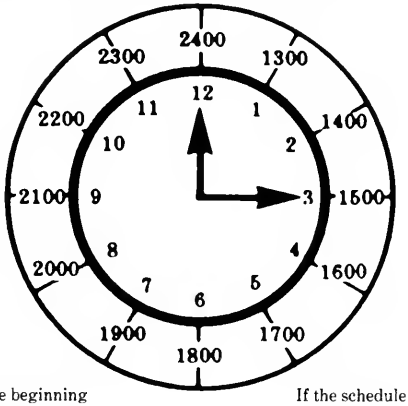
The "$" symbol beside the departmental abbreviation and course number indicates that the course has been designated as requiring student use of University, College/School or Departmental laboratory or computing resources. Students enrolling in each course so designated will be charged at $15.00 laboratory/computer course fee.

Courses numbered from one through 99 are preparatory courses carrying no college credit; courses in the 100, 200, 300 and 400 series are primarily designed for undergraduates; courses in the 500 series for graduates and advanced undergraduates; and courses in the 600 series for graduates only. Consent of the department is required to register for all practicum and individual special topics or special problems courses as well as internships and thesis or dissertation research.

All courses are subject to cancellation by the Director of Summer Sessions if there is inadequate enrollment.

Waiver of prerequisites is at the discretion of the instructor.

Please note that class meeting times in this bulletin are indicated in international time which is measured in hours numbered to 24 instead of 12.



If the schedule shows the class beginning at:	The beginning hour in terms of a 12-hour clock is:
0800	8:00 a.m.
0900	9:00 a.m.
1000	10:00 a.m.
1100	11:00 a.m.
1200	12:00 noon
1300	1:00 p.m.
1400	2:00 p.m.
1500	3:00 p.m.

If the schedule shows the class beginning at:	The beginning hour in terms of a 12-hour clock is:
1600	4:00 p.m.
1700	5:00 p.m.
1800	6:00 p.m.
1900	7:00 p.m.
2000	8:00 p.m.
2100	9:00 p.m.
2200	10:00 p.m.

SPECIAL GRADUATE CATEGORIES

FIRST SESSION AND SECOND SESSION

GR 596S	MR Summer Research	(046-596-001) 0
GR 597	Master's Exam Only	(046-597-001) 0
GR 598	MR Thesis Preparation	(046-598-001) 0
GR 696S	DR Summer Research	(046-696-001) 0
GR 697	Dissertation Research	(046-697-001) 0
GR 698	DR Thesis Preparation	(046-698-001) 0

Accounting

FIRST SESSION

ACC 210 Accounting I—Concepts of Financial Reporting 3
0800-0930 (004-210-001) Rockness
0800-0930 (004-210-002) Bartley
0950-1120 (004-210-003) Bartley
1140-1310 (004-210-004) Staff

ACC 220 Accounting II—An Introduction to Managerial Accounting 3
Prerequisite: ACC 210
0950-1120 (004-220-001) Staff
1140-1310 (004-220-002) McKee

ACC 310 Intermediate Financial Accounting I 3
Prerequisite: ACC 220
0950-1120 (004-310-001) Rockness

ACC 330 An Introduction to Income Taxation 3
Prerequisites: ACC 210 and EB 201
0800-0930 (004-330-001) Peace
0950-1120 (004-330-002) Peace

ACC 410 Advanced Financial Accounting 3
Prerequisite: ACC 311
0800-0930 (004-410-001) Frazier

ACC 450 Auditing Financial Information 3
Prerequisites: ACC 311, EB(ST) 350
0950-1120 (004-450-001) McKee

ACC 498 Independent Study in Accounting 1-6
Hours arranged (004-498-001) Staff

SECOND SESSION

ACC 210 Accounting I—Concepts of Financial Reporting 3
0800-0930 (004-210-001) Staff
0950-1120 (004-210-002) Staff

ACC 220 Accounting II—An Introduction to Managerial Accounting 3
Prerequisite: ACC 210
0800-0930 (004-220-001) Williams
0950-1120 (004-220-002) Williams

ACC 311 Intermediate Financial Accounting II 3
Prerequisite: ACC 310
1140-1310 (004-311-001) Staff
0950-1120 (004-311-002) Staff

ACC 320 Managerial Uses of Cost Data 3
Prerequisite: ACC 220
0950-1120 (004-320-001) Zuckerman

ACC 420 Production Cost Analysis and Control 3
Prerequisites: ACC 320 and EB (ST) 350
0800-0930 (004-420-001) Zuckerman

ACC 460 Specialized Financial Reporting Theory and Practice 3
Prerequisite: ACC 311
1140-1310 (004-460-001) Staff

ACC 498 Independent Study in Accounting 1-6
Hours arranged (004-498-001) Staff

TEN-WEEK SESSION

ACC 210E Accounting I—Concepts of Financial Reporting 3
1745-1930 TuTh (004-210-051) Brooks

ACC 220E Accounting II—An Introduction to Managerial Accounting 3
Prerequisite: ACC 210
1945-2130 TuTh (004-220-051) Staff

Agriculture and Life Sciences

FIRST SESSION

ALS 499H Honors Research 1-3
For junior and senior students in the College of Agriculture and Life Sciences who have a GPA of 3.0 or better. Participation is by invitation.
Hours arranged (006-499-001) Craig

SECOND SESSION

ALS 499H Honors Research 1-3
For junior and senior students in the College of Agriculture and Life Sciences who have a GPA of 3.0 or better. Participation is by invitation.
Hours arranged (006-499-001) Craig

Animal Science

FIRST SESSION

ANS 590 Topical Problems in Animal Science Maximum 6
Hours arranged (010-590-001) Cornwell

ANS 699 Research in Animal Science Credits Arranged
Hours arranged (010-699-001) Lassiter

SECOND SESSION

ANS (FS, NTR) 301 Modern Nutrition 3
Prerequisite: Sophomore standing. Food Science majors may use as a free elective only.
0950-1120 (010-301-001) Ash

ANS 590 Topical Problems in Animal Science Maximum 6
Hours arranged (010-590-001) Cornwell

ANS 699 Research in Animal Science Credits Arranged
Hours arranged (010-699-001) Lassiter

ADULT EDUCATION SESSION

*** ANS 500 Advanced Ruminant Nutrition** 3
Prerequisite: ANS 204 or ANS 415 Pond/Crickenberger/Whitlow
0900-1200
June 6-June 24—Three-Week Course—Final Exam June 24

Anthropology

FIRST SESSION

ANT 251 Physical Anthropology 3
1140-1310 (012-251-001) Rovner

ANT 252 Cultural Anthropology 3
0800-0930 (012-252-001) Nickerson
0950-1120 (012-252-002) Nickerson

ANT 252E Cultural Anthropology 3
1745-1930 MTuWTh (012-252-003) Staff

ANT 253 Prehistoric Archaeology 3
0950-1120 (012-253-001) Rovner

ANT 498 Special Topics in Anthropology 1-6
Prerequisite: Six hours of SOC/ANT
Hours arranged (012-498-001) Suval

ANT 591 Special Topics in Anthropology Credits Arranged
Prerequisite: ANT 501 or equivalent
Hours arranged (012-591-001) Suval

SECOND SESSION

ANT 251 Physical Anthropology 3
0800-0930 (012-251-001) Staff

ANT 252 Cultural Anthropology 3
0800-0930 (012-252-001) Ellovich
0950-1120 (012-252-002) Ellovich
1140-1310 (012-252-003) Wallace

ANT 252E Cultural Anthropology 3
1745-1930 MTuWTh (012-252-004) Staff

ANT 254 Language and Culture 3
0950-1120 (012-254-001) Wallace

ANT 498 Special Topics in Anthropology 1-6
Prerequisite: Six hours of SOC/ANT
Hours arranged (012-498-001) Suval

ANT 591 Special Topics in Anthropology Credits Arranged
Prerequisite: ANT 501 or equivalent
Hours arranged (012-591-001) Suval

***Course taught in the three-week Regional Summer School for Adult, Extension and Community College Educators (June 6-24). Special registration procedures are required. See page 28 for additional information.**

Architecture

FIRST SESSION

ARC 349 Historic Architecture Research 3
Prerequisite: DN 141 or DN 142 or ARC 244
Hours arranged (013-349-001) Weinel

ARC 494 Internship in Architecture 3-6
Prerequisites: Junior standing in Architecture; 3.0 GPA or better; and written approval of department head
Maximum 6 credit hours
Hours arranged (013-494-001) Burns

ARC 495 Independent Study in Architecture 1-3
Prerequisites: Junior standing in Architecture; 3.0 GPA or better; and written approval of department head
Maximum 6 credit hours
Hours arranged (013-495-001) Burns

ARC 595 Independent Study 1-3
Prerequisite: Graduate standing
Hours arranged (013-595-001) Burns

ARC 691 Special Topics in Architecture Credits Arranged
Prerequisite: Graduate standing
Hours arranged (013-691-001) Burns

SECOND SESSION

ARC 494 Internship in Architecture 3-6
Prerequisites: Junior standing in Architecture; 3.0 GPA or better; and written approval of department head
Maximum 6 credit hours
Hours arranged (013-494-001) Burns

ARC 495 Independent Study in Architecture 1-3
Prerequisites: Junior standing in Architecture; 3.0 GPA or better; and approval of department head
Maximum 6 credit hours
Hours arranged (013-495-001) Burns

ARC 595 Independent Study 1-3
Prerequisite: Graduate standing
Hours arranged (013-595-001) Burns

ARC 692 Special Topics in Architecture Credits Arranged
Prerequisite: Graduate standing
Hours arranged (013-692-001) Burns

TEN-WEEK SESSION

$ ARC 400 Architecture Studio 6
Prerequisite: DF 102 or written approval of department head and Dean
1340-1750 MTuWTh (013-400-051) Rifki
May 24-July 21—Eight-Week Course—Final Exam July 21

Biological and Agricultural Engineering

FIRST SESSION

BAE 590 Special Problems Credits Arranged
Prerequisite: Senior or Graduate standing in Biological and Agricultural Engineering
Hours arranged (016-590-001) Blum

BAE 690 Special Topics 1-4
Prerequisite: Graduate standing
Hours arranged (016-690-001) Sowell

BAE 699 Research in Biological and Agricultural Engineering Credits Arranged
Prerequisite: Graduate standing in Biological and Agricultural Engineering
Hours arranged (016-699-001) Sowell

SECOND SESSION

BAE 590 Special Problems Credits Arranged
Prerequisite: Senior or Graduate standing in Biological and Agricultural Engineering
Hours arranged (016-590-001) Blum

BAE 690 Special Topics 1-4
Prerequisite: Graduate standing
Hours arranged (016-690-001) Sowell

BAE 699 Research in Biological and Agricultural Engineering Credits Arranged
Prerequisite: Graduate standing in Biological and Agricultural Engineering
Hours arranged (016-699-001) Sowell

Biochemistry

FIRST SESSION

BCH 490 Special Studies in Biochemistry 1-3
Prerequisite: Senior standing
Hours arranged (015-490-001) Staff

$ BCH 554 Radioisotope Techniques in Biology 2
Prerequisite: BCH 451 or Consent of Instructor
0800-1200 (015-554-001) Sisler
May 24-June 14—Three-week course—Final Exam June 14

BCH 590 Special Topics in Biochemistry Credits Arranged
Prerequisite: BCH 451 or equivalent
Hours arranged (015-590-001) Staff

BCH 695 Special Topics in Biochemistry Credits Arranged
Prerequisite: Graduate standing in Biochemistry
Hours arranged (015-695-001) Staff

BCH 699 Biochemical Research Credits Arranged
Hours arranged (015-699-001) Staff

SECOND SESSION

BCH 451 Introductory Biochemistry 3
Prerequisite: CH 223
0950-1120 (015-451-001) Staff

BCH 490 Special Studies in Biochemistry 1-3
Prerequisite: Senior standing
Hours arranged (015-490-001) Staff

BCH 590 Special Topics in Biochemistry — Credits Arranged
Prerequisite: BCH 451 or equivalent
Hours arranged (015-590-001) — Staff

BCH 695 Special Topics in Biochemistry — Credits Arranged
Prerequisite: Graduate standing in Biochemistry
Hours arranged (015-695-001) — Staff

BCH 699 Biochemical Research — Credits Arranged
Hours arranged (015-699-001) — Staff

Biomathematics

FIRST SESSION

BMA 591 Special Topics — Maximum 3
Prerequisite: Consent of Instructor
Hours arranged (018-591-001) — Staff

BMA 691 Advanced Special Topics — 1-3
Prerequisite: Consent of Instructor
Hours arranged (018-691-001) — Staff

BMA 699 Research — Credits Arranged
Hours arranged (018-699-001) — Staff

SECOND SESSION

BMA 591 Special Topics — Maximum 3
Prerequisite: Consent of Instructor
Hours arranged (018-591-001) — Staff

BMA 691 Advanced Special Topics — 1-3
Prerequisite: Consent of Instructor
Hours arranged (018-691-001) — Staff

BMA 699 Research — Credits Arranged
Hours arranged (018-699-001) — Staff

Botany

FIRST SESSION

BO (ZO) 360 Introduction to Ecology — 3
(See Zoology)

$ BO (ZO) 365 Ecology Laboratory — 1
(See Zoology)

BO 590 Topical Problems — 1-3
Prerequisite: Consent of Instructor
Hours arranged (019-590-001) — Staff

BO 699 Research — Credits Arranged
Hours arranged (019-699-001) — Staff

SECOND SESSION

$ BO 200 Plant Life — 4
LR 0800-0930 (019-200-001) — Beckmann
LB 1340-1750 MW (019-200-101)
LB 1340-1750 TuTh (019-200-102)

BO 590 Topical Problems 1-3
Prerequisite: Consent of Instructor
Hours arranged (019-590-001) Staff

BO 699 Research Credits Arranged
Hours arranged (019-699-001) Staff

Biological Sciences

FIRST SESSION

$ BS 100 General Biology 4
Students may not receive credit for both BS 100 and BS 105
LR 0800-0930 (017-100-001) Wynn
LB 1020-1300 TuTh (017-100-101)
LB 1340-1620 TuTh (017-100-102)
LB 1020-1300 WF (017-100-103)
LB 1340-1620 WF (017-100-104)

BS 495A Special Topics in Biology 1-6
Hours arranged (017-495-001) Staff

BS 495T Special Topics in Biology: Laboratory Techniques for Secondary Teachers 3
Prerequisite: Consent of Instructor
Hours arranged Lytle/Williams
June 20-July 1—Two-week course—Final exam July 1

Special registration procedures are required for this course. Contact Dr. Charles F. Lytle, Biological Sciences, NCSU, Box 7611, Raleigh, NC 27695-7611 (919/737-3341).

SECOND SESSION

BS 495A Special Topics in Biology 1-6
Hours arranged (017-495-001) Staff

Civil Engineering

FIRST SESSION

CE 213 Introduction to Mechanics 3
Corequisite: MA 202. Not for CE Department majors.
0730-0900 (022-213-001) Staff

CE 214 Engineering Mechanics—Statics 3
Prerequisite: PY 205
Corequisite: MA 202
0910-1040 (022-214-001) Staff

CE 215 Engineering Mechanics—Dynamics 3
Prerequisite: A grade of C or better in CE 214
Corequisite: MA 301
1050-1220 (022-215-001) Staff

CE 313 Mechanics of Solids 3
Prerequisite: A grade of C or better in CE 214
Corequisite: MA 301
0910-1040 (022-313-001) Staff

CE 498A Special Problems in Civil Engineering 1-4
Prerequisite: Senior standing
Hours arranged (022-498-001) Wahls

CE 562 Construction Productivity 3
Prerequisite: CE 463 or equivalent
Hours arranged (022-562-001) Staff

CE 598 Civil Engineering Projects 1-6
Hours arranged (022-598-001) Wahls

CE 698 Advanced Reading in Civil Engineering 1-3
Prerequisite: Graduate standing
Hours arranged (022-698-001) Wahls

CE 699 Civil Engineering Research Credits Arranged
Hours arranged (022-699-001) Wahls

SECOND SESSION

CE 213 Introduction to Mechanics 3
Corequisite: MA 202. Not for CE Department majors.
0730-0900 (022-213-001) Staff

CE 214 Engineering Mechanics—Statics 3
Prerequisite: PY 205
Corequisite: MA 202
0910-1040 (022-214-001) Staff

CE 215 Engineering Mechanics—Dynamics 3
Prerequisite: A grade of C or better in CE 214
Corequisite: MA 301
1050-1220 (022-215-001) Staff

CE 313 Mechanics of Solids 3
Prerequisite: A grade of C or better in CE 214
Corequisite: MA 301
0730-0900 (022-313-001) Staff

CE 498A Special Problems in Civil Engineering 1-4
Prerequisite: Senior standing
Hours arranged (022-498-001) Wahls

CE 598 Civil Engineering Projects 1-6
Hours arranged (022-598-001) Wahls

CE 698 Advanced Reading in Civil Engineering 1-3
Prerequisite: Graduate standing
Hours arranged (022-698-001) Wahls

CE 699 Civil Engineering Research Credits Arranged
Hours arranged (022-699-001) Wahls

TEN-WEEK SESSION

CE 325 Structural Analysis 3
Prerequisites: CE 202 and CE 313
0910-1040 MWF (022-325-051) Staff

CE 327 Reinforced Concrete Design 3
Prerequisites: CE 325 and CE 332
1050-1220 TuTh (022-327-051) Staff

$ CE 382 Hydraulics 4
Prerequisites: CE 202, CE 215, MA 301
LR 0730-0900 MWF (022-382-051) Staff
LB 0730-0900 TuTh (022-382-151)

CE 426 Structural Steel Design 3
Prerequisite: CE 325
0910-1040 MWF (022-426-051) Staff

Chemistry

FIRST SESSION

$ CH 101 General Chemistry I 4
Prerequisite: MA 111 with a grade of C or better
LR 0800-0930 (021-101-001) Staff
LB 0940-1340 MW (021-101-101) (021-101-102) (021-101-103)
LB 1340-1750 MW (021-101-110) (021-101-111) (021-101-112)

$ CH 104 Experimental Chemistry 1
Prerequisite: CH 101
Corequisite: CH 105
LB 1340-1750 MW (021-104-001) Staff

CH 105 Chemistry Principles and Applications 3
Prerequisite: CH 101 with a grade of C or better. Credit cannot be received for both CH 105 and either CH 103 or CH 107.
0950-1120 (021-105-001) Staff

$ CH 107 Principles of Chemistry 4
Prerequisite: CH 101 with a grade of C or better.
LR 0950-1120 (021-107-001) Staff
LB 1340-1750 MW (021-107-109) (021-107-113) (021-107-114) (021-107-115) (021-107-116)

$ CH 221 Organic Chemistry I 4
Prerequisite: CH 107. Credit is not allowed for both CH 220 and CH 221.
LR 0800-0930 (021-221-001) Staff
LB 0940-1340 MW (021-221-101) (021-221-102) (021-221-103)
LB 1340-1750 MW (021-221-105) (021-221-106)

$ CH 223 Organic Chemistry II 4
Prerequisite: CH 221
LR 0800-0930 (021-223-001) Staff
LB 0940-1340 TuTh (021-223-109) (021-223-111)
LB 1340-1750 TuTh (021-223-112) (021-223-113)

$ CH 315 Quantitative Analysis 4
Prerequisite: CH 103 or CH 107, or CH 104 and CH 105. Credit is not allowed for both CH 315 and CH 317.
LR 0800-0930 (021-315-001) Staff
LB 0940-1340 MW (021-315-101)
LB 1340-1750 MW (021-315-102)

CH 401 Systematic Inorganic Chemistry 3
Corequisite: CH 431 or CH 331
0950-1120 (021-401-001) Staff

CH 431 Physical Chemistry I 3
Prerequisites: CH 107, MA 202, PY 203 or PY 208
Corequisite: MA 301
1140-1310 (021-431-001) Staff

$ CH 499 Senior Research in Chemistry 1-3
Prerequisite: Three years in Chemistry
Hours arranged (021-499-001) Staff

CH 699 Chemical Research Credits Arranged
Prerequisite: Graduate standing in Chemistry
Hours arranged (021-699-001) Staff

SECOND SESSION

$ CH 101 General Chemistry I 4
Prerequisite: MA 111 with a grade of C or better
LR 0800-0930 (021-101-001) Staff
LB 0940-1340 MW (021-101-101) (021-101-102)
LB 1340-1750 MW (021-101-110) (021-101-111)

$ CH 103 General Chemistry II 4
Prerequisite: CH 101
LR 0800-0930 (021-103-001) Staff
LB 0940-1340 MW (021-103-104) (021-103-105)
LB 1340-1750 MW (021-103-112)

$ CH 104 Experimental Chemistry 1
Prerequisite: CH 101
Corequisite: CH 105
LB 1340-1750 MW (021-104-001) Staff

CH 105 Chemistry Principles and Applications 3
Prerequisite: CH 101 with a grade of C or better. Credit cannot be received for both CH 105 and either CH 103 or CH 107.
0950-1120 (021-105-001) Staff

$ CH 107 Principles of Chemistry 4
Prerequisite: CH 101 with a grade of C or better.
LR 0950-1120 (021-107-001) Staff
LB 1340-1750 MW (021-107-109) (021-107-113) (021-107-114) (021-107-115)

$ CH 221 Organic Chemistry I 4
Prerequisite: CH 107. Credit is not allowed for both CH 220 and CH 221.
LR 0800-0930 (021-221-001) Staff
LB 0940-1340 MW (021-221-101) (021-221-102)

$ CH 223 Organic Chemistry II 4
Prerequisite: CH 221
LR 0800-0930 (021-223-001) Staff
LB 0940-1340 MW (021-223-109) (021-223-112)
LB 0940-1340 TuTh (021-223-110) (021-223-111)
LB 1340-1750 MW (021-223-115)

CH 433 Physical Chemistry II 3
Prerequisites: CH 431 and MA 301
1140-1310 (021-433-001) Staff

$ CH 499 Senior Research in Chemistry 1-3
Prerequisite: Three years in Chemistry
Hours arranged (021-499-001) Staff

CH 595T Special Topics in Chemistry: High School Teachers I 6
Prerequisite: Three years of chemistry or equivalent teaching experience.
0950-1120 (021-595-001) Staff

CH 691 Seminar Credits Arranged
Prerequisite: Graduate standing in Chemistry
Hours arranged (021-691-001) Staff

CH 699 Chemical Research Credits Arranged
Prerequisite: Graduate standing in Chemistry
Hours arranged (021-699-001) Staff

Chemical Engineering

FIRST SESSION

$ CHE 205 Chemical Process Principles 4
Prerequisites: MA 201, PY 205, CH 107
Corequisite: MA 202
1020-1230 (020-205-001) Staff

CHE 497 Chemical Engineering Projects I 3
Prerequisites: Senior standing, CHE 330
Hours arranged (020-497-001) Staff

CHE 498 Chemical Engineering Projects II 1-3
Prerequisites: Senior standing, CHE 330
Hours arranged (020-498-001) Staff

CHE 597 Chemical Engineering Projects 1-3
Prerequisite: Graduate standing
Hours arranged (020-597-001) Staff

CHE 699 Research Credits Arranged
Hours arranged (020-699-001) Staff

SECOND SESSION

$ CHE 225 Chemical Process Systems 3
Prerequisites: PY 208, a grade of C or better in CHE 205
Corequisite: MA 301
LR 1020-1230 TuTh (020-225-001) Staff
LB 0950-1120 MWF (020-225-101)
LB 1140-1310 MWF (020-225-102)

CHE 497 Chemical Engineering Projects I 3
Prerequisites: Senior standing, CHE 330
Hours arranged (020-497-001) Staff

CHE 498 Chemical Engineering Projects II 1-3
Prerequisites: Senior standing, CHE 330
Hours arranged (020-498-001) Staff

CHE 597 Chemical Engineering Projects 1-3
Prerequisite: Graduate standing
Hours arranged (020-597-001) Staff

CHE 699 Research Credits Arranged
Hours arranged (020-699-001) Staff

CO-OP PROGRAM

TWELVE-WEEK SESSION
(Deadlines for Ten-Week Session apply)

Engineering Undergraduate Students Only

COP 100E Co-op Work Program 0
Hours arranged (025-100-051) Weston

COP 200E Co-op Work Program 0
Hours arranged (025-200-051) Weston

COP 300E Co-op Work Program 0
Hours arranged (025-300-051) Weston

COP 400E Co-op Work Program 0
Hours arranged (025-400-051) Weston

COP 500E Co-op Work Program 0
Hours arranged (025-500-051) Weston

Forest Resources Undergraduate Students Only

COP 100F Co-op Work Program 0
Hours arranged (025-100-052) Weston

COP 200F Co-op Work Program 0
Hours arranged (025-200-052) Weston

COP 300F Co-op Work Program 0
Hours arranged (025-300-052) Weston

COP 400F Co-op Work Program 0
Hours arranged (025-400-052) Weston

COP 500F Co-op Work Program 0
Hours arranged (025-500-052) Weston

Humanities and Social Sciences Undergraduate Students Only

COP 100L Co-op Work Program 0
Hours arranged (025-100-053) Weston

COP 200L Co-op Work Program 0
Hours arranged (025-200-053) Weston

COP 300L Co-op Work Program 0
Hours arranged (025-300-053) Weston

COP 400L Co-op Work Program 0
Hours arranged (025-400-053) Weston

COP 500L Co-op Work Program 0
Hours arranged (025-500-053) Weston

Physical and Mathematical Sciences Undergraduate Students Only

COP 100P Co-op Work Program 0
Hours arranged (025-100-054) Weston

COP 200P Co-op Work Program 0
Hours arranged (025-200-054) Weston

COP 300P Co-op Work Program 0
Hours arranged (025-300-054) Weston

COP 400P Co-op Work Program Hours arranged (025-400-054)	0 Weston
COP 500P Co-op Work Program Hours arranged (025-500-054)	0 Weston
Textiles Undergraduate Students Only	
COP 100T Co-op Work Program Hours arranged (025-100-055)	0 Weston
COP 200T Co-op Work Program Hours arranged (025-200-055)	0 Weston
COP 300T Co-op Work Program Hours arranged (025-300-055)	0 Weston
COP 400T Co-op Work Program Hours arranged (025-400-055)	0 Weston
COP 500T Co-op Work Program Hours arranged (025-500-055)	0 Weston
Agriculture and Life Sciences Undergraduate Students Only	
COP 100A Co-op Work Program Hours arranged (025-100-056)	0 Weston
COP 200A Co-op Work Program Hours arranged (025-200-056)	0 Weston
COP 300A Co-op Work Program Hours arranged (025-300-056)	0 Weston
COP 400A Co-op Work Program Hours arranged (025-400-056)	0 Weston
COP 500A Co-op Work Program Hours arranged (025-500-056)	0 Weston
Design Undergraduate Students Only	
COP 100D Co-op Work Program Hours arranged (025-100-057)	0 Weston
COP 200D Co-op Work Program Hours arranged (025-200-057)	0 Weston
COP 300D Co-op Work Program Hours arranged (025-300-057)	0 Weston
COP 400D Co-op Work Program Hours arranged (025-400-057)	0 Weston
COP 500D Co-op Work Program Hours arranged (025-500-057)	0 Weston
Education Undergraduate Students Only	
COP 100W Co-op Work Program Hours arranged (025-100-058)	0 Weston
COP 200W Co-op Work Program Hours arranged (025-200-058)	0 Weston

COP 300W Co-op Work Program 0
Hours arranged (025-300-058) Weston

COP 400W Co-op Work Program 0
Hours arranged (025-400-058) Weston

COP 500W Co-op Work Program 0
Hours arranged (025-500-058) Weston

Graduate Students Only

COP 500N Co-op Work Program 0
Hours arranged. Full-time Alternating. (025-500-059) Weston

COP 500R Co-op Work Program 0
Hours arranged. Part-time Parallel. (025-500-060) Weston

Crop Science

FIRST SESSION

CS 591 Special Problems Credits Arranged
Prerequisite: Consent of Instructor
Hours arranged (024-591-001) Emery

CS 699 Research Credits Arranged
Prerequisite: Graduate standing
Hours arranged (024-699-001) Emery

SECOND SESSION

CS 591 Special Problems Credits Arranged
Prerequisite: Consent of Instructor
Hours arranged (024-591-001) Emery

CS 699 Research Credits Arranged
Prerequisite: Graduate standing
Hours arranged (024-699-001) Emery

ADULT EDUCATION SESSION

***CS 591G Crop Stress Relations** 3
Prerequisite: BO 424 or an equivalent plant physiology course
0800-1000 (plus three 3-hour field trips, times arranged) Patterson
June 6-June 24—Three-Week Course—Final Exam June 24

***Course taught in the three-week Regional Summer School for Adult, Extension and Community College Educators (June 6-24). Special registration procedures are required. See page 28 for additional information.**

Computer Science

TEN-WEEK SESSION

$ CSC 101E Introduction to Programming 3
Prerequisite: MA 111 with a grade of C or better
LR 1745-1930 MW (023-101-051) Nelson
LB 1945-2130 MW (023-101-151) (023-101-152) (023-101-153) (023-101-154) (023-101-155) (023-101-156)

$ CSC 102 Programming Concepts 3
Prerequisite: CSC 101
1340-1525 MW (023-102-051) Brain

$ CSC 102E Programming Concepts 3
Prerequisite: CSC 101
1745-1930 MW (023-102-052) Brain

$ CSC 111 Introduction to FORTRAN Programming 2
0800-0930 MW (023-111-051) Martin

CSC 200A Introduction to Computers and Their Uses 3
A student who has previously taken CSC 101 or CSC 111 may not receive credit for this course.
1140-1255 TuTh (023-200-051) Lindhome/Curtis
NOTE: Students registering for CSC 200A must also register for CSC 200X

$ CSC 200X Introduction to Computers Laboratory 0
1305-1605 Tu (023-200-151)
0900-1200 W (023-200-152)
1305-1605 W (023-200-153)

CSC 200E Introduction to Computers and Their Uses 3
A student who has previously taken CSC 101 or CSC 111 may not receive credit for this course.
1615-1730 TuTh (023-200-052) Lindhome/Curtis
NOTE: Students registering for CSC 200E must also register for CSC 200Y

$ CSC 200Y Introduction to Computers Laboratory 0
1745-2045 Tu (023-200-161)
1745-2045 W (023-200-162)
1745-2045 Th (023-200-163)

$ CSC 201 Basic Computer Organization and Assembly Language 3
Prerequisite: CSC 102
1340-1525 TuTh (023-201-051) E. Hodges

$ CSC 201E Basic Computer Organization and Assembly Language 3
Prerequisite: CSC 102
1945-2130 TuTh (023-201-052) Lasher

$ CSC 202E Concepts and Facilities of Operating Systems 3
Prerequisite: CSC 201 or equivalent
1745-1930 TuTh (023-202-051) Miller

$ CSC 302 Introduction to Numerical Methods 3
Prerequisites: CSC 101 or CSC 111, MA 202
1200-1345 MW (023-302-051) Reid

$ CSC 311 Data Structures 3
Prerequisite: CSC 102
1140-1325 TuTh (023-311-051) L. Hodges

$ CSC 311E Data Structures 3
Prerequisite: CSC 102
1745-1930 TuTh (023-311-052) E. Hodges

$ CSC 312 Computer Organization and Logic 4
Prerequisite: CSC 201
Corequisite: CSC 322
LR 0950-1120 MW (023-312-051) Martin
LB 1340-1550 MW (023-312-151) (023-312-152)

CSC (MA) 322 Discrete Mathematical Structures 3
Prerequisite: MA 202
Corequisite: CSC 311
0910-1055 MW (023-322-051) Williamson

$ CSC 417 Theory of Programming Languages 3
Prerequisite: CSC (MA) 322
1200-1345 MW (023-417-051) Williamson

CSC 421E Introduction to Management Information Systems 3
Prerequisite: CSC 311
1745-1930 MW (023-421-051) Reid

$ CSC 431E File Organization and Processing 3
Prerequisite: CSC 311
1545-1730 TuTh (023-431-051) Ruchte

$ CSC 461 Computer Graphics 3
Prerequisites: MA 202 or MA 212; CSC 101 or CSC 111
1340-1525 TuTh (023-461-051) Love

$ CSC 461E Computer Graphics 3
Prerequisites: MA 202 or MA 212; CSC 101 or CSC 111
1745-1930 TuTh (023-461-052) L. Hodges

CSC 495 Special Topics in Computer Science 1-6
Prerequisite: Consent of Instructor
Hours arranged (023-495-051) Honeycutt

$ CSC 499 Independent Research in Computer Science 1-6
Prerequisite: Consent of Department
Hours arranged (023-499-051) Honeycutt

Computer Studies

TEN-WEEK SESSION

$ CSE 452 Assembly Language and Basic Computer Organization 1
Prerequisites: Higher level programming language and Consent of Instructor
No degree credit for Computer Science or Computer Studies majors or anyone having received credit for CSC 201 or CSC 256.
1340-1525 TuTh (009-452-051) E. Hodges

$ CSE 452E Assembly Language and Basic Computer Organization 1
Prerequisites: Higher level programming language and Consent of Instructor
No degree credit for Computer Science or Computer Studies majors or anyone having received credit for CSC 201 or CSC 256.
1945-2130 TuTh (009-452-052) Lasher

$ CSE 453 Data Structures 1
Prerequisites: Higher level programming language and Consent of Instructor
Corequisite: CSE 452 or equivalent
No degree credit for Computer Science or Computer Studies majors or anyone having received credit for CSC 311.
1140-1325 TuTh (009-453-051) L. Hodges

$ CSE 453E Data Structures 1
Prerequisites: Higher level programming language and Consent of Instructor
Corequisite: CSE 452 or equivalent
No degree credit for Computer Science or Computer Studies majors or anyone having received credit for CSC 311.
1745-1930 TuTh (009-453-052) E. Hodges

CSE 454 Computer Organization and Logic 1
Prerequisites: CSE 452 or equivalent and Consent of Instructor
No degree credit for Computer Science or Computer Studies majors or anyone having received credit for CSC 312.
0950-1120 MW (009-454-051) Martin

CSE 693 Individual Topics in Computer Studies 1-3
Prerequisites: Graduate standing, Consent of Instructor
Hours arranged (009-693-051) Honeycutt

$ CSE 699 Computer Studies Research Credits Arranged
Prerequisites: Graduate standing, Consent of Instructor
Hours arranged (009-699-051) Honeycutt

Design

FIRST SESSION

DN 494 Internship in Design 3-6
Prerequisites: Junior standing; 3.0 GPA or better; and approval of department head
Maximum 6 credit hours
Hours arranged (026-494-001) Joyner

DN 495 Independent Study in Design 1-3
Prerequisite: Junior standing in Design; 3.0 GPA or better; and approval of department head
Maximum 6 credit hours
Hours arranged (026-495-001) Joyner

SECOND SESSION

DN 494 Internship in Design 3-6
Prerequisites: Junior standing; 3.0 GPA or better; and approval of department head
Maximum 6 credit hours
Hours arranged (026-494-001) Joyner

DN 495 Independent Study in Design 1-3
Prerequisites: Junior standing in Design: 3.0 GPA or better; and approval of department head
Maximum 6 credit hours
Hours arranged (026-495-001) Joyner

Economics and Business

FIRST SESSION

EB 201 Economics I 3
Credit will not be awarded for both EB 201 and EB 212. Students interested in Agriculture and Natural Resources should enroll in EB 212 instead of this course.
0800-0930 (027-201-001) Flath
0950-1120 (027-201-002) Flath
0950-1120 (027-201-003) Liebowitz
0950-1120 (027-201-004) V. Smith
1340-1510 (027-201-005) Liebowitz
1140-1310 (027-201-006) Staff
0800-0930 (027-201-007) Staff

EB 202 Economics II 3
Prerequisite: EB 201 or EB 212
0800-0930 (027-202-001) Staff
0950-1120 (027-202-002) Staff

EB 301 Intermediate Microeconomics 3
Prerequisites: MA 113 or MA 112 and EB 201 or EB 212
0800-0930 (027-301-001) Grennes
0950-1120 (027-301-002) Ball
1340-1510 (027-301-003) Ball

EB 302 Intermediate Macroeconomics 3
Prerequisites: EB 201 or EB 212; MA 113 or MA 112
0800-0930 (027-302-001) Rossana
1140-1310 (027-302-002) McElroy
0950-1120 (027-302-003) McElroy

EB 307 Business Law I 3
Prerequisite: EB 201 or EB 212. Credit for both EB 306 and EB 307 is not allowed.
1140-1310 (027-307-001) Carraway

EB 313 Marketing Methods 3
Prerequisite: EB 201 or EB 212
1140-1310 (027-313-001) Kimbrough
0950-1120 (027-313-002) Kimbrough

EB 325 Managerial Economics 3
Prerequisite: EB 201 or EB 212
0800-0930 (027-325-001) Sloan
0950-1120 (027-325-002) Sloan

EB 326 Human Resource Management 3
Prerequisite: EB 201 or EB 212
1140-1310 (027-326-001) Fisher
0950-1120 (027-326-002) Fisher

EB (ST) 350 Economics and Business Statistics 3
Prerequisites: MA 114; EB 201 or EB 212 or equivalent
0800-0930 (027-350-001) Wilson
0950-1120 (027-350-002) Wilson
0800-0930 (027-350-003) V. Smith

EB 404 Money, Financial Markets, and the Economy 3
Prerequisite: EB 302
0800-0930 (027-404-001) Karanjia

EB 420 Corporation Finance 3
Prerequisites: EB 201 or EB 212 and ACC 260 or ACC 265
0950-1120 (027-420-001) Karanjia
0800-0930 (027-420-002) Kupiec

EB 422 Investments and Portfolio Management 3
Prerequisites: EB (ST) 350 or ST 311 and EB 420
0950-1120 (027-422-001) Kupiec

EB 431 Labor Economics 3
Prerequisite: EB 301
0800-0930 (027-431-001) Wessels
0950-1120 (027-431-002) Wessels

EB 448 International Economics 3
Prerequisite: EB 301
0950-1120 (027-448-001) Grennes

EB 475 Comparative Economic Systems 3
Prerequisite: EB 201 or EB 212
0950-1120 (027-475-001) Turner

EB 498 Independent Study in Economics and Business 1-6
Prerequisite: Consent of department
Hours arranged (027-498-001) Staff

EB 502 Income and Employment Theory 3
Prerequisites: MA 113, EB 301 and EB 302, EB (ST) 350
0800-0930 (027-502-001) Lapp

EB 598 Topical Problems in Economics 1-6
Prerequisite: Consent of Instructor
Hours arranged (027-598-001) Staff

EB 699 Research in Economics Credits Arranged
Prerequisite: Graduate standing
Hours arranged (027-699-001) Staff

SECOND SESSION

EB 201 Economics I 3
Credit will not be awarded for both EB 201 and EB 212. Students interested in Agriculture and Natural Resources should enroll in EB 212 instead of this course.
0800-0930 (027-201-001) Staff
0950-1120 (027-201-002) (027-201-004) Staff
1140-1310 (027-201-003) Staff

EB 202 Economics II 3
Prerequisite: EB 201 or EB 212
0800-0930 (027-202-001) Staff
0950-1120 (027-202-002) Staff

EB 212 Economics of Agriculture 3
Prerequisite: MA 111. Credit will not be awarded for both EB 201 and EB 212.
0950-1120 (027-212-001) Peeler

EB 301 Intermediate Microeconomics 3
Prerequisites: MA 113 or MA 112 and EB 201 or EB 212
0950-1120 (027-301-001) Staff
0800-0930 (027-301-002) Staff

EB 302 Intermediate Macroeconomics 3
Prerequisites: EB 201 or EB 212; MA 113 or MA 112
0950-1120 (027-302-001) Fisher
0950-1120 (027-302-002) Cuddy
0800-0930 (027-302-003) Cuddy

EB 308 Business Law II 3
Prerequisite: EB 307
0950-1120 (027-308-001) Huggard
1140-1310 (027-308-002) Huggard

EB 313 Marketing Methods 3
Prerequisite: EB 201 or EB 212
0800-0930 (027-313-001) Hess

EB 325 Managerial Economics 3
Prerequisite: EB 201 or EB 212
0950-1120 (027-325-001) Newmark

EB (ST) 350 Economics and Business Statistics 3
Prerequisites: MA 114; EB 201 or EB 212 or equivalent
0800-0930 (027-350-001) McCrickard
0950-1120 (027-350-002) McCrickard

EB (HI) 370 The Rise of Industrialism 3
Prerequisite: EB 201 or EB 212
1140-1310 (027-370-001) D. Fisher

EB 420 Corporation Finance 3
Prerequisites: EB 201 or EB 212, and ACC 260 or ACC 265
0800-0930 (027-420-001) M. Fisher

EB 422 Investments and Portfolio Management 3
Prerequisites: EB (ST) 350 or ST 311 and EB 420
0950-1120 (027-422-001) Jones
1140-1310 (027-422-002) Jones

EB 431 Labor Economics 3
Prerequisite: EB 301
0800-0930 (027-431-001) Fearn

EB 498 Independent Study in Economics and Business 1-6
Prerequisite: Consent of department
Hours arranged (027-498-001) Staff

EB 501 Price Theory 3
Prerequisites: MA 113 and EB 301
1140-1310 (027-501-001) Fearn

EB 598 Topical Problems in Economics 1-6
Prerequisite: Consent of Instructor
Hours arranged (027-598-001) Staff

EB 699 Research in Economics Credits Arranged
Prerequisite: Graduate standing
Hours arranged (027-699-001) Staff

TEN-WEEK SESSION

EB 307E Business Law I 3
Prerequisite: EB 201 or EB 212. Credit for both EB 306 and EB 307 is not allowed.
1745-1930 MW (027-307-051) Staff

EB 603E History of Economic Thought 3
Prerequisites: EB 501, EB 502 or equivalent
1745-1930 MW (027-603-051) D. Fisher

EB 625E Long Range Planning in Business and Industry 3
Prerequisite: EB 501
1745-1930 TuTh (027-625-051) Newmark

ADULT EDUCATION SESSION

***EB 403 Economics of Consumer Decisions** 3
Prerequisite: EB 201 or EB 212 or equivalent
1330-1630 Walden
June 6-June 24—Three-Week Course—Final Exam June 24

***EB 433 U. S. Agricultural Policy** 3
Prerequisite: EB 301 or EB 401
0830-1130 Holder
June 6-June 24—Three-Week Course—Final Exam June 24

***Course taught in the three-week Regional Summer School for Adult, Extension and Community College Educators (June 6-24). Special registration procedures are required. See page 28 for additional information.**

FIRST SESSION

ECE 331 Principles of Electrical Engineering I 3
Prerequisites: MA 201, PY 208
Not available to EE and CPE majors
0800-0930 (030-331-001) Staff

ECE 435 Elements of Control 3
Prerequisites: ECE 301, ECE 302, ECE 314
0950-1120 (030-435-001) Staff

ECE 699 Electrical Engineering Research Credits Arranged
Prerequisites: Graduate standing in Electrical and Computer Engineering and approval of advisor
Hours arranged (030-699-001) Staff

SECOND SESSION

ECE 332 Principles of Electrical Engineering II 3
Prerequisite: ECE 331
Not available to undergraduates in Electrical Engineering
1140-1310 (030-332-001) Staff

ECE 436 Digital Control Systems 3
Prerequisite: ECE 435
1730-1915 MTuWTh (030-436-001) Staff

ECE 699 Electrical Engineering Research Credits Arranged
Prerequisites: Graduate standing in Electrical and Computer Engineering and approval of advisor
Hours arranged (030-699-001) Staff

TEN-WEEK SESSION

ECE 211 Electric Circuits I 3
Prerequisites: Sophomore standing and GPA 2.4 or above with a grade of C or better in ENG 111, MA 141S, MA 241S, and PY 205.
Corequisites: PY 208, MA 202S (Note: students may satisfy the MA corequisite by scheduling MA 202S in the Second Summer Session)
1140-1255 MWF (030-211-051) Staff

ECE 212 Fundamentals of Logic Design 3
Prerequisites: Sophomore standing and GPA 2.4 or above and a grade of C or better in ENG 111, MA 141S, MA 241S, and PY 205.
0950-1105 MWF (030-212-051) Staff

$ ECE 213 Electronic Circuits I Laboratory 1
Prerequisite: ECE 211 (Correspondence students)
Corequisite: ECE 211
1345-1635 M (030-213-051) Staff
1135-1425 Tu (030-213-052) Staff
1445-1735 Tu (030-213-053) Staff
1345-1635 W (030-213-054) Staff
1135-1425 Th (030-213-055) Staff
1445-1735 Th (030-213-056) Staff

$ ECE 214 Fundamentals of Logic Design Laboratory 1
Corequisite: ECE 212
1135-1425 M (030-214-051) Staff
1445-1735 M (030-214-052) Staff
1135-1425 Tu (030-214-053) Staff
1445-1735 Tu (030-214-054) Staff
1135-1425 W (030-214-055) Staff
1445-1735 W (030-214-056) Staff

$ ECE 301 Linear Systems 3
Prerequisite: A grade of C or better in ECE 211
0950-1105 MWF (030-301-051) Staff

$ ECE 302 Electrical Circuits II with Numerical Applications 3
Prerequisites: CSC 101 and a grade of C or better in ECE 211
0800-0915 MWF (030-302-051) Staff

ECE 303 Electromagnetic Fields 3
Prerequisites: MA 301S and a grade of C or better in ECE 211
1140-1255 MWF (030-303-051) Kauffman

ECE 409 Introduction to Telecommunications Engineering 3
Prerequisite: ECE 301
0800-0915 MWF (030-409-051) Bottomley

ECE 540 Electromagnetic Fields 3
Prerequisite: ECE 448
1530-1645 MWF (030-540-051) Kauffman

Education

FIRST SESSION

ED 105 College Developmental Reading 3
Credit is not applicable toward graduation in any curriculum.
1300-1430 (028-105-001) Kuzminski

ED 200 Principles for Teaching Geography 3
0940-1110 (028-200-001) Harper

ED 203 Introduction to Teaching Mathematics and Science 3
0800-1120 (028-203-001) Wheatley

ED 205 Introduction to Teaching Humanities and Social Sciences 3
Prerequisite: Sophomore standing
0800-0930 (028-205-001) Harper

ED 296 Special Topics in Education 1-3
Hours arranged (028-296-001) Williams

ED 296B Special Topics in Education: Health Care Delivery Systems 3
1700-2030 MTh (028-296-002) Patterson

ED 344 School and Society 3
Prerequisite: Junior or Senior standing
1340-1510 (028-344-001) Staff

ED 451 Improving Reading In Secondary Schools 2
Prerequisite: Six hours of ED and/or PSY
1135-1235 (028-451-001) Kuzminski

ED 496 Special Topics in Education 1-3
Prerequisites: Junior or Senior standing and Consent of Instructor
Hours arranged (028-496-001) Williams

ED 496N Special Topics in Education: New Developments in Teaching English as a Second Language 3
Prerequisites: Junior or Senior standing and Consent of Instructor
1745-1900 MTuWTh (028-496-002) Fennell

ED 526 Teaching in College 3
1300-1430 (028-526-001) Wheatley

ED 530E Theories and Techniques of Counseling 3
Prerequisite: Six hours of ED or PSY
Corequisite: ED 520 or equivalent
1600-1930 TuTh (028-530-001) Saidla
1600-1930 MW (028-530-002) Gerler

ED 590 Special Problems in Guidance Maximum 6
Prerequisites: Six hours graduate work in department or equivalent and Consent of Instructor
Hours arranged (028-590-001) Staff

ED 592 Special Problems in Mathematics Teaching 1-3
Prerequisite: ED 471 or equivalent
Hours arranged (028-592-001) Staff

ED 593C Special Problems in Occupational Education: Innovation/Entrepreneurship for Educational Leadership 3
Prerequisite: Senior standing, PBS status, or Graduate standing in OED
0900-1600 (028-593-001) Wenig
June 13-June 28—Two-Week Course—Final Exam June 28

Registration for this course must be completed during the regularly scheduled Pre-registration and Registration times set for the First Summer Session.

ED 594 Special Problems in Science Teaching 1-6
Prerequisite: ED 476 or equivalent
Hours arranged (028-594-001) Staff

ED 596 Topical Problems in Adult and Community College Education Credits Arranged
Prerequisite: Graduate standing or PBS status
Hours arranged (028-596-001) Staff

ED 596A Topical Problems in Adult and Community College Education: Death and Dying—A Lifespan Issue 3
Prerequisite: Graduate standing or PBS status
1600-1930 MW (028-596-002) Glass

ED 596B Topical Problems in Adult and Community College Education: Working in Groups in Adult Education 3
Prerequisite: Graduate standing or PBS status
1600-1930 TuTh (028-596-003) Glass

ED 597 Special Problems in Education 1-3
Prerequisite: Graduate standing or PBS status
Hours arranged (028-597-001) Exum

ED 597G Special Problems in Education: Personal Publishing 3
Prerequisite: Graduate standing or PBS status
1600-1930 TuTh (028-597-002) Ballenger

ED 598 Special Problems in Curriculum and Instruction 1-6
Prerequisites: Six hours of ED or PSY and Consent of Instructor
Hours arranged (028-598-001) Staff

ED 598F Special Problems in Curriculum and Instruction: Alternatives for the Middle Years 3
Prerequisites: Six hours of ED or PSY and Consent of Instructor
0830-1500 Arnold
0830-1500 Stevenson
June 20-July 1—Two-Week course—Final Exam July 1
Special registration procedures are required. See page 27 for additional information.

ED 599 Research Projects in Education 1-3
Prerequisites: Consent of Instructor; ED 532 or equivalent
Hours arranged (028-599-001) Exum

ED 599A Research Projects in Education: Adult and Community College Education 1-3
Prerequisites: Consent of Instructor; ED 532 or equivalent
Hours arranged (028-599-002) Staff

ED 621 Internship in Education 3-9
Prerequisites: Nine credit hours in graduate level courses and Consent of Instructor
Hours arranged (028-621-001) Exum

ED 621A Internship in Education: Special Education 3
Prerequisites: Nine credit hours in graduate level courses and Consent of Instructor
Hours arranged (028-621-002) Crossland

ED 636 Observation and Supervised Field Work 1-3
Prerequisite: Consent of Instructor
Hours arranged (028-636-001) Staff

ED 639E Group Counseling 3
Prerequisites: ED 530 and one of the following: ED 520, ED 534, ED 553, or ED 535
1600-1930 TuTh (028-639-001) Gerler

ED 699 Thesis and Dissertation Research Credits Arranged
Prerequisites: 15 hours of Education; Consent of Instructor
Hours arranged (028-699-001) Exum

ED 699A Thesis and Dissertation Research: Adult and Community College Education Credits Arranged
Prerequisites: 15 hours of Education; Consent of Instructor
Hours arranged (028-699-002) Staff

SECOND SESSION

ED 105 College Developmental Reading 3
Credit is not applicable toward graduation in any curriculum
0800-0930 (028-105-001) Staff

ED 210 College Tutoring 2
Registration priority will be given to students who plan to become tutors or who are tutoring
LR Hours arranged (028-210-001) Staff
LB 1200-1300 MWF (028-210-101)

ED 296 Special Topics in Education 1-3
Hours arranged (028-296-001) Williams

ED 344 School and Society 3
Prerequisite: Junior or Senior standing
0945-1125 (028-344-001) Staff

ED 496 Special Topics in Education 1-3
Prerequisites: Junior or Senior standing and Consent of Instructor
Hours arranged (028-496-001) Williams

ED 532 Introduction to Educational Inquiry 3
Prerequisite: Graduate standing or PBS status
1140-1310 (028-532-001) Staff

ED 541B Practicum in Education Administration 1-6
Prerequisites: ED 550 and Consent of Instructor
Hours arranged (028-541-001) Taylor

ED 590 Special Problems in Guidance Maximum 6
Prerequisites: Six hours graduate work in department or equivalent and Consent of Instructor
Hours arranged (028-590-001) Staff

ED 592 Special Problems in Mathematics Teaching 1-3
Prerequisite: ED 471 or equivalent
Hours arranged (028-592-001) Staff

ED 593A Special Problems in Occupational Education: Teaching Technical Content in Agricultural Education 3
Prerequisites: Senior standing, PBS status, or Graduate standing in OED
1600-1900 (028-593-001) Malpiedi
July 5-July 25—Three-Week Course—Final Exam July 25

ED 593B Special Problems in Occupational Education: Advanced Teaching Procedures in Agricultural Education 3
Prerequisites: Senior standing, PBS status, or Graduate standing in OED
0900-1200 (028-593-002) Flowers
July 5-July 25—Three-Week Course—Final Exam July 25

ED 593C Special Problems in Occupational Education: Advanced Microcomputer Applications in Occupational Education 3
Prerequisites: Senior standing, PBS status, or Graduate standing in OED
1300-1600 (028-593-003) Malpiedi
July 5-July 25—Three-Week Course—Final Exam July 25

ED 593D Special Problems in Occupational Education: Marketing Education and Training Programs 3
Prerequisites: Senior standing, PBS status, or Graduate standing in OED
1730-2130 WTh (028-593-004) Burrow

ED 594 Special Problems in Science Teaching 1-6
Prerequisite: ED 476 or equivalent
Hours arranged (028-594-001) Staff

ED 596 Topical Problems in Adult and Community College Education Credits Arranged
Prerequisite: Graduate standing or PBS status
Hours arranged (028-596-001) Staff

ED 597 Special Problems in Education 1-3
Prerequisite: Graduate standing or PBS status
Hours arranged (028-597-001) Exum

ED 598 Special Problems in Curriculum and Instruction 1-6
Prerequisites: Six hours of ED or PSY and Consent of Instructor
Hours arranged (028-598-001) Staff

ED 598D Special Problems in Curriculum and Instruction: Teaching of Writing Institute (Capital Area Writing Project) 6
Prerequisites: Six hours of ED or PSY and Consent of Instructor
0815-1530 (028-598-005) Pritchard
0815-1530 (028-598-006) Buckner
June 27-July 26—Four-Week Course—Final Exam July 26
(See "Special Courses and Institutes," page 30)

ED 598J Special Problems in Curriculum and Instruction: Counseling the Gifted Individual 3
Prerequisites: Six hours of ED or PSY and Consent of Instructor
1300-1600 (028-598-007) Aubrecht
June 20-July 11—Three-Week Course—Final Exam July 11
(See "Special Courses and Institutes," page 28)

ED 598I Special Problems in Curriculum and Instruction: Intelligence 3
Prerequisites: Six hours of ED or PSY and Consent of Instructor
0900-1200 (028-598-008) Aubrecht
June 20-July 11—Three-Week Course—Final Exam July 11
(See "Special Courses and Institutes," page 28)

ED 599 Research Projects in Education 1-3
Prerequisites: Consent of Instructor; ED 532 or equivalent
Hours arranged (028-599-001) Exum

ED 599A Research Projects in Education: Adult and Community College Education 1-3
Prerequisites: Consent of Instructor; ED 532 or equivalent
Hours arranged (028-599-002) Staff

ED 621 Internship in Education 3-9
Prerequisites: Nine credit hours in graduate level courses and Consent of Instructor
Hours arranged (028-621-001) Exum

ED 636 Observation and Supervised Field Work 1-3
Prerequisite: Consent of Instructor
Hours arranged (028-636-001) Staff

ED 693 Advanced Special Problems in Occupational Education: Clinical Evaluation of Students 3
Prerequisite: Master's degree in Vocational field or Consent of Instructor
1710-2030 MW (028-693-001) Davis

ED 699 Thesis and Dissertation Research Credits Arranged
Prerequisites: 15 hours of education; Consent of Instructor
Hours arranged (028-699-001) Exum

ED 699A Thesis and Dissertation Research: Adult and Community College Education Credits Arranged
Prerequisites: 15 hours of education; Consent of Instructor
Hours arranged (028-699-002) Staff

ADULT EDUCATION SESSION

The following courses will be taught in the three-week Regional Summer School of Adult, Extension and Community College Educators (June 6-24). Special registration procedures are required. See page 28 for additional information.

ED 596C Topical Problems in Adult and Community College Education: Instructional Leadership in the Community College 3
Prerequisite: Graduate standing or PBS status. Limited to participants in the Instructional Administrators Leadership Institute or by Consent of Instructor
0845-1630 Tollefson
June 13-June 24—Two-Week Course—Final Exam June 24

ED 596D Topical Problems in Adult and Community College Education: Extension Education Methods 3
Prerequisite: Graduate standing or PBS status
0830-1200 Lamble
June 6-June 24—Three-Week Course—Final Exam June 24

ED 596I Topical Problems in Adult and Community College Education: Emerging Issues in Adult Education 3
Prerequisite: Graduate standing or PBS status
1300-1630 Griffith
June 6-June 24—Three-Week Course—Final Exam June 24

ED 596J Topical Problems in Adult and Community College Education: Leading and Working with People 1
Prerequisite: Graduate standing or PBS status
0830-1200 Joseph
June 6-June 10—One-Week Course—Final Exam June 10

ED 596K Topical Problems in Adult and Community College Education: Developing Supervisory Skills 1
Prerequisite: Graduate standing or PBS status
0830-1200 Joseph
June 13-June 17—One-Week Course—Final Exam June 17

ED 596M Topical Problems in Adult and Community College Education: Improving Administrative Skills 1
Prerequisite: Graduate standing or PBS status
0830-1200 Joseph
June 20-June 24—One-Week Course—Final Exam June 24

ED 696 Seminar in Adult and Community College Education: Leadership Strategies 2
Prerequisite: Graduate standing. Limited to participants in the Instructional Administrators Leadership Institute or by Consent of Instructor
Hours arranged Tollefson
June 13-June 24—Two-Week Course—Final Exam June 24

English

FIRST SESSION

FRESHMAN ENGLISH

ENG 111 Composition and Rhetoric 3
General University requirement. Successful completion of ENG 111 requires a grade of C or better.
0800-0930 (036-111-001) (036-111-004) Staff
0950-1120 (036-111-002) (036-111-005) Staff
1140-1310 (036-111-003) (036-111-006) Staff

ENG 112 Composition and Reading 3
General University requirement.
Prerequisite: A grade of C or better in ENG 111.
0800-0930 (036-112-001) (036-112-004) (036-112-007) Staff
0950-1120 (036-112-002) (036-112-005) (036-112-008) Staff
1140-1310 (036-112-003) (036-112-006) Staff

WRITING AND LANGUAGE

The prerequisite for all courses in writing and language at the 200-level and above is the completion of ENG 111 and ENG 112.

ENG 214 Introduction to Editing 3
1140-1310 (036-214-001) Kochersberger

ENG 215 Principles of News and Article Writing 3
0950-1120 (036-215-001) Kochersberger

ENG 221 Communication for Business and Management 3
0800-0930 (036-221-001) Covington

ENG 321 The Communication of Technical Information 3
Prerequisite: Junior standing
0800-0930 (036-321-001) (036-321-004) Staff
0950-1120 (036-321-002) (036-321-005) Staff
1140-1310 (036-321-003) (036-321-006) Staff

LITERATURE

The prerequisite for all literature courses is the completion of ENG 111 and ENG 112.

ENG 205 Studies in Great Works of Literature 3
The courses ENG 205, ENG 206, ENG 207, and ENG 208 are designed for students not enrolled in Humanities and Social Sciences.
0950-1120 (036-205-001) Staff

ENG 208 Studies in Fiction 3
The courses ENG 205, ENG 206, ENG 207, and ENG 208 are designed for students not enrolled in Humanities and Social Sciences.
0800-0930 (036-208-001) Staff
0950-1120 (036-208-002) Staff
1140-1310 (036-208-003) Staff

ENG 251 Major British Writers 3
Credit will not be given for both ENG 251 and either ENG 261 or ENG 262.
0800-0930 (036-251-001) Staff
1140-1310 (036-251-002) Staff

ENG 252 Major American Writers 3
Credit will not be given for both ENG 252 and either ENG 265 or ENG 266.
0950-1120 (036-252-001) Staff

ENG 261 English Literature I 3
1140-1310 (036-261-001) Staff

ENG 262 English Literature II 3
0950-1120 (036-262-001) Staff

ENG 265 American Literature I 3
0800-0930 (036-265-001) Staff
0950-1120 (036-265-002) (036-265-004) Staff
1140-1310 (036-265-003) Staff

ENG 266 American Literature II 3
0800-0930 (036-266-001) Staff
0950-1120 (036-266-002) Staff
1140-1310 (036-266-003) Staff

ENG 298 Special Projects in English 1-3
Hours arranged (036-298-001) Staff

ENG 324 Modern English 3
0950-1120 (036-324-001) Fennell

ENG 487 Shakespeare, The Later Plays 3
Corequisite: A 200-level English course is desirable preparation
0800-0930 (036-487-001) Hester

ENG 498 Special Topics in English 1-6
Prerequisite: Six hours in ENG above the freshman level.
Hours arranged (036-498-001) Staff

FOR GRADUATES ONLY

The prerequisite for all 600-level English courses is graduate standing unless additional prerequisites are noted.

ENG 662 Eighteenth-Century English Literature 3
1140-1310 (036-662-001) Durant

ENG 692 Special Topics in American Literature 3
Prerequisite: Consent of seminar chairman.
Hours arranged (036-692-001) Staff

ENG 698 Bibliography and Methodology 1-3
Hours arranged (036-698-001) Staff

ENG 699 Research in Literature (Thesis) Credits Arranged
Prerequisite: Consent of graduate adviser.
Hours arranged (036-699-001) Thesis Director

SECOND SESSION

FRESHMAN ENGLISH

ENG 110 Developmental English 3
Credit is not applicable toward graduation in any curriculum. Students placed in ENG 110 must receive a grade of S in order to advance to ENG 111.
0800-0930 (036-110-001) Staff

ENG 111 Composition and Rhetoric 3
General University requirement. Successful completion of ENG 111 requires a grade of C or better
0800-0930 (036-111-001) (036-111-004) Staff
0950-1120 (036-111-002) (036-111-005) Staff
1140-1310 (036-111-003) (036-111-006) Staff

ENG 112 Composition and Reading 3
General University requirement.
Prerequisite: A grade of C or better in ENG 111.
0800-0930 (036-112-001) (036-112-004) (036-112-007) Staff
0950-1120 (036-112-002) (036-112-005) Staff
1140-1310 (036-112-003) (036-112-006) Staff

WRITING AND LANGUAGE

The prerequisite for all courses in writing and language at the 200-level and above is the completion of ENG 111 and ENG 112.

ENG 221 Communication for Business and Management 3
0800-0930 (036-221-001) Weinberg

ENG 321 The Communication of Technical Information 3
Prerequisite: Junior standing.
0800-0930 (036-321-001) (036-321-004) Staff
0950-1120 (036-321-002) (036-321-005) Staff
1140-1310 (036-321-003) Staff

LITERATURE

The prerequisite for all literature courses is the completion of ENG 111 and ENG 112.

ENG 205 Studies in Great Works of Literature 3
The courses ENG 205, ENG 206, ENG 207, and ENG 208 are designed for students not enrolled in Humanities and Social Sciences.
0950-1120 (036-205-001) Staff

ENG 208 Studies in Fiction 3
The courses ENG 205, ENG 206, ENG 207, and ENG 208 are designed for students not enrolled in Humanities and Social Sciences.
0800-0930 (036-208-001) Staff
1140-1310 (036-208-002) Staff

ENG 251 Major British Writers 3
Credit will not be given for both ENG 251 and either ENG 261 or ENG 262.
0950-1120 (036-251-001) Staff

ENG 252 Major American Writers 3
Credit will not be given for both ENG 252 and either ENG 265 or ENG 266.
1140-1310 (036-252-001) Staff

ENG 261 English Literature I 3
0800-0930 (036-261-001) Staff

ENG 262 English Literature II 3
0950-1120 (036-262-001) Staff

ENG 265 American Literature I 3
0800-0930 (036-265-001) Staff
0950-1120 (036-265-002) Staff
1140-1310 (036-265-003) Staff

ENG 266 American Literature II 3
0800-0930 (036-266-001) Staff
0950-1120 (036-266-002) Staff
1140-1310 (036-266-003) Staff

ENG 298 Special Projects in English 1-3
Hours arranged (036-298-001) Staff

ENG 375 The Film: A Literary Medium 3
Prerequisite: Junior standing
1140-1310 (036-375-001) Staff

ENG 463 The Victorian Period 3
Prerequisite: Two semesters of English literature
1140-1310 (036-463-001) Harrison

ENG 498 Special Topics in English 1-6
Prerequisite: Six hours in ENG above the freshman level.
Hours arranged (036-498-001) Staff

FOR GRADUATES ONLY

The prerequisite for all 600-level English courses is graduate standing unless additional prerequisites are noted.

ENG 655 American Romantic Period 3
0800-0930 (036-655-001) Stein

ENG 670 Twentieth-Century British Prose 3
0950-1120 (036-670-001) Halperen

ENG 692 Special Topics in American Literature 3
Prerequisite: Consent of seminar chairman
Hours arranged (036-692-001) Staff

ENG 693 Special Topics in English Literature: Fantasy and Science Fiction 3
Prerequisite: Consent of seminar chairman.
1140-1310 (036-693-001) W. Meyers

ENG 698 Bibliography and Methodology 1-3
Hours arranged (036-698-001) Staff

ENG 699 Research in Literature (Thesis) Credits Arranged
Prerequisite: Consent of graduate adviser.
Hours arranged (036-699-001) Thesis Director

TEN-WEEK SESSION

FRESHMAN ENGLISH

ENG 111E Composition and Rhetoric 3
General University requirement. Successful completion of ENG 111 requires a grade of C or better
1745-1930 MW (036-111-051) Staff

ENG 112E Composition and Reading 3
General University requirement.
Prerequisite: A grade of C or better in ENG 111.
1745-1930 MW (036-112-051) Staff
1945-2130 MW (036-112-052) Staff

WRITING AND LANGUAGE

The prerequisite for all courses in writing and language at the 200-level and above is the completion of ENG 111 and ENG 112.

ENG 321E The Communication of Technical Information 3
Prerequisite: Junior standing
1745-1930 TuTh (036-321-051) Staff
1945-2130 TuTh (036-321-052) Staff

LITERATURE

The prerequisite for all literature courses is the completion of ENG 111 and ENG 112.

ENG 208E Studies in Fiction 3
The courses ENG 205, ENG 206, ENG 207, and ENG 208 are designed for students not enrolled in Humanities and Social Sciences.
1945-2130 MW (036-208-051) Staff

ENG 261E English Literature I 3
1745-1930 MW (036-261-051) Staff

ENG 265E American Literature I 3
1745-1930 TuTh (036-265-051) Staff

ENG 266E American Literature II 3
1945-2130 TuTh (036-266-051) Staff

Entomology

FIRST SESSION

ENT 590 Special Problems Credits Arranged
Prerequisite: Consent of Instructor
Hours arranged (038-590-001) Staff

ENT 699 Research Credits Arranged
Prerequisite: Graduate standing
Hours arranged (038-699-001) Staff

SECOND SESSION

ENT 590 Special Problems Credits Arranged
Prerequisite: Consent of Instructor
Hours arranged (038-590-001) Staff

ENT 699 Research Credits Arranged
Prerequisite: Graduate standing
Hours arranged (038-699-001) Staff

Foreign Languages & Literatures

FRENCH

FIRST SESSION

$ FLF 101 Elementary French I 3
0800-0930 (064-101-001) Hammond
0950-1120 (064-101-002) Paschal
0800-0930 (064-101-003) Stack

$ FLF 101E Elementary French I 3
1745-1930 MTuWTh (064-101-004) Staff

$ FLF 102 Elementary French II 3
Prerequisite: FLF 101
1140-1310 (064-102-001) Paschal
1140-1310 (064-102-002) Staff

FLF 201 Intermediate French I 3
Prerequisite: FLF 102 or FLF 105
0950-1120 (064-201-001) Hammond
0950-1120 (064-201-002) Stack

SECOND SESSION

$ FLF 102 Elementary French II 3
Prerequisite: FLF 101
0800-0930 (064-102-001) Paliyenko
0800-0930 (064-102-002) Staff

$ FLF 102E Elementary French II 3
Prerequisite: FLF 101
1745-1930 MTuWTh (064-102-003) Ryan

FLF 201 Intermediate French I 3
Prerequisite: FLF 102 or FLF 105
0950-1120 (064-201-001) Paliyenko
0950-1120 (064-201-002) Staff

FLF 202 Intermediate French II 3
Prerequisite: FLF 201
1140-1310 (064-202-001) Ryan

GERMAN

FIRST SESSION

$ FLG 101 Elementary German I 3
0950-1120 (065-101-001) Simonsen
1140-1310 (065-101-002) Jezierski

FLG 201 Intermediate German I 3
Prerequisite: FLG 102. Credit for both FLG 201 and FLG 210 is not allowed.
0800-0930 (065-201-001) Simonsen

SECOND SESSION

$ FLG 102 Elementary German II 3
Prerequisite: FLG 101
0950-1120 (065-102-001) Tschacher
1140-1310 (065-102-002) Tschacher

SPANISH

FIRST SESSION

$ FLS 101 Elementary Spanish I 3
0800-0930 (068-101-001) Gonzalez
0950-1120 (068-101-002) Gonzalez
0950-1120 (068-101-003) Jezierski
1545-1730 MTuWTh (068-101-004) Alonso
1140-1310 (068-101-005) Kelly

$ FLS 102 Elementary Spanish II 3
Prerequisite: FLS 101
0800-0930 (068-102-001) Lioret
0950-1120 (068-102-002) Lioret
0950-1120 (068-102-003) Navey
1140-1310 (068-102-004) Navey

$ FLS 201 Intermediate Spanish I 3
Prerequisite: FLS 102 or FLS 105
0950-1120 (068-201-001) Wright
0950-1120 (068-201-002) Feeny
1140-1310 (068-201-004) Wright
1140-1310 (068-201-005) Feeny

$ FLS 201E Intermediate Spanish I 3
Prerequisite: FLS 102 or FLS 105
1745-1930 MTuWTh (068-201-003) Alonso

FLS 304 Modern Latin American Literature 3
Prerequisite: FLS 202 or equivalent
1545-1730 MTuWTh (068-304-001) Kelly

SECOND SESSION

$ FLS 101 Elementary Spanish I 3
0800-0930 (068-101-001) Matos
0950-1120 (068-101-002) Matos

$ FLS 102 Elementary Spanish II 3
Prerequisite: FLS 101
0800-0930 (068-102-001) Arias
0950-1120 (068-102-002) Arias
0950-1120 (068-102-003) Castro
1140-1310 (068-102-004) Castro

$ FLS 201 Intermediate Spanish I 3
Prerequisite: FLS 102 or FLS 105
0800-0930 (068-201-001) Grace
0950-1120 (068-201-002) Grace
0950-1120 (068-201-003) Malaxecheverria
1140-1310 (068-201-004) Malaxecheverria

FLS 202 Intermediate Spanish II 3
Prerequisite: FLS 201
0950-1120 (068-202-001) Alder

Forestry

FIRST SESSION

$ FOR 111 Introduction to Field Forestry 2
Summer Pre-Camp (May 9-May 20)
Open only to students transferring to a forestry major.
0800-1700 (040-111-001) Staff

FOR 491 Senior Problems in Forestry 1-6
Prerequisite: Consent of department
Hours arranged (040-491-001) Staff

FOR 592 Special Topics in Forestry Credits Arranged
Hours arranged (040-592-001) Staff

FOR 691 Graduate Seminar 1
Hours arranged (040-691-001) Perry

FOR 692 Advanced Topics in Forestry Credits Arranged
Hours arranged (040-692-001) Staff

FOR 699 Research in Forestry Credits Arranged
Hours arranged (040-699-001) Staff

SECOND SESSION

FOR 491 Senior Problems in Forestry 1-6
Prerequisite: Consent of department
Hours arranged (040-491-001) Staff

FOR 592 Special Topics in Forestry Credits Arranged
Hours arranged (040-592-001) Staff

FOR 691 Graduate Seminar 1
Hours arranged (040-691-001) Perry

FOR 692 Advanced Topics in Forestry Credits Arranged
Hours arranged (040-692-001) Staff

FOR 699 Research in Forestry Credits Arranged
Hours arranged (040-699-001) Staff

TEN-WEEK SESSION

$ FOR 204 Silviculture 2
Prerequisites: Junior standing in FOR; meet Summer Camp eligibility standards
0800-1700 (040-204-051) Jervis

$ FOR 261 Forest Communities 2
Prerequisites: Junior standing in FOR; meet eligibility requirements for Summer Camp
0800-1700 (040-261-051) Braham

$ FOR 264 Forest Pest Management 1
Prerequisite: Junior standing in FOR; meet Summer Camp eligibility standards
0800-1700 (040-264-051) Farrier/Grand

$ FOR 274 Mapping and Mensuration 4
Prerequisites: Junior standing in FOR; meet Summer Camp eligibility standards
0800-1700 (040-274-051) Jervis/Steensen

$ FOR (FW) 310 Fisheries and Wildlife Inventory and Management 6
(See Fisheries and Wildlife)

Note: See page 31 for course "Forestry and Wildlife Concepts for Biologists" offered at Highlands Biological Station.

Food Science

FIRST SESSION

FS 491 Special Topics in Food Science 1-6
Prerequisites: Twelve hours of Food Science and Consent of Instructor
Hours arranged (039-491-001) Staff

FS 591 Special Problems in Food Science 1-6
Prerequisite: Senior or Graduate standing
Hours arranged (039-591-001) Staff

FS 691 Special Research Problems in Food Science — Credits Arranged
Hours arranged (039-691-001) — Staff

FS 699 Research in Food Science — Credits Arranged
Hours arranged (039-699-001) — Staff

SECOND SESSION

FS (ANS, NTR) 301 Modern Nutrition — 3
(See Animal Science)

FS 491 Special Topics in Food Science — 1-6
Prerequisites: Twelve hours of Food Science and Consent of Instructor
Hours arranged (039-491-001) — Staff

FS 591 Special Problems in Food Science — 1-6
Prerequisite: Senior or Graduate standing
Hours arranged (039-591-001) — Staff

FS 691 Special Research Problems in Food Science — Credits Arranged
Hours arranged (039-691-001) — Staff

FS 699 Research in Food Science — Credits Arranged
Hours arranged (039-699-001) — Staff

Fisheries and Wildlife

FIRST SESSION

FW (ZO) 221 Conservation of Natural Resources — 3
0950-1120 (051-221-001) — Staff

TEN-WEEK SESSION

$ FW (FOR) 310 Fisheries and Wildlife Inventory and Management — 6
Summer Camp
Prerequisites: FW (ZO) 353 or FW (ZO) 420; Junior or Senior standing
0800-1700 (051-310-051) — Staff

Graphic Communications

FIRST SESSION

GC 101 Engineering Graphics I — 2
0800-0930 (098-101-001) — Hilliard
0800-0930 (098-101-002) — Vander Wall
0950-1120 (098-101-003) — Hilliard
0950-1120 (098-101-004) — Vander Wall

SECOND SESSION

GC 101 Engineering Graphics I — 2
0800-0930 (098-101-001) — Freeman
0800-0930 (098-101-002) — Markley
0950-1120 (098-101-003) — Freeman
0950-1120 (098-101-004) — Markley

Genetics

FIRST SESSION

GN 301 Genetics in Human Affairs 3
Prerequisite: Students should have Sophomore standing
0800-0930 (041-301-001) McKenzie
0950-1120 (041-301-002) McKenzie

GN 411 Principles of Genetics 3
Prerequisites: BS 100, Junior standing
1140-1310 (041-411-001) Staff

GN 695 Special Problems in Genetics 1-3
Prerequisites: Advanced Graduate standing and Consent of Instructor
Hours arranged (041-695-001) Staff

GN 699 Research Credits Arranged
Prerequisites: Graduate standing, Consent of Advisor
Hours arranged (041-699-001) Staff

SECOND SESSION

GN 695 Special Problems in Genetics 1-3
Prerequisites: Advanced Graduate standing and Consent of Instructor
Hours arranged (041-695-001) Staff

GN 699 Research Credits Arranged
Prerequisites: Graduate standing, Consent of Advisor
Hours arranged (041-699-001) Staff

History

FIRST SESSION

HI 205 Western Civilization Since 1400 3
1140-1310 (044-205-001) Staff

HI 207 Ancient World to 180 A.D. 3
0800-0930 (044-207-001) Sack
0950-1120 (044-207-002) Sack

HI 210 Modern Europe 1815-Present 3
0950-1120 (044-210-001) Vincent

HI 233 The World in the 20th Century 3
0800-0930 (044-233-001) Vincent

HI 244 United States Since 1914 3
0800-0930 (044-244-001) Hobbs
0950-1120 (044-244-002) Wishy

HI 275 Introduction to History of South and East Africa 3
0950-1120 (044-275-001) Vickery

HI 452 Recent America 3
Prerequisite: Three hours of History
0950-1120 (044-452-001) Hobbs

HI 476 Leadership in Modern Africa 3
Prerequisite: Three hours of History
1140-1310 (044-476-001) Vickery

HI 498 Independent Study in History 1-6
Prerequisite: Three hours of History
Hours arranged (044-498-001) Staff

HI 576 Leadership in Modern Africa 3
Prerequisite: Six hours of advanced History (400-level or above) or equivalent. Credit in both HI 476 and HI 576 is not allowed.
1140-1310 (044-576-001) Vickery

HI 685 Independent Study 1-6
Prerequisite: Graduate standing or PBS status
Hours arranged (044-685-001) Staff

HI 691 Practicum in Applied History 1-6
Prerequisites: HI 601, HI 602, HI 685
Hours arranged (044-691-001) Staff

HI 699 Research in History Credits Arranged
Prerequisite: Six hours of advanced History or equivalent
Hours arranged (044-699-001) Staff

SECOND SESSION

HI 208 The Middle Ages 3
0800-0930 (044-208-001) Newby
0950-1120 (044-208-002) Newby

HI 209 Europe, Renaissance to Waterloo, 1300-1815 3
1140-1310 (044-209-001) Staff

HI 216 Latin America Since 1826 3
0950-1120 (044-216-001) Beezley

HI 242 United States: 1783-1845 3
0950-1120 (044-242-001) King

HI 243 United States: 1845-1914 3
0950-1120 (044-243-001) Smith
1140-1310 (044-243-002) King

HI 244 United States Since 1914 3
0800-0930 (044-244-001) Harris

HI 333 History of American Sport 3
0800-0930 (044-333-001) Beezley

HI (EB) 370 The Rise of Industrialism 3
(See Economics and Business)

HI 446 Civil War and Reconstruction 3
Prerequisite: Three hours of History. Credit for both HI 446 and HI 546 will not be allowed.
0950-1120 (044-446-001) Harris

HI 461 Civilization of the Old South 3
Prerequisite: Three hours of History. Credit for both HI 461 and HI 561 will not be allowed.
1140-1310 (044-461-001) Smith

HI 498 Independent Study in History 1-6
Prerequisite: Three hours of History
Hours arranged (044-498-001) Staff

HI 546 Civil War and Reconstruction 3
Prerequisite: Six hours of advanced History. Credit for both HI 446 and HI 546 will not be allowed.
0950-1120 (044-546-001) Harris

HI 561 Civilization of the Old South 3
Prerequisite: Six hours of advanced History (400-level or above) or equivalent. Credit for both HI 461 and HI 561 will not be allowed.
1140-1310 (044-561-001) Smith

HI 685 Independent Study 1-6
Prerequisite: Graduate standing or PBS status
Hours arranged (044-685-001) Staff

HI 691 Practicum in Applied History 1-6
Prerequisites: HI 601, HI 602, HI 685
Hours arranged (044-691-001) Staff

HI 699 Research in History Credits Arranged
Prerequisite: Six hours of advanced History or equivalent
Hours arranged (044-699-001) Staff

Horticultural Science

FIRST SESSION

$ HS 400 Residential Landscaping 6
Prerequisites: DF 234; HS 211, HS 212, HS 342; HS 416 or DN 433; SSC 200; DN 257, DN 430. Seniors in the Landscape Horticulture area of concentration given priority.
0900-1400 (045-400-001) Hooker

HS 495 Special Topics in Horticultural Science 1-6
Hours arranged (045-495-001) Staff

HS 595 Special Topics in Horticultural Science 1-6
Prerequisite: Consent of Instructor
Hours arranged (045-595-001) Staff

HS 599 Research Principles Credits Arranged
Prerequisite: Consent of Instructor
Hours arranged (045-599-001) Staff

HS 695 Graduate Topics in Horticultural Science 1-6
Prerequisite: Consent of Instructor
Hours arranged (045-695-001) Staff

HS 699 Research Credits Arranged
Prerequisites: Graduate standing in Horticulture, Consent of Advisory Committee Chairman
Hours arranged (045-699-001) Staff

SECOND SESSION

HS 495 Special Topics in Horticultural Science 1-6
Hours arranged (045-495-001) Staff

HS 595 Special Topics in Horticultural Science 1-6
Prerequisite: Consent of Instructor
Hours arranged (045-595-001) Staff

HS 599 Research Principles Credits Arranged
Prerequisite: Consent of Instructor
Hours arranged (045-599-001) Staff

HS 695 Graduate Topics in Horticultural Science 1-6
Prerequisite: Consent of Instructor
Hours arranged (045-695-001) Staff

HS 699 Research Credits Arranged
Prerequisite: Graduate standing in Horticulture, Consent of Advisory Committee Chairman
Hours arranged (045-699-001) Staff

ADULT EDUCATION SESSION

***HS 595A Special Topics in Horticultural Science: Production Maintenance and Marketing of Quality Horticultural Crops** 3
Prerequisite: Consent of Instructor
0900-1200-MTuThF Wilson
and
0900-1700 W
June 6-June 24—Three-Week Course—Final Exam June 24

***Course taught in the three-week Regional Summer School of Adult, Extension and Community College Educators (June 6-24). Special registration procedures are required. See page 28 for additional information.**

Industrial Arts

FIRST SESSION

$ IA 115 Wood Processing I 3
1020-1310 (047-115-001) DeLuca

$ IA 122 Metal Technology I 3
0750-0940 (047-122-001) Haynie

IA 590 Laboratory Problems in Industrial Arts: Advanced Technology 3
Prerequisites: Senior standing and Consent of Instructor
1630-1800 (047-590-001) DeLuca

SECOND SESSION

$ IA 115 Wood Processing I 3
0750-0940 (047-115-001) Troxler

$ IA 351 General Ceramics 3
1020-1310 (047-351-001) Troxler

Industrial Engineering

FIRST SESSION

IE 311 Engineering Economic Analysis 3
Prerequisite: MA 102 (non-engineering students may use MA 112 or MA 113)
0800-0930 (049-311-001) Liggett

$ IE 361 Deterministic Models in Industrial Engineering 3
Prerequisite: MA 303 or MA 405. For IE, ECE, and CSC majors and minors only.
0800-0930 (049-361-001) Bernhard

$ IE 452 Ergonomics 3
Corequisite: IE 352. For IE and FMM majors and IE minors only.
LR 0950-1120 (049-452-001) Ayoub
LB Hours arranged (049-452-101)

IE 495 Project Work in Industrial Engineering 1-6
Prerequisites: Junior standing and Consent of Instructor
Hours arranged (049-495-001) Staff

IE 498 Senior Design Project 3
Prerequisites: IE 308, IE 311, IE 441, IE 443, IE 452, IE 453
Hours arranged (049-498-001) Ayoub

IE 591 Project Work 1-6
Prerequisite: Graduate standing
Hours arranged (049-591-001) Staff

IE 651 Special Studies in Industrial Engineering Credits Arranged
Prerequisite: Graduate standing
Hours arranged (049-651-001) Staff

IE 699 Industrial Engineering Research Credits Arranged
Prerequisite: Graduate standing
Hours arranged (049-699-001) Staff

SECOND SESSION

IE 311 Engineering Economic Analysis 3
Prerequisite: MA 102 (non-engineering students may use MA 112 or MA 113)
0800-0930 (049-311-001) Canada

IE 443 Quality Control 3
Prerequisite: ST 361
LR 0800-0930 (049-443-001) Tye-Coleman
PR 1340-1550 MW (049-443-201)

$ IE 453 Facilities Design 3
Prerequisites: IE 351 and IE 352
LR 0950-1120 (049-453-001) Canada
LB Hours arranged (049-453-101)

IE 495 Project Work in Industrial Engineering 1-6
Prerequisites: Junior standing and Consent of Instructor
Hours arranged (049-495-001) Staff

IE 591 Project Work 1-6
Prerequisite: Graduate standing
Hours arranged (049-591-001) Staff

IE 651 Special Studies in Industrial Engineering Credits Arranged
Prerequisite: Graduate standing
Hours arranged (049-651-001) Staff

IE 699 Industrial Engineering Research Credits Arranged
Prerequisite: Graduate standing
Hours arranged (049-699-001) Staff

Landscape Architecture

FIRST SESSION

LAR 494 Internship in Landscape Architecture 3-6
Prerequisite: Junior standing in Landscape Architecture; 3.0 GPA or better; and approval of department head
Maximum 6 credit hours
Hours arranged (052-494-001) Dalton

LAR 495 Independent Study in Landscape Architecture 1-3
Prerequisite: Junior standing in Landscape Architecture; 3.0 GPA or better; and approval of department head
Maximum 6 credit hours
Hours arranged (052-495-001) Dalton

LAR 595 Independent Study 1-3
Prerequisite: Graduate standing
Hours arranged (052-595-001) Dalton

LAR 691 Degree Seminar 0
Prerequisite: Three LAR 600 studios
Hours arranged (052-691-001) Dalton

$ LAR 698 Advanced Research Project 2-6
Prerequisite: Two LAR 600 studios or Consent of Instructor
Hours arranged (052-698-001) Dalton

SECOND SESSION

LAR 494 Internship in Landscape Architecture 3-6
Prerequisite: Junior standing in Landscape Architecture; 3.0 GPA or better; and approval of department head
Maximum 6 credit hours
Hours arranged (052-494-001) Dalton

LAR 495 Independent Study in Landscape Architecture 1-3
Prerequisite: Junior standing in Landscape Architecture; 3.0 GPA or better; and approval of department head
Maximum 6 credit hours
Hours arranged (052-495-001) Dalton

LAR 595 Independent Study 1-3
Prerequisite: Graduate standing
Hours arranged (052-595-001) Dalton

LAR 691 Degree Seminar 0
Prerequisite: Three LAR 600 studios
Hours arranged (052-691-001) Dalton

$ LAR 698 Advanced Research Project 2-6
Prerequisite: Two LAR 600 studios or Consent of Instructor
Hours arranged (052-698-001) Dalton

FIRST SESSION

MA 111 Algebra and Trigonometry 4
Credit is not allowed for both MA 100 and MA 111. For students in Engineering, Physical and Mathematical Sciences, Design, Biological and Agricultural Engineering (Science program), Biological Sciences (all options), and Mathematics Education, Science Education, credit in MA 111 does not count toward graduation requirements.
0730-0940 (054-111-001) (054-111-002) Staff
1020-1230 (054-111-003) (054-111-004) (054-111-005) Staff

MA 112 Analytic Geometry and Calculus A 4
Prerequisite: MA 111 or equivalent completed in high school
Credit is not allowed for more than one of MA 141, MA 112, MA 113.
0730-0940 (054-112-001) Staff
1020-1230 (054-112-002) Staff

MA 113 Elements of Calculus 4
Prerequisite: MA 111 or placement via NCSU Math placement exam
Credit is not allowed in more than one of MA 141, MA 112, MA 113. MA 113 may not be substituted for MA 141 as a curricular requirement.
0730-0940 (054-113-001) (054-113-002) Staff

MA 114 Introduction to Finite Mathematics With Applications 3
Prerequisite: MA 111 or equivalent completed in high school
0800-0930 (054-114-001) (054-114-002) Staff

MA 115 Basic Algebra 4
Credit in MA 115 is not allowed if student has prior credit for MA 141, MA 111, MA 112, MA 113, or MA 114. Credit for graduation is not given for MA 115 in any curricula.
1020-1230 (054-115-001) Kolb

MA 122 Mathematics of Finance 3
Prerequisite: MA 115 or equivalent completed in high school
0800-0930 (054-122-001) (054-122-002) Staff

MA 141 Analytic Geometry and Calculus I 4
Prerequisite: MA 111 with grade of C or better, or placement via NCSU Mathematics Placement Examination.
Credit not allowed for more than one of MA 141, MA 112, MA 113.
0730-0940 (054-141-001) (054-141-002) (054-141-003) Staff
1020-1230 (054-141-004) (054-141-005) (054-141-006) Staff

MA 202 Analytic Geometry and Calculus III 4
Prerequisite: MA 201 with a grade of C or better.
MA 202 will not substitute for MA 242.
0730-0940 (054-202-001) (054-202-002) Staff
1020-1230 (054-202-003) (054-202-004) Staff

MA 202S Analytic Geometry and Calculus III 4
Prerequisite: MA 201S with a grade of C or better. MA 202S will not substitute for MA 242
0730-0940 (054-202-070) Staff

MA 241 Analytic Geometry and Calculus II 4
Prerequisite: MA 141 with a grade of C or better
0730-0940 (054-241-001) (054-241-002) Staff
1020-1230 (054-241-004) (054-241-005) Staff

MA 225 Structure of the Real Number System 3
Prerequisite: MA 201
0800-0930 (054-225-001) Staff

MA 301 Introduction to Differential Equations 3
Prerequisite: Credit for 12 semester hours of calculus. Credit not allowed if MA 241 taken previously at NCSU.
0800-0930 (054-301-001) (054-301-002) Staff
1140-1310 (054-301-003) (054-301-004) Staff

MA 405 Introduction to Linear Algebra and Matrices 3
Prerequisite: One year of calculus
0800-0930 (054-405-001) (054-405-002) Staff
1140-1310 (054-405-003) Staff

MA 421 Introduction to Probability 3
Prerequisite: One year of calculus
1140-1310 (054-421-001) Staff

MA 433 History of Mathematics 3
Prerequisite: One year of calculus
0800-0930 (054-433-001) Staff

MA 501 Advanced Mathematics for Engineers and Scientists I 3
Prerequisite: MA 301 or equivalent. Credit for this course and MA 401 is not allowed.
1140-1310 (054-501-001) Staff

MA 511 Advanced Calculus I 3
Prerequisite: MA 301. May not be taken for credit by undergraduate Mathematics majors.
1140-1310 (054-511-001) Staff

MA 512 Advanced Calculus II 3
Prerequisite: MA 301
1140-1310 (054-512-001) Staff

MA 513 Introduction to Complex Variables 3
Prerequisite: MA 202
0800-0930 (054-513-001) Staff

MA 697 Master's Project 3
Hours arranged (054-697-001) Franke

MA 699 Research Credits Arranged
Hours arranged (054-699-001) Franke

SECOND SESSION

MA 100 Precalculus Trigonometry 2
Credit not allowed for both MA 100 and MA 111. For students in Engineering, Physical and Mathematical Sciences, Design, Biological and Agricultural Engineering (Science program), Biological Sciences (all options), and Mathematics Education, Science Education, credit in MA 100 does not count toward graduation requirements.
0730-0835 (054-100-001) Staff

MA 111 Algebra and Trigonometry 4
Credit is not allowed for both MA 100 and MA 111. For students in Engineering, Physical and Mathematical Sciences, Design, Biological and Agricultural Engineering (Science program), Biological Sciences (all options) and Mathematics Education, Science Education, credit in MA 111 does not count toward graduation requirements.
0730-0940 (054-111-001) (054-111-002) Staff
1020-1230 (054-111-004) (054-111-005) (054-111-006) Staff

MA 112 Analytic Geometry and Calculus A 4
Prerequisite: MA 111 or equivalent completed in high school
Credit is not allowed in more than one of MA 141, MA 112, MA 113.
1020-1230 (054-112-001) Staff

MA 113 Elements of Calculus 4
Prerequisite: MA 111 or placement via NCSU Math Placement exam
Credit is not allowed in more than one of MA 141, MA 112, MA 113.
MA 113 may not be substituted for MA 141 as a curricular requirement.
1020-1230 (054-113-001) (054-113-002) Staff

MA 114 Introduction to Finite Mathematics with Applications 3
Prerequisite: MA 111 or equivalent completed in high school
0800-0930 (054-114-001) (054-114-002) Staff

MA 115 Basic Algebra 4
Credit in MA 115 is not allowed if student has prior credit for MA 141, MA 111, MA 112, MA 113, or MA 114. Credit toward graduation is not given for MA 115 in any curricula.
0730-0940 (054-115-001) Staff
1020-1230 (054-115-002) Waters

MA 141 Analytic Geometry and Calculus I 4
Prerequisite: MA 111 with a grade of C or better, or placement via NCSU Mathematics Placement Examination.
Credit not allowed for more than one of MA 141, MA 112, MA 113.
0730-0940 (054-141-001) Staff
1020-1230 (054-141-002) (054-141-003) Staff

MA 202 Analytic Geometry and Calculus III 4
Prerequisite: MA 201 with a grade of C or better. MA 202 will not substitute for MA 242
0730-0940 (054-202-001) (054-202-002) Staff
1020-1230 (054-202-003) (054-202-004) Staff

MA 212 Analytic Geometry and Calculus B 3
Prerequisite: MA 112
1140-1310 (054-212-001) Staff

MA 241 Analytic Geometry and Calculus II 4
Prerequisite: MA 141 with a grade of C or better
0730-0940 (054-241-001) (054-241-002) Staff
1020-1230 (054-241-003) (054-241-004) Staff

MA 301 Introduction to Differential Equations 3
Prerequisite: Credit for 12 semester hours of calculus. Credit not allowed if MA 241 taken previously at NCSU.
0800-0930 (054-301-001) (054-301-002) Staff
1140-1310 (054-301-003) (054-301-004) Staff

MA 401 Applied Differential Equations II 3
Prerequisite: MA 301. Credit for MA 401 and MA 501 will not be given.
0800-0930 (054-401-001) Staff

MA 405 Introduction to Linear Algebra and Matrices 3
Prerequisite: One year of calculus
0800-0930 (054-405-001) Staff
1140-1310 (054-405-002) Staff

MA 502 Advanced Mathematics for Engineers and Scientists II 3
Prerequisite: MA 301 or equivalent. Any student receiving credit for MA 502 may receive credit for, at most, one of the following: MA 405, MA 512, or MA 513.
1140-1310 (054-502-001) Staff

MA 512 Advanced Calculus II 3
Prerequisite: MA 301
0800-0930 (054-512-001) Staff

MA 697 Master's Project 3
Hours arranged (054-697-001) Staff

MA 699 Research Credits Arranged
Hours arranged (054-699-001) Staff

TEN-WEEK SESSION

MA 111E Algebra and Trigonometry 4
Credit is not allowed for both MA 100 and MA 111. For students in Engineering, Physical and Mathematical Sciences, Design, Biological and Agricultural Engineering (Science program), Biological Sciences (all options), and Mathematics Education, Science Education credit in MA 111 does not count toward graduation requirements.
1915-2150 MW (054-111-051) (054-111-052) Staff

MA 113E Elements of Calculus 4
Prerequisite: MA 111 or placement via NCSU Math Placement exam
Credit is not allowed in more than one of MA 141, MA 112, MA 113. MA 113 may not be substituted for MA 141 as a curricular requirement.
1915-2150 TuTh (054-113-051) Staff

MA 114E Introduction to Finite Mathematics with Applications 3
Prerequisite: MA 111 or equivalent completed in high school
1945-2130 MW (054-114-051) Staff

MA (CSC) 322 Discrete Mathematical Structures 3
(See Computer Science)

Mechanical and Aerospace Engineering

FIRST SESSION

MAE 206 Engineering Statics 3
Prerequisite: PY 205
Corequisite: MA 202
0800-0930 (055-206-001) Brown
1140-1310 (055-206-002) Staff

MAE 208 Engineering Dynamics 3
Prerequisite: MAE 206 or CE 214
Corequisite: MA 301
1140-1310 (055-208-001) Keltie

MAE 301 Engineering Thermodynamics I 3
Prerequisites: MA 202, PY 208 or PY 202
0800-0930 (055-301-001) Afify
0800-0930 (055-301-002) Staff
0950-1120 (055-301-003) Afify
0950-1120 (055-301-004) Staff
1140-1310 (055-301-005) Staff
1140-1310 (055-301-006) Brown

MAE 302 Engineering Thermodynamics II 3
Prerequisites: MAE 301, CSC 111
0800-0930 (055-302-001) Leach

$ MAE 305 Mechanical Engineering Laboratory I 1
Prerequisite: Junior standing in ME
1340-1750 TuTh (055-305-001) Batton
1340-1750 MW (055-305-002) Staff
1750-2200 MW (055-305-003) Staff

MAE 308 Fluid Mechanics I 3
Prerequisites: MA 202; MAE 208 or CE 215 or CE 213; CSC 111 or CSC 101
Corequisite: MAE 301
0950-1120 (055-308-001) Hodgson
1140-1310 (055-308-002) Staff

MAE 310 Conduction and Radiation Heat Transfer 3
Prerequisites: MA 301, MAE 301, CSC 111
0800-0930 (055-310-001) Staff
0950-1120 (055-310-002) Edwards

MAE 314 Solid Mechanics 3
Prerequisites: MAE 206, CE 213 or CE 214
Corequisite: MAT 201
0800-0930 (055-314-001) Edwards
0950-1120 (055-314-002) Silverberg

MAE 316 Strength of Mechanical Components 3
Prerequisites: MAE 314, CSC 111; students in ME, AE, NE only
1140-1310 (055-316-001) Staff

MAE 411 Machine Component Design 3
Prerequisites: MAE 315, MAE 316
0800-0930 (055-411-001) Maday

MAE 435 Principles of Automatic Control 3
Prerequisite: MA 301
0950-1120 (055-435-001) Maday

MAE 586 Project Work in Mechanical Engineering 1-6
Hours arranged (055-586-001) Staff

MAE 686 Advanced Topics in Mechanical Engineering 1-3
Prerequisite: Graduate standing
Hours arranged (055-686-001) Staff

MAE 699 Mechanical Engineering Research Credits Arranged
Prerequisites: Graduate standing in mechanical engineering and consent of advisor.
Hours arranged (055-699-001) Staff

SECOND SESSION

MAE 206 Engineering Statics 3
Prerequisite: PY 205
Corequisite: MA 202
0800-0930 (055-206-001) Staff
1140-1310 (055-206-002) Staff

MAE 208 Engineering Dynamics 3
Prerequisite: MAE 206 or CE 214
Corequisite: MA 301
0800-0930 (055-208-001) Staff

MAE 261 Aerospace Vehicle Performance 3
Prerequisites: MA 201, PY 205
0800-0930 (055-261-001) Hale

MAE 301 Engineering Thermodynamics I 3
Prerequisites: MA 202, PY 208 or PY 202
0800-0930 (055-301-001) Boles
0800-0930 (055-301-002) Johnson
0950-1120 (055-301-003) Boles
0950-1120 (055-301-004) Staff
1140-1310 (055-301-005) Staff

MAE 302 Engineering Thermodynamics II 3
Prerequisites: MAE 301, CSC 111
1140-1310 (055-302-001) Johnson

$ MAE 306 Mechanical Engineering Laboratory II 1
Prerequisite: MAE 305
1340-1750 TuTh (055-306-001) Batton
1340-1750 MW (055-306-002) Staff
1750-2200 MW (055-306-003) Staff

MAE 308 Fluid Mechanics I 3
Prerequisites: MA 202; MAE 208 or CE 215 or CE 213; CSC 111 or CSC 101
Corequisite: MAE 301
0800-0930 (055-308-001) Smetana

MAE 314 Solid Mechanics 3
Prerequisites: MAE 206, CE 213 or CE 214
Corequisite: MAT 201
0950-1120 (055-314-001) Smetana
1140-1310 (055-314-002) Staff

MAE 410 Convective Heat Transfer and Fluid Flow 3
Prerequisites: MAE 301, MAE 308
Corequisite: MAE 310
0950-1120 (055-410-001) Leach

MAE 462 Flight Vehicle Stability and Control 3
Prerequisites: MAE 261, MAE 435
0950-1120 (055-462-001) Hale

MAE 586 Project Work in Mechanical Engineering 1-6
Hours arranged (055-586-001) Staff

MAE 686 Advanced Topics in Mechanical Engineering 1-3
Prerequisite: Graduate standing
Hours arranged (055-686-001) Staff

MAE 699 Mechanical Engineering Research Credits Arranged
Prerequisites: Graduate standing in mechanical engineering and consent of advisor.
Hours arranged (055-699-001) Staff

TEN-WEEK SESSION

MAE 315 Dynamics of Machines 3
Prerequisites: MAE 208, CSC 111
1000-1115 MWF (055-315-051) Staff

Materials Science and Engineering

FIRST SESSION

MAT 201 Structure and Properties of Engineering Materials 3
Prerequisite: CH 105
LR 1200-1330 (061-201-001) Staff
PR 1340-1620 TuTh (061-201-201) (061-201-202)

$ MAT 210 Experiments in Materials Engineering 1
Corequisite: MAT 201
LB 1340-1650 MWF (061-210-001) Staff

MAT 495 Materials Engineering Projects 1-6
Prerequisite: Junior or Senior standing
Hours arranged (061-495-001) Staff

MAT 595 Advanced Materials Experiments 1-3
Prerequisite: Senior or Graduate standing
Hours arranged (061-595-001) Staff

MAT 699 Materials Science and Engineering Research Credits Arranged
Hours arranged (061-699-001) Staff

SECOND SESSION

$ MAT 200 Mechanical Properties of Structural Materials 2
Prerequisites: CH 105 and the first course in Engineering Mechanics
LR 1020-1120 MWF (061-200-001) Fahmy
LB 1340-1650 MWF (061-200-101) (061-200-102)

MAT 201 Structure and Properties of Engineering Materials 3
Prerequisite: CH 105
LR 1200-1330 (061-201-001) Fahmy
PR 1340-1620 TuTh (061-201-201) (061-201-202)

MAT 495 Materials Engineering Projects 1-6
Prerequisite: Junior or Senior standing
Hours arranged (061-495-001) Staff

MAT 595 Advanced Materials Experiments 1-3
Prerequisite: Senior or Graduate standing
Hours arranged (061-595-001) Staff

MAT 699 Materials Science and Engineering Research Credits Arranged
Hours arranged (061-699-001) Staff

Microbiology

FIRST SESSION

MB 490 Special Topics in Microbiology 1-3
Prerequisites: Three courses in Microbiology and permission of instructor
Hours arranged (057-490-001) Staff

MB 590 Topical Problems Credits Arranged
Prerequisites: Graduate standing and Consent of Instructor
Hours arranged (057-590-001) Staff

MB 692 Special Problems in Microbiology Credits Arranged
Hours arranged (057-692-001) Staff

MB 699 Microbiology Research Credits Arranged
Hours arranged (057-699-001) Staff

SECOND SESSION

$ MB 401 General Microbiology 4
Prerequisites: BS 100, CH 223 or CH 220
LR 0950-1120 (057-401-001) Shore
LB 1340-1750 TuTh (057-401-101)

MB 490 Special Topics in Microbiology 1-3
Prerequisites: Three courses in Microbiology and permission of instructor
Hours arranged (057-490-001) Staff

MB 590 Topical Problems Credits Arranged
Prerequisites: Graduate standing and Consent of Instructor
Hours arranged (057-590-001) Staff

MB 692 Special Problems in Microbiology Credits Arranged
Hours arranged (057-692-001) Staff

MB 699 Microbiology Research Credits Arranged
Hours arranged (057-699-001) Staff

Marine, Earth and Atmospheric Sciences

EARTH SCIENCE (GEOLOGY/GEOPHYSICS)

FIRST SESSION

MEA 101 Introduction to Geology I: Physical 3
Credit is not allowed for both MEA 101 and MEA 120. Recommended that MEA 110 be taken concurrently.
0800-0930 (053-101-001) Kimberley

$ MEA 110 Introduction to Geology I: Laboratory 1
Corequisite: MEA 101 or MEA 120
1020-1230 MW (053-110-001) Staff
1340-1550 TuTh (053-110-002) Staff

MEA 465 Geologic Field Camp I 3
Prerequisites: MEA 351, MEA 440, MEA 452
First part of six weeks out-of-state summer field camp. Both MEA 465 and MEA 466 must be taken in the same summer.
Hours arranged (053-465-001) Staff

MEA 475 Geophysical Field Methods 2
Prerequisite: MEA 471
Credit is not allowed for both MEA 475 and MEA 575.
Hours arranged (053-475-001) Won/Bevis

MEA 575 Geophysical Field Methods 2
Prerequisite: MEA 570
Hours arranged (053-575-001) Won/Bevis

MEA 593 Special Topics 1-6
Prerequisite: Consent of Instructor
Hours arranged (053-593-001) Staff

MEA 695 Seminar 1
Prerequisite: Graduate standing
Hours arranged (053-695-001) Staff

MEA 699 Research Credits Arranged
Prerequisite: Consent of Instructor
Hours arranged (053-699-001) Staff

SECOND SESSION

MEA 101 Introduction to Geology I: Physical 3
Credit is not allowed for both MEA 101 and MEA 120. Recommended that MEA 110 be taken concurrently.
0800-0930 (053-101-001) Staff

$ MEA 110 Introduction to Geology I: Laboratory 1
Corequisite: MEA 101 or MEA 120
1020-1230 MW (053-110-001) Staff
1340-1550 TuTh (053-110-002) Staff

MEA 466 Geologic Field Camp II 3
Prerequisite: MEA 465
Second part of six weeks out-of-state summer field camp. Both MEA 465 and MEA 466 must be taken in the same summer.
Hours arranged (053-466-001) Staff

MEA 593 Special Topics 1-6
Prerequisite: Consent of Instructor
Hours arranged (053-593-001) Staff

MEA 695 Seminar 1
Prerequisite: Graduate standing
Hours arranged (053-695-001) Staff

MEA 699 Research Credits Arranged
Prerequisites: Consent of Instructor
Hours arranged (053-699-001) Staff

MARINE SCIENCE

FIRST SESSION

MEA 593 Special Topics 1-3
Prerequisite: Consent of Instructor
Hours arranged (053-593-001) Staff

MEA 693 Advanced Special Topics 1-3
Prerequisites: Graduate standing and consent of staff
Hours arranged (053-693-001) Staff

MEA 699 Research Credits Arranged
Prerequisites: Graduate standing and consent of advisory committee
Hours arranged (053-699-001) Staff

SECOND SESSION

MEA 593 Special Topics 1-3
Prerequisite: Consent of Instructor
Hours arranged (053-593-001) Staff

MEA 693 Advanced Special Topics 1-3
Prerequisites: Graduate standing and consent of staff
Hours arranged (053-693-001) Staff

MEA 699 Research Credits Arranged
Prerequisites: Graduate standing and consent of advisory committee
Hours arranged (053-699-001) Staff

ATMOSPHERIC SCIENCE (METEOROLOGY)

FIRST SESSION

MEA 493 Special Topics in Meteorology 1-3
Prerequisite: Consent of department
Hours arranged (053-493-001) Staff

MEA 593 Special Topics 1-6
Prerequisite: Consent of staff
Hours arranged (053-593-001) Staff

MEA 695 Seminar 1
Prerequisite: Graduate standing
Hours arranged (053-695-001) Staff

MEA 699 Research Credits Arranged
Prerequisites: Graduate standing and consent of advisory committee
Hours arranged (053-699-001) Staff

SECOND SESSION

MEA 493 Special Topics in Meteorology 1-3
Prerequisite: Consent of department
Hours arranged (053-493-001) Staff

MEA 593 Special Topics 1-6
Prerequisite: Consent of staff
Hours arranged (053-593-001) Staff

MEA 695 Seminar 1
Prerequisite: Graduate standing
Hours arranged (053-695-001) Staff

MEA 699 Research Credits Arranged
Prerequisites: Graduate standing and consent of advisory committee
Hours arranged (053-699-001) Staff

Music

FIRST SESSION

MUS 200 Understanding Music 3
0800-0930 (069-200-001) Bliss
0800-0930 (069-200-002) Kramer
0950-1120 (069-200-003) Kramer

MUS 210 A Survey of Music in America 3
0800-0930 (069-210-001) Hammond

MUS 260 History of Jazz 3
0950-1120 (069-260-001) Hammond

MUS 320 Music of the Twentieth Century 3
0950-1120 (069-320-001) Bliss

SECOND SESSION

MUS 200 Understanding Music 3
0800-0930 (069-200-001) Petters
0950-1120 (069-200-002) Petters
0800-0930 (069-200-003) Ward
0950-1120 (069-200-004) Ward

Nuclear Engineering

FIRST SESSION

$ NE 202 Fundamentals of Nuclear Energy 4
Prerequisite: PY 208
0950-1120 (070-202-001) Hankins

NE 491 Special Topics in Nuclear Engineering 1-4
Prerequisite: Consent of Instructor
Hours arranged (070-491-001) Staff

NE 591 Special Topics in Nuclear Engineering I 3
Prerequisite: Consent of Instructor
Hours arranged (070-591-001) Staff

NE 691 Advanced Topics in Nuclear Engineering I 3
Prerequisite: Consent of Instructor
Hours arranged (070-691-001) Staff

NE 692 Advanced Topics in Nuclear Engineering II 3
Prerequisite: Consent of Instructor
Hours arranged (070-692-001) Staff

NE 699 Research in Nuclear Engineering Credits Arranged
Prerequisite: Graduate standing
Hours arranged (070-699-001) Staff

SECOND SESSION

NE 491 Special Topics in Nuclear Engineering 1-4
Prerequisite: Consent of Instructor
Hours arranged (070-491-001) Staff

NE 591 Special Topics in Nuclear Engineering I 3
Prerequisite: Consent of Instructor
Hours arranged (070-591-001) Staff

NE 691 Advanced Topics in Nuclear Engineering I 3
Prerequisite: Consent of Instructor
Hours arranged (070-691-001) Staff

NE 692 Advanced Topics in Nuclear Engineering II 3
Prerequisite: Consent of Instructor
Hours arranged (070-692-001) Staff

NE 699 Research in Nuclear Engineering Credits Arranged
Prerequisite: Graduate standing
Hours arranged (070-699-001) Staff

Nutrition

FIRST SESSION

NTR 699 Research in Nutrition Credits Arranged
Prerequisite: Graduate standing
Hours arranged (071-699-001) Staff

SECOND SESSION

NTR (ANS, FS) 301 Modern Nutrition 3
(See Animal Science)

NTR 699 Research in Nutrition Credits Arranged
Prerequisite: Graduate standing
Hours arranged (071-699-001) Staff

Operations Research

FIRST SESSION

OR 591 Special Topics in Operations Research 1-3
Prerequisite: Consent of Instructor
Hours arranged (073-591-001) Staff

OR 691 Special Topics in Operations Research 3
Prerequisites: OR 501, OR (IE, MA) 505
Hours arranged (073-691-001) Staff

OR (IE, MA) 692 Special Topics in Mathematical Programming 3
Prerequisite: OR (IE, MA) 505
Hours arranged (073-692-001) Staff

OR 699 Project in Operations Research 1-3
Hours arranged (073-699-001) Staff

SECOND SESSION

OR 591 Special Topics in Operations Research 1-3
Prerequisite: Consent of Instructor
Hours arranged (073-591-001) Staff

OR 691 Special Topics in Operations Research 3
Prerequisites: OR 501, OR (IE, MA) 505
Hours arranged (073-691-001) Staff

OR (IE, MA) 692 Special Topics in Mathematical Programming 3
Prerequisite: OR (IE, MA) 505
Hours arranged (073-692-001) Staff

OR 699 Project in Operations Research 1-3
Hours arranged (073-699-001) Staff

Political Science and Public Administration

PUBLIC ADMINISTRATION

FIRST SESSION

PA 590 Readings and Research 1-3
Prerequisite: Graduate standing
Hours arranged (034-590-001) Staff

PA 611 Seminar in Public Personnel Management 3
Prerequisites: Graduate standing or Management Development Certificate Program and six semester hours of 500-level course work
1830-2100 MTuTh (034-611-001) Sims

PA 617 Seminar in Organization Theory 3
Prerequisites: Graduate standing or Management Development Certificate Program and six semester hours of 500-level course work
0800-0930 (034-617-001) Vasu

PA 691 Internship in Public Affairs 1-6
Prerequisite: Minimum 9 hours graduate work
Hours arranged (034-691-001) Staff

SECOND SESSION

***PA 516E Public Policy Analysis** 3
Prerequisite: Advanced undergraduate standing including 12 hours of political science, Graduate standing or PBS status
1900-2200 MW (034-516-001) Swiss

PA 590 Readings and Research 1-3
Prerequisite: Graduate standing
Hours arranged (034-590-001) Staff

PA 612 The Budgetary Process 3
Prerequisites: Graduate standing or Management Development Certificate Program and six semester hours of 500-level course work
1630-1830 MTuWTh (034-612-001) Coe

***PA 614E Management Systems** 3
Prerequisites: Graduate standing or Management Development Certificate Program and six semester hours of 500-level course work
1900-2200 TuTh (034-614-001) Swiss

***There will be additional class meetings on July 23 and August 10. The final examination will be on August 12.**

POLITICAL SCIENCE

FIRST SESSION

PS 201 Introduction to American Government 3
0800-0930 (080-201-001) Pavlik
0950-1120 (080-201-002) Pavlik
0950-1120 (080-201-003) Gilbert

PS 231 International Relations 3
0950-1120 (080-231-001) McClintock

PS 331 U.S. Foreign Policy 3
0800-0930 (080-331-001) Gilbert

PS 361 Introduction to Political Theory 3
0800-0930 (080-361-001) Kessler

$ PS 471 Survey Research 3
0950-1120 (080-471-001) Vasu

PS 490 Readings and Research in Political Science 1-6
Prerequisite: Consent of department
Hours arranged (080-490-001) Staff

PS 492 Honors Readings and Thesis in Political Science 3-6
Prerequisite: Admission to Honors Program and Consent of Instructor
Hours arranged (080-492-001) Staff

PS 590 Readings and Research 1-3
Prerequisite: Graduate standing or PBS status
Hours arranged (080-590-001) Staff

PS 699 Research in Politics Credits Arranged
Prerequisite: Graduate standing and approval of advisor
Hours arranged (080-699-001) Staff

SECOND SESSION

PS 201 Introduction to American Government 3
0800-0930 (080-201-001) Solari
0950-1120 (080-201-002) Holtzman

PS 301 The President and Congress 3
Prerequisite: PS 201
0800-0930 (080-301-001) Holtzman

PS 312 Introduction to Public Administration 3
Credit for PS 312 and PS 511 is not allowed.
0800-0930 (080-312-001) Coe

PS 490 Readings and Research in Political Science 1-6
Prerequisite: Consent of department
Hours arranged (080-490-001) Staff

PS 492 Honors Readings and Thesis in Political Science 3-6
Prerequisite: Admission to Honors Program and Consent of Instructor
Hours arranged (080-492-001) Staff

PS 498 Special Topics in Political Science: Political Economy 3
Prerequisite: Six hours PS
0950-1120 (080-498-001) Solari

PS 590 Readings and Research 1-3
Prerequisite: Graduate standing or PBS status
Hours arranged (080-590-001) Staff

PS 699 Research in Politics Credits Arranged
Prerequisites: Graduate standing and approval of adviser
Hours arranged (080-699-001) Staff

TEN-WEEK SESSION

PS 202E State and Local Government 3
1730-1930 MTh (080-202-051) McClain

PS 491 Internship in Political Science 1-6
Prerequisite: Consent of Instructor
Hours arranged (080-491-051) McClain

Product Design

FIRST SESSION

PD 494 Internship in Product Design 3-6
Prerequisites: Junior standing in Product Design; 3.0 GPA or better; and approval of department head
Maximum 6 credit hours
Hours arranged (082-494-001) Khachatoorian

PD 495 Independent Study in Product Design 1-3
Prerequisites: Junior standing in Product Design; 3.0 GPA or better; and approval of department head
Maximum 6 credit hours
Hours arranged (082-495-001) Khachatoorian

PD 595 Independent Study in Product Design 1-3
Prerequisite: Graduate standing
Hours arranged (082-595-001) Khachatoorian

PD 691 Special Topics in Product Design 1-6
Prerequisite: Graduate standing
Hours arranged (082-691-001) Khachatoorian

SECOND SESSION

PD 494 Internship in Product Design 3-6
Prerequisites: Junior standing in Product Design; 3.0 GPA or better; and approval of department head
Maximum 6 credit hours
Hours arranged (082-494-001) Khachatoorian

PD 495 Independent Study in Product Design 1-3
Prerequisites: Junior standing in Product Design; 3.0 GPA or better; and approval of department head
Maximum 6 credit hours
Hours arranged (082-495-001) Khachatoorian

PD 595 Independent Study in Product Design 1-3
Prerequisite: Graduate standing
Hours arranged (082-595-001) Khachatoorian

PD 691 Special Topics in Product Design 1-6
Prerequisite: Graduate standing
Hours arranged (082-691-001) Khachatoorian

Physical Education

FIRST SESSION

PE 100 (Coed) Health and Physical Fitness 1
0830-0930 (075-100-001) Combs

PE 112 Beginning Swimming 1
0940-1040 (075-112-001) Almekinders
1040-1140 (075-112-002) Almekinders

PE 220 Water Aerobics 1
Prerequisite: PE 112
1300-1400 (075-220-001) Berle

PE 221 Intermediate Swimming 1
Prerequisite: PE 113 or equivalent skill
0940-1040 (075-221-001) Goldberg

PE 226 Skin and Scuba Diving I 2
Prerequisite: PE 221 or equivalent skill
1040-1240 (075-226-001) Goldberg
1500-1700 MTuWTh (075-226-002) Stewart

PE 231 Body Conditioning and Aerobics 1
0940-1040 (075-231-001) Berle
1040-1140 (075-231-002) Berle

PE 232 Personal Defense for Women 1
1300-1400 (075-232-001) Combs

PE 237 Weight Training 1
0940-1040 (075-237-001) Combs
1200-1300 (075-237-002) Combs

PE 237E Weight Training 1
1745-1845 MTuWTh (075-237-003) Stewart

PE 241 Angling 1
Additional Fee Assessed
0830-0930 (075-241-001) Kascenska

PE 242 Badminton 1
1200-1300 (075-242-001) Daniels

PE 243 Bowling 1
$38.00 Bowling Fee
1300-1400 (075-243-001) Leath
1400-1500 (075-243-002) Leath

PE 245 Golf 1
0940-1040 (075-245-001) Patch
1040-1140 (075-245-002) Patch
1300-1400 (075-245-003) Patch
1400-1500 (075-245-004) Patch

PE 249 Tennis I 1
0830-0930 (075-249-001) Berle
0940-1040 (075-249-002) Wall
1040-1140 (075-249-003) Wall
1300-1400 (075-249-004) Almekinders
1400-1500 (075-249-005) Almekinders

PE 250 Tennis II 1
1040-1140 (075-250-001) Leath

PE 251 Target Archery 1
1040-1140 (075-251-001) Shannon

PE 256 Racquetball 1
0940-1040 (075-256-001) Leath

PE 256E Racquetball 1
1945-2045 MTuWTh (075-256-002) Stewart

PE 258 Basic Rockclimbing 1
1040-1140 (075-258-001) Kascenska
1300-1400 (075-258-002) Kascenska
1400-1500 (075-258-003) Kascenska

PE 265 Softball 1
1040-1140 (075-265-001) J. B. Brown
1300-1400 (075-265-002) Daniels

PE 269 Volleyball 1
1300-1400 (075-269-001) Wall
1400-1500 (075-269-002) Wall

PE 280 Emergency Medical Care and First Aid 2
This Course Does Not Constitute Credit Toward Meeting Physical Education Requirements.
0940-1040 (075-280-001) Daniels

SECOND SESSION

PE 100 (Coed) Health and Physical Fitness 1
0830-0930 (075-100-001) L. Brown

PE 112 Beginning Swimming 1
0940-1040 (075-112-001) R. Smith

PE 226 Skin and Scuba Diving I 2
Prerequisite: PE 221 or equivalent skill
1200-1400 (075-226-001) L. Brown

PE 229 Swim Conditioning 1
Prerequisite: PE 221
0940-1040 (075-229-001) L. Brown

PE 237 Weight Training 1
1200-1300 (075-237-001) R. Smith
1300-1400 (075-237-002) R. Smith
1615-1715 MTuWTh (075-237-003) DeWitt

PE 242 Badminton 1
1040-1140 (075-242-001) Gwyn
1200-1300 (075-242-002) Halstead

PE 243 Bowling 1
$38.00 Bowling Fee
1300-1400 (075-243-001) Cooper
1400-1500 (075-243-002) Cooper

PE 245 Golf 1
0940-1040 (075-245-001) Cooper
1040-1140 (075-245-002) Cooper
1200-1300 (075-245-003) Brothers
1300-1400 (075-245-004) Gwyn
1400-1500 (075-245-005) Gwyn

PE 249 Tennis I 1
0940-1040 (075-249-001) Cheek
1040-1140 (075-249-002) Cheek

PE 249E Tennis I 1
1745-1845 MTuWTh (075-249-003) DeWitt

PE 251 Target Archery 1
0830-0930 (075-251-001) R. Smith
1040-1140 (075-251-002) Halstead

PE 256 Raquetball 1
0940-1040 (075-256-001) Brothers
1040-1140 (075-256-002) Brothers
1500-1600 MTuWTh (075-256-003) DeWitt

PE 256E Racquetball 1
1945-2045 MTuWTh (075-256-004) DeWitt

PE 265 Softball 1
1300-1400 (075-265-001) Cheek
1400-1500 (075-265-002) Cheek

PE 269 Volleyball 1
0940-1040 (075-269-001) Gwyn

Philosophy

FIRST SESSION

PHI 201 Logic 3
0800-0930 (074-201-001) Levin
0950-1120 (074-201-002) Levin

PHI 205 Problems and Types of Philosophy 3
0800-0930 (074-205-001) VanDeVeer
0950-1120 (074-205-002) VanDeVeer

PHI 314 Issues in Business Ethics 3
0800-0930 (074-314-001) Pierce
0950-1120 (074-314-002) Pierce

PHI 340 Philosophy of Science 3
0800-0930 (074-340-001) Antony
0950-1120 (074-340-002) Antony

SECOND SESSION

PHI 201 Logic 3
0800-0930 (074-201-001) Levine
0950-1120 (074-201-002) Levine

PHI 205 Problems and Types of Philosophy 3
0800-0930 (074-205-001) Hambourger
0950-1120 (074-205-002) Hambourger

PHI 340 Philosophy of Science 3
0800-0930 (074-340-001) Austin
0950-1120 (074-340-002) Austin

Physiology

FIRST SESSION

PHY 590 Special Problems in Physiology Credits Arranged
Prerequisites: Graduate standing, Consent of Instructor
Hours arranged (078-590-001) Britt

PHY 699 Physiological Research Credits Arranged
Prerequisites: Graduate standing, Consent of Instructor
Hours arranged (078-699-001) Britt

SECOND SESSION

PHY 699 Physiological Research Credits Arranged
Prerequisites: Graduate standing, Consent of Instructor
Hours arranged (078-699-001) Britt

Pest Management

FIRST SESSION

PM 495 Special Topics in Integrated Pest Management 1-6
Prerequisite: PM 111. A total of only 6 hours of either PM 495 and/or ALS 400 can be applied towards B.S. requirements.
Hours arranged (076-495-001) Staff

PM 590 Advanced Topics in Integrated Pest Management 1-6
Prerequisite: PM 405 or PM 415
Hours arranged (076-590-001) Staff

SECOND SESSION

PM 495 Special Topics in Integrated Pest Management 1-6
Prerequisite: PM 111. A total of only 6 hours of either PM 495 and/or ALS 400 can be applied towards B.S. requirements.
Hours arranged (076-495-001) Staff

PM 590 Advanced Topics in Integrated Pest Management 1-6
Prerequisite: PM 405 or PM 415
Hours arranged (076-590-001) Staff

Poultry Science

FIRST SESSION

PO 495 Special Problems in Poultry Science 1-6
Prerequisites: Junior standing and Consent of Instructor
Hours arranged (081-495-001) Ort

PO 698 Special Problems in Poultry Science 1-6
Prerequisite: Graduate standing
Hours arranged (081-698-001) Ort

PO 699 Poultry Research Credits Arranged
Prerequisite: Graduate standing
Hours arranged (081-699-001) Ort

SECOND SESSION

PO 495 Special Problems in Poultry Science 1-6
Prerequisites: Junior standing and Consent of Instructor
Hours arranged (081-495-001) Ort

PO 698 Special Problems in Poultry Science 1-6
Prerequisite: Graduate standing
Hours arranged (081-698-001) Ort

PO 699 Poultry Research Credits Arranged
Prerequisite: Graduate standing
Hours arranged (081-699-001) Ort

Plant Pathology

FIRST SESSION

PP 595 Special Problems in Plant Pathology Credits Arranged
Prerequisite: Consent of Instructor Maximum 6
Hours arranged (079-595-001) Klarman

PP 699 Research in Plant Pathology Credits Arranged
Prerequisites: Graduate standing and Consent of Instructor
Hours arranged (079-699-001) Klarman

SECOND SESSION

PP 595 Special Problems in Plant Pathology Credits Arranged
Prerequisite: Consent of Instructor Maximum 6
Hours arranged (079-595-001) Klarman

PP 699 Research in Plant Pathology Credits Arranged
Prerequisites: Graduate standing and Consent of Instructor
Hours arranged (079-699-001) Klarman

TEN-WEEK SESSION

$ PP 503 Plant Disease Diagnoses 4
Prerequisites: PP 501 and PP 502A,B,C or equivalent
0800-1700 MF (079-503-051) Grand/Jones

ADULT EDUCATION SESSION

***PP 595A Special Problems in Plant Pathology: Plant Diseases—Principles, Diagnoses and Management** 4
Prerequisite: B.S. in a Plant Science
0900-1600 Averre
June 6-June 24—Three-Week Course—Final Exam June 24

***Course taught in the three-week Regional Summer School for Adult, Extension and Community College Educators (June 6-24). Special registration procedures are required. See page 28 for additional information.**

Psychology

FIRST SESSION

PSY 200 Introduction to Psychology 3
0800-0930 (083-200-001) Staff
0800-0930 (083-200-002) Pond
0950-1120 (083-200-003) Pond
0950-1120 (083-200-004) Cunningham
1140-1310 (083-200-005) Cunningham

PSY 210 Applied Psychology 3
Prerequisite: PSY 200
0950-1120 (083-210-001) Smith

PSY 300 Perception 3
Prerequisite: PSY 200
0950-1120 (083-300-001) Krauss

PSY 304 Educational Psychology 3
0800-0930 (083-304-001) Street
0950-1120 (083-304-002) Staff

PSY 307 Industrial and Organizational Psychology 3
Prerequisite: PSY 200
0800-0930 (083-307-001) Reardin

PSY 376 Human Growth and Development 3
Prerequisite: PSY 200 or PSY 304
0950-1120 (083-376-001) Baker-Ward
1140-1310 (083-376-002) Baker-Ward

PSY 475 Child Psychology 3
Prerequisite: PSY 200 or PSY 304
0950-1120 (083-475-001) Walker
1140-1310 (083-475-002) Walker

PSY 476 Psychology of Adolescent Development 3
Prerequisite: PSY 200 or PSY 304
0800-0930 (083-476-001) Staff

PSY 499 Individual Study in Psychology 1-6
Prerequisite: Consent of department
Hours arranged (083-499-001) Staff

PSY 533 Biological Factors in Abnormal Behavior 3
Prerequisites: 6 hours of PSY and 6 hours of biology
0800-1000 (083-533-001) Kalat

PSY 599 Research Problems in Psychology Credits Arranged
Prerequisite: Consent of Instructor
Hours arranged (083-599-001) Staff

PSY 693 Psychological Clinic Practicum Maximum 12
Prerequisites: Twelve hours in graduate psychology, which must include clinical skill courses PSY 571 and PSY 572 and/or Consent of Instructor
Hours arranged (083-693-001) Staff

PSY 699 Thesis and Dissertation Research Credits Arranged
Prerequisites: Graduate standing, Consent of Instructor
Hours arranged (083-699-001) Staff

SECOND SESSION

PSY 200 Introduction to Psychology 3
0800-0930 (083-200-001) Flannagan
0800-0930 (083-200-002) Cheuvront
0950-1120 (083-200-003) Staff
1140-1310 (083-200-004) Habler
1330-1500 (083-200-005) Staff

PSY 304 Educational Psychology 3
0800-0930 (083-304-001) Janowitz
0950-1120 (083-304-002) Staff

PSY 307 Industrial and Organizational Psychology 3
Prerequisite: PSY 200
0800-0930 (083-307-001) Reardin

PSY 376 Human Growth and Development 3
Prerequisite: PSY 200 or PSY 304
0800-0930 (083-376-001) Staff

PSY 476 Psychology of Adolescent Development 3
Prerequisite: PSY 200 or PSY 304
0800-0930 (083-476-001) Donley

PSY 499 Individual Study in Psychology 1-6
Prerequisite: Consent of department
Hours arranged (083-499-001) Staff

PSY 535 Tests and Measurements 3
Prerequisite: Six hours of psychology
0800-0930 (083-535-001) Westbrook
0950-1120 (083-535-002) Westbrook

PSY 577 Adolescent Development 3
Prerequisite: Six hours of psychology or Consent of Instructor
0800-0930 (083-577-001) Snyder
0950-1120 (083-577-002) Snyder

PSY 599 Research Problems in Psychology Credits Arranged
Prerequisite: Consent of Instructor
Hours arranged (083-599-001) Staff

PSY 693 Psychological Clinic Practicum Maximum 12
Prerequisites: Twelve hours in graduate psychology, which must include clinical skill courses PSY 571 and PSY 672 and/or Consent of Instructor
Hours arranged (083-693-001) Staff

PSY 699 Thesis and Dissertation Research Credits Arranged
Prerequisites: Graduate standing and Consent of Instructor
Hours arranged (083-699-001) Staff

Physics

FIRST SESSION

$ PY 205 General Physics 4
Prerequisite: MA 141. Required in most Engineering curricula.
LR 0800-0930 (077-205-001) Staff
LR 0950-1120 (077-205-002) Staff
LB 0730-0940 MW (077-205-101)
LB 1250-1500 MW (077-205-102)
LB 1020-1230 MW (077-205-103)
LB 1250-1500 MW (077-205-105)
LB 1250-1500 TuTh (077-205-106)
LB 1520-1730 MW (077-205-107)

$ PY 208 General Physics 4
Prerequisite: PY 205
LR 0800-0930 (077-208-001) Staff
LR 0950-1120 (077-208-002) Staff
LB 0730-0940 MW (077-208-101)
LB 1020-1230 MW (077-208-103)
LB 1020-1230 TuTh (077-208-104)
LB 1250-1500 MW (077-208-105)
LB 1250-1500 TuTh (077-208-106)
LB 1520-1730 MW (077-208-107)

$ PY 211 General Physics 4
Prerequisite: MA 111 or MA 116. Credit is not allowed for PY 211 and either PY 201 or PY 205.
LR 0800-0930 (077-211-001) Staff
LB 1250-1500 MW (077-211-101)
LB 1250-1500 TuTh (077-211-102)

$ PY 212 General Physics 4
Prerequisite: PY 211. Credit is not allowed for PY 212 and either PY 202 or PY 208.
LR 0950-1120 (077-212-001) Staff
LB 1250-1500 MW (077-212-101)
LB 1250-1500 TuTh (077-212-102)

PY 221 College Physics 5
Prerequisite: MA 115
1020-1300 (077-221-001) Staff

$ PY 231 Physics for Non-Scientists 4
For Humanities and Social Sciences students only
LR 0950-1120 (077-231-001) Staff
LB 1250-1500 MW (077-231-101)

PY 499 Special Problems in Physics 1-6
Prerequisite: Consent of department
Hours arranged (077-499-001) Staff

PY 590 Special Topics in Physics Credits Arranged
Prerequisite: Consent of department
Hours arranged (077-590-001) Staff

PY 699 Research Credits Arranged
Hours arranged (077-699-001) Staff

SECOND SESSION

$ PY 205 General Physics 4
Prerequisite: MA 141. Required in most Engineering curricula.
LR 0800-0930 (077-205-001) Staff
LR 0950-1120 (077-205-002) Staff
LB 0730-0940 MW (077-205-101)
LB 1020-1230 MW (077-205-103)
LB 1250-1500 MW (077-205-105)
LB 1250-1500 TuTh (077-205-106)
LB 1520-1730 MW (077-205-107)

$ PY 208 General Physics 4
Prerequisite: PY 205
LR 0800-0930 (077-208-001) Staff
LR 0950-1120 (077-208-002) Staff
LB 0730-0940 MW (077-208-101)
LB 1020-1230 MW (077-208-103)
LB 1250-1500 MW (077-208-105)
LB 1250-1500 TuTh (077-208-106)
LB 1520-1730 MW (077-208-107)

$ PY 211 General Physics 4
Prerequisite: MA 111 or MA 116. Credit is not allowed for PY 211 and either PY 201 or PY 205.
LR 0950-1120 (077-211-001) Staff
LB 1250-1500 MW (077-211-101)
LB 1250-1500 TuTh (077-211-102)

$ PY 212 General Physics 4
Prerequisite: PY 211. Credit is not allowed for PY 212 and either PY 202 or PY 208.
LR 0800-0930 (077-212-001) Staff
LB 1250-1500 MW (077-212-101)
LB 1250-1500 TuTh (077-212-102)

PY 221 College Physics 5
Prerequisite: MA 115
1020-1300 (077-221-001) Staff

PY 407 Introduction to Modern Physics 3
Prerequisites: MA 202, PY 208
0800-0930 (077-407-001) Staff

PY 499 Special Problems in Physics 1-6
Prerequisite: Consent of department
Hours arranged (077-499-001) Staff

PY 590 Special Topics in Physics Credits Arranged
Prerequisite: Consent of department
Hours arranged (077-590-001) Staff

PY 699 Research Credits Arranged
Hours arranged (077-699-001) Staff

Religion

FIRST SESSION

REL 300 Religious Traditions of the World 3
0800-0930 (087-300-001) VanderKam
0950-1120 (087-300-002) VanderKam

SECOND SESSION

REL 300 Religious Traditions of the World 3
0800-0930 (087-300-001) Mullin
0950-1120 (087-300-002) Mullin

Recreation Resources Administration

FIRST SESSION

RRA 152 Introduction to Recreation 3
0800-0930 (085-152-001) Sternloff
0950-1120 (085-152-002) Sternloff

RRA 475 Recreation and Park Internship 9
Prerequisites: Senior standing, RRA 359
Hours arranged (085-475-001) Kirsch

RRA 591 Recreation Resources Problems 1-4
Prerequisites: Advanced undergraduate or Graduate standing
Hours arranged (085-591-001) Staff

RRA 675 Field Studies in Recreation 1-4
Prerequisite: Minimum of nine hours graduate credit
Hours arranged (085-675-001) Staff

RRA 692 Advanced Problems in Recreation Credits Arranged
Prerequisite: Twelve hours RRA courses
Hours arranged (085-692-001) Staff

RRA 699 Research in Recreation Credits Arranged
Prerequisite: Twelve hours RRA courses
Hours arranged (085-699-001) Staff

SECOND SESSION

RRA 152 Introduction to Recreation 3
0800-0930 (085-152-001) Love

RRA 591 Recreation Resources Problems 1-4
Prerequisite: Advanced undergraduate or Graduate standing
Hours arranged (085-591-001) Staff

RRA 595 Special Topics in Recreation Resources: Aging & Leisure 3
Prerequisites: Graduate standing; Consent of Instructor
0950-1120 (085-595-001) Love

RRA 675 Field Studies in Recreation 1-4
Prerequisite: Minimum of nine hours graduate credit
Hours arranged (085-675-001) Staff

RRA 692 Advanced Problems in Recreation Credits Arranged
Prerequisite: Twelve hours RRA courses
Hours arranged (085-692-001) Staff

RRA 699 Research in Recreation Credits Arranged
Prerequisite: Twelve hours RRA courses
Hours arranged (085-699-001) Staff

Sociology

FIRST SESSION

SOC 202 Principles of Sociology 3
0800-0930 (092-202-001) Thomson
0800-0930 (092-202-002) Staff
0950-1120 (092-202-003) Devey
1140-1310 (092-202-004) Devey
1140-1310 (092-202-005) Della Fave

SOC 202E Principles of Sociology 3
1745-1930 MTuWTh (092-202-006) Staff

SOC 203 Current Social Problems 3
0950-1120 (092-203-001) Staff

SOC 204 Sociology of Family 3
0800-0930 (092-204-001) Troost
0950-1120 (092-204-002) Troost
0950-1120 (092-204-003) Risman
1140-1310 (092-204-004) Risman

SOC 204E Sociology of Family 3
1745-1930 MTuWTh (092-204-005) Uzzell
1945-2130 MTuWTh (092-204-006) Uzzell

SOC 205 Work: Occupations and Professions 3
1140-1310 (092-205-001) Staff

SOC 301 Human Behavior 3
Prerequisite: SOC 202 or PSY 200
0800-0930 (092-301-001) Hyman
0950-1120 (092-301-002) Hyman

SOC 301E Human Behavior 3
Prerequisite: SOC 202 or PSY 200
1745-1930 MTuWTh (092-301-003) Staff

SOC 305 Race and Ethnic Relations 3
Prerequisite: Three credits of SOC
0950-1120 (092-305-001) Della Fave

SOC 306 Criminology 3
Prerequisite: Three credits of SOC
0800-0930 (092-306-001) Zingraff

$ SOC 416 Social Research Methods 3
Prerequisite: Senior standing, ST 311 or Consent of Instructor
0950-1120 (092-416-001) Thomson

SOC 420 Sociology of Corrections 3
Prerequisites: SOC 306 and PS 311
1140-1310 (092-420-001) Zingraff

SOC 498 Special Topics in Sociology 1-6
Prerequisite: Six hours of SOC above 200 level
Hours arranged (092-498-001) Staff

SOC 591 Special Topics in Sociology 1-6
Prerequisite: Consent of Instructor
Hours arranged (092-591-001) Staff

SOC 595 Practicum in Sociology 3-6
Prerequisites: Graduate standing in the Master of Sociology program and 9 hours of SOC at the 500-600 level.
Hours arranged (092-595-001) Staff

SOC 699 Research in Sociology Credits Arranged
Prerequisite: Consent of chairman of graduate student committee
Hours arranged (092-699-001) Staff

SECOND SESSION

SOC 202 Principles of Sociology 3
0800-0930 (092-202-001) (092-202-002) Staff
0950-1120 (092-202-003) Marsh
0950-1120 (092-202-004) Staff
1140-1310 (092-202-005) Staff

SOC 202E Principles of Sociology 3
1745-1930 MTuWTh (092-202-006) Staff

SOC 203 Current Social Problems 3
0950-1120 (092-203-001) Staff

SOC 203E Current Social Problems 3
1945-2130 MTuWTh (092-203-002) Brown

SOC 204 Sociology of Family 3
0800-0930 (092-204-001) Staff
0950-1120 (092-204-002) (092-204-003) Staff
1140-1310 (092-204-004) Staff

SOC 204E Sociology of Family 3
1745-1930 MTuWTh (092-204-005) Staff
1945-2130 MTuWTh (092-204-006) Staff

SOC 301 Human Behavior 3
Prerequisite: SOC 202 or PSY 200
0800-0930 (092-301-001) Brisson
0950-1120 (092-301-002) Brisson

SOC 305 Race and Ethnic Relations 3
Prerequisite: Three credits of SOC
1140-1310 (092-305-001) Woodrum

SOC 400 Theories of Social Structure 3
Prerequisite: Three hours credit 200 level
0800-0930 (092-400-001) Woodrum

SOC 425 Juvenile Delinquency 3
Prerequisite: SOC 202; SOC 301 desirable
0950-1120 (092-425-001) Hill

SOC 498 Special Topics in Sociology 1-6
Prerequisite: Six hours of SOC above the 200 level
Hours arranged (092-498-001) Suval

SOC 515 Deviant Behavior 3
Prerequisite: Six hours SOC or ANT, or Graduate standing or PBS status
1140-1310 (092-515-001) Hill

SOC 541 Social Systems and Planned Change 3
Prerequisite: Three hours of Sociology
1745-1930 MTuWTh (092-541-001) Marsh

SOC 591 Special Topics in Sociology 1-6
Prerequisite: Consent of Instructor
Hours arranged (092-591-001) Suval

SOC 595 Practicum in Sociology 3-6
Prerequisites: Graduate standing in the Master of Sociology program and 9 hours of SOC at 500-600 level.
Hours arranged (092-595-001) Suval

SOC 699 Research in Sociology Credits Arranged
Prerequisite: Consent of chairman of graduate study committee
Hours arranged (092-699-001) Suval

Speech-Communication

FIRST SESSION

SP 101 Speech Improvement 3
Not accepted for area emphasis requirement in Public Communication
0950-1120 (037-101-001) Franklin

SP 103 Introduction to the Theatre 3
0950-1120 (037-103-001) Caple

SP 110 Public Speaking 3
0800-0930 (037-110-001) Franklin
0800-0930 (037-110-002) Schrag
0950-1120 (037-110-003) Schrag
0950-1120 (037-110-004) Parker
1140-1310 (037-110-005) Parker

SP 112 Interpersonal Communication 3
0800-0930 (037-112-001) DeJoy
0800-0930 (037-112-002) Staff
0950-1120 (037-112-003) DeJoy
0950-1120 (037-112-004) Staff
1140-1310 (037-112-005) Anderson

SP 146 Business and Professional Communication 3
Speech-Communication majors may not count SP 146 in the major
0800-0930 (037-146-001) Hankins

SP 203 Theory and Practice of Acting 3
0800-0930 (037-203-001) Caple

SP 204 Writing for the Electronic Media 3
0800-0930 (037-204-001) Staff

SP 214 Introduction to Audio Production 3
Preference is given to Speech-Communication majors.
1140-1310 (037-214-001) Alchediak

SP 298 Special Projects in Speech-Communication 1-3
0950-1120 (037-298-001) Staff

SP 298A Special Projects in Speech-Communication: Intercultural Communication 3
0950-1120 (037-298-002) Hankins

SP 312 Patterns of Miscommunication 3
0950-1120 (037-312-001) Munn

SP 322 Nonverbal Communication 3
Prerequisite: SP 112
0950-1120 (037-322-001) Anderson

SP 342 Interviewing 3
Prerequisite: Junior standing
0800-0930 (037-342-001) Munn

SP 354 Portable Video Production 3
Preference given to Speech-Communication majors.
0950-1120 (037-354-001) Alchediak

SP 498 Special Topics in Speech-Communication 1-3
Prerequisites: Nine hours of speech and Junior standing and permission of the department.
Hours arranged (037-498-001) Staff

SECOND SESSION

SP 103 Introduction to the Theatre 3
0800-0930 (037-103-001) Russell

SP 110 Public Speaking 3
0800-0930 (037-110-001) Long
0950-1120 (037-110-002) Long
0950-1120 (037-110-003) Camp
1140-1310 (037-110-004) Camp

SP 112 Interpersonal Communication 3
0800-0930 (037-112-001) Staff
0950-1120 (037-112-002) (037-112-003) Staff
1140-1310 (037-112-004) Staff

SP 146 Business and Professional Communication 3
Speech-Communication majors may not count SP 146 in the major
0800-0930 (037-146-001) Staff

SP 200 Introduction to Communication Inquiry 3
Prerequisite: SP 100
0950-1120 (037-200-001) Funkhouser

SP 203 Theory and Practice of Acting 3
0950-1120 (037-203-001) Russell

SP 214 Introduction to Audio Production 3
Preference is given to Speech-Communication majors.
1140-1310 (037-214-001) Staff

SP 304 Survey of Telecommunication 3
1140-1310 (037-304-001) Funkhouser

SP 322 Nonverbal Communication 3
Prerequisite: SP 112
1140-1310 (037-322-001) Staff

SP 498 Special Topics in Speech-Communication 1-3
Prerequisites: Nine hours of speech and Junior standing and permission of the department.
Hours arranged (037-498-001) Staff

Soil Science

FIRST SESSION

SSC 590 Special Problems — Credits Arranged
Prerequisite: SSC 200
Hours arranged (093-590-001) — Staff

SSC 699 Research — Credits Arranged
Prerequisite: Graduate standing in SSC
Hours arranged (093-699-001) — Staff

SECOND SESSION

SSC 590 Special Problems — Credits Arranged
Prerequisite: SSC 200
Hours arranged (093-590-001) — Staff

SSC 699 Research — Credits Arranged
Prerequisite: Graduate standing in SSC
Hours arranged (093-699-001) — Staff

ADULT EDUCATION SESSION

***SSC 560 Advanced Soil Management** — 3
Prerequisites: SSC 200, SSC 341
0900-1600 — Cook/Denton
June 6 - June 24—Three-Week Course—Final Exam June 24

***Course taught in the three-week Regional Summer School for Adult, Extension and Community College Educators (June 6-24). Special registration procedures are required. See page 28 for additional information.**

Statistics

FIRST SESSION

ST 311 Introduction to Statistics — 3
0950-1120 (094-311-001) — Latour

ST (EB) 350 Economics and Business Statistics — 3
(See Economics and Business)

ST 361 Introduction to Statistics for Engineers — 3
Prerequisite: College Algebra
0800-0930 (094-361-001) — Kianifard

ST 371 Introduction to Probability and Distribution Theory — 3
Prerequisite: MA 201
Corequisite: MA 202
0950-1120 (094-371-001) — Wesler
0800-0930 (094-371-002) — Wesler

ST 493 Special Topics in Statistics — 1-3
Prerequisite: Consent of Instructor
Hours arranged (094-493-001) — Staff

ST 511S Experimental Statistics I — 3
Prerequisite: ST 311 or Graduate standing
1140-1310 (094-511-001) — Pollock

ST 515 Experimental Statistics for Engineers 3
Prerequisite: ST 361 or Graduate standing
0950-1120 (094-515-001) Quesenberry

ST 591 Special Problems 1-3
Hours arranged (094-591-001) Staff

ST 691 Advanced Special Problems 1-3
Prerequisites: ST 402 or equivalent, ST 681
Hours arranged (094-691-001) Staff

ST 699 Research Credits Arranged
Hours arranged (094-699-001) Staff

SECOND SESSION

ST(EB) 350 Economics and Business Statistics 3
(See Economics and Business)

ST 372 Introduction to Statistical Inference and Regression 3
Prerequisite: ST 371
0950-1120 (094-372-001) Dietz

ST 512S Experimental Statistics II 3
Prerequisite: ST 511 or equivalent
0800-0930 (094-512-001) Giesbrecht

$ ST 516 Experimental Statistics for Engineers 3
Prerequisite: ST 515
0950-1120 (094-516-001) Hader

ST 591 Special Problems 1-3
Hours arranged (094-591-001) Staff

ST 691 Advanced Special Problems 1-3
Prerequisites: ST 402 or equivalent, ST 681
Hours arranged (094-691-001) Staff

ST 699 Research Credits Arranged
Hours arranged (094-699-001) Staff

TEN-WEEK SESSION

ST 595 Statistical Consulting 1
Prerequisites: ST 512 and ST 522
Hours arranged (094-595-051) Berger/Proctor

Social Work

FIRST SESSION

SW 498 Special Topics in Social Work 1-6
Prerequisite: Nine hours of Social Work. Bachelor of social work students.
Hours arranged (086-498-001) Peebles

SECOND SESSION

SW 312 Social Work Practice in Health Care 3
Prerequisite: For Social Work students only
1745-1930 MTuWTh (086-312-001) Brown

SW 498 Special Topics in Social Work 1-6
Prerequisite: Nine hours of Social Work. Bachelor of social work students.
Hours arranged (086-498-001) Peebles

Textile Chemistry

FIRST SESSION

T 203 Introduction to Polymer Chemistry 3
Prerequisite: CH 101
0800-0930 (095-203-001) Staff

TC 490 Special Topics in Textile Chemistry 1-6
Hours arranged (096-490-001) Mock

TC 591 Special Topics in Textile Science 1-4
Prerequisites: Senior or Graduate standing and Consent of Instructor
Hours arranged (096-591-001) Mock

TC 699 Textile Research for Textile Chemistry Credits Arranged
Hours arranged (096-699-001) Mock

SECOND SESSION

$ T 301 Technology of Dyeing and Finishing 4
Prerequisite: T 203
LR 0800-0930 (095-301-001) Staff
LB 1340-1620 MW (095-301-101)

T 493 Industrial Internship in Textiles 3
Prerequisites: Textile core courses. Limited to 3 hours as free elective.
Hours arranged (095-493-001) Massey

TC 490 Special Topics in Textile Chemistry 1-6
Hours arranged (096-490-001) Mock

TC 591 Special Topics in Textile Science 1-4
Prerequisites: Senior or Graduate standing and Consent of Instructor
Hours arranged (096-591-001) Mock

TC 699 Textile Research for Textile Chemistry Credits Arranged
Hours arranged (096-699-001) Mock

Textile Engineering and Science

FIRST SESSION

$ T 220 Yarn Production Systems 3
Prerequisites: T 105, MA 111
LR 0950-1050 (095-220-001) Banks-Lee
LB 1340-1620 TuTh (095-220-101)

TES 490 Development Projects in Textile Engineering 2-3
Prerequisites: Senior standing and 2.75 GPA. Course may be taken twice provided projects are different.
Hours arranged (097-490-001) Gupta

TES 590 Special Projects in Textiles Engineering and Science 2-3
Prerequisites: Senior or Graduate standing and Consent of Instructor
Hours arranged (097-590-001) Gupta

TES 697 Independent Study in Textiles 3
Hours arranged (097-697-001) Gupta

TES 699 Textile Thesis or Dissertation Research Credits Arranged
Hours arranged (097-699-001) Gupta

SECOND SESSION

T 493 Industrial Internship in Textiles 3
Prerequisites: Textile core courses. Limited to 3 hours as free elective.
Hours arranged (095-493-001) Massey

TES 490 Development Projects in Textile Engineering 2-3
Prerequisites: Senior standing and 2.75 GPA. Course may be taken twice provided projects are different.
Hours arranged (097-490-001) Gupta

TES 590 Special Projects in Textiles Engineering and Science 2-3
Prerequisites: Senior or Graduate standing and Consent of Instructor
Hours arranged (097-590-001) Gupta

TES 697 Independent Study in Textiles 3
Hours arranged (097-697-001) Gupta

TES 699 Textile Thesis or Dissertation Research Credits Arranged
Hours arranged (097-699-001) Gupta

Textile Management and Technology

FIRST SESSION

TMT 490 Development Project in Textile Technology 2-3
Prerequisites: Senior standing and 2.75 GPA. Course may be taken twice provided projects are different subject matter.
Hours arranged (102-490-001) Robinson

TMT 590 Special Projects in Textile Management and Technology 2-3
Prerequisites: Senior or Graduate standing and Consent of Instructor
Hours arranged (102-590-001) Tucker

TMT 697 Independent Study in Textiles 3
Hours arranged (102-697-001) Tucker

TMT 699 Textile Thesis or Dissertation Research Credits Arranged
Hours arranged (102-699-001) Tucker

SECOND SESSION

$ T 250 Textile Fabrics: Formation and Structure 3
Prerequisites: T 105 and MA 111
LR 0950-1050 (095-250-001) Donaldson
LB 1340-1620 TuTh (095-250-101)

T 493 Industrial Internship in Textiles 3
Prerequisites: Textile core courses. Limited to 3 hours as free elective.
Hours arranged (095-493-001) Massey

TMT 490 Development Project in Textile Technology 2-3
Prerequisites: Senior standing and 2.75 GPA. Course may be taken twice provided projects are different subject matter.
Hours arranged (102-490-001) Robinson

TMT 590 Special Projects in Textile Management and Technology 2-3
Prerequisites: Senior or Graduate standing and Consent of Instructor
Hours arranged (102-590-001) Berkstresser

TMT 697 Independent Study in Textiles 3
Hours arranged (102-697-001) Berkstresser

TMT 699 Textile Thesis or Dissertation Research — Credits Arranged
Hours arranged (102-699-001) — Berkstresser

Toxicology

FIRST SESSION

TOX 590 Special Problems in Toxicology — 1-3
Prerequisite: Graduate standing
Hours arranged (088-590-001) — Staff

TOX 699 Research — Credits Arranged
Prerequisite: Graduate standing
Hours arranged (088-699-001) — Staff

SECOND SESSION

TOX 590 Special Problems in Toxicology — 1-3
Prerequisite: Graduate standing
Hours arranged (088-590-001) — Staff

TOX 699 Research — Credits Arranged
Prerequisite: Graduate standing
Hours arranged (088-699-001) — Staff

University Studies

FIRST SESSION

UNI 301 Science and Civilization — 3
Prerequisite: Sophomore standing
0800-0930 (089-301-001) — Stalnaker

UNI 302 Contemporary Science and Human Values — 3
Prerequisite: Sophomore standing
0950-1120 (089-302-001) — Stalnaker

UNI 495Z Special Topics in University Studies: AIDS — 1
1200-1315 (089-495-001) — Turnbull

SECOND SESSION

UNI 301 Science and Civilization — 3
Prerequisite: Sophomore standing
0950-1120 (089-301-001) — Hoffman

UNI 302 Contemporary Science and Human Values — 3
Prerequisite: Sophomore standing
1140-1310 (089-302-001) — Hoffman

Visual Design

FIRST SESSION

$ VD 400 Visual Design Studio — 6
Prerequisite: DF 102 or written approval of department head and Dean
Corequisites: DN 456, DN 242
0750-1300 (042-400-001) — Deere

VD 494 Internship in Visual Design 3-6
Prerequisites: Junior standing in Visual Design; 3.0 GPA or better; and written approval of department head
Maximum 6 credit hours
Hours arranged (042-494-001) Khachatoorian

VD 495 Independent Study in Visual Design 1-3
Prerequisites: Junior standing in Visual Design; 3.0 GPA or better; and approval of department head
Maximum 6 credit hours
Hours arranged (042-495-001) Khachatoorian

VD 595 Independent Study in Visual Design 1-3
Hours arranged (042-595-001) Khachatoorian

VD 691 Special Topics in Visual Design 1-6
Prerequisite: Permission of Graduate advisor
Hours arranged (042-691-001) Khachatoorian

SECOND SESSION

VD 494 Internship in Visual Design 3-6
Prerequisites: Junior standing in Visual Design; 3.0 GPA or better; and written approval of department head
Maximum 6 credit hours
Hours arranged (042-494-001) Khachatoorian

VD 495 Independent Study in Visual Design 1-3
Prerequisites: Junior standing in Visual Design; 3.0 GPA or better; and approval of department head
Maximum 6 credit hours
Hours arranged (042-495-001) Khachatoorian

VD 595 Independent Study in Visual Design 1-3
Hours arranged (042-595-001) Khachatoorian

VD 691 Special Topics in Visual Design 1-6
Prerequisite: Permission of Graduate advisor
Hours arranged (042-691-001) Khachatoorian

Veterinary Medical Sciences

FIRST SESSION

VMS 590 Special Topics in Veterinary Medical Sciences 1-3
Prerequisite: Senior or Graduate standing
Hours arranged (084-590-001) Bentley/Berkhoff/Brown/Henrikson

VMS 690B Special Topics in Pathology 1-4
Prerequisites: DVM degree and Consent of Instructor
Hours arranged (084-690-001) Brown/Staff

VMS 690C Special Topics in Laboratory Pharmacology 1-3
Prerequisites: Graduate standing and Consent of Instructor
Hours arranged (084-690-002) Bentley/Staff

VMS 694A Seminar in Necropsy Pathology 1
Prerequisites: DVM or equivalent degree and Consent of Instructor
Hours arranged (084-694-001) Brown/Staff

VMS 694B Seminar in Surgical Pathology 1
Prerequisites: DVM or equivalent degree and Consent of Instructor
Hours arranged (084-694-002) Brown/Staff

VMS 699 Research in Veterinary Medical Sciences 1-3
Prerequisite: Graduate standing
Hours arranged (084-699-001) Bentley/Berkhoff/Brown/Henrikson

SECOND SESSION

VMS 590 Special Topics in Veterinary Medical Sciences 1-3
Prerequisite: Senior or Graduate standing
Hours arranged (084-590-001) Bentley/Berkhoff/Brown/Henrikson

VMS 690B Special Topics in Pathology 1-4
Prerequisites: DVM degree and Consent of Instructor
Hours arranged (084-690-001) Brown/Staff

VMS 690C Special Topics in Laboratory Pharmacology 1-3
Prerequisites: Graduate standing and Consent of Instructor
Hours arranged (084-690-002) Bentley/Staff

VMS 694A Seminar in Necropsy Pathology 1
Prerequisites: DVM or equivalent degree and Consent of Instructor
Hours arranged (084-694-001) Brown/Staff

VMS 694B Seminar in Surgical Pathology 1
Prerequisites: DVM or equivalent degree and Consent of Instructor
Hours arranged (084-694-002) Brown/Staff

VMS 699 Research in Veterinary Sciences 1-3
Prerequisite: Graduate standing
Hours arranged (084-699-001) Bentley/Berkhoff/Brown/Henrikson

Wood and Paper Science

FIRST SESSION

$ WPS 205 Wood Products Practicum 5
Prerequisite: WPS 201 or WPS 202
0800-1700 (090-205-001) Gilmore/Kelly

WPS 491 Senior Problems in Wood and Paper Science 1-4
Prerequisite: Consent of department
Hours arranged (090-491-001) Staff

WPS 591 Wood and Paper Science Problems Credits Arranged
Prerequisite: Senior or Graduate standing
Hours arranged (090-591-001) Staff

WPS 693 Advanced Wood and Paper Science Problems Credits Arranged
Prerequisite: Graduate standing
Hours arranged (090-693-001) Staff

WPS 699 Problems and Research Credits Arranged
Prerequisite: Graduate standing
Hours arranged (090-699-001) Staff

SECOND SESSION

WPS 491 Senior Problems in Wood and Paper Science 1-4
Prerequisite: Consent of department
Hours arranged (090-491-001) Staff

WPS 591 Wood and Paper Science Problems Credits Arranged
Prerequisite: Senior or Graduate standing
Hours arranged (090-591-001) Staff

WPS 693 Advanced Wood and Paper Science Problems Credits Arranged
Prerequisite: Graduate standing
Hours arranged (090-693-001) Staff

WPS 699 Problems and Research Credits Arranged
Prerequisite: Graduate standing
Hours arranged (090-699-001) Staff

Zoology

FIRST SESSION

$ BS 100 General Biology 4
(See Biological Sciences)

$ ZO 201 General Zoology 4
Prerequisite: BS 100 or BS 105
LR 0800-0930 (099-201-001) Staff
LB 1340-1750 MW (099-201-101)
LB 1340-1750 TuTh (099-201-102)

ZO 205 Introduction to Cellular and Developmental Zoology 4
Prerequisite: BS 100
1020-1230 (099-205-001) Staff

ZO (FW) 221 Conservation of Natural Resources 3
(See Fisheries and Wildlife)

ZO (BO) 360 Introduction to Ecology 3
Prerequisite: A 200 level Biology course
0950-1120 (099-360-001) Staff

$ ZO (BO) 365 Ecology Laboratory 1
Corequisite: ZO (BO) 360
1340-1750 MW (099-365-101) Staff
1340-1750 TuTh (099-365-102)

ZO 590 Special Studies Credits Arranged
Prerequisites: Twelve semester credits in Zoology and Consent of Instructor
Hours arranged (099-590-001) G. Miller

ZO 699 Research in Zoology Credits Arranged
Prerequisites: Twelve semester credits in Zoology and Consent of Instructor
Hours arranged (099-699-001) G. Miller

SECOND SESSION

$ ZO 305 Cell and Animal Physiology Laboratory 2
Prerequisite: ZO 205
1300-1700 TuTh (099-305-001) Staff

ZO 421E Principles of Physiology 3
Prerequisites: CH 223, PY 212, ZO 201 or ZO 303
1910-2200 MTuWTh (099-421-001) Staff

ZO 590 Special Studies Credits Arranged
Prerequisites: Twelve semester credits in Zoology and Consent of Instructor
Hours arranged (099-590-001) G. Miller

ZO 699 Research in Zoology Credits Arranged
Prerequisites: Twelve semester credits in Zoology and Consent of Instructor
Hours arranged (099-699-001) G. Miller

LATE AFTERNOON AND EVENING CLASSES

FIRST SESSION

ANTHROPOLOGY

ANT 252E Cultural Anthropology 3
1745-1930 MTuWTh (012-252-003) Staff

EDUCATION

ED 296B Special Topics in Education: Health Care Delivery Systems 3
1700-2030 MTh (028-296-002) Patterson

ED 496N Special Topics in Education: New Developments in Teaching English as a Second Language 3
Prerequisites: Junior or Senior standing and Consent of Instructor
1745-1900 MTuWTh (028-496-002) Fennell

ED 530E Theories and Techniques of Counseling 3
Prerequisite: Six hours of ED or PSY
Corequisite: ED 520 or equivalent
1600-1930 TuTh (028-530-001) Saidla
1600-1930 MW (028-530-002) Gerler

ED 596A Topical Problems in Adult and Community College Education: Death and Dying—A Lifespan Issue 3
Prerequisite: Graduate standing or PBS status
1600-1930 MW (028-596-002) Glass

ED 596B Topical Problems in Adult and Community College Education: Working in Groups in Adult Education 3
Prerequisite: Graduate standing or PBS status
1600-1930 TuTh (028-596-003) Glass

ED 597G Special Problems in Education: Personal Publishing 3
Prerequisite: Graduate standing or PBS status
1600-1930 TuTh (028-597-002) Ballenger

ED 639E Group Counseling 3
Prerequisites: ED 530 and one of the following: ED 520, ED 534, ED 553, or ED 535
1600-1930 TuTh (028-639-001) Gerler

FOREIGN LANGUAGES AND LITERATURES

FRENCH

$ FLF 101E Elementary French I 3
1745-1930 MTuWTh (064-101-004) Staff

SPANISH

$ FLS 101 Elementary Spanish I 3
1545-1730 MTuWTh (068-101-004) Alonso

$ FLS 201E Intermediate Spanish I 3
Prerequisite: FLS 102 or FLS 105
1745-1930 MTuWTh (068-201-003) Alonso

FLS 304 Modern Latin American Literature 3
Prerequisite: FLS 202 or equivalent
1545-1730 MTuWTh (068-304-001) Kelly

INDUSTRIAL ARTS

IA 590 Laboratory Problems in Industrial Arts: Advanced Technology 3
Prerequisites: Senior standing and Consent of Instructor
1630-1800 (047-590-001) DeLuca

POLITICAL SCIENCE AND PUBLIC ADMINISTRATION

PUBLIC ADMINISTRATION

PA 611 Seminar in Public Personnel Management 3
Prerequisites: Graduate standing or Management Development Certificate Program and six semester hours of 500-level course work
1830-2100 MTuTh (034-611-001) Sims

PHYSICAL EDUCATION

PE 237E Weight Training 1
1745-1845 MTuWTh (075-237-003) Stewart

PE 256E Racquetball 1
1945-2045 MTuWTh (075-256-002) Stewart

SOCIOLOGY

SOC 202E Principles of Sociology 3
1745-1930 MTuWTh (092-202-006) Staff

SOC 204E Sociology of Family 3
1745-1930 MTuWTh (092-204-005) Uzzell
1945-2130 MTuWTh (092-204-006) Uzzell

SOC 301E Human Behavior 3
Prerequisite: SOC 202 or PSY 200
1745-1930 MTuWTh (092-301-003) Staff

SECOND SESSION

ANTHROPOLOGY

ANT 252E Cultural Anthropology 3
1745-1930 MTuWTh (012-252-004) Staff

ELECTRICAL AND COMPUTER ENGINEERING

ECE 436 Digital Control Systems 3
Prerequisite: ECE 435
1730-1915 MTuWTh (030-436-001) Staff

EDUCATION

ED 593A Special Problems in Occupational Education: Teaching Technical Content in Agricultural Education 3
Prerequisites: Senior standing, PBS status, or Graduate standing in OED
1600-1900 (028-593-001) Malpiedi
July 5-July 25—Three-Week Course—Final Exam July 25

ED 593D Special Problems in Occupational Education: Marketing Education and Training Programs 3
Prerequisites: Senior standing, PBS status, or Graduate standing in OED
1730-2130 WTh (028-593-004) Burrow

ED 693 Advanced Special Problems in Occupational Education: Clinical Evaluation of Students 3
Prerequisite: Master's degree in Vocational field or Consent of Instructor
1710-2030 MW (028-693-001) Davis

FOREIGN LANGUAGES AND LITERATURES

FRENCH

§ FLF 102E Elementary French II 3
Prerequisite: FLF 101
1745-1930 MTuWTh (064-102-003) Ryan

POLITICAL SCIENCE AND PUBLIC ADMINISTRATION

PUBLIC ADMINISTRATION

***PA 516E Public Policy Analysis** 3
Prerequisite: Advanced undergraduate standing including 12 hours of political science, Graduate standing or PBS status
1900-2200 MW (034-516-001) Swiss

PA 612 The Budgetary Process 3
Prerequisites: Graduate standing or Management Development Certificate Program and six semester hours of 500-level course work
1630-1830 MTuWTh (034-612-001) Coe

***PA 614E Management Systems** 3
Prerequisites: Graduate standing or Management Development Certificate Program and six semester hours of 500-level course work
1900-2200 TuTh (034-614-001) Swiss

***There will be additional class meetings on July 23 and August 10. The final examination will be on August 12.**

PHYSICAL EDUCATION

PE 237 Weight Training 1
1615-1715 MTuWTh (075-237-003) DeWitt

PE 249E Tennis I 1
1745-1845 MTuWTh (075-249-003) DeWitt

PE 256E Racquetball 1
1945-2045 MTuWTh (075-256-004) DeWitt

SOCIOLOGY

SOC 202E Principles of Sociology 3
1745-1930 MTuWTh (092-202-006) Staff

SOC 203E Current Social Problems 3
1945-2130 MTuWTh (092-203-002) Brown

SOC 204E Sociology of Family 3
1745-1930 MTuWTh (092-204-005) Staff
1945-2130 MTuWTh (092-204-006) Staff

SOC 541 Social Systems and Planned Change 3
Prerequisite: Three hours of Sociology
1745-1930 MTuWTh (092-541-001) Marsh

SOCIAL WORK

SW 312 Social Work Practice in Health Care 3
Prerequisite: For Social Work students only
1745-1930 MTuWTh (086-312-001) Brown

ZOOLOGY

ZO 421E Principles of Physiology 3
Prerequisites: CH 223, PY 212, ZO 201 or ZO 303
1910-2200 MTuWTh (099-421-001) Staff

TEN-WEEK SESSION

ACCOUNTING

ACC 210E Accounting I—Concepts of Financial Reporting 3
1745-1930 TuTh (004-210-051) Brooks

ACC 220E Accounting II—An Introduction to Managerial Accounting 3
Prerequisite: ACC 210
1945-2130 TuTh (004-220-051) Staff

COMPUTER SCIENCE

$ CSC 101E Introduction to Programming 3
Prerequisite: MA 111 with a grade of C or better
LR 1745-1930 MW (023-101-051) Nelson
LB 1945-2130 MW (023-101-151) (023-101-152) (023-101-153)
(023-101-154) (023-101-155) (023-101-156)

$ CSC 102E Programming Concepts 3
Prerequisite: CSC 101
1745-1930 MW (023-102-052) Brain

CSC 200E Introduction to Computers and Their Uses 3
A student who has previously taken CSC 101 or CSC 111 may not receive credit for this course.
1615-1730 TuTh (023-200-052) Lindhome/Curtis
NOTE: Students registering for CSC 200E must also register for CSC 200Y.

$ CSC 200Y Introduction to Computers Laboratory 0
1745-2045 Tu (023-200-161)
1745-2045 W (023-200-162)
1745-2045 Th (023-200-163)

$ CSC 201E Basic Computer Organization and Assembly Language 3
Prerequisite: CSC 102
1945-2130 TuTh (023-201-052) Lasher

$ CSC 202E Concepts and Facilities of Operating Systems 3
Prerequisite: CSC 201 or equivalent
1745-1930 TuTh (023-202-051) Miller

$ CSC 311E Data Structures 3
Prerequisite: CSC 102
1745-1930 TuTh (023-311-052) E. Hodges

CSC 421E Introduction to Management Information Systems 3
Prerequisite: CSC 311
1745-1930 MW (023-421-051) Reid

$ CSC 431E File Organization and Processing 3
Prerequisite: CSC 311
1545-1730 TuTh (023-431-051) Ruchte

$ CSC 461E Computer Graphics 3
Prerequisites: MA 202 or MA 212; CSC 101 or CSC 111
1745-1930 TuTh (023-461-052) L. Hodges

COMPUTER STUDIES

$ CSE 452E Assembly Language and Basic Computer Organization 1
Prerequisites: Higher level programming language and Consent of Instructor
No degree credit for Computer Science or Computer Studies majors or anyone having received credit for CSC 201 or CSC 256.
1945-2130 TuTh (009-452-052) Lasher

$ CSC 453E Data Structures 1
Prerequisites: Higher level programming language and Consent of Instructor
Corequisite: CSE 452 or equivalent
No degree credit for Computer Science or Computer Studies majors or anyone having received credit for CSC 311.
1745-1930 TuTh (009-453-052) E. Hodges

ECONOMICS AND BUSINESS

EB 307E Business Law I 3
Prerequisite: EB 201 or EB 212
Credit for both EB 306 and EB 307 is not allowed.
1745-1930 MW (027-307-051) Staff

EB 603E History of Economic Thought 3
Prerequisites: EB 501, EB 502 or equivalent
1745-1930 MW (027-603-051) D. Fisher

EB 625E Long Range Planning in Business and Industry 3
Prerequisite: EB 501
1745-1930 TuTh (027-625-051) Newmark

ELECTRICAL AND COMPUTER ENGINEERING

ECE 540 Electromagnetic Fields 3
Prerequisite: ECE 448
1530-1645 MWF (030-540-051) Kauffman

ENGLISH

FRESHMAN ENGLISH

ENG 111E Composition and Rhetoric 3
General University requirement.
Successful completion of ENG 111 requires a grade of C or better.
1745-1930 MW (036-111-051) Staff

ENG 112E Composition and Reading 3
General University requirement.
Prerequisite: A grade of C or better in ENG 111
1745-1930 MW (036-112-051) Staff
1945-2130 MW (036-112-052) Staff

WRITING AND LANGUAGE

The prerequisite for all courses in writing and language at the 200-level and above is the completion of ENG 111 and ENG 112.

ENG 321E The Communication of Technical Information 3
Prerequisite: Junior standing
1745-1930 TuTh (036-321-051) Staff
1945-2130 TuTh (036-321-052) Staff

LITERATURE

The prerequisite for all literature courses is the completion of ENG 111 and ENG 112.

ENG 208E Studies in Fiction 3
The courses ENG 205, ENG 206, ENG 207, and ENG 208 are designed for students not enrolled in Humanities and Social Sciences.
1945-2130 MW (036-208-051) Staff

ENG 261E English Literature I 3
1745-1930 MW (036-261-051) Staff

ENG 265E American Literature I 3
1745-1930 TuTh (036-265-051) Staff

ENG 266E American Literature II 3
1945-2130 TuTh (036-266-051) Staff

MATHEMATICS

MA 111E Algebra and Trigonometry 4
Credit is not allowed for both MA 100 and MA 111. For students in Engineering, Physical and Mathematical Sciences, Design, Biological and Agricultural Engineering (Science program), Biological Sciences (all options), and Mathematics Education, Science Education credit in MA 111 does not count toward graduation requirements.
1915-2150 MW (054-111-051) (054-111-052) Staff

MA 113E Elements of Calculus 4
Prerequisite: MA 111 or placement via NCSU Math Placement exam
Credit is not allowed in more than one of MA 141, MA 112, MA 113. MA 113 may not be substituted for MA 141 as a curricular requirement.
1915-2150 TuTh (054-113-051) Staff

MA 114E Introduction to Finite Mathematics with Applications 3
Prerequisite: MA 111 or equivalent completed in high school
1945-2130 MW (054-114-051) Staff

POLITICAL SCIENCE AND PUBLIC ADMINISTRATION

POLITICAL SCIENCE

PS 202E State and Local Government 3
1730-1930 MTh (080-202-051) McClain

SUMMER SESSIONS FACULTY

A

Charlie Frank Abrams, Jr., Ph.D., Professor, Biological and Agricultural Engineering
Gale Gordon Acuff, Jr., M.A., Lecturer, English
D. A. Adams, Ph.D., Associate Professor, Forestry and University Studies
Elsayed M. Afify, Ph.D., Professor, Mechanical and Aerospace Engineering
Paul F. Agris, Ph.D., Professor, Biochemistry
Shuaib H. Ahmad, Ph.D., Associate Professor, Civil Engineering
James A. Alchediak, M.A., Lecturer, Speech-Communication
William D. Allen, M.S., Visiting Instructor, Electrical and Computer Engineering
Sally V. Almekinders, M.Ed., Assistant Professor, Physical Education
Ruth D. Anderson, Ph.D., Associate Professor, Speech-Communication
Louise M. Antony, Ph.D., Assistant Professor, Philosophy and Religion
Frank B. Armstrong, Ph.D., Professor, Biochemistry
John F. Arnold, Ph.D., Associate Professor, Curriculum and Instruction
Sarah L. Ash, Ph.D., Visiting Assistant Professor, Animal Science
Lyn C. Aubrecht, Ph.D., Adjunct Assistant Professor, Curriculum and Instruction
David Franklin Austin, Ph.D., Assistant Professor, Philosophy and Religion
C. W. Averre, III, Ph.D., Professor, Plant Pathology
Mahmoud Amin Ayoub, Ph.D., Professor, Industrial Engineering

B

Lynne E. Baker-Ward, Ph.D., Assistant Professor, Psychology
David Ball, Ph.D., Associate Professor, Economics and Business
Hershell Ray Ball, Jr., Ph.D., Professor, Food Science
Pamela Banks-Lee, Ph.D., Assistant Professor, Textile Engineering and Science
Gwen Louise Barclay, M.A., Lecturer, English
James C. Barker, Ph.D., Extension Professor, Biological and Agricultural Engineering
Emma L. Barnhardt, M.A.T., Lecturer, Mathematics
Jon Bartley, Ph.D., Associate Professor, Economics and Business
George O. Batton, B.S., Lecturer, Mechanical and Aerospace Engineering
Gerald Robert Baughman, Ph.D., Associate Professor, Biological and Agricultural Engineering
Robert L. Beckmann, Ph.D., Associate Professor, Botany
William H. Beezley, Ph.D., Professor, History
Ray Braman Benson, Jr., Ph.D., Professor, Materials Science and Engineering
Henry A. Bent, Ph.D., Professor, Chemistry
Peter J. Bentley, Ph.D., Burroughs Wellcome Distinguished Professor, Veterinary Medicine
Roger L. Berger, Ph.D., Associate Professor, Statistics
Herman J. Berkhoff, Ph.D., Professor, Veterinary Medicine
Gordon A. Berkstresser, III, Ph.D., Professor and Head, Textile Management and Technology
A. Lynn Berle, M.Ed., Assistant Professor, Physical Education
Richard Harold Bernhard, Ph.D., Professor, Industrial Engineering
Leonidas Judd Betts, Jr., Ed.D., Associate Professor, English
Michael G. Bevis, Ph.D., Assistant Professor, Marine, Earth and Atmospheric Sciences
William L. Bingham, Ph.D., Associate Professor, Civil Engineering
Paul Edward Bishop, Ph.D., Associate Professor, Microbiology
Milton Clay Bliss, M.A., Assistant Director, Music
George B. Blum, Jr., MAE, Professor and Teaching Coordinator, Biological and Agricultural Engineering
Michael A. Boles, Ph.D., Associate Professor, Mechanical and Aerospace Engineering
Charles B. Boss, Ph.D., Associate Professor, Chemistry
Robert W. Bottcher, Ph.D., Assistant Professor, Biological and Agricultural Engineering
Laura J. Bottomley, M.S., Visiting Instructor, Electrical and Computer Engineering
Edmond F. Bowden, Ph.D., Assistant Professor, Chemistry
Henry Dittimus Bowen, Ph.D., Professor, Biological and Agricultural Engineering
Lawrence H. Bowen, Ph.D., Professor, Chemistry
Leon C. Boyd, Ph.D., Assistant Professor, Food Science
Albert S. Boyers, M.S., Lecturer, Mechanical and Aerospace Engineering
R. R. Braham, Ph.D., Assistant Professor, Forestry
James J. Brickley, Ph.D., Adjunct Associate Professor, Electrical and Computer Engineering
Robert C. Brisson, Ph.D., Associate Professor, Sociology and Anthropology
Eugene Brooks, Ph.D., Lecturer, Economics and Business
Joel V. Brothers, M.A.T., Assistant Professor, Physical Education
H. Larry Brown, M.S., Assistant Professor, Physical Education
Henry S. Brown, Ph.D., Professor, Marine, Earth and Atmospheric Sciences
James S. Brown, MSW, Assistant Professor, Sociology and Anthropology
Talmage T. Brown, Jr., Ph.D., Professor, Veterinary Medicine
Thomas H. Brown, Jr., M.S., Visiting Instructor, Mechanical and Aerospace Engineering
William S. Bryan, MWPS, Research Assistant and Teaching Technician, Wood and Paper Science

Sally B. Buckner, Ph.D., Visiting Assistant Professor, Curriculum and Instruction
Rita Layden Buhr, M.A., Lecturer, English
Carl L. Bumgardner, Ph.D., Professor, Chemistry
Kathryn Ann Burak, M.F.A., Lecturer, English
Robert P. Burns, M.Arch., Professor, Design
James L. Burrow, Ph.D., Associate Professor, Occupational Education

C

Leon Raymond Camp, Ph.D., Associate Professor, Speech-Communication
John Robert Canada, Ph.D., Professor, Industrial Engineering
Patricia C. Caple, Ph.D., Associate Professor, Speech-Communication
Roy Eugene Carawan, Ph.D., Associate Professor, Food Science
Halbert H. Carmichael, Ph.D., Professor, Chemistry
Ernest Carraway, J.D., Lecturer, Economics and Business
Daniel Edward Carroll, Jr., Ph.D., Professor, Food Science
George Louis Catignani, Jr., Ph.D., Associate Professor, Food Science
Thomas C. Caves, Ph.D., Associate Professor, Chemistry
Richard Edward Chandler, Ph.D., Professor, Mathematics
A. C. Chao, Ph.D., Associate Professor, Civil Engineering
Harvey Johnson Charlton, Ph.D., Assistant Professor, Mathematics
William A. Cheek, M.S., Assistant Professor, Physical Education
Rey T. Chern, Ph.D., Assistant Professor, Chemical Engineering
Moody Chu, Ph.D., Associate Professor, Mathematics
Lung Ock Chung, Ph.D., Associate Professor, Mathematics
Timothy G. Clapp, Ph.D., Assistant Professor, Textile Engineering and Science
Edward Depriest Clark, Sr., Ph.D., Associate Professor, English
G. C. Cobb, Jr., Ph.D., Associate Professor, Physics
Charles K. Coe, D.P.A., Assistant Professor, Political Science and Public Administration
Jo-Ann D. Cohen, Ph.D., Associate Professor, Mathematics
Russell C. Combs, M.S., Assistant Professor, Physical Education
A. W. Cooper, Ph.D., Professor and Head, Forestry
Nelvin E. Cooper, M.E., Associate Professor, Physical Education
Alonzo F. Coots, Ph.D., Associate Professor, Chemistry
John C. Cornwell, Ph.D., Associate Professor and Teaching Coordinator, Animal Science
David Harrison Covington, Ph.D., Assistant Professor, English
Harris Bradford Craig, Ph.D., Associate Director of Academic Affairs for the School of Agriculture and Life Sciences, Director of the Agricultural Institute, and Professor of Food Science
Judy Bush Crofton, M.A., Lecturer, English
Cathy Crossland, Ed.D., Associate Professor, Curriculum and Instruction
Michael Cuddy, Ph.D., Visiting Professor, Economics and Business
Joseph W. Cunningham, Ph.D., Professor, Psychology
Susan J. Curtis, B.S., Visiting Lecturer, Computer Science

D

Mark Anthony Daeschel, Ph.D., Assistant Professor (USDA), Food Science
Deborah W. Dalton, M.L.A., Associate Professor, Design
John Michael Anthony Danby, Ph.D., Professor, Mathematics
Jerry M. Daniels, M.A., Associate Professor, Physical Education
C. B. Davey, Ph.D., Carl Alwin Schenck Professor, Forestry and Soil Science
Judith A. Davis, Ph.D., Assistant Professor, Occupational Education
W. R. Davis, Ph.D., Professor, Physics
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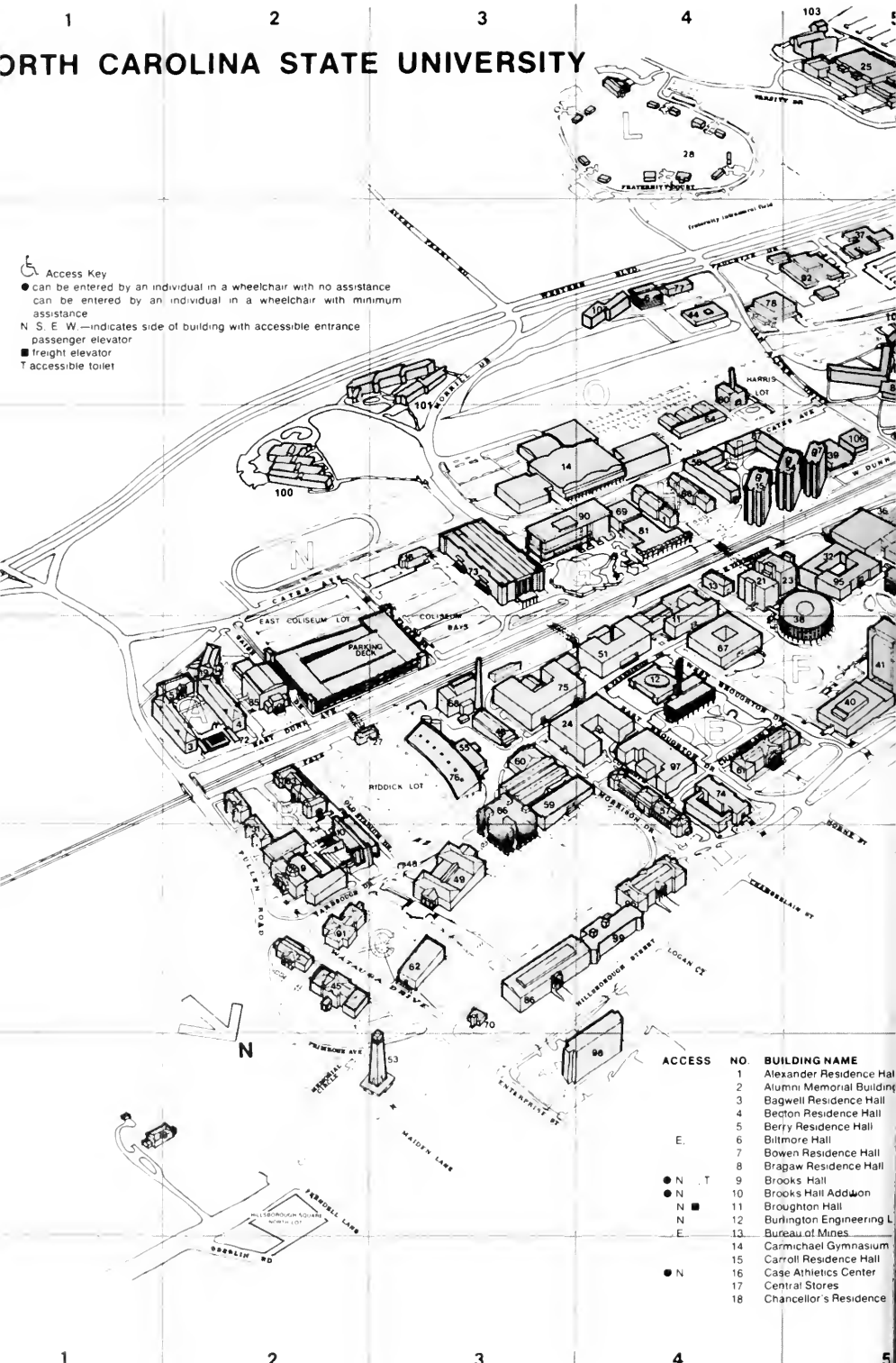

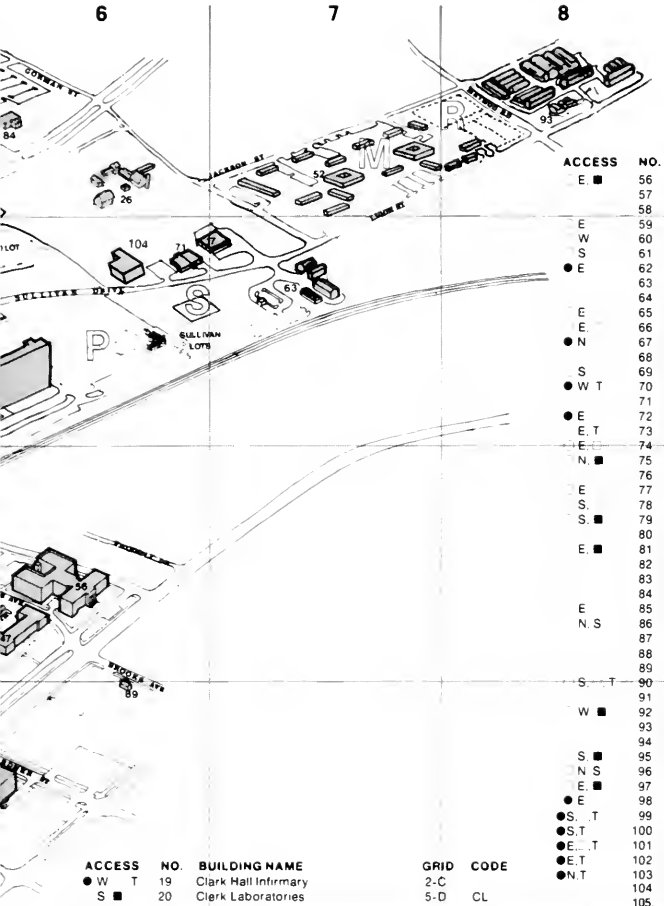

ACCESS	NO.	BUILDING NAME	GRID	CODE
E, ■	56	Nelson Textile Building	6-D	N
	57	1911 Building	4-C	
	58	Owen Residence Hall	4-D	
E	59	Page Hall	3-C	PA
W	60	Park Shops	3-C	PS
S	61	Patterson Hall	4-C	PT
● E	62	Peele Hall	3-B	
	63	Physical Plant Maint. Center	7-E	
	64	Physical Plant Shops (Armory)	4-D	
E	65	Phytotron	5-D	PHY
E	66	Poe Hall	3-C	POE
● N	67	Polk Hall	4-C	PK
	68	Power Plant	3-C	
S	69	Price Music Center	4-D	PMC
● W, T	70	Primrose Hall	3-B	
	71	Print Shop/University Graphics	6-E	
● E	72	Quad Snack Bar	2-C	
E, T	73	Wm. Neal Reynolds Coliseum	3-D	
E	74	Ricks Hall	4-C	RI
N, ■	75	Riddick Engineering Labs	3-C	RD
	76	Riddick Stadium	3-C	
E	77	Robertson Wing, Biltmore Hall	4-E	
S	78	Schaub Food Science Building	4-E	SFS
S, ■	79	Scott Hall	5-D	SC
	80	Steam Plant	4-E	
E, ■	81	NCSU Bookstores	4-D	
	82	Sullivan Residence Hall	6-E	
	83	Syme Residence Hall	2-C	
	84	Television Center	6-F	TVS
E	85	Thompson Theater/Craft Center	2-C	TT
N, S	86	Tompkins Hall	3-B	T
	87	Tucker Residence Hall	4-D	
	88	Turlington Residence Hall	4-D	
	89	Turner House	6-C	
S, T	90	University Student Center	3-D	USC
	91	Watauga Hall	2-B	
W, ■	92	Weaver Laboratories	5-E	DSW
	93	Weed Control Laboratories	8-F	
	94	Welch Residence Hall	2-C	
S, ■	95	Williams Hall	5-D	WMS
N, S	96	Winston Hall	4-B	WN
E, ■	97	Withers Hall	4-C	WI
● E	98	North Residence Hall	3-A	
● S, T	99	Caldwell Hall	4-B	
● S, T	100	Weisiger-Brown Building (GAF)	2-D	
● E, T	101	South Residence Hall	3-D	
● E, T	102	Dining Hall	5-E	
● N, T	103	Solar Demonstration House	5-F	
	104	Administrative Services Center	6-E	
	105.	Research Facility (on Centennial Campus) (Not Shown)		
	106.	Student Service Center		
	107.	Natural Resources Research Center		

ACCESS	NO.	BUILDING NAME	GRID	CODE
● W, T	19	Clark Hall Infirmary	2-C	
S, ■	20	Clark Laboratories	5-D	CL
N	21	Cox Hall	4-D	COX
N, T	22	Cultural Center	5-D	
N	23	Dabney Hall	4-D	DAB
● W, ■	24	Daniels Hall	4-C	DAN
● W, T	25	McKimmon Extension Continuing Education Center	5-F	
	26	Farm Unit 5	6-F	
N	27	Field House	2-C	
	28	Fraternity Court	4-F	
S, ■	29	Gardner Hall	5-D	GA
● N, T	30	Bostian Hall	5-D	
	31	Gold Residence Hall	2-C	
	32	Williams Hall Addition	5-D	AGH
	33	Greenhouse—Biological Sciences	5-D	BSG
	34	Greenhouse—Horticulture	5-D	HGH
	35	Greenhouse—840 Method Rd	8-F	
	36	Greenhouse—Plant Pathology	5-D	PPG
E	37	Grinnells Animal Health Lab	5-E	GHL
N, T	38	Harrelson Hall	5-D	HA
● N, T	39	Harris Hall	5-D	
W	40	D. H. Hill Library—Original Wing	5-C	DHL
W, T	41	D. H. Hill Library—Book Stack Tower	5-C	
N, S	42	D. H. Hill Library—Erdahl-Cloyd Wing	5-C	
		North Campus Bookshop	5-C	
● N, T	43	Hillsborough Building	5-C	HLB
W	44	Hodges Wood Products Lab	4-E	HWP
	45	Holladay Hall	2-B	
	46	Information Center, Visitor Parking	3-B	
S, ■	47	Kilgore Hall	6-D	KI
	48	Laundry/Copy Center	3-C	
	49	Leazar Hall	3-B	LEZ
	50	Lee Residence Hall	5-E	
● S	51	Mann Hall	4-C	MN
	52	E. S. King Village (17 Apt. Bldgs. A-Q)	7-F	
	53	Memorial Tower	3-A	
	54	Metcalf Residence Hall	4-D	
● S	55	Morris Building	3-C	

COURTS AND FIELDS	GRID
A. Bagwell-Becton-Berry Quad	2-C
B. Gold-Welch-Syme-Brooks Court	2-C
C. Mary E. Yarbrough Court	3-B
D. Court of North Carolina	3-B
E. Gardner Arboretum	4-C
F. University Plaza (Brickyard)	5-C
G. University Student Center Plaza	4-D
H. Turlington-Alexander Court	4-D
J. Tucker-Owen Court	4-D
K. Lee-Sullivan-Bragaw Court	5-E
L. Fraternity Court	4-F
M. E. S. King Village Court	7-F
N. Paul H. Derr Track	2-D
O. Miller Fields	4-E
P. Doak Field	6-E
Q. McKimmon Center Court	5-F
R. The Big Acre	8-F
S. Tennis Courts	6-E

PARKING LOTS	GRID
Brooks Ave. Lot	6-C
Carmichael Lot	3-D
Coliseum Bays	3-D
East Coliseum Lot	2-C
Friendly Drive Lot	6-D
Harris Lot	4-E
Hillsborough Building Lots	6-C
Parking Deck	2-C
Riddick Lot	3-C
Sullivan Lots	6-E
West Lot	6-E
Additional West Lot Parking	5-E
Yarbrough Lot	3-C
Hillsborough Square North	2-A

Director of Summer Sessions
North Carolina State University
Box 7401
Raleigh, N. C. 27695-7401

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Raleigh, North Carolina 27611

BULLETIN

1988-1990 GRADUATE CATALOG

NORTH CAROLINA STATE UNIVERSITY

December 1987

Prominent in the above aerial of the central North Carolina State University campus are three high-rise residence halls (foreground), the circular Harrelson Hall with the adjacent towers of Cox and Dabney Halls, and in the upper left, the tower of the D. H. Hill Library. The central campus encompasses some 623 acres.

NORTH CAROLINA STATE UNIVERSITY BULLETIN

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North Carolina State University
Raleigh, North Carolina

Graduate Catalog
1988-90


PEELE HALL

CONTENTS

NORTH CAROLINA STATE UNIVERSITY

North Carolina State University is one of the nation's major public universities large, complex, national and international in scope, and a leader in education and research. It ranks among the top universities in the nation and shares the distinctive character of Land-Grant state universities nationally broad academic offerings, extensive public service, national and international activities, and large-scale extension and research programs.

North Carolina State University is committed to equality of educational opportunity and does not discriminate against applicants, students, or employees based on race, color, national origin, religion, sex, age or handicap. Moreover, N. C. State University is open to people of all races and actively seeks to promote racial integration by recruiting and enrolling a larger number of black students.

N. C. State's rich and varied academic program is comprised of 86 undergraduate degree programs spanning 82 fields of study, 105 master's degree programs spanning 75 fields of study, 48 doctoral degree programs and the doctor of veterinary medicine program. The University offers approximately 2,900 courses.

Research activities span a broad spectrum of about 1,400 scientific, technological and scholarly endeavors with a budget of more than $100 million annually.

Extension organizations in each of the 100 counties in North Carolina and in the Cherokee Indian Reservation assist in carrying the University's teaching and applied research programs throughout the State. The diversity of these programs spans such fields as agriculture, design, education, engineering, forestry, humanities, marine sciences, textiles, urban affairs and veterinary medicine.

The annual University budget is more than $345 million and it has approximately 5,600 employees. There are more than 2,900 faculty and professional staff, including 1,500 graduate faculty and 250 adjunct faculty.

There are 171 campus buildings on the central campus of 623 acres. In addition, the University has acquired an adjacent property of 900 acres which will allow expansion. It has some 88,000 acres on a statewide basis, including one research and endowment forest of 78,000 acres. Near the main campus are research farms; biology and ecology sites; genetics, horticulture and floriculture nurseries; forests and other areas such as Carter-Finley Stadium, which together comprise about 2,500 acres.

The University's total enrollment is more than 24,500 including approximately 17,300 undergraduate students, 3,800 graduate students and 3,400 lifelong education students. The total student population is made up of approximately 9,200 women and 15,300 men including 2,290 blacks and 1,896 other minority students. Students come to N. C. State from nearly every state in the nation and at least 91 foreign countries are represented by the more than 1,100 international students.

The University is organized in eight colleges, the School of Design and the Graduate School. The eight schools are Agriculture and Life Sciences, Education, Engineering, Forest Resources, Humanities and Social Sciences, Physical and Mathematical Sciences, Textiles, and Veterinary Medicine. In addition, a complex of divisions and programs provides for a wide range of special programs in academic affairs, research and extension.

North Carolina State University is one of the three Research Triangle Universities along with Duke University and the University of North Carolina at Chapel Hill. In the 30-mile triangle formed by the three universities is the 5,500-acre Research Triangle Park; the Research Triangle Institute, a subsidiary of the three universities; and the Triangle Universities Computation Center, a central facility for the extensive computing centers of the institutions.

NCSU is a member of the National Association of State Universities and Land-Grant Colleges. It is also a member of the American Council on Education, the College Entrance Examination Board, the Council of Graduate Schools in the United States, the National Commission on Accrediting, and the Southern Association of Colleges and Schools.

The University is accredited by national and regional accrediting agencies applicable to the University and its numerous professional fields.

Nondiscrimination Statement

North Carolina State University is dedicated to equality of opportunity within its community. Accordingly, North Carolina State University does not practice or condone discrimination, in any form, against students, emplolyees or applicants on the grounds of race, color, national origin, religion, sex, age or handicap. North Carolina State University commits itself to positive action to secure equal opportunity regardless of those characteristics.

North Carolina State University supports the protection available to members of its community under all applicable Federal laws, including Titles VI and VII of the Civil Rights Act of 1964, Title IX of the Education Amendments of 1972, Sections 799A and 845 of the Public Health Service Act, the Equal Pay and Age Discrimination Acts, the Rehabilitation Act of 1973, the Vietnam Veterans Readjustment Assistance Act of 1974, and Executive Order 11246. For information concerning these provisions, contact:

Dr. Lawrence M. Clark
Associate Provost & Affirmative Action Officer
201 Holladay Hall
P. O. Box 7101
North Carolina State University
Raleigh, North Carolina 27695-7101
Phone: 919/737-3409

ADMINISTRATION

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A. M. Witherspoon, *Associate Dean*
D. A. Emery, *Acting Associate Dean*

Graduate School—Administrative Board

	Term Expires
D. W. Stewart, *Interim Dean*	
A. M. Witherspoon, *Associate Dean*	
D. A. Emery, *Acting Associate Dean*	
B. F. Beers, *Professor of History*	April, 1989
R. D. Bereman, *Professor of Chemistry; Associate Dean for Academic Affairs, College of Physical and Mathematical Sciences*	June, 1990
D. R. Buchanan, *Professor of Textile Engineering and Science*	September, 1988
D. W. Dalton, *Associate Professor of Landscape Architecture*	August, 1989
S. E. Elmaghraby, *University Professor of Industrial Engineering and Operations Research; Director of the Operations Research Program*	December, 1989
H. A. Exum, *Associate Professor of Counselor Education; Associate Dean for Research and Graduate Studies, College of Education*	June, 1991
J. K. Ferrell, *Alcoa Professor of Chemical Engineering; Director of Graduate Programs, College of Engineering*	June, 1990
A. Fingeret, *Associate Professor of Adult and Community College Education*	June, 1991
B. H. Johnson, *Professor of Animal Science and Graduate Administrator*	November, 1989
E. J. Kamprath, *William Neal Reynolds Professor of Soil Science*	June, 1991
G. E. Mitchell, *Professor of Physics; Associate Head of the Department and Graduate Administrator*	March, 1991
R. G. Pearson, *Professor of Wood and Paper Science and Graduate Administrator*	June, 1991
D. G. Simmons, *Professor of Veterinary Medicine, Microbiology and Poultry Science*	April, 1988

THE CALENDAR

FALL SEMESTER, 1987

August 21	Fri.	Registration/change day (late registration, drop/add.)
August 24	Mon.	First day of classes.
September 7	Mon.	Holiday.
September 8	Tues.	Last day to add a course; last day to withdraw or drop a course with a refund.
September 21	Mon.	Last day to drop a course at the 400 level or below without a grade.
October 2	Fri.	Mid-semester reports due.
October 9	Fri.	Fall vacation begins at 10:00 p.m.
October 14	Wed.	Classes resume at 7:50 a.m.
October 23	Fri.	Last day to drop a course at the 500 or 600 level without a grade.
November 6	Fri.	*Deadline for submission of theses to the Graduate School, in final form as approved by advisory committees, by candidates for master's and doctoral degrees in December, 1987. Last day for unconditional pass on final oral examinations by candidates for master's degrees not requiring theses.*
November 24	Tues.	Thanksgiving vacation begins at 10:00 p.m.
November 30	Mon.	Classes resume at 7:50 a.m.
December 4	Fri.	Last day of classes.
December 7-12	Mon.-Sat.	Final examinations.
December 14-15	Mon.-Tues.	Final examinations.

SPRING SEMESTER, 1988

January 8	Fri.	Registration/change day (late registration, drop/add.)
January 11	Mon.	First day of classes.
January 25	Mon.	Last day to add a course; last day to withdraw or drop a course with a refund.
February 8	Mon.	Last day to drop a course at the 400 level or below without a grade.
February 22	Mon.	Mid-semester reports due.
March 4	Fri.	Spring vacation begins at 10:00 p.m.
March 14	Mon.	Classes resume at 7:50 a.m.
March 18	Fri.	Last day to drop a course at the 500 or 600 level without a grade.

March 25	Fri.	*Deadline for submission of theses to the Graduate School, in final form as approved by advisory committees, by candidates for master's and doctoral degrees in May, 1988. Last day for unconditional pass on final oral examinations by candidates for master's degrees not requiring theses.*
April 4	Mon.	Holiday
April 22	Fri.	Last day of classes.
April 25-30	Mon.-Sat.	Final examinations.
May 2-3	Mon.-Tues.	Final examinations.
May 7	Sat.	Commencement.

SUMMER SESSIONS, 1988

First Session

May 23	Mon.	Registration/change day.
May 24	Tues.	First day of classes.
May 30	Mon.	Last day to add a course; last day to withdraw of drop a course with a refund.
June 3	Fri.	Last day to drop a course at the 400 level or below without a grade.
June 10	Fri.	Last day to drop a course at the 500 or 600 level without a grade.
June 24	Fri.	Last day of classes.
June 27-28	Mon.-Tues.	Final examinations.

Second Session

July 5	Tues.	Registration/change day.
July 6	Wed.	First day of classes.
July 11	Mon.	Last day to add a course; last day to withdraw or drop a course with a refund.
July 11	Mon.	*Deadline for submission of theses to the Graduate School, in final form as approved by advisory committees, by candidates for master's and doctoral degrees in August, 1988. Last day for unconditional pass on final oral examinations by candidates for master's degrees not requiring theses.*
July 15	Fri.	Last day to drop a course at the 400 level or below without a grade.
July 22	Fri.	Last day to drop a course at the 500 or 600 level without a grade.
August 8	Mon.	Last day of classes.
August 9-10	Tues.-Wed.	Final examinations.

FALL SEMESTER, 1988

August 26	Fri.	Registration/change day (late registration, drop/add).
August 29	Mon.	First day of classes.
September 5	Mon.	Holiday.
September 6	Tues.	Last day to add a course; last day to withdraw or drop a course with a refund.
September 12	Mon.	Last day to drop a course at the 400 level or below without a grade.
October 7	Fri.	Mid-semester reports due.
October 14	Fri.	Fall vacation begins at 10:00 p.m.
October 19	Wed.	Classes resume at 7:50 a.m.
October 28	Fri.	Last day to drop a course at the 500 or 600 level without a grade.
November 11	Fri.	*Deadline for submission of theses to the Graduate School, in final form as approved by advisory committees, by candidates for master's and doctoral degrees in December, 1988. Last day for unconditional pass on final oral examinations by candidates for master's degrees not requiring theses.*
November 22	Tues.	Thanksgiving vacation begins at 10:00 p.m.
November 28	Mon.	Classes resume at 7:50 a.m.
December 9	Fri.	Last day of classes.
December 12-17	Mon.-Sat.	Final examinations.
December 19-20	Mon.-Tues.	Final examinations.

SPRING SEMESTER, 1989

January 6	Fri.	Registration/change day (late registration, drop/add).
January 9	Mon.	First day of classes.
March 3	Fri.	Spring vacation begins at 10:00 p.m.
March 13	Mon.	Classes resume at 7:50 a.m.
March 24	Fri.	*Deadline for submission of theses to the Graduate School, in final form as approved by advisory committees, by candidates for master's and doctoral degrees in May, 1989. Last day for unconditional pass on final oral examinations by candidates for master's degrees not requiring theses.*
March 27	Mon.	Holiday.
April 21	Fri.	Last day of classes.
April 24-29	Mon.-Sat.	Final examinations.
May 1-2	Mon.-Tues.	Final examinations.
May 6	Sat.	Commencement.

SUMMER SESSIONS, 1989

First Session

May 22	Mon.	Registration/change day.
May 23	Tues.	First day of classes.
June 23	Fri.	Last day of classes.
June 26-27	Mon.-Tues.	Final examinations.

Second Session

July 3	Mon.	Registration/change day.
July 4	Tues.	Holiday.
July 5	Wed.	First day of classes.
July 10	Mon.	*Deadline for submission of theses to the Graduate School, in final form as approved by advisory committees, by candidates for master's and doctoral degrees in August, 1989. Last day for unconditional pass on final oral examination by candidates for master's degrees not requiring theses.*
August 7	Mon.	Last day of classes.
August 8-9	Tues.-Wed.	Final examinations.

NOTE: This calendar is subject to periodic review and revision.

The Graduate School

Graduate instruction was first offered at North Carolina State University in 1893, and the first doctoral degree was conferred in 1926. In the ensuing years, the Graduate School has grown steadily and now provides instruction and facilities for advanced study and research in the fields of agriculture and life sciences, design, education, engineering, forest resources, humanities and social sciences, physical and mathematical sciences, textiles and veterinary medicine. In 1986-87, the University granted 182 Doctor of Philosophy degrees, 18 Doctor of Education degrees and 678 master's degrees.

The Graduate School is currently composed of more than 1,500 graduate faculty members. Educated at major universities throughout the world and established both in advanced teaching and research, these scholars guide the University's more than 3,800 master's and doctoral students from all areas of the United States and some 91 other countries.

The faculty and students have available exceptional facilities, including libraries, laboratories, modern equipment and special research areas. Additionally, a cooperative agreement exists among the Graduate Schools of the University of North Carolina at Chapel Hill, the University of North Carolina at Greensboro, Duke University and North Carolina State University which increases the educational and research possibilities associated with each.

Graduate Student Association

The Graduate Student Association (GSA) is an academic, political and social organization composed of all graduate students and governed by duly elected officials and representatives from the departmental graduate student chapters. It is officially recognized by the university as the voice of the graduate students. The GSA President has full voting membership on the Graduate School Administrative Board and the GSA has the ability to broach responsible grievances to the administration on behalf of any graduate student.

Among the services that the GSA sponsors, one of its most viable academic programs is the Travel Fund. Through this fund graduate students may obtain funds to present original research work at professional meetings. The GSA also sponsors, along with the Alumni Association and the Academy of Outstanding Teachers, an annual awards ceremony to honor those teaching assistants of outstanding merit. In addition, the GSA, through its standing committees, sponsors various social events and provides support for departmental GSA chapters.

Generally, the GSA can provide assistance on most questions concerning graduate student life. Graduate students may contact GSA via their departmental representative or via the president of the Association whose telephone number can be obtained through the Graduate School. All graduate students are also invited to participate in the business meetings which are usually held on the last Monday of each month. Contact departmental representatives for time and place.

GENERAL INFORMATION

Application

Applications for admission must be accompanied by the following: two official transcripts from all colleges and universities previously attended, references from at least three people who know of the student's academic record and potential for graduate study, a non-refundable application fee of $25 and, in some cases, an official statement of the student's Graduate Record Examination scores. Application and reference forms may be obtained by writing or visiting the Dean of the Graduate School, 104 Peele Hall, Box 7102, North Carolina State University, Raleigh, N. C. 27695-7102. When completed, all application materials should be returned according to instructions. Application is made for a specific degree program and date of enrollment (see "Admission").

Graduate Record Examination (GRE) Scores

The following departments and programs will not act on applications unless accompanied by GRE scores for at least the GRE General (Aptitude) Test (verbal and quantitative):

*Adult and Community College Education
Agricultural Education
Biochemistry
Biomathematics
Botany
Computer Studies
Crop Science
Curriculum and Instruction
Ecology
Educational Administration and Supervision
Electrical and Computer Engineering
English
Entomology
Forestry
**Genetics
Guidance and Personnel Services
History
Horticultural Science
Industrial Arts Education
Industrial Engineering
Marine, Earth and Atmospheric Sciences
Mathematics
Mathematics Education
Nutrition
Occupational Education
Plant Pathology

*The master's program in Adult and Community College Education requires the GRE or Miller Analogies.
**The Genetics program requires the GRE General and Advanced Test.

Political Science
***Psychology
Public Affairs
Rural Sociology
Science Education
Sociology
Special Education
Statistics
Toxicology
Vocational Industrial Education
Zoology

Many departments, although not normally requiring GRE scores, may in special instances require their submission as additional information to be used in making a judgment of the student's potential for success in a graduate program. Information regarding the GRE and registration forms may be obtained from the Educational Testing Service, Box 955, Princeton, NY 08540 or Box 1502, Berkeley, CA 94701.

***Psychology requires the Subject (Advanced) Test and Miller Analogies as well.

International Students

Students whose native language is other than English, regardless of citizenship must submit TOEFL (Test of English as a Foreign Language) scores as evidence of ability to use English at a level of competence sufficient for graduate work. A minimum TOEFL score of 500, with section scores of no less than 45, is required prior to admission. (Minimum score subject to change; departments may establish a higher minimum requirement.) The test date must be within 24 months of the application deadline date before the semester for which the application is being reviewed. An *official* score report issued by the Educational Testing Service is required. All international students must be cleared by the Department of Foreign Languages and Literatures during the first two weeks of their initial semester in residence and may be required to take additional course work in English. In addition, the international applicant must provide the University with verification that the required funds are available to support the proposed program of advanced study. Foreign nationals in the United States at the time application is made must also provide information regarding their current visa status. The University provides special forms to be used by the applicant in supplying this information.

Admission

The procedures followed in evaluating an applicant's potential for success in graduate work and the criteria used for admissions decisions vary according to departments and schools and reflect an evaluation of the applicant's potential to engage in graduate work and the capability of the individual departments to accommodate additional students. Most departments consider applications as they arrive, while others accumulate applications and make recommendations on admission at certain times during the year. Generally, requests for admission are considered by departmental admissions committees which forward the departmental recommendations to the Dean of the Graduate School.

Students are admitted to full or provisional status in a specific degree program. Admission is granted for a specific semester or summer term. Any change in the admission date must be requested in writing and approved by the department and Graduate School. Once the requirements for that degree program have been completed, no further registration as a graduate student will be permitted unless admission to a new graduate classification has been formally approved. Students with special objectives may request admission in the "Graduate-Unclassified Status" (see next page) or register in the "Post-Baccalaureate Studies" program (see next page) through the Division of Continuing Education.

FULL GRADUATE STANDING

To be considered for admission in full graduate standing, an applicant must have a baccalaureate degree from a college or university recognized as standard by a regional or general accrediting agency and must have at least a "B" average in the undergraduate major or in the latest graduate degree program.

PROVISIONAL ADMISSION

1. Provisional admission may be granted to applicants with bachelor's degrees from accredited institutions who lack undergraduate work considered essential for graduate study in a major field. Course work, without graduate credit, will be required to make up such deficiencies before admission to full status can be granted.

Applicants with bachelor's degrees from nonaccredited institutions may be granted provisional admission when their academic records warrant this status. Additional course work will be required of such students when deficiencies in previous training are apparent.

Full graduate standing is granted when the deficiencies responsible for the provisional status are corrected, provided the student has maintained a satisfactory academic record (3.0 Grade Point Average) on all course work taken in a graduate classification. A change from provisional status to full graduate standing is effected only upon the recommendation of the department in which the student is seeking the degree.

2. Students with bachelor's degrees from accredited institutions whose scho-

lastic records are below the standards for admission to full graduate standing may be admitted provisionally when unavoidable, extenuating circumstances affected their undergraduate averages or when progressive improvement in their undergraduate work warrants provisional admission. Students admitted provisionally under these circumstances will have their status changed to full graduate standing after completion of nine or more graduate credit hours following admission provided the student has maintained at least a "B" average.

A graduate student is not eligible for appointment to an assistantship or fellowship while on provisional status.

GRADUATE-UNCLASSIFIED STATUS

The Graduate-Unclassified status is a temporary classification and students admitted to this status are not candidates for degrees. They may take courses for graduate credit but may not apply more than 10 credits earned while in this status to any program leading to an advanced degree at this institution. Unclassified graduate students are expected to meet the same admissions requirements that apply to graduate students in full standing. Any individual having an interest in applying for admission as a Graduate-Unclassified Student should correspond with the Graduate Dean describing his or her particular interests and objectives prior to making application.

POST-BACCALAUREATE STUDIES (PBS)

The Post-Baccalaureate Studies (PBS) classification is designed for U. S. citizens who wish to undertake academic work beyond the baccalaureate degree but who are not currently admitted to a degree program. This classification is not open to international students with the exception of the spouse of a regularly enrolled NCSU student. In special cases where students are sponsored by an agency of the U. S. government for specialized, non-degree study, approval may be given by the Graduate School for registration in the Post-Baccalaureate Studies classification. The following policies apply to students who wish to register for PBS:

1. All must have baccalaureate degrees from accredited institutions of higher education.
2. All classes taken for credit by PBS students will be graded in the usual manner that applies for the particular course (A,B,C,D,NC or S,U). All courses taken at NCSU will show on the student's transcript. If the student is admitted as a graduate student, a maximum of nine hours may apply toward the minimum requirements of the degree for which the student is enrolled, including hours approved for graduate credit while classified as a senior, unclassified undergraduate or professional engineering student. Only the *first* nine hours of course work taken at the graduate level in the PBS category can be accepted toward degree requirements unless a request for some other combination of nine hours is made by the student's advisory committee and approved both by the College or School Dean and the Graduate Dean.

3. The grade point average (GPA) of a graduate student who has credits in the PBS category will be based on all courses taken at the 400-600 level. However, no course taken six (6) years prior to enrollment into a program will be considered in the GPA calculation.
4. Registration is limited to a maximum of two courses per semester. Individuals who are employed full-time should limit their PBS registrations to one course per semester.
5. The PBS classification carries with it no implication that the student will be admitted to the Graduate School in any degree classification.
6. All course work accepted for degree credit must be approved by the student's advisory committee as being germane to the program. Requests for degree credit for courses completed in the PBS classification are considered after admission to a graduate degree program when the student's Plan of Graduate Work is filed with the Graduate School.
7. PBS students are expected to familiarize themselves with Graduate School policies and to seek further advice or clarification as needed.

Grades of all courses taken after the first nine hours will be recorded on PBS students' transcripts.

COLLEGE OF ENGINEERING PROFESSIONAL DEGREE PROGRAM

Professional degree students are admitted as undergraduate students, are classified as "PR" students and are subject to rules and regulations as established and administered by the Dean of the College of Engineering.

A professional degree student who is subsequently admitted to the Graduate School may, with the approval of the master's advisory committee, the major department and the Graduate School receive graduate credit for a maximum of nine hours credit for courses in which a grade of "B" or higher was received.

COOPERATIVE EDUCATION PROGRAM

The Cooperative Education Program is designed to be an integral part of a graduate student's educational program and is available to all majors. The program is designed to complement classroom learning by providing sponsored, paid work assignments in industry, business, and government. The work experience is selected in terms of its relationship to a student's major and/or career goals and provides for full-time work on alternating semesters or part-time work on a parallel plan while carrying a reduced load of courses. Co-op participation does not constitute an interruption of college work. Co-op work assignments have been approved and are monitored by the program staff.

To be eligible for the Co-op Program, graduate students must have completed one semester of graduate study, be in good academic standing, have the approval of their graduate advisers, and have an interview with the Director of Cooperative Education. For program completion, graduate students must work a minimum of one fall or spring semester full-time or two semesters part-time. However, most employers look for an increased level of productivity on the part of the student and, therefore, expect the graduate student to plan on additional work semesters.

International students also qualify for the Co-op Program provided they meet visa regulations on curricular practical training.

For further information, contact William D. Weston, Director of Cooperative Education, Box 7110, 737-2199.

Certificate Renewal

Public school personnel who are primarily interested in "certification credit" may enroll in the PBS program through the Division of Continuing Education without forwarding transcripts of previous work to the Graduate School. In such cases, the School of Education will be responsible for assessing the adequacy of the applicant's qualifications for enrollment in the course(s) concerned.

Registration and Records

The Office of Registration and Records must have authorization from the Dean of the Graduate School before a graduate student in any classification will be permitted to register for classes. This authorization will be sent to the Office of Registration and Records at the time the student is notified of acceptance for graduate study. All students attending classes must be registered for credit or audit. Grade records are furnished the students at the end of each scheduled school term.

MEDICAL HISTORY AND IMMUNIZATION RECORDS

All graduate students admitted to a degree program are required by State law to submit a report of medical history and immunization documentation prior to completing their initial registration. This report must document immunization against tetanus, measles, German measles and polio. NCSU students returning to Graduate School must have their medical history on file updated. The required reports should be received in the Student Health Service at least thirty days before registration.

INTERINSTITUTIONAL REGISTRATION

North Carolina State University participates in an Interinstitutional Registration program with the University of North Carolina at Chapel Hill, the University of North Carolina at Greensboro and Duke University. Under this agreement, graduate students enrolled at this university may undertake course work on these campuses upon the recommendation of their advisory committees. Courses offered by North Carolina A&T University and by the University of North Carolina at Charlotte over the Microelectronics Center of North Carolina communications system are also available through Interinstitutional Registration.

Even though taking a course on another campus, the graduate student is exclusively under the administrative direction of the North Carolina State University Graduate School. Enrollment for courses on other campuses will take place on this campus, using special forms obtained from the Office of Registration and Records. The Graduate School shall consider courses taken on other campuses as a part of the student's normal load, and the billing for such work will be through the Office of Finance and Business. The procedures followed in the summer sessions are somewhat different; detailed instructions are available in the Office of Registration and Records.

When the grading system on the campus being visited is different from the North Carolina State University system, grades received under Interinstitutional Registration will be converted to the North Carolina State University system. "H," "P," "L" and "F" grades earned at the University of North Carolina at Chapel Hill and "E," "G," "S" and "F" grades earned at Duke University will be converted to "A," "B," "C" and "NC" grades, respectively.

COURSE LOAD

A full-time graduate course load is 9 to 15 credits per semester (including audits) and 6 credits per summer session (including audits). Audits in subjects in which the student has no previous experience will be evaluated at full credit value in determining course load. Audits taken as repetition of work previously accomplished are considered at one half of their value in calculating course loads. With the single exception of foreign language audits, all audit registrations must fall within the range of maximum permissible course loads.

Foreign students on F-1 and J-1 visas are required by the Immigration and Naturalization Service to carry a full-time course of study to remain in status.

Graduate students holding assistantships are restricted to the following maximum semester course loads: full time, 3 hours; three-quarters time, 6 hours; one-half time, 9 hours; one-quarter time, 12 hours. External employment obligations of students on assistantships plus their assistantship obligations should not exceed these limits. Additionally, graduate assistants are limited to the following maximum totals of credit hours over the duration of their appointments:

Assistantship Classification	*Length of Appointment*	*Maximum Credit Hours*
Full time	9 months	6
Full time	12 months	9
¾ time	9 months	12
¾ time	12 months	16
½ time	9 months	18
½ time	12 months	24
¼ time	9 months	24
¼ time	12 months	30

SENIORS

A member of the senior class may, with prior approval of the Dean of the Graduate School, register for graduate credit in courses at the 400 and 500 levels as long as the combined graduate and undergraduate credit load is not more than 15 hours. Seniors with an accumulated grade point average of 3.2 or better in their major may enroll for a combined graduate and undergraduate credit load of 18 hours upon the recommendation of the student's advisor and approval by the department and the Graduate School. No more than six hours of graduate credit may be accumulated by a senior, and those graduate credits may not be applied toward the requirements for a baccalaureate degree. Courses at the 600 level are not ordinarily open to undergraduates, although occasional exceptions are made for senior honor students.

Seniors desiring to take courses for graduate credit should contact their major advisers who will forward appropriate requests to the Graduate Dean for approval.

AUDITS

Students wishing to audit courses must have the approval of their advisers and of the instructors teaching the courses. While auditors receive no course credit, they are expected to attend class regularly. The degree to which auditors must participate in class beyond regular attendance is optional with the instructors; any such requirements should be clearly explained to the auditors in writing at the beginning of the semester. An instructor who feels that an auditor has failed to fulfill the stipulated requirements is justified in marking "NR" (no recognition given for audit) on the grade report roll.

GRADUATION

There are three official graduations for graduate students per year, occurring at the end of the fall and spring semesters and at the end of the second summer session. Formal commencement exercises are held only at the end of spring semester, but any student who graduated the preceding second summer session or fall semester is eligible to participate if he or she notifies the Graduate School in writing of such an intent at least four weeks in advance of the actual commencement date. Conversely, any student scheduled to graduate in the spring semester is required to attend commencement unless he or she has notified the Graduate Office in writing of the desire to have the degree conferred *in absentia*.

The diplomas for those students graduating at the end of second summer session or fall semester and those receiving permission to receive the degree *in absentia* are mailed by the Office of Registration and Records which is also responsible for the ordering of diplomas.

Tuition and Fees

A statement of tuition and fees is mailed to each preregistered student approximately five weeks before the beginning of any term. The statement must be returned with full payment or complete financial assistance information by the

due date appearing on the statement. Normally the due date is approximately two weeks before classes begin. Non-preregistered students are required to pay their tuition and fees at registration.

All students are responsible for tuition appropriate to their residence status unless payment is specifically provided by the terms of a fellowship, traineeship or assistantship.

SEMESTER RATE SCHEDULE—1987-88 ACADEMIC YEAR

RESIDENTS OF NORTH CAROLINA*

Hours	*Tuition*	*Required Fees*	*Total*
0-Thesis	$116	$ 19	$135
0-2	63	65	128
3-5	126	65	191
6-8	189	131	320
9+	252	196	448

NONRESIDENTS**

Hours	*Tuition*	*Required Fees*	*Total*
0-Thesis	$ 366	$ 19	$ 385
0-2	513	65	578
3-5	1,027	65	1,092
6-8	1,540	131	1,671
9+	2,053	196	2,249

SUMMER SESSION RATE SCHEDULE—1988

	RESIDENTS OF NORTH CAROLINA	NONRESIDENTS
Hours	*Tuition and Required Fees*	*Tuition and Required Fees*
0-Thesis	$123	$ 373
0-2	128	578
3-5	191	1,092
6-8	254	1,605
9+	317	2,118

SPECIAL REGISTRATION AND FEES—1987-88 ACADEMIC YEAR

******Summer Research [GR 596S (master's candidates) or GR 696S (doctoral candidates)]***

For graduate students whose programs of work specify no formal course work during a summer session and who will be devoting full time to thesis research.

*For definition of in-state and out-of-state rates, see pp. 23-25.

**Under certain conditions, nonresident students who have been offered an assistantship, traineeship or fellowship may be eligible for reduced tuition rates.

***Assessed the 0-Thesis rate.

*********Examination Only [GR 597 (master's candidates)]*
For graduate students in master's programs not requiring a thesis who have completed all requirements except the final oral examination by the beginning of the term in which the degree is to be awarded.

*********Thesis Preparation Only [GR 598 (master's candidates) or GR 698 (doctoral candidates)]*
For graduate students who have completed all course work, research and residence requirements and who are writing a thesis or dissertation.

*********Dissertation Research [GR 697 (doctoral candidates)]*
For doctoral students who have scheduled no formal course work during a given term, who have passed the preliminary examinations, who have completed at least six hours of departmental research on the doctoral program and who are devoting full time to the dissertation. Students so registered are full-time; the course carries no credit hour designation.

Audits

During semester when registered and paying for other course work	One audit free, each additional audit same cost as for credit
During semester when not registered for other course work	Same cost as for credit
During any summer session	Same cost as for credit
Full-time Faculty or Staff	$ 7
Microfilming Doctoral Dissertation	$42

Office of International Visitors

A special administrative management fee of $250 per semester and $150 per summer session is required from a contracting agency sponsoring international students who are programmed and advised by the University's Office of International Visitors.

(ALL CHARGES ARE SUBJECT TO CHANGE WITHOUT NOTICE)

FULL-TIME FACULTY AND EMPLOYEES

Full-time faculty of instructor rank and above and other full-time employees of the University who hold membership in the Teachers' and State Employees' Retirement System may register for credit or as auditors with free tuition privileges for one course in any academic term at any campus of the University of North Carolina. Free tuition privileges do not apply during the summer. Each applicant for free tuition must submit through regular channels a form provided by the University.

***Assessed the 0-Thesis rate.

REFUND OF TUITION AND FEES

A student who officially withdraws from school during the first two weeks of a semester or by the end of the fourth day of a summer session will receive a tuition and fees refund of the full amount paid less a registration fee. The withheld fee amounts to $15 the first week and $25 the second week. After the two-week period, no refund will be made.

In some instances, circumstances justify the waiving of rules regarding refunds. An example might be withdrawal because of sickness. Students have the privilege of appeal to the Fee Appeals Committee when they feel special consideration is merited. Applications for such appeals may be obtained from the University Cashier and Student Accounts Office, 2 Peele Hall.

RESIDENCE STATUS FOR TUITION PURPOSES

The basis for determining the appropriate tuition charge rests upon whether a student is a resident or a nonresident for tuition purposes. Each student must make a statement as to the length of his or her residence in North Carolina with assessment by the institution of that statement to be conditioned by the following:

Residence—To qualify as a resident for tuition purposes, a person must become a legal resident and remain a legal resident for at least twelve months immediately prior to classification. Thus, there is a distinction between legal residence and residence for tuition purposes. Furthermore, twelve months' legal residence means more than simple abode in North Carolina. In particular, it means maintaining a domicile (permanent home of indefinite duration) as opposed to "maintaining a mere temporary residence or abode incident to enrollment in an institution of higher education." The burden of establishing facts which justify classification of a student as a resident entitled to in-state tuition rates is on the applicant for each classification, who must show his or her entitlement by the preponderance (the greater part) of the residentiary information.

Initiative—Being classified a resident for tuition purposes is contingent on the student's seeking such status and providing all information that the institution may require in making the determination.

Parents' Domicile—If an individual, irrespective of age, has living parent(s) or court-appointed guardian of the person, the domicile of such parent(s) or guardian is, prima facie, the domicile of the individual; but this prima facie evidence of the individual's domicile may or may not be sustained by other information. Further, nondomiciliary status of parents is not deemed prima facie evidence of the applicant child's status if the applicant has lived (though not necessarily legally resided) in North Carolina for the five years preceding enrollment or re-registration.

Effect of Marriage—Marriage alone does not prevent a person from becoming or continuing to be a resident for tuition purposes, nor does marriage in any circumstance insure that a person will become or continue to be a resident for tuition purposes. Marriage and the legal residence of one's spouse are, however, relevant information in determining residentiary intent. Furthermore, if both a husband and his wife are legal residents of North Carolina and if one of them has been a legal resident longer than the other, then the longer duration may be claimed by either spouse in meeting the twelve-month requirement for in-state tuition status.

Military Personnel—A North Carolinian who serves outside the State in the armed forces does not lose North Carolina domicile simply by reason of such service. Students from the military may prove retention of establishment of residence by reference, as in other cases, to residentiary acts accompanied by residentiary intent.

In addition, a separate North Carolina statute affords tuition rate benefits to certain military personnel and their dependents even though not qualifying for the in-state tuition rate by reason of twelve months legal residence in North Carolina. Members of the armed services, while stationed in and concurrently living in North Carolina, may be charged a tuition rate lower than the out-of-state tuition rate to the extent that the total of entitlements for applicable tuition costs available from the federal government, plus certain amounts based under a statutory formula upon the in-state tuition rate, is a sum less than the out-of-state tuition rate for the pertinent enrollment. A dependent relative of a service member stationed in North Carolina is eligible to be charged the in-state tuition rate while the dependent relative is living in North Carolina with the service member and if the dependent relative has met any requirement of the Selective Service System applicable to the dependent relative. These tuition benefits may be enjoyed only if the applicable requirements for admission have been met; these benefits alone do not provide the basis for receiving those derivative benefits under the provisions of the residence classification statute reviewed elsewhere in this summary.

Grace Period—If a person (1) has been a bona fide legal resident, (2) has consequently been classified a resident for tuition purposes and (3) has subsequently lost North Carolina legal residence while enrolled at a public institution of higher education, that person may continue to enjoy the in-state tuition rate for a grace period of twelve months measured from the date on which North Carolina legal residence was lost. If the twelve months end during an academic term for which the person is enrolled at a State institution of higher education, the grace period extends, in addition, to the end of that term. The fact of marriage to one who continues domiciled outside North Carolina does not by itself cause loss of legal residence, marking the beginning of the grace period.

Minors—Minors (persons under 18 years of age) usually have the domicile of their parents, but certain special cases are recognized by the residence classification statute in determining residence for tuition purposes.

(a) If a minor's parents live apart, the minor's domicile is deemed to be North Carolina for the time period(s) that either parent, as a North Carolina legal resident, may claim and does claim the minor as a tax dependent, even if other law or judicial act assigns the minor's domicile outside North Carolina. A minor thus deemed to be a legal resident will not, upon achieving majority before enrolling at an institution of higher education, lose North Carolina legal residence if that person (1) upon becoming an adult "acts, to the extent that the person's degree of actual emancipation permits, in a manner consistent with bona fide legal residence in North Carolina" and (2) "begins enrollment at an institution of higher education not later than the fall academic term next following completion of education prerequisite to admission at such institution."

(b) If a Minor has lived for five or more consecutive years with relatives (other than parents) who are domiciled in North Carolina and if the relatives have

functioned during this time as if they were personal guardians, the minor will be deemed a resident for tuition purposes for an enrolled term commencing immediately after at least five years in which these circumstances have existed. If under this consideration a minor is deemed to be a resident for tuition purposes immediately prior to his or her eighteenth birthday, that person on achieving majority will be deemed a legal resident of North Carolina of at least 12 months' duration. This provision acts to confer in-state tuition status even in the face of other provisions of law to the contrary; however, a person deemed a resident of 12 months' duration pursuant to this provision continues to be a legal resident of the State only so long as he or she does not abandon North Carolina domicile.

Lost but Regained Domicile—If a student ceases enrollment at or graduates from an institution of higher education while classified a resident for tuition purposes and then both abandons and reacquires North Carolina domicile within a 12-month period, that person, if he or she continues to maintain the reacquired domicile into re-enrollment at an institution of higher education, may re-enroll at the in-state tuition rate without having to meet the usual 12-month durational requirement. However, any one person may receive the benefit of this provision only once.

Change of Status—A student admitted to initial enrollment in an institution (or permitted to re-enroll following an absence from the institutional program which involved a formal withdrawal from enrollment) must be classified by the admitting institution either as a resident or as a non-resident for tuition purposes prior to actual enrollment. A residence status classification once assigned (and finalized pursuant to any appeal properly taken) may be changed thereafter (with corresponding change in billing rates) only at intervals corresponding with the established primary divisions of the academic year.

Transfer Students—When a student transfers from one North Carolina public institution of higher education to another, he or she is treated as a new student by the institution to which he or she is transferring and must be assigned an initial residence status classification for tuition purposes.

Prevailing North Carolina Law—General Statute (G.S.) 116-143.1 is the prevailing statute governing residence status classification. Copies of the applicable law and/or implementing regulations are available for inspection in the Office of Undergraduate Admissions, 112 Peele Hall.

To initiate a review of a residence status classification, a student must submit a Residence-and-Tuition Status Application to the Graduate School office, 104 Peele Hall. Questions about residency should be directed to that office.

Fellowships and Graduate Assistantships

Graduate students may receive financial support through fellowships, traineeships and teaching or research assistantships sponsored by federal, state and private agencies. Prospective students may request consideration for financial assistance by completing the appropriate sections of the admissions application form. Applicants for these awards should correspond directly with the department of major interest concerning the availability of awards and related information. Enrolled students should contact the major department. Prospective and enrolled graduate students are encouraged to apply for national, regional and foundation fellowships in addition to awards sponsored through the University.

The University offers approximately 1,600 assistantships each year. Stipend rates for teaching and research assistantships are competitive with other univer sities. For further information on the availability of assistantships, applicants should contact the program area of interest.

Unless tuition is expressly provided by the terms of the award, an award recipient must pay tuition at the rate determined by his or her residence status. However, a nonresident graduate student awarded an assistantship or a fellowship may be eligible for a reduced tuition rate comparable to the in-state rate. Further information may be obtained by contacting the Graduate School office or the department of major interest.

A graduate student must be in good academic standing (B or better average) to be eligible for appointment to an assistantship, fellowship or traineeship and must be registered in each semester in which the appointment is in effect.

MINORITY PRESENCE GRANT PROGRAM

Under the Board of Governors general Minority Presence Grant Program, black students may be eligible for special financial assistance if they are residents of North Carolina, enrolled for at least three hours of degree-credit course work and demonstrate financial need.

The Minority Presence Grant Program for Doctoral Study, Law and Veterinary Medicine provides stipends of up to $4,000 for the academic year, with an option of $500 in additional support for study in the summer sessions, for black residents of North Carolina who are selecte to participate. Recipients must be full-time students pursuing doctoral degrees, law degrees or degrees in veterinary medicine at East Carolina University, North Carolina State University, The University of North Carolina at Chapel Hill or The University of North Carolina at Greensboro.

AMERICAN INDIAN STUDENT LEGISLATIVE GRANT PROGRAM

The General Assembly of North Carolina has provided funds for the American Indian Student Legislative Grant Program for a number of grants to American Indian students interested in pursuing doctoral degrees at NCSU. The fellowships have a maximum value of $4,000 annually.

To be eligible for a fellowship, interested students must be enrolled full-time and in good standing in a doctoral degree program, meet state residency requirements, have financial need and be an American Indian under the program's definition. This definition states that an eligible individual is one who maintains cultural identification as an American Indian through membership in an Indian tribe recognized by the State of North Carolina or by the federal government or through other tribal affiliation or community recognition.

ALUMNI ASSOCIATION GRADUATE FELLOWSHIP SUPPLEMENTS

The NCSU Alumni Association each year funds Graduate Fellowship Supplements in an effort to recruit more outstanding graduate students, with the highly competitive award process being coordinated through the Graduate School office. For the 1987-88 academic year twenty Graduate Fellowship Supplements were funded; eighteen of these were awarded across campus and two were awarded to support the management of University Archives. These supplements are awarded on a one-time-only basis as a financial incentive *above and beyond* whatever fellowship or assistantship may be offered.

DEPARTMENTAL FELLOWSHIPS

Several departments offer fellowships funded from private sources. Students are nominated for these fellowships by their departments or programs with selection being made by faculty committees or by the Graduate School. For additional information concerning such fellowships, the applicant should contact the appropriate college, department or program. Examples of such fellowships are listed below:

PHY Training Grant, USDA National Needs Fellowship, Biotechnology Fellowship and Purina Mills Research Fellowship, all through the College of Agriculture and Life Sciences; Dairyman Inc. Fellowship in the Department of Animal Science; Pioneer Hybred International in the Department of Crop Science; Chemical Industries Institute for Toxicology through the Toxicology Program; Fellowship through the Department of Plant Pathology; E. G. Moss and R. J. Reynolds Fellowships through the N. C. Agricultural Research Service in the College of Agriculture and Life Sciences; Harkema Fellowship in the Department of Zoology; NASA Traineeship, Eastman Scholarship and ARO Fellowships in the Department of Mechanical and Aerospace Engineering; Nuclear Energy Fellowship, Fusion Technology Fellowship and Murray Fellowship through the Department of Nuclear Engineering; Dupont Manufacturing Systems Fellowship through the Integrated Manufacturing Systems Engineering Institute; Kimley-Horm Graduate Scholarship and Carolina Asphalt Association, Inc., through the Department of Civil Engineering; ECE Levels I, II and III Supplementary Fellowships, IBM Graduate Fellowship (solid state-electronics), IBM Graduate Fellowship in Manufacturing Research, IBM Graduate Fellowship in Computer Networking and Dupont Graduate Fellowships through the Department of Electrical and Computer Engineering; Dupont Fellowship in Chemical Engineering, Phillips Graduate Fellowship, Southeastern Regional and PIA Supplemental Fellowship in the Department of Chemical Engineering; Dean's Fellowships, Microelectronics Center of N.C. and National Consortium for Minorities in Engineering (GEM), all through the College of Engineering; SOHIO Fellowship in the Department of Physics; Gertrude M. Cox Fellowship in the Department of Statistics; Mary Lee and Luther Barnhardt Scholarship in the Department of History; Title IX Fellowship in the Department of Political Science and Public Administration; H. W. Close Fellowship through the College of Textiles.

NATIONAL, REGIONAL AND FOUNDATION FELLOWSHIPS

These awards are made to an individual rather than to the University. Recipients are chosen through competitions expressive of the terms of each award.

Examples of these awards follow:

NSF Graduate Fellowship—The Fellowship Office, National Research Council, 2101 Constitution Avenue, N.W., Washington, D.C. Pre-application packets are available in the Graduate School office, 104 Peele Hall.

American Association of University Women Fellowships—Applications are available through local chapters.

Other Financial Aid

LONG-TERM LOANS

Perkins Loans (Formerly National Direct Student Loans): Graduate students who are American citizens or eligible noncitizens may apply to the Financial Aid Office for consideration for long term, low interest loans. To qualify for loans, students must be making satisfactory academic progress and must show financial need. The Financial Aid Form is the proper form to be completed for financial aid consideration. Other required forms—Student Data Sheet and Financial Aid Transcript—should be requested along with the FAF from the University's Financial Aid Office. Students are expected to apply for and to accept any available assistantships or fellowships before applying for loans. In the event that the funds available through the Financial Aid Office are insufficient to meet the need of all students who apply and are eligible, priority for these loans will be given to students working on their first undergraduate degree and graduate students will be referred to other programs (see Guaranteed Student Loans).

Graduate students may borrow up to $18,000 inclusive of any undergraduate Perkins Loans. There is no interest on the loan while the borrower is a full- or half-time student at an institution of higher education. Five months after ceasing to be at least a half-time student, if you are a new borrower, interest begins at five percent per year. The repayment period begins at the same time. A ten-year repayment period is possible for large indebtedness; however, a minimum payment of $30 per month is required. Interest does not accrue and repayment installments may be postponed during any period not in excess of three years during which the borrower is a member of the Armed Forces of the United States or is a Peace Corps or Vista volunteer. Reduction of obligations to repay may result from teaching in schools with high concentrations of low income families or from teaching handicapped children. New legislation also provides that the Defense Department may repay a portion of your loan if you serve as an enlisted person in certain military occupations after receiving a Perkins Loan.

Institutional Long-Term Loans: These loans are made from University funds. Institutional loans are made and are to be repaid under the same terms as the Perkins Loans except that there are no forgiveness features.

NOTE: Due to a lack of sufficient funds for all students, priority for Perkins Loans and Institutional Loans will be given to undergraduate students.

Guaranteed Student Loan Program: This program provides loans from private lenders. Procedures are different in each state. Information for available loans may be obtained in the Financial Aid Office. Interest is at eight percent per year with the Federal government paying the interest during the in-school period. To determine eligibility for a Guaranteed Student Loan, the financial aid administrator will add the student's Expected Family Contribution to the student's other financial aid. If the total financial aid is less than the cost of education the student is considered to have need and is eligible for a Guaranteed Student Loan.

Graduate/professional students who are eligible may borrow under the Guaranteed Student Loan program through College Foundation, Inc. or other lending agencies in the student's state of legal residence, a maximum of $7,500 per academic year or the total cost of education less other financial aid (including assistantships and fellowships) whichever is less. A maximum of $54,750 may be borrowed for graduate/professional study, including undergraduate loans. College Foundation Loans are insured by the North Carolina Education Assistance Authority or the United States Department of Education. Students from other states may obtain information about similar plans from the Financial Aid Office.

PART-TIME JOBS

The College Work Study Program is a federal program designed to provide part-time jobs to students who show need of financial assistance. The same application, the Financial Aid Form, is used to apply for both loans and jobs. Effort is made to assign students to jobs in keeping with their special interests and skills. As is the case with campus-administered loans, priority for these funds is given to undergraduate students pursuing their first undergraduate degree.

Other jobs not based on need are listed at the Financial Aid Office and are open to all students.

SHORT-TERM EMERGENCY LOANS

Loans, usually in amounts of $100 or less, to meet emergency expenses may be obtained on short notice at the Financial Aid Office. These loans, in that they are designed for short term, emergency use, must be repaid within about 30 days. A loan may not be taken out between semesters or summer sessions.

Military Education and Training

The Reserve Officer Training Corps (ROTC) selects interested University students for enrollment in Army ROTC (AROTC) or in Air Force ROTC (AFROTC) for officer education and training leading toward a commission.

The Army and Air Force ROTC departments educate and train University students, graduate and undergraduate, for a commission in their respective

military services. These students must have four full semesters (undergraduate or graduate) remaining at the time they enter the ROTC Program (exceptions for Army ROTC are noted below). Uniforms and books for ROTC are provided. Transfer credit is allowed for previous ROTC course work at other institutions.

Graduate students who will be at NCSU for at least two years may, upon successful completion of a six-weeks' summer training period, be enrolled in the Air Force ROTC Program. Entry requirements for either program may also be met by having met any *one* of the following requirements:

1. Completed basic level ROTC courses as an undergraduate.
2. Be an honorably discharged veteran.
3. Have completed military basic training and be a member of an Army/Air Force Reserve or National Guard Unit.
4. Successfully complete a two-weeks, on-campus program (Army ROTC only).

Air Force ROTC offers a Flight Screening Program for selected cadets which is conducted by an Air Force flying school in Texas during the summer at no expense to the student. Students successfully completing ROTC flight screening may be selected for further flight training as an Air Force pilot.

Graduate students enrolled in the junior and senior years of ROTC receive $100 per month. Scholarships which pay all tuition, fees and costs of required textbooks in addition to the $100 per month are available on a competitive basis.

Special provisions for veterans are made in Army ROTC whereby they are granted placement credit for their prior service experience and training. Additionally, Army ROTC offers the student several points of entry into the ROTC Program, under a process of granting ROTC placement credit for college courses or other worthwhile experiences that contribute to the requisite skills of a second lieutenant. Army ROTC counselors are available to evaluate the students' prior learning experiences and advise them as to where they can be placed in ROTC. Under the Army's Simultaneous Membership Program, the graduate student may participate in the Army Reserve or National Guard and receive approximately $84 per month in addition to the $100 monthly stipend. The National Guard provides up to $500 tuition costs per year for its members. The student must enlist in the specified component and have completed basic training prior to entry into the program.

Additional information on Army ROTC may be obtained from the Professor of Military Science, Room 154, Reynolds Coliseum (737-2428) and Air Force ROTC from the Professor of Aerospace Studies, Room 145, Reynolds Coliseum (737-2417).

Health Services

The Student Health Service, located in Clark Hall Infirmary, offers health care to students in a campus facility staffed by eight full-time physicians, three Family Nurse Practitioners, a pharmacist, laboratory technicians, registered nurses, health educators and support staff.

During fall and spring semester, the Health Service is open 24 hours a day, seven days a week except during holidays and breaks. Physicians maintain regular office hours Monday through Friday and are on call at other times.

(Students must check-in by 4:30 p.m. to see a physician.) A limited-hours outpatient clinic is in operation during summer sessions and semester breaks.

All currently enrolled students are eligible for medical care. The pre-paid health fee covers professional services such as nurse and M.D. visits, laboratory tests, cold medications and health education. There is a nominal charge for x-rays, prescriptions and specialty clinics. Students are responsible for all services received off-campus, *e.g.*, M.D. or hospital.

The University offers students the opportunity to enroll in a student group health and accident insurance plan which helps cover the cost of referrals to off-campus specialists or to hospitals for serious illnesses.

International students are required to enroll in a student health insurance program.

For additional information, telephone 737-2563.

Housing

ON-CAMPUS HOUSING

The University operates 19 residence halls for single students with a total capacity to accommodate approximately 6,300 students. Eight of the halls are arranged in suites of four or five rooms with a common bathroom. Ten others have rooms which open onto a central corridor with bathrooms at separate intervals. North Hall has private baths in each double room.

Rooms are provided with basic furnishings such as bed, chest of drawers, desk, chair and waste basket for each double or single room occupant. An optional linen rental service is available through the University Laundry and Dry Cleaning Service.

The 1987-88 rental fee for a main campus residence hall double room is $610 per semester per student and may increase in future years. Room rents in North Hall and South Hall are higher. With the exception of Watauga Hall (graduate and upper class residence hall), new freshmen and continuing residents have priority for a room assignment over new graduate students. Students who are unable to secure on-campus housing before school begins may contact the Housing Assignments Office, 201 Harris Hall, on or after September concerning the availability of housing on campus at that time.

OFF-CAMPUS HOUSING

The Housing Assignments Office also maintains a self-help facility which makes available listings of off-campus housing accommodations sent to them by private landlords; however, specific arrangements for this housing must be contracted for by those individuals concerned. The listings are not mailed as they change frequently and most landlords and tenants prefer to complete the rental transaction in person rather than by telephone or mail. The Housing Assignments Office is open from 8:00 a.m. until 5:00 p.m., Monday through Friday only.

STUDENT FAMILY HOUSING

The University also maintains 300 apartments for student families, including efficiency, one-bedroom and two-bedroom units. The monthly rental rates for the 1987-88 year are $210 (includes gas) for efficiencies, $202 for one-bedroom apartments and $224 for the two-bedroom units. All apartments have built-in dresser drawers, closets, a stove and a refrigerator. Interested students should write to E. S. King Village, P Building, North Carolina State University, Raleigh, NC 27607 for family housing applications and information or telephone (919) 737-2430.

Additional Information

If additional information is needed, contact the Graduate School, 104 Peele Hall, P. O. Box 7102, North Carolina State University, Raleigh, N.C. 27695-7102 (telephone 919/737-2871).

GRADUATE PROGRAMS

The Graduate School offers programs of study leading to the master's degree in 75 fields and the doctorate in 48. Each student's program is planned with an advisory committee of graduate faculty members to provide the opportunity for gaining advanced knowledge in the particular field of study. Graduate education is the final stage in the development of intellectual independence. It is different from undergraduate education in that the student is encouraged to establish premises, to hypothesize and to defend both the procedure and the conclusions of independent investigation. The burden of proof for the verifiability of knowledge rests on the student, not on the faculty member. Emphasis is placed upon the student's scholarly development through formal course work, seminars, research and independent investigation.

Graduate students are expected to familiarize themselves with the requirements for the degrees for which they are candidates and are held responsible for the fulfillment of these requirements.

The Graduate School offers courses of study in the following fields:

Aerospace Engineering—M.S., Ph.D.
Agriculture—Master of
Agricultural Economics—M.S.
Animal Science—M.S., Ph.D.
Applied Mathematics—M.S., Ph.D.
Architecture—Master of
Archival Management—M.A.
Biochemistry—M.S., Ph.D.
Biomathematics—Master of, M.S., Ph.D.
Biological and Agricultural Engineering—Master of, M.S., Ph.D.
Botany—M.S., Ph.D.
Chemical Engineering—Master of, M.S., Ph.D.
Chemistry—Master of, M.S., Ph.D.
Civil Engineering—Master of, M.S., Ph.D.
Computer Studies—Master of, M.S.
Crop Science—M.S., Ph.D.
Ecology—M.S.
Economics—Master of, Ph.D.
Education—(Master of Education offered in fields listed below)
- Adult and Community College Education—M.S., Ed.D.
- Agricultural Education—M.S.
- Curriculum and Instruction—M.S., Ed.D.
- Educational Administration and Supervision—M.S., Ed.D.
- Guidance and Personnel Services—M.S., Ed.D.
- Industrial Arts Education—M.S., Ed.D.
- Mathematics Education—M.S., Ph.D.
- Middle Grades Education—M.S.
- Occupational Education—M.S., Ed.D.
- Science Education—M.S., Ph.D.
- Special Education—M.S.
- Vocational Industrial Education—M.S.

Electrical and Computer Engineering—Master of, M.S., Ph.D.
*Engineering—Master of
English—M.A.
Entomology—M.S., Ph.D.
Fiber and Polymer Science—Ph.D.
Food Science—M.S., Ph.D.
Forestry—Master of, M.S., Ph.D.
Genetics—M.S., Ph.D.
History—M.A.
Horticultural Science—M.S., Ph.D.
Industrial Engineering—Master of, M.S., Ph.D.
Integrated Manufacturing Systems Engineering—Master of
Landscape Architecture—Master of
Life Sciences—Master of
Management—M.S.
Marine, Earth and Atmospheric Sciences—M.S., Ph.D.
Materials Science and Engineering—M.S., Ph.D.
Mathematics—M.S., Ph.D.
Mechanical Engineering—Master of, M.S., Ph.D.
Microbiology—M.S., Ph.D.
Nuclear Engineering—Master of, M.S., Ph.D.
Nutrition—M.S., Ph.D.
Operations Research—M.S., Ph.D.
Physics—M.S., Ph.D.
Physiology—M.S., Ph.D.
Plant Pathology—M.S., Ph.D.
Political Science—M.A.
Poultry Science—M.S.
Product Design—Master of
Psychology—M.S., Ph.D.
Public Affairs—Master of
Recreation Resources Administration—Master of, M.S.
Rural Sociology—M.S.
Sociology—Master of, Ph.D.
Soil Science—M.S., Ph.D.
Statistics—Master of, M.S., Ph.D.
Technology for International Development—Master of
Textile Chemistry—M.S.
Textile Engineering and Science—M.S.
Textile Management and Technology—M.S.
Toxicology—Master of, M.S., Ph.D.
**Urban Design—Master of
Veterinary Medical Sciences—M.S., Ph.D.
Wildlife Biology—Master of, M.S.
Wood and Paper Science—Master of, M.S., Ph.D.
Zoology—M.S., Ph.D.

*Off-campus only.
**No new applications are being accepted. Students interested in this area should contact the School of Design.

Master's Degrees

The Graduate School offers programs of study leading to the Master of Science degree, the Master of Arts degree and the Master's degree in certain designated fields.

MASTER OF SCIENCE AND MASTER OF ARTS

For all Master of Science and Master of Arts degrees, the programs are planned with the objective of making possible a reasonable, comprehensive mastery of the subject matter in the chosen field. Training and experience in research are provided to familiarize the student with the methods, ideals and goals of independent investigation.

ADVISORY COMMITTEE AND PLAN OF GRADUATE WORK

The advisory committee is composed of at least three members of the Graduate Faculty, one of whom is designated as the chair and one of whom represents the supporting area. This committee is appointed by the Graduate Dean upon the recommendation of the head of the major department.

The student's program of study is planned so as to provide a comprehensive view of the major field of interest and to provide training in research in this field and related areas of knowledge. As great a latitude is permitted in the selection of courses as is compatible with a well-defined major and supporting courses. In general, it is expected that approximately two-thirds of the course work will be in the major and one-third in supporting courses. Since there are many possible combinations of course work, a specific Plan of Graduate Work is developed by the advisory committee with the student. The program of course work to be followed by the student and the thesis problem selected must be approved by the student's advisory committee, the head of the department and the Graduate School. The Plan of Graduate Work should be submitted to the Graduate School for approval prior to completion of one-half of the program.

CO-MAJOR

Students may co-major at the master's level with the approval of both departments and appropriate representation on the advisory committee. Co-majors must meet all requirements for majors in both departments. One degree is awarded and the co-major is noted on the transcript. A co-major must involve degree programs with similar requirements. Co-majors are not permitted between thesis and non-thesis degree programs or between Doctor of Philosophy and Doctor of Education degree programs. Enrolled co-majors will be classified in only one program for record purposes.

RESIDENCE

Students engaged in a course of study leading to the Master of Science or Master of Arts degree are required to be in residence, pursuing graduate work, for a minimum of one full academic year or its equivalent.

CREDITS

A minimum of 30 semester credits is required for the Master of Science or Master of Arts; however, the number of credit hours included in a Plan of Graduate Work often exceeds this minimum. At least 20 semester hours must come from 500- and 600-level courses, with no fewer than six credits being at the 600-level. The program may include no more than six hours of research and no more than two hours of departmental seminar, unless the total program exceeds 30 hours. Courses at the 400-level counted toward the minimal 30-hour requirement may not come from the major field.

CREDIT FROM OUTSIDE SOURCES

Transfer Credit. No more than six of the required academic credits will be accepted from other institutions. A graduate course may be considered for transfer to a master's program provided it has been completed in a graduate or post-baccalaureate classification at an accredited graduate school with a grade of "B" or better. Transfer credit may not be used to fill the 20-hour 500- and 600-level course requirement in master's programs.

Transfer of Undergraduate Credit. No graduate credit will be allowed for excess credits completed in an undergraduate classification at another institution.

Correspondence Courses and Extension Courses. No graduate credit will be allowed for correspondence courses or for courses completed by extension at universities other than NCSU.

Credit by Extension. A maximum of six semester credits taken prior to admission to a graduate program and earned through NCSU extension study may be applied toward degree requirements provided the courses are graduate level and are taught by members of the NCSU Graduate Faculty. If a student has been admitted to the Graduate School and an approved Plan of Graduate Work has been submitted, six additional semester credits may be obtained in off-campus NCSU graduate courses to apply toward the minimal credit hour requirement for the degree. Credit accepted by extension reduces the amount of credit which may be transferred from other institutions.

GRADING AND ACADEMIC STANDING

Performance in lecture courses is evaluated as "A" (Excellent), "B" (Good), "C" (Passing), "D" or "NC" (No credit). In order to receive graduate degree credit, a grade of "C" or higher is required. All grades on courses taken for graduate credit as an undergraduate at NCSU and all grades on courses taken in a graduate classification at NCSU in courses numbered 400 and above are included in the graduate grade point average. Courses at the 300 level and below are not considered for graduate credit and grades earned on them do not enter the grade point average.

Performance in research, seminar and special problems courses is evaluated as either "S" (Satisfactory) or "U" (Unsatisfactory), and these grades are not used in computing the grade point average. However, a student who receives a "U" on any course will not receive credit for that course and may be required to repeat it.

The "Master Listing of Approved Graduate Courses" identifies the approved grading (A,B,C,D,NC or S,U) for each 500- and 600-level course. Generally, courses numbered through the 590 series and the 690 series will receive "S" or

"U" grading. Other course numbers will carry A,B,C,D,NC grading. Any deviation from the approved grading for a particular course must be requested by the department and approved by the Academic School Dean and the Graduate Dean prior to teaching the course. Also included in the GPA calculation and the determination of academic standing are all 400-600-level credits earned by a student in a PBS classification at NCSU within six years of the date of enrollment as a graduate student. (See the Post-baccalaureate Studies section for restrictions concerning Post-baccalaureate Studies courses.)

The grade of "IN" (Incomplete) may be given in any course at the discretion of the instructor. A student who receives an "IN" must complete the unfinished work to have the Incomplete converted to a final grade by the end of the next semester in which the student is enrolled provided that this period is not longer than 12 months from the end of the semester or summer session in which the Incomplete was received; otherwise, the "IN" will be automatically converted to "NC" or "U," in accord with the grading approved for the particular course. All grades of "IN" must be cleared prior to graduation.

Except in the case of Interinstitutional Registration (see p. 18), grades on courses transferred from another institution will not be included in computing the grade point average.

Graduate students are given a notice of academic warning if they have accumulated less than nine hours at the 400-level or above and have less than a 3.0 ("B" average). Graduate students are placed on academic probation if they accumulate nine or more but less than eighteen credit hours at the 400-level or above and have a grade point average of less than 3.0 ("B" average). A student's graduate study is terminated if eighteen or more credit hours at the 400-level or above are accumulated with a grade point average of less than 3.0 ("B" average). In the case of program termination, no further registration in a graduate classification will be permitted. Under extenuating circumstances the student will be reinstated upon the written recommendation of the department and approval by the Graduate Dean. (Effective Fall 1978 for all graduate students.) Departments have the prerogative of recommending the termination of a student's graduate admission at any time.

Students who are eligible to attend the first summer session are eligible to attend either or both summer sessions. For example, students who receive a notice of "Graduate Admission Terminated" at the end of the first summer session may register for the second summer session unless the major department recommends otherwise.

A graduate student must be in good academic standing (B or better average) to be eligible for appointment to an assistantship, fellowship or traineeship and must be registered in each semester in which the appointment is in effect.

LANGUAGE REQUIREMENTS

A reading knowledge of one modern foreign language (Germanic, Romance or Slavic) is required of students pursuing the Master of Arts in English and of students engaged in the Master of Science programs in chemistry and mathematics. In the Master of Arts program in political science, competence in a foreign language or in research methodology is required. The Departments of Entomology, History and Mathematics and Science Education leave the decision to the student's advisory committee.

Proficiency can be demonstrated in one of two ways:

1. By passing a traditional reading knowledge examination, which can be requested by the student at any time.
2. By passing the final examination in a course especially designed for graduate students who have no previous knowledge of a foreign language or who wish to refresh their knowledge of a language. The Department of Foreign Languages and Literatures offers such courses, normally in the fall, for each of the three major foreign languages: French (FLF 401), German (FLG 401) and Spanish (FLS 401). These courses concentrate exclusively on teaching students to understand the written word and do not provide instruction or testing in speaking and original composition. Failure to pass the course carries with it no penalty other than the fact that the student's language requirement will remain unfulfilled. These courses are neither counted for credit nor used in computing the grade point average.

THESIS

Theses prepared by candidates for the Master of Science or Master of Arts degree must represent an original investigation into a subject which has been approved by the student's advisory committee and the head of the major department. Three copies of the thesis in final form as approved by the advisory committee, each signed by the members of the advisory committee, must be submitted to the Graduate School by a specific deadline in the semester or summer session in which the degree is to be conferred. Detailed information on form and organization of the thesis is presented in the University's *Guide for the Preparation of Theses*, which is available in the Graduate School office.

COMPREHENSIVE WRITTEN EXAMINATIONS

Written examinations covering the subject matter of the major and supporting fields may be required of the candidate. When required, such examinations must be successfully completed prior to requesting the comprehensive oral examination. Information concerning written examination schedules should be obtained from the student's major department.

COMPREHENSIVE ORAL EXAMINATIONS

A candidate for the Master of Science or Master of Arts degree must pass a comprehensive oral examination to demonstrate to the advisory committee that he or she possesses a reasonable mastery of the subject matter of the major and supporting fields and that this knowledge can be used with promptness and accuracy. This examination may not be held until all other requirements, except completion of the course work in current registration during the final semester, are satisfied. Application for the examination must be filed with the Dean of the Graduate School by the chair of the advisory committee at least two weeks prior to the date on which the examination is to be held and must be accompanied by certification that the thesis is complete except for such revisions which may be necessary as a result of the final examination.

A unanimous vote of approval by the advisory committee is required for passing the oral examination. Approval of the examination may be conditioned, however, upon the completion of additional work to the satisfaction of the advisory committee. A formal reexamination will not be required in this case. Failure of a student to pass the oral examination terminates the student's graduate work at this institution unless otherwise unanimously recommended by the advisory committee. Only one reexamination will be permitted. All committee actions may be appealed by written application to the Graduate Dean.

Oral examinations for master's degree candidates are open to the graduate faculty by right and to the University community by unanimous consent of the advisory committee and the student being examined. Discussions and decisions regarding the student's performance are private to the advisory committee.

TIME LIMIT

All requirements for the master's degree must be completed within six calendar years, beginning with the date the student commences courses carrying graduate credit applicable to the degree program, unless a more restrictive time limit has been established by the academic school.

MASTER'S DEGREE IN A DESIGNATED FIELD

The University offers a number of master's degree programs in designated fields. These programs vary in requirements and persons having an interest in these programs are advised to contact the major department for further information including specific prerequisites and degree requirements. General Graduate School policies as stated on page 35 through 39 apply to these degree programs with the exception of references to the master's thesis.

MASTER OF AGRICULTURE DEGREE AND MASTER OF LIFE SCIENCES DEGREE

The requirements for either of these degrees are as follows:

1. A total of 36 semester hours is required.
2. A minimum of four semester hours in special problems is required; not more than six semester hours in special problems will be allowed. This work replaces the research thesis requirement for the Master of Science or Master of Arts degrees.
3. A minimum of 20 credit hours of 500- or 600-level course work is required. There are no specific requirements as to courses in the 600-level group.
4. A reading knowledge of a modern foreign language is not required.

In all other respects, the requirements for the Master of Agriculture or the Master of Life Sciences degree are the same as those for the Master of Science and Master of Arts degrees.

Summary of Procedures for Master's Degrees

1. Letter of inquiry from prospective student to Graduate School or department head.
2. Mailing of proper forms to student.
3. Receipt of application materials and required fee.
4. Review of application materials by department or program.
5. Department forwards recommendation regarding applicant's admissibility to Graduate Dean.
6. The department's recommendation is reviewed and the student is notified of the action taken on the request for admission.
7. Student arrives, reports to the department, is assigned an adviser and makes out a roster of courses in consultation with the departmental adviser.
8. Advisory committee of three or more graduate faculty members, one of whom is designated as the chair and one of whom represents the supporting field, appointed by the Graduate Dean upon the recommendation of the department head.
9. Plan of Work prepared by the advisory committee with the student and submitted in quadruplicate to the department head and the Graduate School for approval prior to completion of one-half of the proposed program.
10. Three copies of the approved Plan of Work returned to the department. One copy is kept in department files, one is returned to the committee chair and one is given to the student.
11. Student passes language examination (if required by the major department).
12. Written examination in the major and/or supporting fields may be required of the candidate. If required, written examinations must be successfully completed prior to requesting the comprehensive oral examination.
13. A copy of a preliminary draft of the thesis is submitted to the chair of the student's advisory committee for review. (Thesis degrees only).
14. The diploma order request form must be filed with the Graduate School by the end of the third week of the semester or summer session of anticipated graduation. Failure to submit the form by this date may result in the student's not receiving the diploma at graduation.
15. At least two weeks prior to the final oral examination, the chair of the student's advisory committee submits the thesis to advisory committee members for review. (Thesis degrees only).
16. The final oral examination may be scheduled when all other requirements, except completion of the course work for the final semester, are satisfied. Permission for the candidate to take the final oral examination is requested of the Graduate School at least two weeks before the examination and, in the case of thesis degrees, must be accompanied by a certification that the thesis is complete except for such revisions as may be necessary as a result of the final examination. Specific deadline dates for non-thesis master's candidates appear in The Calendar.
17. The Graduate Dean schedules the examination and notifies the student and advisory committee of the time and place. The report on the final examination should be filed with the Graduate School as soon as the examination has been completed.

18. Three copies of the thesis signed by each member of the student's advisory committee must be submitted to the Graduate School by a specific deadline in the semester or summer session in which the degree is to be conferred. Specific deadline dates appear in The Calendar.
19. The thesis is reviewed by the Graduate School to insure that the format conforms with the specifications prescribed in the *Guide for the Preparation of Theses.* (Thesis degrees only).
20. All course work scheduled in a graduate degree classification must be completed prior to graduation.
21. A grade point average of at least 3.0 is required for graduation.
22. All degree requirements must be completed within six calendar years, beginning with the date the student commences courses carrying graduate credit applicable to the degree program, unless a more restrictive time limit has been established by the academic school.

Doctor of Philosophy and Doctor of Education Degrees

The doctorate symbolizes the ability of the recipient to undertake original research and scholarly work at the highest levels without supervision. The degree is therefore not granted simply upon completion of a stated amount of course work but rather upon demonstration by the student of a comprehensive knowledge and high attainment in scholarship in a specialized field of study. The student must demonstrate this ability by writing a dissertation reporting the results of an original investigation and by passing a series of comprehensive examinations in the field of specialization and related areas of knowledge.

ADVISORY COMMITTEE AND PLAN OF GRADUATE WORK

An advisory committee of at least four graduate faculty members, one of whom will be designated as chair, will be appointed by the Dean of the Graduate School upon the recommendation of the head of the major department. The committee, which must include at least one representative of the minor field, will, with the student, prepare a Plan of Graduate Work which must be approved by the department head and the Graduate School. In addition to the course work to be undertaken, the subject of the student's dissertation must appear on the plan; and any subsequent changes in subject or in the overall plan must be submitted for approval.

The program of work must be unified, and all constituent parts must contribute to an organized program of study and research. Courses must be selected from groups embracing one principal subject of concentration, the major, and from a cognate field, the minor. Normally, a student will select the minor work from a single discipline or field which, in the judgment of the advisory committee, provides relevant support to the major field. However, when the advisory committee finds that the needs of the student will best be served by work in an interdisciplinary minor, it has the alternative of developing a special program in lieu of the usual minor.

CO-MAJOR

Students may co-major at the doctoral level with the approval of both departments and appropriate representation on the advisory committee. Co-majors must meet all requirements for majors in both departments. One degree is awarded and the co-major is noted on the transcript. A co-major must involve degree programs with similar requirements. Co-majors are not permitted between thesis and non-thesis degree programs or between Doctor of Philosophy and Doctor of Education degree programs. Enrolled co-majors will be classified in only one program for record purposes.

RESIDENCE REQUIREMENT

For the Doctor of Philosophy and the Doctor of Education degrees, the student is expected to be registered for graduate work at an accredited graduate school for at least six semesters beyond the baccalaureate degree.

The basic University residence requirements are defined below. However, academic schools have the prerogative of establishing more restrictive requirements within the respective schools. (The College of Education requires a minimum of one academic year of full-time resident study).

At least two residence credits, as defined below, must be secured in continuous residence (registration in consecutive semesters) as a graduate student at the University. Failure to take work during the summer does not break continuity; however, summer work may be used in partial fulfillment of this requirement.

Residence credit is determined by the number of semester hours of graduate work carried during a given term. During a regular semester, residence credit is calculated in the following manner:

Semester Credits (Hours)	*Residence Credits*
9 or more	1
6-8	2/3
less than 6 (including registration for "Thesis Preparation")	1/3

The residence credit for a six-week summer term is equal to one-half of the corresponding amount for a regular semester. For example, six semester hours carried during a summer session will earn one-third of a residence credit; less than six credit hours will earn one-sixth of a residence credit.

GRADING AND ACADEMIC STANDING

The grading system and grade requirements for all doctoral programs are the same as those for master's degree programs, as described on pages 36-37.

LANGUAGE REQUIREMENTS

A reading knowledge of at least one modern foreign language is required by some departments for the Doctor of Philosophy degree. Doctoral students should contact the major department for specific language requirements. For the Doctor of Education degree, the decision as to whether or not there will be a language requirement is left to the student's advisory committee.

Students who choose to demonstrate a reading knowledge of a language may select from any of the Romance, Germanic or Slavic languages (or any combination in those programs requiring two languages). The Department of Foreign Languages and Literatures offers courses in French, German and Spanish especially designed for graduate students who have no previous knowledge of a foreign language or who wish to refresh their knowledge of a language. These courses concentrate exclusively on teaching students to understand the written word and do not provide instruction or testing in speaking and original composition. A passing grade on the final examination in one of these courses is sufficient evidence of a reading knowledge of the language.

To demonstrate comprehension in depth of one language, a student must not only prove that one possesses a reading knowledge of the language but also that he or she is proficient in the oral and compositional elements of that language. Students desiring to master one language in depth should consult the head of the Department of Foreign Languages and Literatures concerning the specific courses which will be necessary to achieve this comprehension; specific arrangements will depend upon the student's background in the language.

Students whose native language is other than English may use English as one of the languages when two are required for the Doctor of Philosophy degree. When English is submitted in partial fulfillment of the dual language requirement, the native language may not be used as the other language.

When only one language is required in the student's program, certification for that language must occur on this campus.

PRELIMINARY COMPREHENSIVE EXAMINATIONS

After completing the language requirement but not earlier than the end of the second year of graduate study and not later than one semester (four months) before the final oral examination, each doctoral student is required to take the preliminary comprehensive examinations. The examinations consist of two parts: written examinations and an oral examination. Requirements for written examinations in the minor field are left to the discretion of the department in which the student is minoring.

The written portion may be conducted in one of two ways. In the first, each member of the advisory committee prepares a set of questions for the student's response, and answers to each set are returned to the appropriate member for grading. This procedure is used by departments which have a relatively small number of doctoral students.

used and the conclusions reached in the research, as reported in the dissertation. It is conducted by an examining committee, which consists of the student's advisory committee and a Graduate School representative. This examination is open to the University community.

A unanimous vote of approval of the advisory committee is required for passing the final oral examination. Approval may be conditioned, however, on the student's meeting specific requirements prescribed by the student's advisory committee. Failure of a student to pass the examination terminates one's work at this institution unless the advisory committee recommends a reexamination. No reexamination may be given until one full semester has elapsed and only one reexamination is permitted.

Many of the larger departments have developed departmental written examinations to be used for all students. These examinations are given several times during the year, and scheduled dates are announced well in advance. Where written departmental examinations of this kind are used, the student will be expected to make arrangements to schedule these examinations.

Regardless of the method employed, the questions involved may cover any phase of the course work taken by the student during graduate study or any subject logically related to an understanding of the subject matter in the major and minor areas of study. The questions are designed to measure the student's mastery of the subject matter and the adequacy of preparation for research. Failure to pass the written preliminary examinations terminates the student's work at this institution, subject to departmental and/or school policies with respect to reexamination.

Upon satisfactory completion of the written portion of the preliminary examinations and after completion of all course work relevant to the examination, authorization for the preliminary oral examination is requested from the Graduate School. This examination is conducted by the student's advisory committee and a representative from the Graduate School and is open to all graduate faculty members. The student and the examining committee will be notified by the Graduate School of the arranged time and place. The oral examination is designed to test the student's ability to relate factual knowledge to specific circumstances, to use this knowledge with accuracy and promptness and to demonstrate a comprehensive understanding of the field of specialization and related areas.

A unanimous vote of approval by the members of the advisory committee is required for the student to pass the preliminary oral examination. Approval may be conditioned, however, on the successful completion of additional work in some particular field(s). All committee actions may be appealed by written application to the Graduate Dean.

Failure to pass the preliminary oral examination terminates the student's work at this institution unless the examining committee recommends a reexamination. No reexamination may be given until at least one full semester has elapsed, and only one reexamination is permitted.

CANDIDACY

A doctoral student is admitted to candidacy upon passing the preliminary examinations without conditions or after fulfilling any conditions specified by the advisory committee.

FINAL ORAL EXAMINATION

The final oral examination is scheduled after the dissertation is complete except for such revisions as may be necessary as a result of the examination, but not earlier than one semester or its equivalent after admission to candidacy and not before all required course work has been completed or is currently in progress. The examination consists of the candidate's defense of the methodology

THE DISSERTATION

The doctoral dissertation presents the results of the student's original investigation in the field of major interest. It must represent a contribution to knowledge, be adequately supported by data and be written in a manner consistent with the highest standards of scholarship. Publication is expected.

The dissertation will be reviewed by all members of the advisory committee and must receive their approval prior to submission to the Graduate School. Three copies of the document signed by all members of the student's advisory committee must be submitted to the Graduate School by a specific deadline in the semester or summer session in which the degree is to be conferred. Prior to final approval, the dissertation will be reviewed by the Graduate School to insure that the format conforms to the specifications prescribed in the *Guide for the Preparation of Theses.* Detailed information on form and organization of the dissertation is presented in the University's *Guide for the Preparation of Theses* which is available in the Graduate School office.

The University has a requirement that all doctoral dissertations be microfilmed by University Microfilms International, of Ann Arbor, Michigan, which includes publication of the abstract in *Dissertation Abstracts International.* The student is required to pay for the microfilming service. (See "Special Registration and Fees" under "Tuition and Fees.")

TIME LIMIT

Doctoral students are allowed a maximum of six calendar years from admission to the doctoral program to attain candidacy for the degree and a maximum of ten calendar years to complete all degree requirements. Academic schools or departments may have more restrictive requirements than the above stated Univerity policy. All students admitted to doctoral programs effective Fall 1979 are subject to the above policy. Time limits for students admitted to doctoral programs prior to Fall 1979 but who were not admitted to candidacy as of Fall 1979 and who do not meet the above policy will be considered on an individual basis. Doctoral students admitted to candidacy prior to the 1979 fall semester are subject to the previous policy which allowed seven calendar years from admission to candidacy to completion of all degree requirements.

Summary of Procedures for the Doctor of Philosophy and Doctor of Education Degrees

1. Letter of inquiry from prospective student to Graduate School or department head.
2. Mailing of proper forms to student.
3. Receipt of application materials and required fee.
4. Review of application materials by department or program.
5. Department forwards recommendation regarding applicant's admissibility to Graduate Dean
6. The department's recommendation is reviewed and the student is notified of the action taken on the request for admission.
7. Student arrives, reports to the department, is assigned an adviser and makes out a roster of courses in consultation with the departmental adviser.
8. Advisory committee of at least four graduate faculty members, one of whom is designated as the chair and one of whom represents the minor field, appointed by the Graduate Dean upon the recommendation of the department head.
9. A dissertation subject is selected and an outline of the proposed research submitted to the student's advisory committee and the department head for review and approval.
10. Plan of Work prepared by the advisory committee with the student and submitted in quadruplicate to the department head and the Graduate School for approval as soon as feasible after completion of 12 hours of course work.
11. Three copies of the approved Plan of Work returned to the department. One copy is kept in department files, one is returned to the committee chair and one is given to the student.
12. Student passes language examination(s). (See page 43.)
13. Written examinations in the major and minor fields are scheduled no earlier than the end of the second year of graduate study and not later than one semester before the final oral examination. The results of these examinations will be reported to the Graduate School.

14. When all written examinations have been completed satisfactorily, the chairman requests the scheduling of the preliminary oral examination at least two weeks prior to the suggested date. Upon approval of the request, a graduate faculty member is selected to represent the Graduate School at the examination, and the student and examining committee are notified of the time and place. The report of the examination is sent to the Graduate School and if the examination has been passed without conditions, the student is admitted to candidacy
15. A copy of the preliminary draft of the dissertation is submitted to the chair of the student's advisory committee for review.
16. The diploma order request form must be filed with the Graduate School by the end of the third week of the semester or summer session of anticipated graduation. Failure to submit the form by this date may result in the student's not receiving the diploma at graduation.

17. At least two weeks prior to the final oral examination, the chair of the student's advisory committee submits the dissertation to advisory committee members for review.
18. One semester or its equivalent after admission to candidacy or later, permission for the candidate to take the final oral examination is requested of the Graduate School by the chair of the candidate's advisory committee. Requests should be filed at least two weeks before the date of the examination and must be accompanied by a certification that the dissertation is complete except for such revisions as may be necessary as a result of the final examination. Upon approval of the request, the student and the examining committee, including a Graduate School representative, are notified of the time and place of the examination. The Graduate School Representative receives a copy of the dissertation at least one week prior to the examination.
19. Three copies of the dissertation signed by each member of the student's advisory committee and five copies of the abstract must be submitted to the Graduate School by a specific deadline in the semester or summer session in which the degree is to be conferred. Specific deadline dates appear in The Calendar. One copy each of the University Microfilms Agreement and the Survey of Earned Doctorate forms must be submitted with the dissertation.
20. The dissertation is reviewed by the Graduate School to insure that the format conforms with the specifications prescribed in the *Guide for the Preparation of Theses.*
21. All course work scheduled in a graduate degree classification must be completed prior to graduation.
22. A grade point average of at least 3.0 is required for graduation.
23. The statute of limitations for completion of degree requirements is described on page 45.

The D. H. Hill Library

Library facilities at North Carolina State University include the main D. H. Hill Library and special libraries for the School of Design and the Colleges of Textiles, Forest Resources and Veterinary Medicine as well as the Curriculum Materials Center in the College of Education. The collections, totaling more than 1,278,592 books and bound journals, 2,711,126 microforms, and 700,000 government publications, have been carefully assembled to serve the educational and research programs of the University.

The D. H. Hill Library contains particularly strong research holdings in the biological and physical sciences and in all fields of engineering, agriculture and forestry. The collection of books and journals in the humanities and social sciences is especially strong in English and American literature, sociology and economics.

The library's comprehensive collection of journals emphasizes the major teaching and research interests at NCSU; approximately 13,500 journals are received regularly. A large collection of state and federal government publications further strengthens the library's research holdings. The D. H. Hill Library has been a depository for U. S. federal documents since 1924. The Library has a comphrehensive collection of government research reports on microfiche including reports published by the Department of Energy (DOE) and its predecessor agencies, the Atomic Energy Commission (AEC) and the Energy Research and Development Administration (ERDA); also, the National Aeronautical and Space Administration (NASA), the Educational Resources Information Center (ERIC) and the National Technical Information Service (NTIS). The library is an official U.S. Patent depository and has a complete collection of U.S. patents on microfilm from 1790 to date.

The Textiles Library, located in Nelson Textile Building, contains holdings in the fields of textiles and textile chemistry. It is regarded as one of the best textile libraries in the country. The School of Design Library, in Brooks Hall, has a fine collection of books, journals and slides in the areas of architecture, landscape architecture and product design. The Forest Resources Library, located in Biltmore Hall, contains a collection of 11,000 monographs in areas ranging from tourism to chemical engineering to botany to hotel management to wood frame construction and is complemented by several hundred serial titles and over 12,000 uncataloged reports. The Veterinary Medical Library is a growing collection that serves the students and faculty of the College of Veterinary Medicine. The Curriculum Materials Center, administered by the College of Education, is located in Poe Hall. The center maintains a collection of educational materials with particular emphasis on teaching methods, research, administration and psychology and includes films, filmstrips, slides, audio tapes, video cassettes and simulation games. A special collection of materials covering the areas of anthropology and third world countries is also maintained. Audiovisual equipment is available for previewing materials in the center and may be borrowed for use in Poe Hall classrooms. The center acquires each textbook adopted by the State Board of Education for secondary level subjects as well as other textbooks and reference materials.

On-line computer-based literature searches are offered by the Library staff on over 100 data bases, including ERIC, BIOSIS, AGRICOLA (Bibliography of

Agriculture) and Psychological Abstracts. Only direct costs are charged to the user.

As a further aid to graduate and faculty research, the library provides interlibrary loan services to obtain material from other research libraries. Direct borrowing privileges are available with UNC-Chapel Hill and Duke University.

Among the many services offered by the library are orientation tours for faculty and graduate students and also lectures on library use to all new students. Comprehensive reference service is available almost all the hours the library is open. A variety of microtext readers and printers in the library and an extensive microfilm collection provide access to much important research material. The Media Center is equipped with audio and video equipment for group and individual viewing and listening. The Library has a growing collection of video and audio cassettes for individual and class use.

Institutes

RESEARCH TRIANGLE

The unique "Research Triangle" in North Carolina has captured national and international attention. It is a complex of three major research universities and a research park. Because of this wealth of educational and research opportunities, the Triangle area contains the highest total of Ph.D. scientists and engineers on a per capita basis in the nation. The Triangle Universities—NCSU, the University of North Carolina at Chapel Hill and Duke University—have a subsidiary campus in the Park—the Research Triangle Institute—which has an annual research revenue of approximately $60 million.

The Park, which announced its first tenant in 1965, now has over 57 public and industrial research organizations situated on 6,650 acres of land. Over 25,000 people work in the Research Triangle Park. Organizations in the Park include the permanent headquarters of the National Institute of Environmental Health Sciences, the Environmental Protection Agency and the National Center for the Humanities as well as facilities of private companies like IBM, Glaxco and Burroughs Wellcome. Two major new research complexes for microelectronics and biotechnology recently built in the Park. Faculty and graduate students from the universities work closely with many of the companies and agencies in the Park and scientists from the Park frequently hold adjunct appointments in one or another of the Triangle Universities.

INSTITUTE OF STATISTICS

The Institute of Statistics is composed of two sections, one at Raleigh and the other at Chapel Hill. At North Carolina State University, the Institute provides statistical consulting services to all branches of the institution, sponsors research in statistical theory and methodology and coordinates the teaching of statistics at the undergraduate and graduate levels. The instructional and other academic functions are performed by the Department of Statistics, which forms a part of the Institute.

WATER RESOURCES RESEARCH INSTITUTE

The Water Resources Research Institute is a unit of the University of North Carolina System and is located on the campus of North Carolina State University. The deans of the College of Engineering and College of Agriculture and Life Sciences, the Vice Chancellor for Research at North Carolina State University and two faculty members from the University of North Carolina at Chapel Hill serve as a board of directors. The Institute was established to promote a multidisciplinary attack on water problems, to develop and support research in response to the needs of North Carolina, to encourage strengthened educational programs in water resources, to coordinate research and educational programs dealing with water resources and to provide a link between the state and federal water resources agencies and related interests in the University.

Research and educational activities are conducted through established departments and schools of the University System. All senior colleges and universities of North Carolina are eligible to participate in the Institute's research program. Basic support for the Institute's program is provided by the Office of Water Research and Technology, U.S. Department of the Interior, under the Water Research and Development Act of 1978 and appropriations from the State of North Carolina.

The Institute has sponsored a graduate minor in water resources which offers a strong water resources program with the major in any of the basic disciplines contributing to water resources planning, conservation, development and management. This capitalizes on the combined training resources of the Raleigh and Chapel Hill campuses of the University System and offers these in an organized way to graduate students seeking interdisciplinary training in this field. Additional information concerning the program is presented elsewhere in this catalog.

The Institute sponsors research and educational symposia and seminars, encourages the development of specialized training opportunities and provides a means for the continuing evaluation and strengthening of the University System's total water resources program.

Special Laboratories and Facilities

ACADEMIC COMPUTING FACILITIES

Centralized computing facilities for the University are located in the Hillsborough Building, in other campus buildings and at Triangle Universities Computation Center (TUCC) in the Research Triangle Park about fifteen miles from the campus. TUCC is owned by North Carolina State University, Duke University and the University of North Carolina at Chapel Hill and provides computing to over twenty research and educational institutions in North Carolina. Access to computing facilities at universities outside North Carolina is available to the University through TUCC via the Internet, Bitnet and Telenet Networks.

Computing at TUCC is supplied by an IBM System 3081 Model KX-32 with a main memory of 32 megabytes, disk storage of over 45 gigabytes and a variety of peripheral and communications equipment. Data are transmitted to and from TUCC via the University's Computer Communications System from many computing sites on the campus.

The main campus computing facility is an IBM 4381-P12 with 16 million bytes of memory and a VAX 8700 with 32 megabytes providing interactive computing services. There is also an IBM 3083 providing administrative data processing services for the campus. These systems are located at the Computing Center in the Hillsborough Building. A high-speed computer terminal facility and computer-to-computer communication with TUCC is provided by the Computing Center. Interactive terminals are located throughout the campus.

A number of special purpose computing facilities also exist. The Computer Graphics Center (CGC) provides a centralized hardware and software facility for image processing and remote sensing. Computers installed include a VAX 11/780 and a number of microprocessors. Peripherals include image display and manipulation devices, plotters, printers, a color graphic camera system and digitizing tables. Software is composed of packages for remote sensing, image processing, time series analysis and computer graphics. Other facilities in most schools provide specialized educational and research computing for their students.

BIOLOGY FIELD LABORATORY

The Biology Field Laboratory is located eight miles from the University campus and comprises a 20-acre pond, 180 acres of extremely varied vegetation types and a modern laboratory building. The latter contains two laboratories, one for class use and another principally for research.

The many unique ecological situations found in this area make it ideal for use by advanced classes of most biological science departments. Likewise, the area is well adapted to a variety of research projects by faculty, graduate students and undergraduates because of its habitat diversity. The close proximity of the laboratory facility to the campus makes possible many types of behavioral, physiological, ecological, taxonomic and limnological studies that could be accomplished only with great difficulty at other locations.

CENTER FOR COMMUNICATIONS AND SIGNAL PROCESSING

North Carolina State University was selected as a site for an Industry/University/Government Cooperative Research Center for Communications and Signal Processing. The National Science Foundation awarded the University a five-year grant totaling $650,000 to be used in conjunction with company membership fees to begin operation of the Center. As of July, 1987, the Center had the following industrial members: Carolina Power and Light Company, Digital Equipment Corp., International Business Machines, Westinghouse Electric Corp., General Electric, Northern Telecom, FiberLAN, United Technologies, AIRMICS, UNISYS, Harris Corp., AT&T and Tellabs. The two objectives of the Center are to conduct basic and applied research that can lead to products and services in the communications and signal processing fields and to strengthen industry/university/government relationships. In addition to providing useful research services to industrial participants, the Center will enhance the education of graduate students by providing them with practical, relevant research topics and the means for carrying out their research.

CENTER FOR SOUND AND VIBRATION

The Center for Sound and Vibration, established in 1969 and administered within the Department of Mechanical and Aerospace Engineering, is composed of faculty pursuing the solution of a wide variety of problems such as occur in machinery and aircraft design particularly related to vibration and sound. Graduate programs exist at M.S. and Ph.D. levels in fields such as noise and vibration control, aeroacoustics, hearing conservation, computer-aided machinery design, active control of vibration and sound, and signal processing. Outstanding experimental facilities, which include large anechoic and reverberant rooms and computer graphics equipment, are available. The Center's programs are financed largely by grants and contracts from industry and federal and state agencies.

COUNSELING LABORATORY

The Department of Counselor Education maintains a special counseling facility on the fifth floor of Poe Hall. The laboratory is staffed by professionally trained graduate students under the supervision of departmental faculty. The major emphasis is on helping a wide variety of persons who face educational, career and personal decisions through short-term counseling and advising. Occupational exploration and aptitude testing are often included. A minimal fee ($10.00) is charged. Appointments are available during the fall and spring semesters.

DIAGNOSTIC TEACHING CLINIC

The Diagnostic Teaching Clinic is operated by the graduate program in special education within the College of Education for the purposes of providing graduate students with opportunities to gain both observational and applied clinical experience in diagnosing and teaching handicapped children of all ages. The clinic accepts referrals from local school systems and from nonpublic school agencies, and the students and staff evaluate the referred children, develop educational programs for them in conjunction with the referring agency and demonstrate teaching techniques for the benefit of those persons who will work with the children. This clinic is open during the day, late afternoon and early evening hours during the fall and spring semesters and throughout the summer months and is utilized by graduate students from several departments with allied curricula in education and psychology.

ELECTRIC POWER RESEARCH CENTER

The Electric Power Research Center is a university/industry cooperative research center recently established within the NCSU College of Engineering. The Center is funded by the University and sponsoring organizations from the various sectors of the electric utility and power industry. The purpose of the Center is to engage in collaborative efforts aimed at enhancing the excellence of research and graduate-level degree programs in electric power systems engineering. This primary purpose is accomplished by providing support for interested faculty and students to be involved in basic and applied research directly relevant to the needs of the multifaceted electric power industry. Motivation to work with the Center derives from the close university/industry interaction, the

leverage afforded to an industrial sponsor's membership dues and the enhanced professional and research opportunities provided to faculty and students in electric power engineering.

While the current research program involves faculty from the Department of Electrical and Computer Engineering and the Department of Nuclear Engineering, the Center will facilitate access to all the various resources of the University and for all sectors of the electric power industry.

ELECTRON MICROSCOPE FACILITIES

There are four electron microscope facilities at NCSU available to graduate students and faculty for research purposes. The College of Agriculture and Life Sciences (SALS) Center for Electron Microscopy is located in Gardner Hall, the Engineering Research Microscope Facility is in Burlington Engineering Labs and the Department of Wood and Paper Science Electron Microscopy Lab is in Biltmore Hall. The new College of Veterinary Medicine (CVM) Electron Microscopy Laboratory is located in the NCSU College of Veterinary Medicine on Hillsborough Street.

The ALS Electron Microscope Center has two scanning microscopes: a Philips 505T and a JEOL T-200 and four transmission electron microscopes: an Hitachi HS-8-B, an Hitachi HU-11-B, a JEOL 100-S and a Philips 400T-STEM equipped with a C-400-M computer control system. The Center also makes available all of the necessary biological preparatory equipment.

Formal instruction is provided through the biological sciences curriculum for transmission electron microscopy, scanning electron microscopy and ultramicrotomy. Advanced techniques are provided on an individual basis or through workshops.

The Engineering Research Analytical Instrument Facility is equipped with new Hitachi scanning transmission (model H-800) and scanning electron (model S-530) microscopes, both equipped with energy-dispersive X-ray spectrometers (Tracor Northern TN 2000 and TN 5500) in addition to older JEOL and Cambridge SEM's.

The H-800 STEM has a maximum accelerating voltage of 200 kV and a lanthanum hexaboride gun, providing high image brightness and penetration with minimal specimen damage, which is used for ceramic, metallurgical, electronic and textile materials. Computer control of all lenses and a motorized 45-degree double-tilting stage make it easy to use, and a high takeoff angle X-ray detector provides high sensitivity elementary analysis, including mapping and quantitative capability. The instrument operates in scanning, transmission and STEM modes with full diffraction capability.

The S-530 SEM accommodates large (6-inch) specimens, has an ultra-low voltage mode for uncoated surface examination and has highly automated focus and picture-taking controls for routine high-quality images. In addition to 50-angstrom resolution secondary electron pictures, the microscope is equipped with a high-resolution backscattered electron detector and a computerized quantitative X-ray spectrometer and EBIC and EBIV systems.

Both microscopes are supported by complete specimen preparation and darkroom facilities and an extensive computerized image processing, analysis and measurement system. The analytical instruments center also operates an electron probe microanalyzer (AMR/3) for wavelength dispersive X-ray analysis on

the micrometer level, several light microscopes and X-ray diffractometers, and an Auger electron spectrometer with ion sputtering which allows depth profiling of elemental composition.

A new scanning Auger microprobe has recently been added (JEOL JAMP 30). This systems features a complete analytical SEM with full automation and an Auger electron spectrometer system for qualitative and quantitative surface analysis. The system also features electron channeling capabilities.

In addition, an ion probe microanalyzer (Cameca IMS 3f) performs secondary ion mass spectrometry (SIMS) with sub-micron lateral resolution and atomic layer depth resolution and typical detection limits in the ppm-ppb range. Both oxygen and cesium ion sources are available and a digital imaging system is used to interpret the three-dimensional elemental distributions. The instrument is used particularly for engineering, electronic and biological materials.

Center personnel teach regular courses covering many of these instrument techniques as well as short courses and offer collaboration with and instruction for graduate students on an individual basis.

The Department of Wood and Paper Science Microscopy Lab is equipped with a Siemens Elmskop-1A transmission electron microscope as well as all other equipment necessary for the preparation and study of specimens. Instruction for graduate students engaged in research is on an individual need basis.

The CVM Electron Microscopy Laboratory is a facility housing a Philips 410 transmission electron microscope for biological specimens and a JOEL JSM-35 scanning electron microscope. All the back-up equipment for preparing specimens to be viewed with either instrument are housed within the Laboratory as well as complete darkroom facilities for the preparation of routine and publication material. A course covering biological scanning and transmission electron microscopy is offered yearly. The Laboratory also offers complete electron microscopy service support to those users desiring it.

HIGHLANDS BIOLOGICAL STATION

North Carolina State University is an institutional member of the Highlands Biological Foundation which provides support for the Highlands Biological Station of the University of North Carolina. This is an inland biological field station located at Highlands, North Carolina. The town of Highlands is in the heart of the Southern Appalachians at an elevation of 3,823 feet. The area has an extremely diverse biota and the highest rainfall in the eastern United States.

Facilities are available throughout the year for pre-and post-doctoral research in botany, zoology, soils and geology. The laboratory building with research rooms and cubicles and the library are well equipped for field-oriented research. Also, five cottages and a dining hall are located on the edge of a six-acre lake. In addition to 16 acres surrounding the lake, the station owns several tracts of undisturbed forested land available for research. Research grants available through the Station provide stipends for room, board and research expenses.

INTEGRATED MANUFACTURING SYSTEMS ENGINEERING INSTITUTE

The Integrated Manufacturing Systems Engineering Institute has been established at North Carolina State University to provide a multifaceted educational, research and technology transfer program in manufacturing systems engineering. The objectives of this program to educate engineers in the theory and practice of integrated manufacturing systems technology; to conduct basic and applied research on topics in cooperation with industry on problems of contemporary manufacturing systems application; and to engage in technology transfer with industry to increase productivity and the quality of manufactured products.

Central to all aspects of the Institute's operation and activity is the integration of computer-aided processes in the design and control of manufacturing facilities in order to strengthen the country's ability to produce manufactured goods of improved quality at lowered cost. Through both internally and externally funded research projects the Institute plans to contribute to the solution of generic design and manufacturing engineering problems and to provide a vehicle for technology transfer.

MATERIALS RESEARCH CENTER

The Materials Research Center was established in 1984 at NCSU as an interdisciplinary program involving persons representing the Department of Chemistry, Electrical and Computer Engineering, Materials Engineering and Physics. The thrust area of the Center serves as a focal point for this cooperative research. However, the experimental efforts are conducted within the four departments noted above.

MICROELECTRONICS CENTER OF NORTH CAROLINA

North Carolina State University is a participating member of the Microelectronics Center of North Carolina (MCNC) which has been established to support the academic and research programs in microelectronics in North Carolina. Other participating institutions are the University of North Carolina at Chapel Hill, Duke University, North Carolina Agricultural and Technical State University, the Research Triangle Institute and the University of North Carolina at Charlotte.

Faculty and students at NCSU have access to the use of MCNC facilities on sponsored research projects and for formal academic courses including microelectronics design and fabrication laboratories. Areas of interest include systems design, systems engineering, integrated circuit technology, semiconductor materials and device physics. Departments at NCSU which are actively involved in the program include Electrical and Computer Engineering, Computer Science, Physics, Chemistry and Materials Engineering.

NUCLEAR REACTOR PROGRAM FACILITIES

The Nuclear Reactor Program provides specialized nuclear facilities to the educational, industrial and governmental organizations of North Carolina for

the purposes of teaching, research and service. The Program facilities include (i) the PULSTAR, a 1-megawatt research and training nuclear reactor with unique neutron irradiation capabilities, (ii) an analytical laboratory featuring neutron activation analysis and radioisotope production and measurement and (iii) a thermal-hydraulics laboratory which has developed a freon loop to simulate the operation of a pressurized water reactor. The Nuclear Reactor Program is associated with the Department of Nuclear Engineering and is located in the Burlington Engineering Laboratories on campus.

ORGANIZATION FOR TROPICAL STUDIES

North Carolina State University is an institutional member of the Organization for Tropical Studies (OTS), a consortium of North and Central American universities which maintains field research and teaching facilities in Costa Rica. Each year OTS sponsors courses in tropical biology that are open to NCSU graduate students with biological science backgrounds. These 8-week courses, offered in winter and summer, are taught in Costa Rica and make use of a network of field stations located throughout the country. NCSU is an active participant in the OTS graduate education program, with an average attendance of two students per year in the tropical biology courses.

The OTS facilities in Costa Rica also provide a unique opportunity for tropical research by NCSU graduate students and faculty. The principal field station, located in the northeastern Atlantic lowlands, has excellent laboratory and housing facilities and provides access to a 3,500-acre tract owned by OTS; 65% of this tract is undisturbed lowland tropical wet forest. Another station is located at mid-elevation in southeastern Costa Rica near the Panamanian border. OTS also utilizes various other sites, including a seasonally dry area in the northwestern part of the country and a high-elevation area at 10,000 feet in the Talamanca range. More information about OTS may be obtained from the campus representative, who can be contacted through the International Programs Office.

PESTICIDE RESIDUE RESEARCH LABORATORY

The Pesticide Residue Research Laboratory is a facility in the College of Agriculture and Life Sciences devoted to research on pesticide residues in animals, plants, soils, water and other entities of man's environment. Although the laboratory is administered through the Department of Entomology, it serves the total needs of the College in cooperative research projects requiring assistance on pesticide residue analysis.

The laboratory functions as a focal point for residue research involving interdepartmental cooperation, but faculty in the laboratory also conduct independent pesticide research on persistence and decomposition in soils and plants, absorption and translocation in plants, distribution in environment and contamination of streams, estuaries and ground water.

The laboratory is equipped with the latest analytical instruments. Graduate study can be undertaken in any aspect of pesticide residues either in the Pesticide Residue Research Laboratory or in one of the cooperating departments.

PRECISION ENGINEERING CENTER

The Precision Engineering Laboratory was established with a $1.25 million grant from the Office of Naval Research in 1982. The goal is to develop techniques for precision manufacturing at tolerances below those attainable with current technology. For example, fabrication of electro-optical devices require manufacturing tolerances better than 1 millionth of an inch. This goal requires new methods for monitoring and controlling the parts being produced or the process being performed. Specific research objectives involve the study of metrology systems, control algorithms, machine structural dynamics, optics, materials, and microprocessors and the details of many different fabrication processes. An interdisciplinary team of faculty from Mechanical and Aerospace Engineering, Materials Science and Engineering, Computer Science and Physics along with research staff and graduate students are working together to address these research areas.

In 1985 the program was expanded with industrial and national laboratory support and in 1986, the program was funded under the University Research Initiative program at ONR for one million dollars a year for five years. These organizations foresee the need for scientists and engineers with a background in precision engineering as well as new technology to meet their growing demands for high-precision products. With this expanded base of support, the Precision Engineering Laboratory is fulfilling these needs.

PSYCHO-EDUCATIONAL CLINIC AND LABORATORIES

The Department of Psychology operates the Psycho-Educational Clinic located in Poe Hall. The clinic provides both a service to the public and training for school psychology graduate students. School-age child assessment and program development are the major services provided. Coordination of internships and practica is also administered through this facility.

Each graduate program in psychology also has laboratory facilities, either independently or shared. Thus, the experimental psychology program has laboratories for neuropsychology, auditory and visual perception, cognition and operant behavior. There is also a training and development laboratory as well as facilities for ergonomics, applied developmental educational psychology, human resource development, industrial/organizational and vocational psychology and social psychology. The latter facilities include one-way viewing rooms with recording equipment.

REPRODUCTIVE PHYSIOLOGY RESEARCH LABORATORY

The Reproductive Physiology Research Laboratory administered through the Department of Animal Science includes environmental control rooms designed to provide constant levels of air temperature, humidity and light for animals involved in studies on reproduction. Facilities and equipment are available for surgery, in vitro growth of embryos, isotope labeling in embryo metabolism and transfer of embryos between females.

Support for research at both the master's and the doctoral levels is available. Students may elect a comparative approach to a specific problem in mammalian reproduction, working with several species, or they may choose to work with a single species. Generally students select a problem associated with the identification of factors influencing early prenatal development, the endocrine control of ovarian function or some aspect of elucidation and control of aberrations in mammalian reproduction.

Cooperative research is possible between the laboratory, the College of Veterinary Medicine and the Medical School or the Environmental Health Sciences Center at the University of North Carolina at Chapel Hill for those students desiring a broader training in the general area of reproductive physiology.

Students whose work is concentrated in reproductive physiology can major in either animal science or physiology with a minor in related disciplines.

SEA GRANT COLLEGE PROGRAM

The University of North Carolina Sea Grant College Program is a state/federal partnership program involving all campuses of the UNC system. A majority of its activities, however, are conducted at the NCSU campus. Sea Grant combines the University's expertise in research, extension and education to focus on practical solutions to problems in the area of coastal and marine resource use and conservation. Graduate and undergraduate research opportunities rest with individual project directors on campus and a special fellowship program administered through the program office.

SOUTHEASTERN PLANT ENVIRONMENTAL LABORATORIES PHYTOTRON

The Southeastern Plant Environment Laboratory, often referred to as the North Carolina State University Phytotron, is especially designed for research dealing with the response of plants and microorganisms to their environment. A high degree of environmental control makes possible simulation of a wide range of climates found in tropical, temperate and northern zones.

Research in the Phytotron deals with all phases of plant biology. Although the majority of the studies are conducted with agricultural crop species, the Phytotron can accommodate ecological investigations, plant biology problems of the space program, experimental taxonomy and air pollution studies as well as basic physiological and biochemical research.

The Phytotron facility is available to the resident research staff, participants in graduate research programs of North Carolina State University and to domestic and foreign visiting scientists.

TRIANGLE UNIVERSITIES NUCLEAR LABORATORY

TUNL is a laboratory for nuclear structure research. Located on the campus of Duke University in Durham the laboratory is staffed by faculty members and graduate students in the Departments of Physics of Duke University, the Univer sity of North Carolina at Chapel Hill and North Carolina State University. Particle accelerators are used to bombard target nuclei with an assortment of

ions of accurately controlled energy spread and spin orientation. The accelerators are a 15 MeV tandem Van de Graaff generator into which negative ions are injected by a 15 MeV AVG cyclotron and a 3 MeV and a 4 MeV Van de Graaff generator. Polarized and pulsed beams are available as well as a new polarized target. On-line computers are used for data collection and analysis.

Personnel from NCSU are partners in the maintenance and operation of the laboratory. There is extensive collaboration with personnel from the other two participating universities. This laboratory, which began operation in 1968, was the first to combine a cyclotron and tandem Van de Graaff generator—the "Cyclo-Graaff."

Special Programs

INTERNATIONAL AREA STUDIES GROUPS

The International Area Studies Groups, comprised of faculty from across the university with common interests in an international studies area, provide a forum for sharing professional experiences; generating and identifying support sources for collaborative scholarly activities; offering seminars for the university; providing a public-service function for the campus and community at large by identifying faculty with expertise in their study area; interacting with visiting scholars and students from the geographic area specific to the study group; and serving an advisory role in institutional linkage development between NCSU and universities in the study area.

RESEARCH PROGRAM AT THE OAK RIDGE ASSOCIATED UNIVERSITIES

North Carolina State University is one of the sponsoring institutions of the Oak Ridge Associated Universities at Oak Ridge, Tennessee. Through this cooperative association, North Carolina State's graduate research program has at its disposal the facilities and research staff at Oak Ridge National Laboratory. Extensive research programs are underway there on physical and biological effects of radiation, radioisotope utilization, materials microstructure and many other areas of materials and nuclear science and engineering. When master's and doctoral candidates have completed their resident work, it may be possible, by special arrangement, for them to do their thesis research at Oak Ridge National Laboratory. In addition, it is possible for the staff members of this University to go to Oak Ridge for advanced study in their particular fields.

UNIVERSITY PATENT AND COPYRIGHT PROCEDURES

North Carolina State University is dedicated to teaching, research and extending knowledge to the public.

It is the policy of the University to carry out its scholarly work in an open and free atmosphere and to publish results obtained therefrom freely, limited only by a short time delay in cases in which this is necessary to establish patent rights. Although the University does not undertake research or developmental work

principally for the purpose of developing patents and commercial applications thereof, patentable inventions sometimes arise out of the research activities of its employees which are carried out wholly or in part with University facilities. As a public service institution, the University has an interest in assuring the utilization of such inventions for the public good. Protection must be provided for at least some of these inventions through patents and the licensing thereof to encourage their development and marketing. Patents and their exploitation, however, represent only a small part of the benefits accruing from either publicly or privately sponsored research.

A portion of the research conducted by the University is supported by government and a portion by private industry. Service to the public, including private industry, is an integral part of the University's mission. As a public institution, the University, in its agreements with private industry or other private organizations, must keep the interests of the general public in view. The rights and privileges set forth in cooperative agreements or contracts, with respect to patents developed as a result of research partly or wholly financed by private parties, must be fair and just to the inventor(s), the sponsor and the public. Research should be undertaken by the University under support from private parties only if it is consistent with and complementary to the University's goals and responsibilities to the public.

SECTION 100—Purposes:

The North Carolina State University Patent and Copyright Procedures are designed to implement the Patent and Copyright Policies of The University of North Carolina. The procedures incorporate the interests of the faculty, staff, and students, the institution, and the sponsors of research, because in many cases those interests are congruent in desiring to encourage innovation and assure broad dissemination of the results of research. These procedures are designed to stimulate and recognize creativity among the faculty, staff, and students, and to establish an institutional process that is flexible enough to accommodate the different types of research and patentable work conducted at a comprehensive research university such as NCSU. Equity and fairness are goals of the procedures in all respects, not only in the distribution of royalty, but also in recognition. While much documentation related to patents, by its very nature, must be confidential, these procedures are designed to be understood by all faculty, staff and students so that they may take advantage of the options available for transfer of University discoveries into useful products that benefit the public. Finally, these procedures should provide an efficient and timely mechanism for reaching a decision about patenting with a minimum involvement of the inventor's time so that he or she may continue to be productive in the laboratory and classroom. To this end the University employs a patents administrator whose duties include providing assistance to faculty, staff and students in matters related to inventions.

SECTION 200—Ownership:

1. As defined by the Patent and Copyright Policies of the Board of Governors of The University of North Carolina, to which these Procedures are expressly

subject, North Carolina State University has a legal interest in all inventions of University personnel, including students, that are conceived or first actually reduced to practice as a part of or as a result of: (a) University research; (b) activities within the scope of the inventor's employment by, or official association with, the University; and (c) activities involving the use of University time, facilities, staff, materials, University information not available to the public, or funds administered by the University.

2. Faculty, staff, and students, whose inventions are made on their own time, outside the scope of their employment or association with the University and without University facilities, materials, or resources and which inventions are, therefore, their exclusive property as specified by the Patent and Copyright Policies, may submit their invention to the University for possible patenting and/or commercial exploitation and management under terms to be agreed upon by the inventor and the University.

3. The provisions of the NCSU Patent Procedures are subject to any applicable laws, regulations or specific provisions of the grants or contracts which govern the rights in inventions made in connection with sponsored research.

4. Under the terms of certain contracts and agreements between NCSU and various agencies of government, private and public corporations, and private interests, NCSU is or may be required to assign or license all patent rights to the contracting party. NCSU retains the right to enter into such agreements whenever such action is considered to be both in its best interest and in the public interest. Ordinarily, the University will not agree to assign rights in future inventions to private corporations or businesses except as set forth in these procedures.

5. All faculty, staff and students engaged in University related or sponsored research shall sign a Patent Agreement.

SECTION 300—Responsibilities of NCSU Personnel:

1. NCSU personnel who, either alone or in association with others, make an invention in which NCSU has or may have an interest shall disclose such inventions to the Vice Chancellor for Research. The Vice Chancellor for Research will promptly acknowledge receipt of disclosures and will distribute the disclosures to the Intellectual Property Committee for consideration at its next meeting.

2. For any invention in which the University has an interest, the inventor, upon request of the Vice Chancellor for Research shall execute promptly all contracts, assignments, waivers or other legal documents necessary to vest in the University or its assignees any or all rights to the invention, including complete assignment of any patents or patent applications relating to the invention.

3. NCSU personnel may not: (a) sign patent agreements with outside persons or organizations that may abrogate the University's rights and interests either as stated in the Patent Policies or as provided in any grant or contract funding the research which led in whole or in part to making the invention, nor (b) without prior authorization, use the name of the University or any of its units in connection with any invention in which the University has an interest.

4. All faculty teaching courses in which students do work that may lead to patentable inventions should inform the students of the existence of the NCSU Patent and Copyright Policies and of these Procedures.

SECTION 400—Suggested Procedures For Record-Keeping:

1. U.S. patent practice places a premium on witnessed records when two or more parties claim the same invention. The date the idea occurred (the "conception") and the date it was put into practice form ("reduced to practice") are vital. Equally important in the eyes of the U.S. Patent Office is the "diligence" shown by contending inventors. They must prove that they regularly pursued work on the invention, documenting their efforts on a day-by-day basis. The intent of U.S. patent laws is to recognize the first inventor; the one who originated the idea. Under these laws, the first to conceive and reduce to practice will receive a patent if his records bear out his claims; the first to conceive and the last to reduce to practice may win if his records show diligence.

2. The careful recording of ideas and laboratory data is a matter of routine for industrial researchers. Each entry is complete and up-to-date, signed and witnessed; a legal record of the day's work. Record-keeping is not nearly so simple for the academic investigator, for he or she may work at odd hours or on weekends; may be closeted in a laboratory, an office or at home; and often lacks easy accessibility to suitable witnesses. Still, the keeping of a witnessed laboratory notebook is advisable. Additionally, such records can serve as valuable repositories of new ideas.

SECTION 500—The Handling of a Disclosure:

1. When faculty or staff members make an invention, it shall be their responsibility to discuss their discovery or invention with the Department Head at which time the possibility of exploring patenting should be considered. Students should first discuss an invention with their instructor, who shall assist them in further discussion within the University. The patents administrator is available to discuss possible inventions and to assist faculty, staff and students in the preparation of disclosures. If the invention appears to be a matter that should be considered for patenting, the inventor(s) should prepare a disclosure utilizing guidelines for invention disclosures which can be obtained for the patents administrator. The Department Head should transmit the disclosure through the Dean of his School to the Vice Chancellor for Research for consideration by the Intellectual Property Committee.

2. Upon receiving a disclosure, the Chairman of the Intellectual Property Committee may refer the disclosure to one of several technical advisory committees to the Intellectual Property Committee. Technical advisory committees will be appointed by the Vice Chancellor for Research and will be composed of faculty and staff who are knowledgable and experienced in broad disciplinary or cross-disciplinary areas. These individuals will be asked to review the disclosure from the point of view of whether or not, based on their knowledge, they believe the invention, if patented, would be a strong, viable, commercial product that would have a large market. The technical advisory committee in each area will meet prior to each Intellectual Property Committee meeting if they have any disclosures presented to them, and will discuss the disclosures and make to the Intellectual Property Committee, prior to its meeting, one of the following recommendations:

A. That the disclosure has significant commercial possibilities.

B. That the disclosure does not appear to have significant commercial possibilities.

C. That the technical advisory committee could not determine, based on its knowledge, whether or not the disclosure has significant commercial possibilities.

3. The Intellectual Property Committee will review each written disclosure promptly. The inventor or a representative shall be allowed to examine all written materials submitted to the Committee in connection with the disclosure and to make a written and oral presentation to the Committee. The Committee will decide on a disposition of the invention to secure the interests of the University, the inventor, the sponsor, if any, and the public. Its decision may include, but is not limited to, one or a combination of the following:

A. To submit the disclosure for review by a patent or invention management firm or agent;

B. To make inquiries of potential licensees that may have an interest in the invention, including the financing of a patent application, where applicable;

C. To conduct a patent search concerning the patentability of the disclosure;

D. To apply for a patent with University resources (an option with limited application because of financial constraints);

E. To release University rights to the inventor subject to an agreement to protect the interests of the University, the sponsor, if any, and the public, including an obligation to pay to the University a percentage of future royalties or profits in cases where it is necessary to recognize the University's contribution;

F. To dedicate the invention to the public;

G. To waive further University interest in the invention.

4. Normally, within four weeks of the receipt of the disclosure, the inventor will be notified in writing of the decision of the Committee on (a) the equities involved including financial participation, (b) whether the University plans to file a patent application, or (c) whether the University will accept assignment of the invention for patenting, licensing and/or commercial handling as applicable. If the University chooses not to file a patent application for an invention in which it has rights, or not to license the invention, or not to dedicate it to the public, upon the inventor's written request the invention, at the Committee's discretion, may be released in writing to the inventor, with the permission of the sponsor, if any.

5. In those cases in which the University has obtained a patent without obligation to sponsors, if no arrangement has been made for commercial development within five years from the date of the issuance of the patent, the inventor(s) may request in writing an assignment of the University's patent rights. The Intellectual Property Committee will promptly either grant the request or advise the inventor of the University's plans for the development of the invention.

SECTION 600—Royalty:

1. NCSU shall share with the inventors revenue it receives from patents or inventions. As noted in Section 200 (4), specific provisions of grants or contracts may govern rights and revenue distribution regarding inventions made in connection with sponsored research; consequently, revenues the University receives from such inventions may be exclusive of payments of royalty shares to sponsors or contractors.

2. The gross royalty revenues (net amount received by the University if there is a specific agreement in a grant or contract with a sponsor) generated by a patent or invention shall be the basis upon which the inventor's royalty is calculated. Unless otherwise agreed, the inventor's share of royalty revenues shall be 25% of the gross revenue. In the case of co-inventors, the 25% of gross revenue shall be subdivided equally among them, unless the inventors, with the concurrence of the Intellectual Property Committee, determine a different share to be appropriate. All such determinations shall be made in writing at the time of disclosure. Applicable laws, regulations or provisions of grants or contracts may, however, require that a lesser share be paid to the inventor. In no event shall the share payable to the inventor or inventors in the aggregate by the University be less than 15% of gross royalties received by the University.

3. To the extent practicable and consistent with State and University budget policies, the remaining revenue received by the University on account of an invention will first be applied to reimburse the University for expenses incurred by it in obtaining and maintaining patents and/or in marketing, licensing and defending patents or licensable inventions and the remainder will be dedicated to research purposes that may include research in the inventor's department or unit, if approved by the Chancellor upon recommendation of the Intellectual Property Committee.

SECTION 700—Inventor Requests for Waiver of University Rights:

1. If an inventor believes that the invention was made outside the general scope of his or her University duties, and if the inventor does not choose to assign the rights in the invention to the University, he or she shall, in the invention disclosure, request that the Intellectual Property Committee determine the respective rights of the University and the inventor in the invention and shall also include information on the following points:

A. The circumstances under which the invention was made and developed;

B. The employee's official duties at the time of the making of the invention;

C. The inventor's intention to request an acknowledgment that the University has no claim if such request is deemed appropriate;

D. The extent to which the inventor is willing voluntarily to assign domestic and foreign rights in the invention to the University if it should be determined that an assignment of the invention to the University is not required under the Patent and Copyright Policies;

E. The inventor's intention to request that the University prosecute a patent application if it should be determined that an assignment of the invention to the University is not required under the Patent and Copyright Policies.

SECTION 800—Publication and Public Use

1. North Carolina State University strongly encourages scholarly publication of the results of research by faculty and students. Though the Patent and Copyright Policies do not limit the right to publish, except for short periods of time necessary to protect patent rights, publication or public use of an invention constitutes a statutory bar to the granting of a United States patent for the invention unless a patent application is filed within one year of the date of such publication or public use. Publication or public use also can be an immediate bar to patentability in certain foreign countries.

2. In order to preserve rights in unpatented inventions, it shall be the duty of the inventor, or of his or her supervisor if the inventor is not available to make such report, to report immediately to the Vice Chancellor for Research any publication, submission of manuscript for publication, sale, public use, or plans for sale or public use, of an invention, if a disclosure has previously been filed. If an invention is disclosed to any person who is not employed by the University or working in cooperation with the University upon that invention, a record shall be kept of the date and extent of the disclosure, the name and address of the person to whom the disclosure was made, and the purpose of the disclosure.

After disclosure to the Intellectual Property Committee, the inventor shall immediately notify the Vice Chancellor for Research of the acceptance for publication of any manuscript describing the invention or of any sale or public use made or planned by the inventor.

SECTION 900—Contractural Arrangements:

1. North Carolina State University will normally seek a waiver of patent rights in contracts and grants with Federal agencies and in doing so will comply with the provisions of Federal law concerning the granting of waivers.

2. The University normally reserves the right to ownership of patents on inventions arising out of research supported in whole or in part by grants or contracts with non-governmental organizations or firms. Contracts or agreements which are entered into between the University and such organizations or agencies should contain clauses setting forth such a reservation unless deviations therefrom are requested by the sponsor and approved by the Vice Chancellor for Research. In the interest of fair treatment to the sponsor in consideration for his investment and in the interest of discharging the University's obligation to the public in the application of its facilities and employee time and talent, special provisions may be negotiated by the Vice Chancellor for Research in such non-government sponsored contracts on options such as the following:

A. The University will retain rights to patents arising out of such sponsored research but, if a significant portion of the research costs are borne by the sponsor, the sponsor may be assured a non-exclusive, non-assignable license at a most favorable royalty rate for the use of the patent.

B. If the sponsor bears essentially all of the costs of the concerned research, including full overhead and all other indirect costs, the University may agree to assign its rights to patents generated thereunder to the sponsor if it wishes to exercise them, but only under an agreement in which the University is free to use the invention for its own research and/or educational purposes without payments of royalty fees. In case the University assigns its patent rights to the sponsor under this option, the sponsor shall be obligated to utilize the patent, and the agreement shall specify that in case of failure to exercise diligent use of the patent commercially within a specified period as agreed upon, including offering the products manufactured thereunder for general public sale, the patent will revert to the University and the University will be free to proceed with licensing and application of the invention covered thereby in any manner it sees fit.

C. If both the sponsor and the University contribute shares in the costs of the sponsored investigations, first choice to patent rights on inventions made thereunder may be, by specification in the agreement, accorded to either party but

with the stipulation that the party holding patent rights will be obligated to exercise use of the patent(s) and with options to the other party in case of failure to apply the patent diligently in commercial practice as set forth in B above. In any case, the agreement shall stipulate that the University will be free to use the invention for its own research and/or educational purposes without payment of royalty fees. Under this option, the University and the sponsor shall agree to share in net royalties accruing from the patent(s) and the licensing of same in proportions approximately equal to their respective declared and verified proportionate shares in the costs of the investigtions, unless the University should elect to dispose of its share by direct sale to the sponsor for an agreed price.

D. In order to protect the potential patent interests of both parties in such contracts in which the sponsor is accorded patent rights, the following procedure may be specified:

"When in the course of the sponsored research project the investigator or investigators conceive or reduce to practice some discovery which appears to be patentable, then the inventor(s) will immediately inform the sponsors and the University of such discovery and will, for a specified period as negotiated (normally three months but in any case not more than twelve months), make available to the sponsor all pertinent information and disclosures which may be required for the development of an appropriate patent application. During this period, the investigators agree not to disclose this material to the public and agree to cooperate in the sponsor's effort to secure the patent. At the end of this agreed period, the investigators and the University will be free to proceed with publications and making public such other documents as they may choose. With the exception of the above mentioned agreed period, the University will operate industry sponsored contracts in the normal manner with no other special considerations being given to the sponsor. Under no circumstances will the sponsor have the right to prevent the publication of material or information derived during the conduct of the program or as a result thereof other than for the agreed period indicated above."

Prior written agreement of the investigators involved in research investigations to be carried out under these conditions must be secured by the University to enable the University to discharge its agreed obligations under such a contract.

SECTION 1000—Patent Management and Administration:

1. North Carolina State University recognizes that the evaluation of inventions and discoveries and the administration, development and processing of patents and licensable inventions involves substantial time and expense and requires talents and experience not ordinarily found among its faculty and staff; therefore, it employs the Director, Office of Technology Administration to provide assistance. The University may contract with outside agents for certain services. It may enter into a contract or contracts with an outside organization covering specific inventions or discoveries believed to be patentable and patents developed therefrom or covering all such inventions, discoveries and patents in which the University has an interest. The University may manage an invention using its own resources.

2. The Chancellor shall appoint a Intellectual Property Committee consisting of no fewer than three members. The Vice Chancellor for Research shall serve as Chairman of the Committee. The Committee shall review and recommend to the Chancellor or his delegate changes in these Procedures, decide upon appropriate disposition of invention disclosures, resolve questions of invention ownership, recommend to the Chancellor the expenditure of invention royalties, and make such recommendations as are deemed appropriate to encourage disclosures and to assure prompt and effective handling, evaluation, and prosecution of invention opportunities and to protect the interests of the University and the public. The Director of the Office of Technology Administration shall serve as staff for the Committee and shall attend all meetings.

SECTION 1100—Copyright Procedures:

1. As a general rule, all rights to copyrightable material are the property of the author. The distribution or royalties, if any, is a matter of arrangement between the author and his or her publishers or licensees. Different treatment may be accorded by the University in case of specific contracts providing for an exception, in cases where the University or sponsor may employ personnel for the purpose of producing a specific work, where different treatment is deemed necessary to reflect the contribution of the institution to the work, as in the case of software* or audiovisual material, or where a sponsored agreement requires otherwise. All agreements concerning copyright ownership should be in writing and should be signed by the parties and approved by the Vice Chancellor for Research prior to the commencement of the work.

2. An institute, center, or other unit of the University that is itself a publisher and that engages faculty members and other employees to write for publication by that unit as a part of their professional duty or produce other copyrightable materials, such as audiovisual materials or computer software, may, subject to the approval of the Vice Chancellor for Research, adopt rules providing that copyright on materials prepared by such faculty members and other employees in the course of their professional work for that unit vests in the University and not in the author.

The Intellectual Property Committee can explore the possibilities of commercial licensing of software developed and owned by the University. Inquiries about the possibilities of licensing software should be addressed to the Vice Chancellor for Research.

*A more comprehensive treatment of the University's procedures relating to computer software is available in a separately published document entitled "Guidelines and Procedures for Determining Ownership of Computer Software."

FIELDS OF INSTRUCTION

COURSE DESCRIPTIONS

The course descriptions are planned for the academic years 1987-1988 and 1988-1989, unless indicated otherwise. Some listed courses may not be taught, however, if registration for a course is insufficient, or if faculty or facilities are not available.

Consent of the department is required for all practicum and individual special topics or special problems courses as well as internships and thesis or dissertation research. In a typical course description, the semester hours of credit, the number of actual lecture and laboratory hours of meeting per week and the term or terms in which the course is offered are shown in this manner: 2(1-2) F,S,Sum. or 1-3 F,S,Sum.

In the first example, the "2" indicates the number of semester hours credit given for satisfactory completion of the course. The "(1-2)" indicates that the course meets for one hour of lecture and two hours of laboratory work each week. In the second example, the "1-3" indicates that a maximum of three and a minimum of one semester hours' credit can be earned. This is to be arranged with the instructor. The "F" designates that the course is to be given in the fall semester. Likewise, the "S" designates spring and the "Sum.," summer.

ABBREVIATIONS USED IN COURSE LISTINGS

Abbreviations used in the course listings are: CI, consent of instructor; PBS, Post-Baccalaureate Studies status; grad. standing, admitted to the Graduate School; undergrad., undergraduate; sr., senior; jr., junior; preq., prerequisite; coreq., corequisite; lab., laboratory; lect., lecture; and alt. years, alternate years.

Courses at the 600-level are not ordinarily open to undergraduates, although occasional exceptions are made for senior honor students.

For 400-level course descriptions, see the Undergraduate Catalog.

Adult and Community College Education

GRADUATE FACULTY

Professor E. J. Boone, *Head*

Professor R. W. Shearon, *Associate Head and Graduate Administrator*

Professors: G. L. Carter Jr., J. C. Glass Jr., R. D. Mustian; *Extension Professor:* D. R. Proctor; *Professors Emeriti:* M. P. Burt, W. L. Carpenter, J. D. George, G. Hyatt Jr., M. S. Knowles; *Associate Professors:* A. Fingeret, R. T. Liles; *Visiting Associate Professors:* G. J. Andrews, P. Meyer; *Associate Professors Emeriti:* W. L. Gragg, E. E. White; *Visiting Lecturers:* B. E. Fountain Jr., L. M. Hoffman, T. A. Tollefson

The department is a component of both the College of Education and the College of Agriculture and Life Sciences. It offers programs of study leading to the Master of Education, Master of Science and Doctor of Education degrees with a major in adult and community college education. The program is directed toward administrators, supervisors and teachers in cooperative extension and community colleges and other adult education agencies.

The department's curriculum is interdisciplinary. It is specifically designed to help students acquire an integrated conceptual and theoretical framework derived from the behavioral and social sciences and education that will equip them to plan, administer and effect viable and relevant programs of change with individual learners, groups and larger societal aggregates in both formal and informal settings.

Further, the curriculum provides opportunities for students to acquire a high level of competence in identifying and diagnosing problematic situations and in proposing alternative courses of action and strategy in seeking solutions to problems. Cognate fields of study include anthropology, economics, politics, psychology and sociology.

The department is housed in Ricks Hall and Poe Hall. Graduate students on assistantships and internships are provided office space and equipment. Other graduate students are provided study space when possible.

For descriptions of the adult and community college education courses listed below, see education.

SELECTED ADVANCED UNDERGRADUATE COURSE

ED 478 Extension as Non-formal Education. *Preq.: Advanced undergrad. or PBS. 3(3-0) S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ED 500 Community College and Two-year Postsecondary Education. *3(3-0) F,S.*

ED 503 The Programming Process in Adult and Community College Education. *3(3-0) F,S.*

ED 510 Adult Education: History, Philosophy, Contemporary Nature. *3(3-0) F,S.*

ED 537 The Extension and Public Service Function in Higher Education. *3(3-0) F,Sum.*

ED 538 Instructional Strategies in Adult and Community College Education. *3(3-0) F.*

ED 539 Educational Gerontology. *3(3-0) S.*

ED 543 Adulthood and Learning: The Later Years. *3(3-0) Alt. S.*

ED 559 The Adult Learner. *3(3-0) S,Sum.*

ED 567 Education of Special Adult Populations. *3(3-0) S,Sum.*

ED 579 Concepts and Principles of Evaluation Applied to Non-formal Adult Education. *3(3-0) S.*

ED 585 Qualitative Research in Adult and Community College Education. *3(3-0) F.*

ED 596 Topical Problems in Adult and Community College Education. *Credits Arranged. F,S,Sum.*

FOR GRADUATES ONLY

ED 600 Organizational Concepts and Theories Applied to Adult and Community College Education. *3(3-0) F,Sum.*

ED 601 Administrative Concepts and Theories Applied to Adult and Community College Education. *3(3-0) S,Sum.*

ED 696 Seminar in Adult and Community College Education. *1-3. F,S.*

Agricultural Communications

AC 590 Special Topics in Agricultural Communications. *Preq.: Sr. or grad. standing. 1-6.* Special Topics may be selected for study in the theoretical approaches to communications problems or experimental investigation with instructor guidance. Graduate Staff

Agricultural Education

For a listing of graduate faculty and departmental information, see education.

Air Conservation

The air conservation faculty includes some 50 faculty members representing 20 departments in four schools. It is the intent of this faculty and the associated program to provide training for students in the many disciplines related to air conservation. Such areas as air sampling, biological effects, air-quality management, sources, meteorology, law and economics and business are all important aspects covered by course offerings and research projects.

A graduate student desiring to minor in air conservation will have on his or her committee a member of the air conservation faculty from outside the individual's major department, representing this minor field. While there are no restrictions on the major, students minoring in air conservation should have a strong background in the life sciences, the physical sciences or engineering. The minor program will normally consist of 9 or more credits for the master's degree, 15 or more for the doctorate.

A variety of courses bearing on different aspects of the air conservation problem may be taken on this campus, at UNC-Chapel Hill or at Duke. The listing below shows relevant courses available at North Carolina State University. For courses at Duke and Chapel Hill see the appropriate catalogs.

Air Pollutants and Their Sources

CE 576 Atmospheric Pollution.

Meteorology and Pollutant Transport

MEA 555 Meteorology of the Biosphere.
MEA 556 Air Pollution Meteorology.
MEA 627 Atmospheric Turbulence and Diffusion.

Air Sampling and Analysis

ST 511 Experimental Statistics for Biological Sciences I.
ST 515 Experimental Statistics for Engineers.
CH 517 Physical Methods of Elemental Trace Analysis.

Effects on Human, Animal and Plant Receptors

FOR 353 Air Photo Interpretation and Photogrammetry.
ZO 400 Biological Issues in Human Ecology.
TOX 515 Environmental Toxicology.
BO 561 Physiological Ecology.

Air Quality Management

MAE 409 Particulate Control in Industrial Atmospheric Pollution.
WPS 525 Pollution Abatement in Forest Products Industries.
CHE 535 Engineering Economy in Air Pollution Control Systems.
MAE 570 Theory of Particulate Collection in Air Pollution Control.

Air Quality Law and Institutions

UNI 495 Special Topics in University Studies (Environment and Law).
PA 511 Public Administration.

Air Conservation Economics

EB 401 Economic Analysis for Non-Majors.
OR 501 Introduction to Operations Research.
EB 515 Environmental and Resource Policy.

Communications concerning the air conservation program, including inquiries from students wishing to minor in air conservation, should be directed to the Chairman, Air Conservation Faculty, Department of Chemical Engineering, P.O. Box 7905, North Carolina State University, Raleigh, North Carolina 27695-7905.

Animal Science

GRADUATE FACULTY

Professor C. A. Lassiter, *Head*

Professor E. E. Jones, *Graduate Administrator*

Professors: J. H. Britt, K. R. Butcher, E. V. Caruolo, A. J. Clawson, D. G. Davenport, E. J. Eisen, R. W. Harvey, B. H. Johnson, W. L. Johnson, J. R. Jones, J. G. Lecce, C. L. Markert, B. T. McDaniel, R. D. Mochrie, B. R. Poulton, A. H. Rakes, H. A. Ramsey, O. W. Robison, F. D. Sargent, J. C. Wilk; *Professors Emeriti:* E. R. Barrick, R. F. Behlow, L. Goode, J. E. Legates, R. M. Myers, I. D. Porterfield, F. H. Smith, L. C. Ulberg, G. H. Wise; *Associate Professors:* R. G. Crickenberger, W. J. Croom Jr., K. L. Esbenshade, R. L. McCraw, R. M. Petters, J. W. Spears, M. W. Tess, L. W. Whitlow; *Associate Professors Emeriti:* E. U. Dillard, J. J. McNeill; *Assistant Professors:* J. D. Armstrong, M. T. Coffey, K. R. Pond, S. P. Washburn

ASSOCIATE MEMBERS OF THE DEPARTMENT

Professor (USDA): J. C. Burns; *Assistant Professor:* M. D. Whitacre

The Department of Animal Science offers programs of graduate study leading to the Master of Agriculture, Master of Science and Doctor of Philosophy degrees. Animal science offers an opportunity for training in a diversity of basic sciences and the integration of such knowledge into the framework of a living system. Students may major not only in animal science but also in any one of the following disciplines: biochemistry, genetics, microbiology, nutrition and physiology. Animal science majors may specialize in one or more of these basic disciplines or in the more applied areas of management and production. The animal

science major provides for the student who prefers a multidisciplinary approach. Majors in a basic discipline are not only educated in it but have the added capability of integrating such knowledge into a living system, *i.e.*, the domestic animal. Minors can be obtained in any of the disciplines listed or in a variety of other areas.

Modern laboratories, specialized equipment and many different species of animals are available as research tools. A program of course work and a research project are developed for each student in accord with one's educational objectives. The primary goal is to provide the student with a challenging opportunity to develop his or her creative ability so that it may contribute significantly to a chosen discipline.

SELECTED ADVANCED UNDERGRADUATE COURSES

ANS 401 Reproductive Physiology. *Preq.: ZO 421. 3(2-3) F.*

ANS 402 Beef Cattle Management. *Preq.: ANS 204. 3(2-3) S.*

ANS 403 Swine Management. *Preq.: ANS 204. 3(2-3) F.*

ANS 404 Dairy Cattle Management. *Preq.: ANS 204. 3(2-3) S.*

ANS 405 Lactation. *Preq.: BS 100. 3(2-3) S.*

ANS 406 Sheep Management. *Preq.: ANS 204. 3(2-3) S. Alt. yrs.*

ANS 410 Horse Science. *Preq.: ANS 310 or CI. 3(2-2) S.*

ANS 411 Breeding and Improvement of Domestic Animals. *Preq.: GN 411. 3(3-0) F.*

ANS (PO, NTR) 415 Comparative Nutrition. *Preq.: CH 220 or both 221 and 223. 3(3-0) F.*

ANS (NTR) 419 Human Nutrition in Health and Disease. *Preqs.: ANS (NTR, PO) 415 or FS 400, BCH 451. 3(3-0) S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ANS 500 Advanced Ruminant Nutrition. *Preq.: ANS 204 or ANS 415. 3(3-0) Sum. Alt. yrs.* Advanced concepts in ruminant nutrition for the practicing agricultural professional. Protein, energy, vitamin and mineral nutrition in relationship to the nutritional needs and practical feeding of beef cattle, dairy cattle, sheep and goats. New developments in feeding systems, feed additives and the prevention and treatment of metabolic disorders.

Crickenberger, Croom, Whitlow

ANS (PHY) 502 Reproductive Physiology of Vertebrates. *Preq.: ZO 421. 3(3-0) S.* Emphasis will be placed on discussions of mechanisms which control the reproductive processes. Mechanisms which are species-limited will be compared with those which are shared by all species. Current knowledge of some subsystems will be investigated in detail while others will be referred to in reviews of well-documented research findings.

Britt, B. H. Johnson, Petters

ANS (GN) 508 Genetics of Animal Improvement. *Preqs.: GN 411, ST 511. 3(3-0) S.* Emphasis is placed on the utilization of basic principles of population and quantitative

genetics in animal improvement. Factors affecting genic and genotypic frequencies and methods of estimating genetic and nongenetic variance, heritabilities and breeding values are presented. The roles of mating systems and selection procedures in producing superior genetic populations are examined. Robison

ANS 510 Advanced Livestock Management. *Preq.: ANS 402 or ANS 403 or ANS 404. 3(3-0) S.* An advanced study of beef cattle, dairy cattle and swine management practices with particular emphasis on input-output relationships and the consequences of alternative management decisions. Problem. (Offered on-campus in even-numbered years.) Davenport

ANS (NTR) 516 Quantitative Nutrition. *3(1-6) S.* (See nutrition.)

ANS 520 Tropical Livestock Production. *Preq.: Six hours of ANS at 400-level. 3(3-0) F.* Modern principles of feeding, genetics, forage production and management are applied to improvement of meat and dairy animals in tropical, subtropical and high-altitude environments. Considers biological and socio-economic constraints to development of livestock industry. Discussion of climatic effects on production applies to U. S. conditions and to developing tropical countries. W. L. Johnson

ANS (NTR) 540 Ruminant Physiology and Metabolism. *Preqs.: BCH 451 or 551, ZO 421. 3(3-0) F. Alt. yrs.* Detailed discussion of the ruminant digestive system, its dependent microbial fermentation and the unique aspects of ruminant tissue metabolism. Emphasis is given to the understanding of the interdependent relationship between the rumen microbial fermentation and the host animal's physiology and metabolism. The effects of changes in diet and physiological state and their relationship to various digestive and metabolic dysfunctions are discussed. Croom, McNeill

ANS (PHY) 580 Mammalian Endocrine Physiology. *Preqs.: BCH 451, ZO 421. 3(3-0) F. Alt. yrs.* Detailed discussion of the mammalian endocrine system with emphasis on the functional aspect, chemistry and mode of action of specific hormones secreted from major endocrine glands. Modern biochemical and physiological principles of hormonal integrations and neuroendocrine integration are examined. B. H. Johnson

ANS 590 Topical Problems in Animal Science. *Maximum 6 F,S.* Special problems may be selected or assigned in various phases of animal science. Graduate Staff

FOR GRADUATES ONLY

ANS (GN) 603 Population Genetics in Animal Improvement. *Preqs.: ST 512, GN 506. 3(3-0) F.* A study of the forces influencing gene frequencies, inbreeding and its effects, and alternative breeding plans. Eisen

ANS (PHY) 604 Experimental Animal Physiology. *Preq.: ZO (PHY) 513 or equivalent. 4(2-4) S.* A study of the theories and techniques involved in the use of animals in physiologic investigation with special emphasis on the diversity of physiological applications on this campus. Caruolo

ANS (NTR, PO) 605 Mineral Metabolism. *Preqs.: ANS (NTR, PO) 415 or BCH 551, BCH 451 and ZO 421. 3(3-0) F.* Requirements, function, distribution, absorption, excretion and toxicity of minerals in humans and domestic animals. Interactions between minerals and other factors affecting mineral metabolism or availability. Emphasis on mechanisms associated with mineral functions and the metabolic bases for the development of signs of deficiency. Spears

ANS 606 Animal Biotechnology: Embryo Manipulation. *Preq.: ANS 502. 4(1-8) F. Alt. yrs.* Advanced training and experience in mammalian embryo manipulation including techniques of superovulation and embryo recovery, in vitro culture, parthenogenetic activation, in vitro fertilization, embryo transfer, embryo aggregation and DNA microinjection. Petters

ANS 690 Seminar in Animal Nutrition. *Preq.: Consent of seminar leaders. 1(1-0) F,S.* Orientation in philosophy of research, preparation for research and general research methodology. Graduate Staff

ANS 699 Research in Animal Science. *Credits Arranged. F,S.* A maximum of six hours is allowed toward the master's degree; no limitation on credits in doctorate program. Graduate Staff

For related courses, see:
BCH 551 General Biochemistry I. *3(3-0) F.*
MB 551 Immunology I. *3(3-0) F.*
NTR 601 Protein and Amino Acid Metabolism. *3(3-0) S.*
NTR 608 Energy Metabolism. *3(3-0) F.*

Anthropology

For anthropology courses, see sociology and anthropology.

Architecture

GRADUATE FACULTY

Professor R. P. Burns Jr., *Program Director*

Associate Professor L. W. Sanders, *Assistant Program Director*

Professors: P. Batchelor, R. H. Clark, C. E. McKinney, M. Pause, G. J. P. Reuer, H. Sanoff, V. F. Shogren, E. W. Taylor; *Professors Emeriti:* G. L. Bireline Jr., J. H. Cox, H. H. Harris, H. L. Kamphoefner, D. R. Stuart; *Associate Professors:* F. C. Harmon, J. W. Place, J. P. Rand, P. Tesar; *Visiting Associate Professor:* E. F. Harris Jr.; *Associate Professor Emeritus:* D. W. Barnes Jr.; *Assistant Professors:* F. A. Rifki, J. O. Tector; *Adjunct Lecturer:* T. C. Howard

The Master of Architecture program prepares students to assume responsible professional roles in architecture. Learning goals for students in the program include 1) developing exceptional competence in architectural design, 2) building a base of knowledge and skills necessary for professional activity, 3) developing a commitment to professional values and responsibilities, 4) discovering the variety of career roles in practice and related fields, and 5) developing as autonomous individuals, willing to assume responsibility for a lifetime of intellectual and creative growth.

Students encounter architectural problems at a variety of scales, requiring analytic, conceptual and developmental abilities. The design studio is the focus of this activity, enabling students to test ideas and theories about design in the context of both "real life" and idealized problems. The final studio is devoted to a self-initiated, detailed architectural project that is carried out under the guidance of the student's graduate advisory committee.

Other course work supplements and amplifies these experiences. A rich variety of courses is available within the Architecture Department in urban and community design, architectural conservation, management, professional practice and building technology. A distinctive characteristic of the program is its context within the School of Design, which offers the additional perspectives of landscape architecture, product design and visual design. Course work may also be taken throughout North Carolina State University and at nearby University of North Carolina at Chapel Hill and Duke University. The program's flexible curriculum offers the student considerable freedom to individualize his or her plan of study, based on personal, educational and professional goals.

The Master of Architecture is a first professional degree accredited by the National Architectural Accrediting Board. As such, it satisfies educational requirements for professional certification established by the various states and the National Council of Architectural Registration Boards. The department also offers a parallel 4 + 1 Bachelor of Architecture program which provides similar qualification for professional certification.

The majority of recent graduates have chosen to enter private architectural practice, undertaking the rich professional challenges it offers. While acknowledging the primacy of the practice orientation, the Master of Architecture program enlarges the professional framework to include alternative, nontraditional career roles as well.

Students are encouraged to exercise initiative and responsibility in realizing their personal educational goals. Student independence is seen as instrumental in helping to shape not only decision-making capabilities but future leadership potential as well.

The Department of Architecture offers three tracks to the Master of Architecture degree. Track 1 is for applicants with a four-year undergraduate degree in architecture and may be completed in two years of full-time study. Track 2 is for applicants holding a five-year NAAB-accredited Bachelor of Architecture degree and normally requires three semesters in residence. Track 3 is for students with degrees in fields other than architecture. This normally requires four semesters of preparatory work before entering the final two-year program of graduate study. Some applicants with design-related academic or professional experimence may be able to complete the preparatory work in less than four semester; each case is evaluated individually.

SELECTED ADVANCED UNDERGRADUATE COURSE

ARC 400 Architecture Studio. *Preq.: DF 102 or written approval of dept. head. May not be taken more than six times. 6(0-9) F,S.*

ARC 403 Pre-Graduate Architectural Design (Series). *Track 3 M.Arch. students only. Maximum of 24 hours 6(0-12) F,S.*

ARC 441 History of Contemporary Architecture. *Preq.: Junior standing or DN 141, 142. 3(3-0) F.*

ARC 447 Ideas in American Architecture I: 1865-1893. *Preq.: Jr. standing. 3(3-0) F. Alt. yrs.*

ARC 448 Ideas in American Architecture II: 1893-1918. *Preq.: Jr. standing. 3(3-0) S. Alt. yrs.*

ARC 449 Urban Form and Structure. *Preq.: Jr. standing. 3(3-0) F.*

ARC 451 Illumination and Design. *Preq.: ARC 253. 3(2-2) S. Alt. yrs.*

ARC 452 Environmental Control Systems and Design. *Preq.: ARC 253. 3(2-2) S. Alt. yrs.*

ARC 457 Architectural Construction Systems. *Preq.: DN 254. 3(2-3) S.*

ARC 494 Internship in Architecture. *Preqs.: Jr. standing in Architecture; 3.0 or better GPA; written approval of dept. head. 3-6 CH.*

ARC 495 Independent Study in Architecture. *Preq.: Jr. standing in Architecture; 3.0 or better GPA; approval of dept. head. 1-3 CH.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ARC 501 Professional Architecture Studio I. *Preqs.: BEDA degree or equivalent and CI; Coreq.: ARC 510. 6(0-12) F,S.* Design studio investigations aimed at the development of an understanding of the major issues confronting the contemporary architect and at the expanding of problem solving abilities in architectural design.

ARC 502 Professional Architecture Studio II. *Preqs.: ARC 501; ARC 510 and CI. 6(0-12) F,S.* Design investigations aimed at the development of an understanding of the major issues confronting the contemporary architect and at the expanding of problem solving abilities in architectural design. This is an individualized, final project studio.

ARC 521, 522 Advanced Architectural Structures I, II. *Preq.: (521) DN 352; (522) ARC 521. 3(3-0) F,S.* Gravity and non-gravity loads on structures; comparative behavior of structural materials; comparative behavior of simple structural systems; approximate and exact analysis procedures as applied to systems; principles of approximate and exact design in timber, steel and reinforced concrete; architectural/structural/mechanical compatibility in systems; basic principles of foundation analyses and design.

ARC 531, 532 Advanced Building Technology I, II. *Preqs.: DN 253, 254. 2(1-3) F,S.* A synthesis of studies in building science undertaken in previous courses. Material assemblies in practical applications, dimensional characteristics of mechanical and construction systems for buildings, and special projects in selected areas of building science.

ARC 542 Investigations in Recent World Architecture. *Preq.: CI. 3(2-1) F.* A lecture-seminar course intended to provide a description and analysis of recent developments in architectural design through an examination of projects by many of the world's most important architects. Primary emphasis will be placed on emerging design concepts and theories as expressed in the built architecture and the visionary proposals of the past two decades.

ARC 543 Analysis of Precedent. *Preq.: Grad. standing or CI. 3(0-3) S.* The investigation of architectural elements, relationships, and ordering ideas through a comparative graphic examination and analysis of the work of architects. Emphasis on buildings as physical artifacts.

ARC 544 Architectural Conservation. *Preq.: Advanced undergrad. in SOD or grad. standing. 3(3-0) S. Alt. yrs.* An examination of the many dimensions of architectural conservation and/or preservation as a significant aspect of architectural practice. Historical evolution, regulatory and economic factors, technology and pertinent design issues will be explored as foundations for individual case studies by class members of selected adaptive use, rehabilitation and restoration projects.

ARC 546 Theory of Building Types. *Preq.: Two ARC studios. 3(3-0) F.* Typology in its theoretical implications and practical applications in architecture. Analysis and documentation of selected building types in their historical evolution. Graphic identification of type characteristics.

ARC 551 Design Methods and Programming. *Preq.: Grad. standing or CI. 3(3-0) F.* An intensive study of a part of the design process involving the social and behavioral needs of the users through disciplined methods of data collection, analysis, organization, communication and evaluation. Emphasis is placed upon the role of programming in the environmental design field and variety of applications used in the profession.

ARC 561 The Practice of Architecture. *3(3-0) F.* A lecture course which examines the practice of architecture, with emphasis given to both normative and emerging procedures in the private architectural firm. The role and function of the practicing architect, legal and regulatory conditions, the nature of professional services, office management and project management processes will be given special attention.

ARC 562 Project Processes in Architecture. *Preq.: Sr. or grad. standing. 3(3-0) S.* A course which examines the processes of project delivery in architectural practice from initiation to completion of projects. Lectures and case studies of current projects will provide the means to explore the nature of architectural services involved, the roles of participants and the creative and technical issues which must be resolved.

ARC 570 Theory of Urban Form. *Preq.: Advanced undergrad. 3(3-0) F. Alt. yrs.* Theory of urban form examines the morphology of cities and their component parts, emphasizing the formal properties of urban space and structure. The first part of the course examines the descriptive properties of cities, while the second part deals with the analysis of parts of cities.

ARC 571 Urban Housing. *Preq.: Advanced undergrad. 3(3-0) S.* Interrelationships between housing and the form and structure of cities. Housing design as a function of economic, public policy, social and technological influences. Emphasis on the physical form of housing in the latter half of the twentieth century.

ARC 572 Urban Programming. *Preq.: Graduate standing or CI. 3(3-0) F. Alt. yrs.* This course is designed to reveal the programmatic requirements of communities in terms of density, size, physical structure and evolutionary characteristics. It is based on the analysis of social and economic characteristics of urban populations and provides the designer and planner with estimates of the projected demand for facilities and services.

ARC 573 Environmental Perception. *Preq.: Grad. standing or CI. 3(3-0) S.* An intensive review of the design research literature that emphasizes people's interaction with the physical environment. Various techniques for measuring human response to the environment will be explored to permit students to develop and analyze their own research projects.

ARC 574 Place and Place Making. *Preq.: Grad. standing or CI. 3(3-0) F.* A seminar-lecture course which examines the definitions, concepts and emergent research findings that are useful in explaining the human sense of place. Particular emphasis is placed upon those physical aspects and relationships which influence this sense of place and over which the designer has some control.

ARC 575 Participatory Design in Architecture. *Preq.: Grad. standing or CI. 3(3-0) S. Alt. yrs.* An examination of the theories and methods pertaining to the participatory design process. The course will probe the nature of advocacy design and examine successful projects in the U. S. and abroad that define a social role for architects.

ARC 581 Conceptual Issues in Architecture and Design I. *Preq.: Advanced undergrad. or grad. standing. 3(0-3) F.* An examination of current issues in American and Western society and their relation to the activities and goals of architects and designers.

ARC 582 Conceptual Issues in Architecture and Design II. *Preq.: Advanced undergrad. or grad. standing. 3(0-3) S.* An investigation into issues and values currently held by participating students and their relation to an anticipated career in architecture and design..

ARC 591 Special Seminar. *Preq.: Grad. standing. 1-3 F,S.* Seminars on subjects of current interest in design which are presented by persons not part of the regular faculty.

ARC 592 Special Topics. *Preq.: Grad. standing. 2-3 F,S.* Topics of current interest to the programs in the School of Design offered by faculty in the School. Subjects offered under this number are normally used to test and develop new courses.

ARC 595 Independent Study. *Preq.: Grad. standing. 1-3 Max. 6. F,S,Sum.* Special problems and projects in various aspects of architecture developed under the direction of an architecture faculty member on a tutorial basis.

FOR GRADUATES ONLY

ARC 600 Advanced Architectural Design (Series). *Preq.: Grad. standing. 6(0-12) F,S.* Advanced studies in architectural design. Projects deal with various aspects of building design, urban design and community design in a comprehensive and integrative manner.

ARC 691, 692 Special Topics in Architecture. *Preq.: Grad. standing. 1-6 F,S.* An investigation of special topics in architecture of particular interest to advanced students under the direction of a faculty member on a tutorial basis. Credits and content will vary with the needs of students.

ARC 698 Project Studio in Architecture. *Preq.: 18 hrs. of ARC 600. 6(0-12) F,S.* Final project for graduate students supervised by members of their graduate advisory committee.

Artificial Intelligence

GRADUATE FACULTY

Professors: R. E. Funderlic, H. E. Schaffer, A. L. Tharp; *Associate Professors:* A. C. Chao, M. G. Joost, H. D. Levin, R. C. Luo, W. J. Rasdorf, R. D. Rodman, W. E. Snyder; *Visiting Associate Professor:* J. A. Bowen; *Assistant Professors:* D. R. Bahler, E. L. Fisher, E. T. Sanii, N. F. Williamson

Artificial Intelligence is the branch of computer science concerned with designing computer systems which exhibit the characteristics normally associated with intelligence in human behavior, such as understanding language, learning, reasoning, solving problems, and so on. At NCSU, Artificial Intelligence is an interdisciplinary field, with faculty from several departments engaged in fundamental research and applications.

The university offers courses of study leading to a minor in Artificial Intelligence as part of the Master of Science and Doctor of Philosophy degrees. This option is available to all graduate students except those in Computer Studies, who can choose Artificial Intelligence as an interest area.

To fulfill the academic requirements for a minor in Artificial Intelligence, each master's student must successfully complete at least three, and each doctoral student, six of the courses in the Artificial Intelligence curriculum. One of the courses must be CSE 511, Artificial Intelligence I. Other courses offered as part of the Artificial Intelligence curriculum include: CSE 502 Computational Linguistics; CSE 602 Computational Semantics; CSE 611 Artificial Intelligence II; CSE(ECE) 559 Pattern Recognition; ECE(CSE) 659 Computer Vision; CSE (CSC,ECE,IE) 575 Voice Communication Systems; CSE(CSC,ECE,IE) 675 Advances in Voice Input/Output Communication Systems; IE 520 Industrial Robotics. There are also a range of special topics courses covering subjects such as Knowledge Engineering, Fuzzy Reasoning, Knowledge Representation, Artificial Intelligence Applications to CAD, and Artificial Intelligence in Manufacturing. Other subjects can be added to an individual student's course of study at the discretion of his or her committee.

Graduate students in Computer Studies who select Artificial Intelligence as an interest area are subject to the same academic requirements that define the Artificial Intelligence minor for students outside of the Computer Studies Department.

Biochemistry

GRADUATE FACULTY

Professor P. G. Agris, *Head*

Associate Professor: J. A. Knopp, *Graduate Administrator*

Professors: F. B. Armstrong, H. R. Horton, J. S. Kahn, I. S. Longmuir, W. L. Miller, E. C. Sisler, E. C. Theil, S. B. Tove; *Assistant Professor:* E. S. Maxwell

ASSOCIATE MEMBERS OF THE DEPARTMENT

Professors: L. W. Aurand, E. E. Jones, H. E. Swaisgood

The field of biochemistry applies and extends the concepts of chemistry and physics to the investigation of biological problems. The Department of Biochemistry offers courses of study leading to the Master of Science and Doctor of Philosophy degrees.

A student entering graduate study in biochemistry should have a bachelor's degree in biochemistry, chemistry or a related physical or biological science. In any case, the undergraduate program of study should have included a minimum of two semesters of organic chemistry, two semesters of physical chemistry, one semester of introductory biochemistry and one semester of qualitative organic analysis. New students entering degree programs take placement examinations

in organic and physical chemistry to determine their level of competence in these areas. Students who lack undergraduate courses considered essential for graduate study in biochemistry may be admitted to the graduate program, provided the deficiencies are corrected early in their graduate work.

Courses in general and experimental biochemistry are required as part of programs leading to advanced degrees in biochemistry. Other courses in biochemistry and related areas are required as recommended by the student's advisory committee. In addition, the student is expected to participate regularly in seminars and obtain teaching experience. Completion of a thesis based on original research is required for both the Master of Science and Doctor of Philosophy degrees, and a reading knowledge of one foreign language is required for the doctoral degree. Research programs are currently being conducted in biochemical genetics, enzyme structures and mechanisms, biochemical aspects of toxicology, regulation of metabolism, fluorescence spectroscopy of proteins and nucleic acids, photosynthesis and electron transport, molecular interactions of ethylene in plants and developmental biochemistry of plants, lipid and membrane metabolism, nucleic acid metabolism, oxygen transport mechanisms, developmental changes in red blood cells and iron metabolism, bio-oxidation of lipids and foods, immobilization of enzymes and biomolecules, mechanisms of hormone action, disulfide bond formation in proteins and peptides, structure and function of nucleic acids, and involvement of sn RNP in autoimmune disease.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

BCH 551 General Biochemistry I. *Preq.: Three years of chemistry, including CH 223 or equivalent and one semester of introductory biochemistry (BCH 451 or equivalent one semester of physical chemistry would be helpful. 3(3-0) F.* Protein structure and function, carbohydrate metabolism and the production of chemical energy, lipids and membrane structure and function, nucleic acids and protein metabolism. Horton

BCH 552 Experimental Biochemistry. *Preqs.: CH 223; CH 315 recommended; Preq. or Coreq.: BCH 551. 3(1-6) F.* An advanced laboratory designed to give students practical experiences in purification and quantitative characterization of enzymes and nucleic acids. Studies with carbohydrates and membrane lipids will also be included. Miller

BCH (PHY) 553 Physiological Biochemistry. *Preq.: BCH 551. 3(3-0) S.* Application of biochemical methods to the elucidation of the function of whole organisms. A. Biochemistry of 1) blood, 2) water, electrolyte, acid-base balance, 3) renal function, 4) muscle metabolism, 5) central nervous system, 6) autonomic nervous system, 7) endocrine system. B. Biochemistry of adaptation to environment: 1) high and low Po_2, 2) hot and cold, 3) wet and dry, 4) pollution. Longmuir

BCH 554 Radioisotope Techniques in Biology. *Preq.: BCH 451 or CI. 2(1-3) Sum.* Theory and application of radioisotope techniques used in biology. The different modes of radioactivity are correlated with methods of measurement. Emphasis on use and limitations of various instruments and techniques and on their application to research problems. Sisler

BCH 555 Plant Biochemistry. *Preq.: BCH 551 or equivalent. 3(3-0) S. Alt. yrs.* * The basic biochemistry of plants. Basic constituents of plants, their metabolic interrelationships and their regulation: cell wall structure, carbohydrates, proteins, nucleic acids, lipids, photosynthesis, respiration, secondary plant products, nitrogen metabolism, phytoalexins and plant hormones. Sisler

*See department for specific year.

BCH 557 Introductory Enzyme Kinetics. *Preqs.: BCH 551 and MA 201 or 212. 3(3-0) F. Alt. yrs.* * Basic principles of chemical kinetics are applied to develop enzyme kinetics. Limitations of the Michaelis equation are considered in light of the general rate equation. Transient state kinetics are then considered. Inhibition and activation, pH functions, effects of temperature, and elucidation of mechanisms follow. The kinetics of allosteric site interactions and of conformational forms complete the course. Main

BCH (GN) 561 Biochemical and Microbial Genetics. *Preqs.: BCH 451 or 551, GN 411 or 505, MB 401 or equivalent. 3(3-0) F. Alt. yrs.** A study of the development of the fields of biochemical and microbial genetics, emphasizing both techniques and concepts currently used in molecular research. Includes lectures and discussions of current research publications. Armstrong

BCH 590 Special Topics in Biochemistry. *Preq.: BCH 451 or equivalent. Credits arranged, Max. 3 F,S,Sum.* The study of topics of special interest by small groups of students instructed by members of the faculty. Graduate Staff

FOR GRADUATES ONLY

BCH 651 Physical Biochemistry. *Preq.: BCH 551. 3(3-0) F. Alt. yrs.* * Structural and physical properties of biological macromolecules and the application of spectroscopic methods to their study. Knopp

BCH 652 Structures and Interactions of Biological Macromolecules. *Preqs.: BCH 551, CH 431 or equivalent. 3(3-0) F. Alt. yrs.* * Theory and interpretation of physical measurements related to structures and interactions of biological macromolecules, emphasizing hydrodynamic methods, thermodynamic methods, ligand interactions at equilibrium and conformational equilibria. Swaisgood

BCH 653 Biochemistry of Hormone Action. *Preq.: BCH 551. 3(3-0) S. Alt. yrs.* * Well defined models of steroid and protein hormone action are studied via lectures, assigned readings and discussions. Students add breadth to the course and depth to their own understanding by searching the literature and writing *or* lecturing about a particular hormone of their own choosing. Miller

BCH 655 General Biochemistry II. *Preq.: BCH 551. 3(3-0) F.* A continuation of BCH 551 with emphasis on enzyme kinetics, allosterism and cooperativity, micelles and biological membranes, bioenergetics and metabolism of carbohydrates and lipids. Tove

BCH 657 General Biochemistry III. *Preq.: BCH 551. 3(3-0) S.* A continuation of BCH 551 with emphasis on enzyme mechanisms, relation of enzyme structure to catalytic mechanisms, and specificity, structure and function of nucleic acids, metabolism of nitrogenous biomolecules and modes of metabolic regulation. Maxwell

BCH (GN) 658 Nucleic Acids: Structure and Function. *Preq.: BCH 657. 3(3-0) F. Alt. yrs.** Structure-function relationships of nucleic acids and nucleic acid-protein complexes, including the physical biochemistry of nucleotides, polynucleotides, DNA, RNA and protein as they relate to the biological processes of replication, transcription and translation. Current techniques used to analyze nucleic acid structure and function. Maxwell

BCH (CH) 659 Natural Products. *3(3-0) F.* (See chemistry.)

BCH 691 Seminar in Biochemistry. *1(1-0) F,S.* Graduate Staff

BCH 695 Special Topics in Biochemistry. *Preq.: Grad. standing in BCH. Credits Arranged. F,S,Sum.* Critical study of special problems and selected topics of current interest in biochemistry and related fields. Graduate Staff

BCH 699 Biochemical Research. *Credits Arranged, F,S,Sum.* Graduate Staff

*See department for specific year.

Biological and Agricultural Engineering

GRADUATE FACULTY

Professor J. H. Ruff, *Head*

Professor R. S. Sowell, *Graduate Administrator*

Professors: C. F. Abrams, H. D. Bowen, B. K. Huang, F. J. Humenik, E. G. Humphries, W. H. Johnson, G. J. Kriz, W. F. McClure, R. P. Rohrbach, L. M. Safley Jr., R. W. Skaggs, R. E. Sneed, L. F. Stikeleather, C. W. Suggs, P. W. Westerman, D. H. Willits, E. H. Wiser, J. H. Young; *Professors (USDA):* J. W. Dickens, T. B. Whitaker; *Extension Professor:* J. C. Barker; *Professors Emeriti:* D. H. Howells, F. J. Hassler; *Associate Professor:* G. R. Baughman; *Visiting Associate Professor:* M. D. Smolen; *Assistant Professors:* R. W. Bottcher, C. G. Bowers Jr.; *Senior Researcher:* S. C. Mohapatra

ASSOCIATE MEMBERS OF THE DEPARTMENT

Professors: D. D. Hamann, A. E. Hassan, V. A. Jones; *Associate Professor:* K. R. Swartzel

The Department of Biological and Agricultural Engineering offers programs of study for the Master of Science, Doctor of Philosophy and Master of Biological and Agricultural Engineering degrees.

In the Master of Science program emphasis is placed on mathematics and theory as the unifying link between otherwise divergent fields of knowledge in the biological and physical sciences and as prerequisites to effective engineering advances in biological and agricultural areas. As the student acquires competence in the advanced methods of science, he or she applies knowledge by conducting an original research investigation and by writing and defending a thesis.

Study for the Doctor of Philosophy degree builds on the Master of Science program with additional formal study followed by a period of independent dissertation research.

Current departmental research projects available for graduate student participation include instrumentation to measure quality and composition of agricultural products, bioengineering properties as related to animal and human medicine, safety and health of agricultural workers, mechanization and automation of horticultural crop production (cucumbers, sweetpotatoes, blueberries and grapes), post-harvest processing and storage of agricultural commodities, environmental control of greenhouses, improved systems for field crop production, crop response to drainage, total water management for Coastal Plains and Tidewater Region soils, hydrologic/water quality modeling of sediment and chemical movement, optimum production efficiency of poultry and animal housing systems, animal waste as nutrient and energy resources, and expert systems and simulation modeling for management decisions.

For those interested primarily in a broadened background of engineering science and technology—without the thesis requirement—the Master of Biological and Agricultural Engineering program permits a wide selection from a variety of advanced courses. While this program is primarily for those intending to terminate graduate study at the master's level, a student may, with departmental approval, develop a plan of study under this program which leads to study for the doctorate.

Graduate students have access to modern well-equipped research laboratories, controlled environment test chambers, excellent computing facilities and a research shop manned by competent mechanics.

SELECTED ADVANCED UNDERGRADUATE COURSES

BAE 411 Farm Power and Machinery. *Preqs.: BAE 211, CH 101, PY 211 or 221. 3(2-3) S.*

BAE 461 Analysis of Agricultural Systems. *Preqs.: MA 114 or 112, EB 212. 3(2-2) F.*

BAE 462 Functional Design of Field Machines. *Preq.: BAE 361; Coreq.: ST 361. 3(2-3) S.*

BAE (CHE) 465 Introduction to Biomedical Engineering. *Preqs.: MA 202 or 212 or PY 212 or 208. 3(3-0) S.*

BAE 471 Soil and Water Engineering. *Preqs.: BS 100, SSC 200, MAE 308. 4(3-2) F.*

BAE 481 Agricultural Structures and Environment. *Preqs.: BAE 342, MAE 314. 4(3-3) F.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

BAE 552 Instrumentation for Agricultural Research and Processing. *Preqs.: EE 331, MA 301. 2(1-3) F.* Theory and application of primary sensing elements and transducers. Generalized performance characteristics and the use of standards. Use of specialized measurement systems for agricultural research and processing including an introduction to correlation and power spectral density measurements. McClure

BAE (CE, MB) 570 Sanitary Microbiology. *3(2-3) S.* (See civil engineering.)

BAE (CE) 578 Agricultural Waste Management. *Preq.: Grad. or advanced undergrad. standing. 3(2-3) F. Alt. yrs.* A study of agricultural and associated processing wastes. Special laboratory techniques required for the characterization of these wastes will be emphasized. Principles and examples considered will be utilized to develop waste management and non-destructive waste utilization systems that are integral to the total operation. Safley

BAE (FS) 585 Food Rheology. *Preqs.: FS 331 or MAE 314. 3(2-3) F. Alt. yrs.* Principles and methods for measuring rheological properties. Theories of elastic, viscous, viscoelastic and viscoplastic behavior and relationships to food texture and commodity damage during harvest, handling and processing. Influence of time, composition and processing on rheological properties. Hamann

BAE 590 Special Problems. *Preq.: Sr. or grad. standing in biological and agricultural engineering. Credits Arranged.* Each student will select a subject on which to do research and write a technical report on the results. The individual may choose a subject pertaining to his or her particular interest in any area of study in biological and agricultural engineering. Graduate Staff

FOR GRADUATES ONLY

BAE 654 Nonequilibrium Thermodynamics in Bioengineering. *Preq.: MA 511. 3(3-0) S. Alt. yrs.* Generalized classical thermodynamics is extended by Onsager's relations to provide a theoretical basis for analyzing the energetics of systems that include life processes. Topics illustrate applications to special systems including isothermal diffusion and sedimentation, membrane permeability, transport processes in continuous systems and systems with temperature gradients. Graduate Staff

BAE 661 Analysis of Function and Design of Biological and Physical Systems. *Preq.: CI. 3(2-3) F. Alt. yrs.* Mathematical and analytical techniques and principles essential in the analysis and design of machines and systems which encompass both the biological and the physical domains and their interfaces. Analytical treatment of physical and biological systems and the functional analysis of machine components are studied to bridge the gap be&$.tween theories and applications. Control systems synthesis and design are treated with emphasis on quantitative dynamic relations be&$.tween elements and system response using transfer function and computer simulation techniques. Graduate Staff

BAE (SSC) 671 Theory of Drainage—Saturated Flow. *Preq.: MA 301. 3(3-0) F. Alt. yrs.* Physical concepts and properties of fluids and porous media are discussed in relation to soil-water movement. The fundamental laws and equations governing saturated flow in porous media are derived and discussed. Mathematical solutions of steady-state and transient flow equations are analyzed to determine their applicability to drainage problems. Analogs and models of particular drainage problems are considered. Skaggs

BAE (SSC) 674 Theory of Drainage—Unsaturated Flow. *Preq.: BAE 671 or equivalent. 3(3-0) S. Alt. yrs.* Forces involved and theories utilized in unsaturated flow of porous media are discussed in relation to soil-water movement. Steady-state and transient unsaturated flow equations for horizontal and vertical moisture movement are developed and solved. The solutions are applied to present day laboratory and field technology. Molecular diffusion and hydrodynamic dispersion are considered in light of current tracing techniques. Skaggs

BAE 690 Special Topics. *Preq.: Grad. standing. 1-4.* A study of topics in the special fields of interest of graduate students under the direction of the graduate faculty. Graduate Staff

BAE 695 Seminar. *Preq.: Grad. standing in BAE. 1(1-0) F,S.* Elaboration of the subject areas, techniques and methods peculiar to professional interest through presentations of personal and published works; opportunity for students to present and critically defend ideas, concepts and inferences. Discussions to point up analytical solutions and analogies between problems in biological and agricultural engineering and other technologies, and to present the relationship of biological and agricultural engineering to the socio-economic enterprise. Graduate Staff

BAE 699 Research in Biological and Agricultural Engineering. *Preq.: Grad. standing in BAE. Credits Arranged.* Performance of a paticular investigation of concern to biological and agricultural engineering. The study will begin with the selection of a problem and culminate with the presentation of a thesis. Graduate Staff

Biological Sciences

Professor C. F. Lytle, *Teaching Coordinator*

There is no separate graduate major in the biological sciences, but both Master of Science and Doctor of Philosophy degrees are offered in several life science departments and programs of the College of Agriculture and Life Sciences. Also,

non-thesis Master of Life Sciences degrees are offered by several departments and programs for students who wish to emphasize course work in a graduate program. Master of Life Sciences degrees may be appropriate for students who are already working or plan to work in a professional capacity in business, industry or government agencies rather than to continue to the doctorate. These degrees are not necessarily terminal, however, and successful students may be able to proceed to other advanced degrees.

Several interdisciplinary courses applicable to several graduate programs are offered by the Biological Sciences Interdepartmental Program.

SELECTED ADVANCED UNDERGRADUATE COURSE

BS 491 Seminar on Professional Development in Biological Sciences. *1(1-0) F.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

BS 510 Advanced Biology for Secondary Teachers. *Preq.: Two years of college biology. 6(4-6) Sum.* A comprehensive review of important principles and concepts of biology for secondary teachers preparing to teach advanced placement biology. Contemporary topics in biology are emphasized; extensive laboratory and field work are included.
Graduate Staff

BS 590 Special Problems in Biological Instrumentation. *Preq.: CI. 1-3 F,S.* Basic components of spectrophotometers including light sources, dispersing devices, detectors and read-out methods; theoretical and practical aspects of electron microscopy; basics of analog and digital computing methods and applications of computers to biological research; methods of separation and identification of bio-polymers; principles of measurement; the application of electronics in biological measuring and sensing devices; and human cytological techniques. Course consists of five-week modules (sections) devoted to specific types of instrumentation. Graduate Staff

FOR GRADUATES ONLY

BS 605 Biological Scanning Electron Microscopy. *Preq.: Grad. standing with some biological background. 2(1-2) S.* Theory and application of scanning electron microscopy, including specimen preparation, microscope alignment and operation, performance evaluation, interpretation of problems and darkroom technique. (Limited to 8 students with prior approval of instructor.) Graduate Staff

BS 610 Biological Transmission Electron Microscopy. *Preq.: Grad. standing with some biological background. 3(2-3) F.* Theoretical and practical aspects of transmission electron microscopy, including microscope alignment and use, performance evaluation, interpretation of problems and darkroom techniques. (Limited to 8 students with prior approval of instructor.) Graduate Staff

BS 611 Ultramicrotomy for Life Sciences. *Preqs.: BS 610, grad. standing. 2(1-4) S.* An intensive laboratory course covering sample preparative techniques for transmission electron microscopy, including tissue preparation, thick sectioning, staining and ultramicrotomy. (Limited to 8 students with prior approval of instructor.) Graduate Staff

BS 690 Seminar in Cell Biology. *Preqs.: Grad. standing, background in biology or chemistry. 1(1-0) S.* A topical appraisal of current literature in selected areas of cell biology through presentations and discussions by students, faculty and visiting scientists.
Graduate Staff

BS 696 Topics in Biological Ultrastructure. *Preq.: Grad. standing (background preferably in biology). 1(1-0) F.* A survey of the ultrastructure of living organisms from viruses to higher plants and animals by means of illustrated lectures. The changes in fine structure associated with differentiating cells and with cells in various metabolic states are examined. Graduate Staff

Biomathematics

GRADUATE FACULTY

Professor D. L. Solomon, *Administrative Coordinator*

Professor H. R. van der Vaart, *Graduate Administrator*

Professors: H. J. Gold, K. H. Pollock; *Adjunct Professor:* M. W. Anderson; *Professor Emeritus:* R. J. Monroe; *Assistant Professors:* S. P. Ellner, C. E. Smith

ASSOCIATE MEMBERS OF THE PROGRAM COMMITTEE

Professors: J. W. Bishir, T. Johnson, G. Namkoong, H. E. Schaffer, J. F. Selgrade, R. E. Stinner; *Associate Professor:* L. A. Real; *Assistant Professor:* G. G. Wilkerson; *Assistant Professor (USDA):* S. M. Schneider

Biomathematics is the development and application of mathematical methods for the study of biological systems. The focus is the modeling process, which is the matching of the biological and physical structure of the system being studied to the mathematical description.

Students pursuing degrees in biomathematics can choose to emphasize (1) the *development* of mathematical modeling methodology as opposed to the *application* of that methodology, (2) the mathematical sciences, by taking advantage of the diverse offering in statistics, mathematics, computer science and operations research, or (3) the biological sciences, by fashioning a program which takes advantage of the courses offered by individual biological science departments or interdepartmental programs such as ecology, physiology, nutrition, wildlife biology and toxicology.

Furthermore, work in biomathematics varies from the study of general biological theory (e.g., population dynamics, feedback regulation in enzyme systems) to specific applications (e.g., pollution of a specific river system). Most research has both elements. Finally, the modeling of biological systems often requires the scholarly resources of several disciplines and thus is characterized by interdisciplinary collaboration. The modeling serves to integrate the contributions of the various areas and to provide a means by which the collaborators communicate.

Applicants to the program are expected to have either a B.S. in biology with evidence of aptitude and interest in mathematics or a B.S. in a mathematical area with evidence of aptitude and interest in biology. All students are expected to have had advanced calculus, linear algebra and general biology. Deficiencies in these areas should be remedied during the first year.

The Biomathematics graduate program is administered as a division within the Department of Statistics, with associate faculty drawn from several other departments. Further information may be found in the description for the Department of Statistics. A brochure is available which describes the biomathematics degree requirements and research interests of the faculty.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

BMA 567 Modeling of Biological Systems. *Preq.: MA 112. 4(3-2) S. Alt. yrs.* An introduction to quantitative modeling in biology. Use of Forrester diagrams, probabilistic and deterministic description of dynamic processes, development of model equations, simulation methods and criteria for model evaluation. Examination of current literature dealing with application of models and simulation in biology. Individual and class modeling projects. Ellner

BMA (MA, ST) 571 Biomathematics I. *Preq.: Advanced calculus, reasonable background in biology or CI. 3(3-0) F.* The role of theory construction and model building in the development of experimental science. The historical development of mathematical theories and models for the growth of one-species populations (logistic and off-shoots), including considerations of age distributions (matrix models, Leslie and Lopez; continuous theory, renewal equation). Some of the more elementary theories on the growth of organisms (von Bertalanffy and others; allometric theories; cultures grown in a chemostat). Mathematical theories of two and more species systems (predator-prey, competition, symbosis; leading up to present-day research), and discussion of some similar models for chemical kinetics. Much emphasis is placed on scrutiny of the biological concepts as well as of the mathematical structure of the models in order to uncover both weak and strong points of the models discussed. Mathematical treatment of the differential equations in these models stresses qualitative and graphical aspects, as well as certain aspects of discretization. Difference equation models. van der Vaart

BMA (MA, ST) 572 Biomathematics II. *Preqs.: BMA 571, elementary probability theory. 3(3-0) S.* Continuation of topics of BMA 571. Some more advanced mathematical techniques concerning nonlinear differential equations of the types encountered in BMA 571: several concepts of stability, asymptotic directions, Liapunov functions; different time-scales. Comparison of deterministic and stochastic models for several biological problems including birth and death processes. Discussion of various other applications of mathematics to biology, some recent research. van der Vaart

BMA 591 Special Topics. *Preq.: CI. Maximum 3. F,S,Sum.* Directed readings, problem sets, written and oral reports as dictated by need and interest of student; new 500-level courses during the developmental phase. Graduate Staff

FOR GRADUATES ONLY

BMA (OR) 611 System Modeling Theory. *Preqs.: MA 405; MA 421 or ST 421; linear systems (e.g., BMA 572 or IE 522 or OR 531). 3(3-0) F. Alt. yrs.* System concepts and modeling processes. Objectives include the following: develop understanding of the modeling process; develop and improve skills in system modeling; provide basis for accessing research literature. Topics include: graph theory and system structure; system morphisms and representation of system dynamics; sensitivity and model validation; models in scientific theory compared with decision-related modeling. Examples from a broad spectrum of application areas. Gold

BMA 691 Advanced Special Topics. *Preq.: CI. 1-3 F,S,Sum.* Directed readings, problem sets, written and oral reports as dictated by need and interest of student; new 600-level courses during the development phase (currently includes courses in stochastic modeling and biophysical theory). Graduate Staff

BMA 694 Seminar. *Preq.: Grad. standing. 1(1-0) F,S.* Graduate students in biomathematics are expected to attend through most of their residence period. Graduate Staff

BMA 699 Research. *Credits Arranged. F,S,Sum.* Graduate Staff

Biotechnology

GRADUATE FACULTY

Professor H. E. Swaisgood, *Chairman*

Professors: F. B. Armstrong, G. C. Bewley, H.-m. Chang, W. J. Dobrogosz, P. B. Carter, B. Hammerberg, H. R. Horton, B. H. Johnson, T. W. Joyce, C. S. Levings, C. L. Markert, W. L. Miller, R. L. Mott, D. F. Ollis, J. G. Scandalios, H. E. Swaisgood, C. S. Teng, E. C. Theil, W. F. Thompson; *Associate Professors:* H. V. Amerson, W. F. Boss, E. V. L. DeBuysscher, R. E. Johnston, T. R. Klaenhammer, T. Melton, R. M. Petters, J. C. H. Shih, S. L. Spiker, H. T. Stalker; *Assistant Professors:* E. F. Bowden S. T. Clark, M. A. Conkling, S. E. Curtis, M. E. Daub, L. H. Frampton, F. J. Fuller, R. J. Linderman, E. S. Maxwell, D. M. Miller, P. E. Orndoff, R. M. Roe, R. M. Shuman, R. B. van Breemen; *Assistant Professor (USDA):* P. H. Sisco

The Biotechnology Program includes faculty from seventeen departments in the Colleges of Agriculture and Life Sciences, Engineering, Forest Resources, Physical and Mathematical Sciences, and Veterinary Medicine. Graduate study leading to a Ph.D. minor in biotechnology may be taken by students who reside and conduct their research in one of the participating departments. To obtain a minor in biotechnology, the student must successfully complete at least two of the laboratory core courses selected from the list below and must conduct graduate thesis research in an area of biotechnology.

Research in biotechnology is focused in three main areas: recombinant DNA technology, bioprocessing/bioanalytical techniques, and *in vitro* culture techniques. The multidisciplinary nature of biotechnology means that a wide range of research topics and techniques are applicable, such as molecular level genetics and associated research in molecular biology, enzyme technology and protein engineering, bioprocessing using cells or enzymes, development of biosensors, hybridoma technology, cell culture techniques and embryo manipulation.

LIST OF APPROVED COURSES

ANS 606 Animal Biotechnology: Embryo Manipulation. *Preq.: ANS 502. 4(1-8) F. Alt. yrs.* Advanced laboratory course providing training and experience in mammalian embryo manipulation including techniques of super ovulation and embryo recovery, *in vitro* culture, parthenogenetic activation, *in vitro* fertilization, embryo aggregation, and DNA microinjection. Petters

CS (BO, GN, HS) 547 Cell and Tissue Techniques in Plant Breeding. *Preqs.: GN 505B and GN 506B or equivalent. 3(1-4) F. Alt. yrs.* Applications of tissue culture and cytogenetic techniques for plant improvement. Callus and suspension cultures, plant regeneration, *in vitro* selection, haploidy, polploidy, aneuploidy, wide hybridization and embryo rescue. Practical lab experiences in tissue culture and cytogenetic techniques. Reed, Stalker

FS 504 Food Proteins and Enzymes. *Preq.: FS 402 or BCH 451. 3(2-3) F. Alt. yrs.* An advanced course in food chemistry with emphasis on proteins and enzymes of particular importance to foods. Protein interactions and their effect on the physical-chemical characteristics of a product will be discussed. Particular emphasis will be given to the preparation and kinetic properties of immobilized enzymes and their use as biochemical reactors in processing operations or as specific electrodes for analytical purposes. Swaisgood

FS 691 Special Research Problems in Food Science. *Credits Arranged. F,S,Sum.* Directed research in a specialized phase of food science designed to provide experience in research methodology and philosophy. Klaenhammer

GN 666 Laboratory in Molecular Genetics. *Preqs.: GN 505 or equivalent and CI. 4(2-6) S. Alt. yrs.* A laboratory course in modern techniques of molecular genetics for advanced students. Techniques will include *in situ* hybridization, recombinant DNA methodology, and DNA sequencing. Enrollment is limited to 12 students. Applications for a place in the course may be obtained from the department. Conkling

MB 660 Experimental Microbial Genetics. *Preqs.: BCH 561, GN 411, MB 401. 4(2-6) F.* Laboratory-oriented presentation of current methodologies and concepts in molecular microbial genetics and their application to strain construction, plasmid and phage manipulations, mutagenesis, cloning and genetic engineering of microorganisms. Melton

PP 605 Molecular Biology of Plant Viruses. *Preqs.: PP 502B, BCH 451 or 551. 4(2-6) S. Alt. yrs.* An in-depth study of plant viruses with emphasis on the relationship between viral structure and function. Areas covered include infection, replication, genomic expression, encapsidation and transmission. Laboratory introduces students to contemporary molecular techniques. Graduate Staff

Botany

GRADUATE FACULTY

Professor E. D. Seneca, *Head*

Associate Professor T. E. Wynn, *Graduate Administrator*

Professors: C. E. Anderson, U. Blum, R. C. Fites, J. W. Hardin, R. L. Mott, W. F. Thompson, J. R. Troyer, A. M. Witherspoon; *Professors (USDA):* W. W. Heck, H. E. Pattee, H. Seltmann; *Visiting Professor:* W. S. Chilton; *Professors Emeriti:* G. R. Noggle, H. T. Scofield, L. A. Whitford; *Associate Professors:* R. L. Beckmann Jr., W. F. Boss, J. M. Stucky, J. F. Thomas, C. G. Van Dyke, T. R. Wentworth; *Assistant Professor:* J. M. Burkholder; *Adjunct Assistant Professor:* D. E. Blume

ASSOCIATE MEMBERS OF THE DEPARTMENT

Professors: A. W. Cooper, B. J. Copeland, R. J. Downs, M. M. Goodman, D. H. Timothy; *Professor (USDA):* S. C. Huber; *Associate Professors:* H. V. Amerson, R. L. Hoffman; *Assistant Professors (USDA):* J. M. Anderson, K. O. Burkey, T. W. Rufty Jr.

The Department of Botany offers programs leading to the Master of Life Sciences (non-thesis), Master of Science and Doctor of Philosophy degrees.

Excellent physical facilities are available for instruction and research in all phases of the departmental program. The Phytotron (part of a two-unit controlled environment facility operated in collaboration with Duke University) offers opportunities for research in experimental taxonomy, ecology, morphology and plant physiology. The department supports a research program in plant cell and tissue culture and plant molecular biology. A herbarium supports studies in systematic botany, and is augmented by herbaria at nearby Duke Univer-

sity and the University of North Carolina at Chapel Hill. Field laboratories are available at the coast, in the Piedmont and in the mountains. The department participates in tropical biology programs through university membership in the Organization for Tropical Studies.

All graduate students will participate at least one semester during a degree program in the departmental instructional program. Graduate students are expected to attend and participate in the seminar program every semester they are in residence.

SELECTED ADVANCED UNDERGRADUATE COURSES

BO 400 Plant Diversity. *Preq.: BO 200. 4(3-3) F.*

BO 403 Systematic Botany. *Preq.: BS 100 or 105 or BO 200. 4(2-4) S.*

BO 413 Introductory Plant Anatomy. *Preq.: BO 200 or equivalent. 3(2-3) S.*

BO (ZO) 414 Cell Biology. *Preqs.: CH 223, PY 212, ZO 201 or 203. 3(3-0) S.*

BO 421 Plant Physiology. *Preqs.: BS 100 or BS 105 or BO 200 and one year of college chemistry. 4(3-3) F,S.*

BO 499 Independent Study in Botany. *Preqs.: At least eight hours of Botany, advanced standing and presentation of plan of work approved by a faculty member. 1-3 F,S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

BO 510 Plant Anatomy. *Preq.: BO 200. 4(2-6) F.* A study of plant cells, ultrastructure, cell types, tissues, organs and patterns of growth and differentiation. Anderson

BO 522 Advanced Morphology and Phylogeny of Seed Plants. *Preq.: BO 403. 4(3-3) F. Alt. yrs.* A comprehensive survey of the morphology and evolution of angiosperms and gymnosperms. Special emphasis is given to vegetative and reproductive morphology of fossil and living forms, and to their presumed evolutionary relationships. Hardin

BO 524 Grasses, Sedges and Rushes. *Preq.: BO 403. 4(2-6) F. Alt. yrs.* A course dealing with three large, economically and ecologically important plant families. A working familiarity will be achieved through an introduction to the special terminology used in dealing with these plants, extensive field work emphasizing species identification and a study of the modern classification of the grasses. Stucky

BO (CS, ENT, PM, PP) 525 Biological Control. *4(3-3) Alt. F.* (See pest management.)

BO 544 Plant Geography. *Preqs.: BO 403, BO (ZO) 360, GN 411 or equivalents. 3(3-0) S. Alt. yrs.* A course in descriptive and interpretive plant geography, synthesizing data from the fields of ecology, genetics, geography, paleobotany and taxonomy. Includes a survey of the present distribution of major vegetation types throughout the world, a discussion of the history and development of this present pattern of vegetation and a discussion of the principles and theories of plant geography. Seneca

BO (CS, GN, HS) 547 Cell and Tissue Techniques in Plant Breeding. *3(1-4) F. Alt. yrs.* (See crop science.)

BO 551 Advanced Plant Physiology I. *Preq.: BO 421 or equivalent. 3(3-0) F.* The first half of a two-semester sequence covering the field of plant physiology. Topics will include cellular transport, water relations, mineral relations, vascular transport and temperature relations. Troyer

BO 552 Advanced Plant Physiology II. *Preqs.: BO 421 or equivalent and biochemistry. 3(3-0) S.* The second half of a two-semester sequence covering the field of plant physiology. Topics will include respiration, photosynthesis, nitrogen metabolism, growth and development. Boss

BO 553 Laboratory in Advanced Plant Physiology I. *Preq. or coreq.: BO 551. 1(0-3) F.* Laboratory to accompany BO 551 Advanced Plant Physiology I. Graduate Staff

BO 554 Laboratory in Advanced Plant Physiology II. *Preq. or coreq.: BO 552. 1(0-3) S.* Laboratory to accompany BO 552 Advanced Plant Physiology II Graduate Staff

BO (ZO) 560 Principles of Ecology. *Preq.: Three semesters of college level biology courses. 4(3-3) F.* A consideration of the principles of ecology at the graduate level. Each of the major subject areas of ecology is developed in sufficient depth to provide a factual and philosophical framework for the understanding of ecology. Blum

BO 561 Physiological Ecology. *Preqs.: BO 421 and BO (ZO) 560 or equivalent. 4(3-3) S. Alt. yrs.* The plant community is approached from a physiological standpoint. Emphasis will be placed on the individual in the community and how it responds to its immediate environment on short- and long-term bases. Blum

BO 565 Plant Community Ecology. *Preq.: BO (ZO) 560 or BO (ZO) 360 or equivalent. 4(3-3) F.* Consideration of the structure and function of terrestrial vascular plant communities, with emphasis on both classical and recent research. Topics include measurement and description of community properties, classification, ordination, vegetation pattern in relation to environment, ecological succession and a survey of the vegetation of North America. Wentworth

BO (BMA) 567 Modeling of Biological Systems. *4(3-2) F.* (See biomathematics.)

BO 570 Quantitative Ecology. *Preqs.: BO (ZO) 560 and ST 512 or equivalent. 3(3-0) F.* A course emphasizing the quantitative techniques and theories of vegetation analysis. Topics include sampling methodologies, the evaluation of sample adequacy, spatial patterns and species associations, the measurement and interpretation of ecological diversity, gradient analysis and classification of communities and plant population dynamics. Graduate Staff

BO (MB) 574 Phycology. *Preq.: BS 100 or BO 200. 3(1-4) S. Alt. yrs.* An introduction to the taxonomy, morphology, reproduction and ecological importance of organisms which may be included in the algae. Attention is given to the local freshwater flow and the physiology of selected species as it relates to algal blooms, water quality and nutrient loading in aquatic habitats. Graduate Staff

BO (MB, PP) 575 The Fungi. *Preq.: BO 200 or equivalent. 3(3-0) F.* An overview of the fungi within the framework of a survey of the major classes. Van Dyke

BO (MB, PP) 576 The Fungi—Lab. *Coreq.: BO 575. 1(0-3) F.* Illustrative material of the fungal assemblages discussed in BO 575. Van Dyke

BO 590 Topical Problems. *Preq.: CI. 1-3 F,S.* Discussions and readings on problems of current interest in the fields of ecology, anatomy and morphology, taxonomy, plant physiology and cell biology. May be repeated with a change in topic for a maximum of six credits. Graduate Staff

FOR GRADUATES ONLY

BO 612 Plant Morphogenesis. *Preq.: Six hours of botany equivalent to BO 400 and BO 421. 4(3-3) S. Alt. yrs.* A review and synthesis of the factors involved in the development of plant form. Tissue culture experiments will demonstrate levels of control from the molecular to the whole organism. Mott

BO 620 Advanced Taxonomy. *Preq.: BO 403. 4(2-6) S. Alt. yrs.* Taxonomic principles and techniques including rules of nomenclature, literature, biosystematic methods, monographic techniques and concepts of categories. Stucky

BO (PP) 625 Advanced Mycology. *4(2-6) F.* (See plant pathology.)

BO 631 Water Relations of Plants. *Preq.: BO 551 or equivalent. 3(3-0) S. Alt. yrs.* A discussion of the physiological water relations of plants with emphasis on theoretical principles and quantitative description. Troyer

BO 633 Plant Growth and Development. *Preqs.: BO (ZO) 414 or BO 421, organic chemistry. 3(3-0) S.* An advanced course in plant physiology covering plant growth, development, differentiation, senescence and biological control mechanisms. Fites

BO 634 Introduction to the Thermodynamics of Biological Systems. *Preq.: BO 551 or CI. 3(3-0) S. Alt. yrs.* An introductory development of the thermodynamic theory relevant to biological systems together with consideration of examples of biological problems to which thermodynamic theory has been applied. Troyer

BO 636 Discussions in Plant Physiology. *Preqs.: BO (ZO) 414 or BO 421, organic chemistry. 1(1-0) F,S.* Group discussions at an advanced level on selected topics. Graduate Staff

BO (ZO) 660 Advanced Topics in Ecology I. *Preq.: BO (ZO) 560. 3(3-0) S.* Subject matter in the major fields of ecology will be developed through seminars and lectures, and principles will be illustrated by laboratory exercises and field trips. Topics covered include microenvironment, population biology, community ecology, ecosystems and nutrient cycling. Graduate Staff

BO (ZO) 661 Advanced Topics in Ecology II. *4(3-3) S.* (See zoology.)

BO 662 Applied Coastal Ecology. *Preq.: BO (ZO) 360 or BO (ZO) 560. 3(3-0) S. Alt. yrs.* Course will cover the environmental factors, the vegetative communities, and man's influence on the ecology of the Coastal Plain of North Carolina. Emphasis will be placed on the coastal fringe (Outer Banks) and the problems involved in Coastal Zone Management. Course is field and problem oriented and is designed primarily for graduate students in environmentally oriented programs. Two field trips are mandatory. Seneca

BO 691 Botany Seminar. *1(1-0) F,S.* Graduate Staff

BO 693 Special Problems in Botany. *Credits Arranged.* Directed research in some phase of botany other than a thesis problem, but designed to provide experience and training in research. Graduate Staff

BO 699 Research. *Credits Arranged. F,S.* Original research preliminary to writing a master's thesis or a doctoral dissertation. Graduate Staff

Chemical Engineering

GRADUATE FACULTY

Professor D. F. Ollis, *Head*

Professor C. K. Hall, *Graduate Administrator*

Professors: R. G. Carbonell, R. M. Felder, J. K. Ferrell, H. B. Hopfenberg, D. B. Marsland, A. S. Michaels, M. R. Overcash, E. P. Stahel, V. T. Stannett; *Adjunct*

Professors: F. O. Mixon, D. R. Squire; *Professors Emeriti:* R. Bright, J. F. Seely, H. B. Smith; *Associate Professors:* P. S. Fedkiw, P. K. Lim, C. J. Setzer, S. Torquato, H. M. Winston; *Adjunct Associate Professor:* J. L. Williams; *Assistant Professors:* C. M. Balik, R. T. Chern, P. K. Kilpatrick, S. W. Peretti; *Lecturers:* H. H. Lamb, W. E. Willis Jr.

The Department of Chemical Engineering offers programs of advanced study leading to the Master of Science, Master of Chemical Engineering and Doctor of Philosophy degrees. Students enrolling for graduate study in the department normally have a bachelor's degree in chemical engineering, but programs can be arranged to accommodate students with degrees in applied mathematics, chemistry, physics and other branches of engineering.

The department occupies 50,000 square feet in the Riddick Engineering Laboratories. Within the building are several general-purpose laboratories for graduate research, fully staffed machine and electronics shops, and a well-equipped instrumental analysis laboratory. Several VAX computers within the department and terminal link to larger mainframe computers provide outstanding programming and word processing capability.

Extensive research in the department is carried out by several faculty members in the areas of biotechnology and polymer and membrane science and engineering. Other active research areas include heterogeneous and homogeneous catalysis, surface science, chemical reaction engineering, fluid dynamics, mass transfer in porous media, solid waste management, membrane separation techniques, batch process simulation and optimization, phase equilibrium thermodynamics, statistical thermodynamics, interfacial phenomena and electrochemical engineering.

The proximity of UNC-Chapel Hill, Duke University and the Research Triangle Park lends considerable support to departmental research programs. The Environmental Protection Agency, for example, has its principal air pollution research facility in the Research Triangle Park, and arrangements can be made for graduate students studying air pollution problems to work at the EPA center under the joint direction of EPA and University staff members.

A brochure describing in greater detail opportunities for graduate study and research in chemical engineering as well as available fellowships and assistantships may be obtained upon request from the graduate administrator.

SELECTED ADVANCED UNDERGRADUATE COURSES

CHE 425 Process System Analysis and Control. *Preq.: CHE 225. 3(3-0) F,S.*

CHE 446 Design and Analysis of Chemical Reactors. *Preq.: CHE 315; Coreq.: CHE 316. 3(3-0) F,S.*

CHE 451 Chemical Engineering Design. *Preqs.: CHE 421, 446. 3(2-2) F,S.*

CHE (BAE) 465 Introduction to Biomedical Engineering. *Preqs.: MA 202 or 212, PY 212 or 208. 3(3-0) F.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

CHE 511 Chemical Engineering Process Modeling. *Preqs.: CHE 311, CHE 312, MA 301. 3(3-0) F.* Applications of the methods of mathematical analysis to the formulation and solution of problems in transport phenomena, process dynamics and chemical reaction engineering. Fedkiw

CHE 513 Thermodynamics I. *Preqs.: CHE 315, 316. 3(3-0) F.* In-depth coverage of chemical engineering thermodynamics principles. Application of non-ideal fluid-phase chemical potentials to problems in phase and chemical reaction equilibria. Relations of molecular structure and intermolecular forces to macroscopic thermodynamic properties. Hall, Kilpatrick,

CHE 515 Transport Phenomena. *Preq.: CHE 311. 3(3-0) F.* A theoretical unified study of transport of momentum, energy and matter. The diffusional operations are introduced in the light of the theory. Carbonell

CHE 516 Transport Phenomena II. *Preq.: CHE 515. 3(3-0) S.* Applications of the principles introduced in CHE 515. The applications discussed include multiphase flow and sedimentation, non-Newtonian and porous media flows, transport through membranes and in electrochemical systems, and thermal instabilities. Carbonell

CHE 517 Chemical Reaction Engineering. *Preq.: CHE 446. 3(3-0) S.* Rates and mechanisms of homogeneous and heterogeneous reactions. Design, analysis and scale-up of batch and continuous chemical reactors. Felder, Stahel

CHE 521 Separation Processes. *Preq.: CHE 312. 3(3-0) S.* The theory and practice of staged multicomponent mass transfer operations and continuous rate processes. Problems unique to specific operations such as extractive and azeotropic distillation. Lamb, Stahel

CHE 525 Chemical Process Control. *Preq.: CHE 425. 3(3-0) F.* The application of control techniques to chemical process systems. Review of single-input, single-output control techniques, sampled data systems and Z-transform methods. Advanced control techniques including multivariable systems, inferential and adaptive control, deadtime control, and interaction analysis. Ferrell, Winston

CHE (OR) 527 Optimization of Engineering Processes. *Preqs.: CHE 451 or OR 501, FORTRAN programming. 3(3-0) F.* The formulation and solution of process optimization problems, with emphasis on nonlinear programming techniques. Computer implementation of optimization algorithms, on-line optimization, simulation methods and structuring of process models to increase computational efficiency. Felder

CHE 535 Engineering Economy in Air Pollution Control Systems. *Preqs.: MAE 409, CE 576 or equivalent first course. 3(3-2) F.* Design of equipment for the abatement of air pollution; estimation of capital cost and operating expenses; economic optimization under various kinds of tax laws. Marsland

CHE 543 Polymer Sciences and Technology. *Preqs.: CHE 223, CHE 316. 3(3-0) F.* Concepts and techniques for the polymerization of macromolecules. Structure, properties, and applications of commercially important polymers. Chern

CHE 551 Biochemical Engineering. *Preqs.: CHE 312, 446. 3(3-0) S.* Enzyme and microbial kinetics and reactor designs for processes involving enzymes and single and mixed cultures. Samples drawn from the full range of applications: food processing, single cell proteins, tissue culture and vaccines, monoclonal antibodies, recombinant DNA and hybridomas, artificial organs, biological waste treatment, and environmental processes. Guinnup, Ollis

CHE 561 Biomedical Engineering I: Fluid Flow and Heat Transfer. *Preq.: CHE (BAE) 465 or equivalent background. 3(3-0) S.* The physiology requisite to modeling and analysis of mammalian systems, coupled with the engineering approach to the biomedical problems of flow of fluids (blood, lymph, air, etc.) in the body and thermal transport from the body surfaces. Beatty, Richardson

CHE (TC) 569 Polymers, Surfactants and Colloidal Materials. *Preqs.: CHE 316, CH 223. 3(3-0) F.* Relationships between molecular structure and bulk properties of nonmetallic materials applied to commercial products and chemical engineering processes. Applications of surface and colloid chemistry and polymer science to product development and process improvement. Chern, Michaels

CHE (TC) 570 Radiation Chemistry and Technology of Polymeric Systems. *Preqs.: CH 221, 431. 3(3-0) S.* Principles and practice of isotope and electron beam radiation treatment. Applications of high energy radiation in polymer chemistry and technology, including the use of radiation to cross-link and degrade polymers. Similarities and differences between radiation polymerization and photopolymerization. Stannett, Williams

CHE 597 Chemical Engineering Projects. *Preq.: Grad. standing. 1-3 F,S.* Independent study of some phase of chemical engineering or a related field. Graduate Staff

CHE 598 Special Topics in Chemical Engineering. *Preq.: Grad. standing. 1-3 F,S.* Directed reading of the chemical engineering literature, introduction to research methodology, and lectures and seminar discussion on topics which vary from term to term. Graduate Staff

FOR GRADUATES ONLY

CHE 611 Chemical Process Design and Simulation. *Preq.: CHE 511. 3(3-0) S.* Application of process analysis, simulation and optimization techniques to case studies of complex chemical processes. Felder

CHE 613 Thermodynamics II. *Preq.: CHE 513. 3(3-0) S.* Topics in chemical engineering thermodynamics. Perturbation theories, critical phenomena, multicomponent phase equilibria, supercritical extraction, irreversible thermodynamics and thermodynamics of macromolecules are representative topics. Hall, Kilpatrick

CHE 617 Advanced Chemical Reaction Engineering. *Preq.: CHE 517. 3(3-0) S.* Topics relating to the design, analysis and operation of homogeneous and heterogeneous chemical reactors. Stahel

CHE 619 Electrochemical Systems Analysis. *Preqs.: CHE 515, 517 or CI. 3(3-0) S. Alt. yrs.* Electrochemical thermodynamics, electrochemical kinetics and catalysis, coupled charge and material transport in an electric field and electrophoretic effects. Design and analysis of electrochemical reactors. Survey of electrochemical industry. Fedkiw

CHE 621 Advanced Mass Transfer. *Preqs.: CHE 515, 521. 3(3-0) Alt. F.* Applications of transport theory to the analysis, synthesis and design of mass-transfer equipment. Principles and design of absorption, extraction, distillation, humidification and drying operations. Carbonell, Lamb

CHE 623 Advanced Fluid Dynamics. *Preqs.: CHE 515, 523. 3(3-0) S.* The principles of fluid dynamics and their application to laminar and turbulent flow, flow in closed channels, flow in packed beds and porous media, particle technology, industrial rheology and two-phase flow. Carbonell

CHE 624 Advanced Heat Transfer. *Preq.: CHE 515, 523. 3(3-0) Alt. S.* Heat transfer between liquids and solids, optimum operating conditions and design of equipment, conduction, heating and cooling of solids, and radiant heat transmission. Ferrell

CHE 651 Separation Processes for Biological Materials. *Preq.: CHE 521 or CHE 551 or CI. 3(3-0) S.* Definition and engineering analysis of major bioseparation techniques useful in product isolation and purification. Topics discussed include solid-liquid separation, crystallization, filtration, extraction, chromatography, membrane processes, distillation, drying, combined operations and process economics. Ollis

CHE (TC) 669 Diffusion in Polymers. *Preq.: CHE 569 or CI. 2(2-0) S.* The theory of small molecule transport in polymers; applications of membrane transport processes in the chemical, polymer, textile, coatings and natural fiber industries. Chern, Hopfenberg

CHE (TC) 671 Special Topics in Polymer Science. *Preq.: CI. 1-3 F.* An intensive treatment of topics in polymer science and technology selected in accord with the state of the art. Chern, Stannett

CHE 693 Advanced Topics in Chemical Engineering. *1-3 F,S.* Recent developments in chemical engineering theory and practice. The topics will vary from term to term. Graduate Staff

CHE 695 Seminar. *1(1-0) F,S.* Weekly seminars on topics of current interest given by resident faculty members, graduate students and visiting lecturers. Graduate Staff

CHE 697 Advanced Chemical Engineering Projects. *Preq.: Grad. standing in CHE. 1-3 F,S, Sum.* Independent study of some phase of chemical engineering or a related field. Graduate Staff

CHE 699 Research. *Credits Arranged. F,S.* Individual research in chemical engineering. A report on this research is required as a graduate thesis. Graduate Staff

Chemistry

GRADUATE FACULTY

Professor K. W. Hanck, *Head*

Professor C. G. Moreland, *Assistant Head for Graduate Studies*

Professor M. L. Miles, *Assistant Head for Business Affairs*

Professor W. P. Tucker, *Assistant Head for Undergraduate Studies*

Professors: K. J. Bachmann, H. A. Bent, R. D. Bereman, L. H. Bowen, C. L. Bumgardner, H. H. Carmichael, L. D. Freedman, F. W. Getzen, F. C. Hentz Jr. Z Z. Hugus Jr., L. A. Jones, S. G. Levine, G. G. Long, A. F. Schreiner, L. B. Sims, E. O. Stejskal, G. H. Wahl Jr., M. H. Whangbo; *Professors Emeriti:* G. O. Doak, R. H. Loeppert, W. A. Reid, P. P. Sutton, R. C. White; *Associate Professors:* C. B. Boss, T. C. Caves, A. F. Coots, Y. Ebisuzaki, S. T. Purrington, W. L. Switzer, D. W. Wertz; *Associate Professor Emeritus:* T. M. Ward; *Assistant Professors:* E. F. Bowden, R. J. Linderman, R. B. van Breemen

The Department of Chemistry offers programs leading to the Master of Chemistry, Master of Science and Doctor of Philosophy degrees. Major fields of specialization are analytical, inorganic, organic and physical chemistry. A wide variety of advanced courses and a broad spectrum of research topics provide preparation for almost every type of position open to a chemist with an advanced degree.

A student entering graduate work in chemistry should have a bachelor's degree in chemistry or its equivalent. This includes the equivalent of one-year

courses in general, organic, physical and analytical chemistry and a semester of inorganic chemistry. At least one year of college physics and two years of mathematics, including differential equations, are necessary. Students who fail to meet these requirements may in some cases be admitted on a provisional basis.

With a large graduate faculty and favorable graduate student to faculty ratio, the chemistry department emphasizes individual attention, small classes and personal collaboration on research with faculty members. Among the variety of active research projects available for thesis work are organic and inorganic synthesis, synthesis/characterization of semiconductors, structure and properties of organometallic compounds and transition metal complexes, stereochemistry, crystallography, kinetics, radiochemistry, electrochemistry, micro and trace analysis, atomic and plasma spectroscopy, micro computer and statistical applications, quantum chemistry, and infrared, Raman, Mossbauer, nuclear magnetic resonance, nuclear quadrupole resonance, electron spin resonance, and natural and magnetic circular dichroism spectroscopy.

The department is equipped with standard instruments and apparatus for teaching and research. Many items of specialized equipment are available including recording spectrophotometers covering the range from far infrared to ultraviolet, nuclear magnetic resonance spectrometers, liquid chromatographs, gas chromatographs, high resolution mass spectrometer, atomic absorption spectrophotometers, electron spin resonance spectrometer, nuclear quadrupole resonance spectrometer, Mossbauer spectrometer, DC plasma spectrometer and X-ray diffractometer. Facilities for interfacing laboratory instruments and computers are available. The department's research activities are housed in a nine-story building and supported by glass, machine and electronic shops.

The department has available for qualified applicants teaching and research assistantships, as well as a number of fellowships.

SELECTED ADVANCED UNDERGRADUATE COURSES

CH 401 Systematic Inorganic Chemistry. *Coreq.: CH 431 or CH 331. 3(3-0) S.*

CH 411 Analytical Chemistry I. *Preq.: CH 434. 4(2-6) F.*

CH 413 Analytical Chemistry II. *Preq.: CH 411. 4(2-6) S.*

CH 428 Qualitative Organic Analysis. *Preq.: CH 223. 3(1-6) F,S.*

CH 431 Physical Chemistry I. *Preqs.: CH 107, MA 202, PY 203 or 208; Coreq.: MA 301. 3(2-1) F,S,Sum.*

CH 433 Physical Chemistry II. *Preqs.: CH 431 and MA 301. 3(2-1) F,S.*

CH 434 Physical Chemistry II Laboratory. *Preq.: CH 431; Coreq.: CH 433. 2(0-4) S.*

CH 435 Physical Chemistry III. *Preqs.: CH 431 and MA 301. 3(3-0) F.*

CH (TC) 461 Introduction to Fiber-Forming Polymers. *Preq.: CH 223. 3(3-0) F.*

CH 490 Chemical Preparations. *Preq.: Three years of CH. 3(0-9) F,S.*

CH 493 Chemical Literature. *Preq.: Three years of CH. 1(1-0) F.*

CH 499 Senior Research in Chemistry. *Preq.: Three years of CH. Credits Arranged. 1-3 F,S,Sum.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

CH 501 Advanced Inorganic Chemistry I. *Preq.: CH 433. 3(3-0) F.* The major emphasis of this course is on the complexes of the transition metals (3d, 4d and 5d). Topics included are the structure, stability, synthesis and raction mechanisms of these complexes. Included also is the consideration of organometallic compounds and of species containing metal-metal bonds.

CH 502 Inorganic Syntheses and Measurements. *Preq.: CH 401. 2(0-6) F.* Synthetic methods in inorganic chemistry, including high-temperature, electrolytic, inert-atmosphere, vacuum line and solvent-system methods. Separation and characterization techniques for inorganic systems will be widely employed.

CH 503 Advanced Inorganic Chemistry II. *Preq.: CH 501. 3(3-0) S.* This course, a continuation of CH 501, deals with the use of photochemical reactions as applied to inorganic complexes, metal cluster complexes and organometallic systems. Other topics treated at length are solid-state chemistry and bioinorganic chemistry. Discussion of structure, synthesis, energetics, reactions and applications is presented. In addition, other topics of current research interest in inorganic chemistry are briefly discussed.

CH 505 Physical Methods in Inorganic Chemistry. *Preqs.: Grad. standing and CH 501 or CI. 3(3-0) S.* The course will describe the use of group, molecular orbital and ligand field theories for spectroscopy and bonding; measurement methodology and the significance of experimental parameters, including electronic, photoluminescence, photoelectron, vibrational spectroscopies, magnetic susceptibility, Mossbauer, esr, nmr, nqr and x-ray structure determinations.

CH (MAT) 507 Chemical Concepts in Materials Science and Engineering. *3(3-0) F.* (See materials science and engineering.)

CH 515 Chemical Instrumentation. *Preq.: CH 431; Coreq.: CH 411. 3(3-0) S.* Basic electronic components and circuits, the response of laboratory instruments, design and modification of typical electronic control and measurement systems. Emphasis will be placed on the transducers and control elements utilized in chemical research.

CH 517 Physical Methods of Elemental Trace Analysis. *Preq.: CH 315 or 331 or CI. 3(3-0) F.* The principles and applications of currently used methods of trace analysis are presented. Designed for students with little or no experience in trace analysis but with a strong interest in or need for analytical data at the trace level. Topics include pulse polarography, potentiometry, UV-Vis spectrophotometry, atomic absorption, emission spectrometry, fluorescence, neutron activation analysis and spark source mass spectrometry.

CH 518 Trace Analysis Laboratory. *Coreq.: CH 517 or CI. 2(0-6) F.* The trace element content of samples is determined by a variety of instrumental techniques including UV-Vis spectrophotometry, fluorescence, emission spectrometry, atomic absorption, pulse polarography and neutron activation analysis.

CH 521 Advanced Organic Chemistry I. *Preqs.: CH 223, 433 or 435. 3(3-0) F.* Structure stereochemistry and reactions of the various classes of hydrocarbons. The molecular orbital treatment of bonding and reactivity of alkenes, the conformational interpretation of cycloalkene and cycloaklene reactivity and the application of optical isomerism to the study of reaction mechanisms will be emphasized.

CH 523 Advanced Organic Chemistry II. *Preq.: CH 521. 3(3-0) S.* An introduction to acid-base theory and mechanistic organic chemistry as applied to synthetically useful organic reactions.

CH 525 Physical Methods in Organic Chemistry. *Preqs.: CH 223 and 433 or 435. 3(3-0) S.* Application of physical methods to the solution of structural problems in organic chemistry. Emphasis will be on spectral methods including infrared, ultraviolet, nuclear magnetic resonance, mass spectrometry, electron paramagnetic resonance, X-ray and electron diffraction and optical rotatory dispersion.

CH 530 Advanced Physical Chemistry. *Preq.: Grad. standing or CI. 3(3-0) F.* A survey of chemical thermodynamics and kinetics, with emphasis on reactions in the liquid phase. Problem solving is an important part of the course. Designed to review and to expand on materials usually covered in a one-year undergraduate physical chemistry course.

CH 531 Chemical Thermodynamics. *Preqs.: CH 433, MA 301. 3(3-0) F.* An extension of elementary principles to the treatment of ideal and real gases, ideal solutions, electrolytic solutions, galvanic cells, surface systems and irreversible processes. An introduction to statistical thermodynamics and the estimation of thermodynamic frunctions from spectroscopic data.

CH 533 Chemical Kinetics. *Preqs.: CH 433, MA 301. 3(3-0) S. Alt. yrs.* An intensive survey of the basic principles of chemical kinetics with emphasis on experimental and mathematical techniques, elements of the kinetic theory and theory of the transition state. Applications to gas reactions, reactions in solution and mechanism studies.

CH 535 Surface Phenomena. *Preqs.: CH 433, MA 301. 3(3-0) S. Alt. yrs.* An intensive survey of the topics of current interest in surface phenomena. Formulations of basic theories are presented together with illustrations of their current applications.

CH 536 Chemical Spectroscopy. *Preq.: CH 435. 3(3-0) S. Alt. yrs.* Introduction to rotational, vibrational and electronic molecular spectroscopy from a quantum mechanical viewpoint. Emphasis on the elucidation of structure, bonding and excited state properties of organic and inorganic molecules.

CH 537 Quantum Chemistry. *Preqs.: MA 301, CH 435 or PY 407. 3(3-0) S.* The elements of wave mechanics applied to stationary energy states and time dependent phenomena. Applications of quantum theory to chemistry, particularly chemical bonds.

CH 539 Colloid Chemistry. *Preqs.: CH 220, 315 or 331, or CI. 3(2-3) S. Alt. yrs.* Theories, basic principles and fundamental concepts including preparation and behavior of sols, gels, emulsions, foams and aerosols and topics in areas of adsorption, Donnan equilibrium dialysis and small-particle dynamics. Laboratory includes independent project studies in specialized areas.

CH 541 Nuclear Chemistry. *Preq.: CH 433 or PY 410. 3(2-3) S. Alt. yrs.* The basic aspects of nuclear chemistry including: (i) nuclear reactions and energy levels, (ii) the types and energetics of radioactive decay, (iii) the formation and properties of radioactive elements, (iv) the effect of individual isotopes on chemical and physical properties and (v) the effects of nuclear radiation on matter.

CH (TC) 562 Physical Chemistry of High Polymers—Bulk Properties. *3(3-0) F.* (See textile chemistry.)

CH 595 Special Topics in Chemistry. *Preq.: CI. 1-3 F,S.* Detailed study of a particular problem or technique pertaining to chemistry.

FOR GRADUATES ONLY

CH 613 Electrochemistry. *Preq.: CH 433. 3(3-0) S. Alt. yrs.* The thermodynamics and kinetics of electrode reactions are presented as well as the experimental methods for studying them. Particular emphasis is placed on the measurement of standard potential and establishing the number of electrons transferred. Applications of electrochemistry in the production/storage of energy and in chemical analysis are discussed.

CH 625 Organic Reaction Mechanisms. *Preqs.: CH 523, CH 433. 3(3-0) S.* A study of the effects of structure and substituents on the direction and rates of organic reactions.

CH 627 Chemistry of Metal-Organic Compounds. *Preq.: CH 521. 3(3-0) F. Alt. yrs.* Preparation, properties and reactions of compounds containing the carbon-metal bond with a brief description of their uses.

CH 631 Chemical Thermodynamics II. *Preq.: CH 531. 3(3-0) S. Alt. yrs.* Statistical interpretation of thermodynamics; use of partition functions; introduction to quantum statistics; application of statistical mechanics to chemical problems, including calculation of thermodynamic properties, equilibria and rate processes.

CH (BCH) 659 Natural Products. *Preqs.: CH 523, 525 or CI. 3(3-0) F.* Illustrative studies of structure determination, synthesis and biosynthesis of natural substances. Modern physical methods and fundamental chemical concepts are stressed. Examples are chosen from such classes as alkaloids, terpenes, steroids and antibiotics.

CH 691 Seminar. *Preq.: Grad. standing in CH. 1(1-0) F,S.* Scientific articles, progress reports on research and special problems of interest to chemists are reviewed and discussed.

CH 695 Advanced Topics in Chemistry. *Preq.: CI. Maximum 3 F,S.* Critical study in one of the branches of chemistry.

CH 697 Advanced Chemistry Projects. *Preq.: Grad. standing in CH. 1-3. F,S,Sum.* Independent literature study of a current subject in chemistry. A critical review paper of the selected subject must be written.

CH 699 Chemical Research. *Preq.: Grad. standing in CH. Credits Arranged. F,S.* Special problems that will furnish material for a thesis. A maximum of six semester credits is allowed toward a master's degree; there is no limitation on credits in the doctoral program.

Civil Engineering

GRADUATE FACULTY

Professor P. Z. Zia, *Head*

Professor H. E. Wahls, *Associate Head, Graduate Program*

Professors: M. Amein, P. D. Cribbins, R. A. Douglas, J. F. Ely, J. S. Fisher, W. S. Galler, A. K. Gupta, K. S. Havner, Y. Horie, J. W. Horn, D. W. Johnston, N. P. Khosla, P. H. McDonald, C. C. Tung; *Adjunct Professors:* R. C. Heath, L. E. King; *Professors Emeriti:* W. F. Babcock, R. E. Fadum, C. L. Heimbach, A.-A. I. Kashef, S. W. Nunnally, C. Smallwood Jr., M. E. Uyanik; *Associate Professors:* S. H. Ahmad, W. L. Bingham, R. H. Borden, A. C. Chao, E. D. Gurley, H.

R. Malcom Jr., V. C. Matzen, M. S. Rahman, W. J. Rasdorf, J. C. Smith, J. R. Stone; *Adjunct Associate Professor:* J. E. Tidwell; *Assistant Professors:* R. C. Borden, F. Farid, P. C. Lambe, J. M. Nau, M. F. Overton, R. R. Rust, A. E. Schultz

The Department of Civil Engineering offers programs of study leading to the Master of Civil Engineering, Master of Science and Doctor of Philosophy degrees. Students may major in construction engineering, geotechnical engineering, public works engineering, structural engineering and mechanics, transportation engineering, coastal and ocean engineering, or sanitary and water resources engineering.

The Master of Civil Engineering degree is a non-thesis program emphasizing engineering design and practice. The program of study must include a minimum of three credit hours of independent study with a final written report. The Master of Science degree requires a thesis for which no more than six semester hours of credit may be used to satisfy the minimum degree requirements. For both degrees, the major and supporting areas of study may be selected from specialty areas within the Department of Civil Engineering. Both degrees require a final oral examination.

For the doctoral program, there are no definite requirements in credit hours. The coursework usually requires about one year of full-time study beyond the master's degree. The major element of the doctoral program is the dissertation, which reports an original investigation that represents a significant contribution to knowledge.

The faculty is engaged in broad research areas including deterministic and probabilistic structural theories and mechanics, fundamental behavior of soils and structures, computer-aided design, artificial intelligence, highway safety, land use and urban planning, hydraulics and hydrology, coastal processes, materials, construction engineering and management, waste disposal and pollution control. Many of the investigations are sponsored by industries and federal and state agencies including the continuing cooperative highway research program.

The department cooperates with other University divisions in joint programs. The department, in collaboration with the Department of Political Science and Public Administration, offers a program in public works engineering administration leading to the Master of Civil Engineering with a co-major in public affairs. Qualified students may schedule courses in this department and in the Department of City and Regional Planning at the University of North Carolina at Chapel Hill to receive a dual degree, a Master of Science with a major in transportation engineering and a Master of Regional Planning. Multidisciplinary study and research programs are also available through the North Carolina Institute for Transportation Research and Education, Water Resources Research Institute and the North Carolina Sea Grant Program.

Students in other disciplines may develop minor areas of study within the framework of departmental course offerings. In particular, courses of instruction in stream sanitation and industrial waste disposal provide the types of training in pollution often in demand by industry.

Brochures and supplementary information on graduate study, research and assistantships and fellowships are available upon request from the graduate administrator of the Department of Civil Engineering. For applicants without a degree from a U.S. institution, GRE scores are required to expedite consideration for admission and financial aid. This requirement may be waived upon written request for applicants with an exceptional scholastic record.

SELECTED ADVANCED UNDERGRADUATE COURSES

CE 406 Transportation Systems Engineering. *Preq.: CE 305; Coreqs.: IE 311, CE 375. 3(3-0) F,S.*

CE 425 Intermediate Structural Analysis. *Preq.: CE 325. 3(3-0) F,S.*

CE 426 Structural Steel Design. *Preq.: CE 325. 3(3-0) F,S.*

CE 428 Structural Design in Wood. *Preq.: CE 325. 3(2-2) F.*

CE 443 Seepage, Earth Embankments and Retaining Structures. *Preq.: CE 342. 3(3-0) F,S.*

CE 463 Cost Analysis and Control. *Preq.: CE 365. 3(2-3) F,S.*

CE 464 Legal Aspects of Contracting. *Preq.: Sr. standing. 3(3-0) F,S.*

CE 466 Building Construction Engineering. *Preqs.: CE 327, 365; Coreq.: CE 426. 3(2-2) F,S.*

CE 484 Water Supply and Waste Water Systems. *Preq.: CE 383. 3(3-0) F,S.*

CE 498 Special Problems in Civil Engineering. *Preq.: Sr. standing. 1-4 F,S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

CE 501 Transportation Systems Analysis. *Preq.: CE 406. 3(3-0) F.* Application of systems analysis to multi-modal transportation studies. Covers the analysis, planning and design of transport facilities for both the public and private sectors. Planning is discussed from the short-run as well as the long-run perspective. Stone

CE 502 Transportation Operations. *Preq.: CE 406. 3(3-0) S.* The analysis of traffic and transportation engineering operations. Graduate Staff

CE 503 Transportation Design. *Preq.: CE 406. 3(2-3) S.* The geometric elements of traffic and transportation engineering design. Cribbins, Horn

CE 504 Water Transportation. *Preq.: CE 305. 3(3-0) F.* The planning, design, construction and operation of waterways, ports, harbors and related facilities. Development of analytical techniques for evaluating the feasibility of piers, ports and multipurpose river basin projects. The design of marine structures and civil works that are significant in civil engineering, including locks, dams, harbors, ports and contractive and protective works. Cribbins

CE 505 Mass Transportation. *Preq.: CE 406. 3(3-0) S.* Definition of the characteristics, trends, issues and technologies related to mass transportation, and the identification of methodologies applicable to the planning, design and management of mass transportation systems. This includes applications to the urban, inter-urban and rural settings for both short- and long-range planning horizons. Stone

CE 506 Municipal Engineering Projects. *Preq.: Sr. standing in CE or CEC. 3(2-3) S.* Special problems relating to public works, public utilities, urban planning and city engineering. Horn

CE 507 Airphoto Analysis I. *Preq.: Sr. standing. 3(2-3) S.* Principles and concepts for engineering evaluation of aerial photographs, including analysis of soils and surface drainage characteristics. Wahls

CE 511, 512 Continuum Mechanics I, II. *Preqs.: CE 313 or MAE 314, CE 382 or MAE 308, MAE 301, MA 405. (511) 3(3-0) F; (512) 3(3-0) S. Alt. yrs.* The concepts of stress and strain are presented in generalized tensor form. Emphasis is placed on the discussion and relative comparisons of the analytical models for elastic, plastic, fluid, viscoelastic, granular and porous media. The underlying thermodynamic principles are presented, the associated boundary value problems are formulated and selected examples are used to illustrate the theory. McDonald

CE 513 Theory of Elasticity I. *Preq.: CE 313 or MAE 314. 3(3-0) S.* The fundamental equations governing the behavior of an elastic solid are developed in various curvilinear coordinate systems. Plane problems, as well as the St. Venant problem of bending, torsion and extension of bars are covered. Displacement fields, stress fields, Airy and complex stress functions are among the methods used to obtain solutions.
Douglas, Gurley, Horie

CE 514 Stress Waves. *Preqs.: MA 301; CE 313 or PY 411 or MA 401 or MEA 351. 3(3-0) F. Alt. yrs.* Introduction to the theory of stress waves in solids. Origins and nature of longitudinal transverse and surface waves originating at an impact site or from other transient disturbances. Determination of stresses, particle velocities, wave velocities. Introduction to wave interaction with other waves and with boundaries and dissimilar materials. Introduction to modern instrumentation and seismic refraction exploration.
Douglas

CE 521 Advanced Strength of Materials. *Preq.: CE 313 or MAE 314. 3(3-0) F.* Stresses and strains at a point: rosette analysis; strength theories, stress concentration and fatigue; torsion and unsymmetrical bending of open and closed sections; inelastic, composite and curved beams; energy methods; shear deflections; and membrane stresses in shells.
Graduate Staff

CE 522 Elastic Stability. *Preqs.: CE 521, MA 301, 405. 3(3-0) S.* A study of elastic and plastic stability. The stability criterion as a determinant. The energy method and the theorem of stationary potential energy. The solution of buckling problems by finite differences and the calculus of variations. The application of successive approximations to stability problems. Graduate Staff

CE 524 Analysis and Design of Masonry Structures. *Coreq.: CE 427. 3(3-0) F. Alt. yrs.* Theory and design of masonry arches, culverts, dams, foundations and masonry walls subjected to lateral loads. Graduate Staff

CE 525 Matrix Structural Analysis. *Preq.: CE 425. 3(3-0) F.* Direct formulation of the banded system stiffness matrix and loading vectors for a first order Displacement Method analysis of two- and three-dimensional structural frames, trusses and grids; analysis by substructures; effects of prestrain, temperature, support settlements, shear deformations and joint deformations; second order analysis; computer applications using existing computer programs. Smith

CE 526 Finite Element Methods for Civil Engineering. *Preqs.: CE 425 and prior programming knowledge. 3(3-0) S.* A basic course in finite element method for civil engineering. Development, theory and formulation of various finite elements. On-hand finite element computer programming. On-hand finite element analysis of civil engineering problems, such as dam structures, hyperbolic cooling towers, slabs and soil-structure interaction problems. Gupta

CE 527 Analysis and Design of Structures for Dynamic Loads. *Preq. or coreq.: CE 525. 3(3-0) F.* Analysis and design of single and multi-degree-of-freedom structures subjected to various types of excitations and initial conditions. Computational aspects of dynamic analysis. Introduction to nonlinear analysis techniques and to approximate methods of analysis. Consideration of strong motion earthquakes. Study of earthquake regulations in building codes. Matzen, Nau

CE 531 Structural Models. *Preq.: CE 427. 3(2-3) F.* Dimensional analysis and structural similitude, indirect and direct models, model materials and experimental techniques, individual project in structural model analysis. Bingham, Matzen

CE 534 Plastic Analysis and Design. *Preq.: CE 427. 3(3-0) S.* Theory of plastic behavior of steel structures; concept of design for ultimate load and the use of load factors. Analysis and design of components of steel frames including bracings and connections. Ely, Smith

CE 536 Theory and Design of Prestressed Concrete. *Coreq.: CE 427. 3(3-0) F.* The principles and concepts of design in prestressed concrete including elastic and ultimate strength analyses for flexure, shear, torsion, bond and deflection. Principles of concordancy and linear transformation for indeterminate prestressed structures. Application of prestressing to tanks and shells. Ahmad, Zia

CE (MEA) 541 Gravity Wave Theory I. *3(3-0) S.* (See marine, earth and atmospheric sciences.)

CE 543 Hydraulics of Ground Water. *Preq.: CE 382 or 342 or equivalent. 3(3-0) S.* Principles of ground water hydraulics; theory of flow through idealized porous media; the flow net solution; seepage and well problems. R. C. Borden

CE 544 Foundation Engineering. *Preq.: CE 342. 3(3-0) S.* Subsoil investigations; excavations; design of sheeting and bracing systems; control of water; footing, grillage and pile foundations; caisson and cofferdam methods of construction. R. H. Borden, Lambe

CE 548 Engineering Properties of Soils I. *Preq.: CE 342. 3(2-3) F.* The study of soil properties that are significant in earthwork engineering, including properties of soil solids, basic physiochemical concepts, classification, identification, plasticity; permeability, capillarity and stabilization. Laboratory work includes classification, permeability and compaction tests. R. H. Borden

CE 549 Engineering Properties of Soils II. *Preq.: CE 548. 3(2-3) S.* Continuation of CE 548, including the study of compressibility, stress-strain relations and shear strength theories for soil. Laboratory work includes consolidation and shear strength tests.
R. H. Borden

CE 551 Theory of Concrete Mixtures. *Preq.: CE 332. 3(3-0) F.* A study in depth of the theory of portland cement concrete mixtures including types and properties of portland special cements; chemical reactions; brief examination of history of mixture design; detailed study of current design methods; properties of fresh and hardened concretes; strength-age-curing relationships; durability; admixtures; special concretes; production and quality control. Graduate Staff

CE 553 Asphalt and Bituminous Materials. *Preq.: CE 332. 3(2-3) S.* A study in depth of properties of asphalts and tars for use in waterproofing and bituminous materials, and theories of design of bituminous mixtures for construction and paving uses including types and properties of asphalt cements, cutbacks, emulsions, blown asphalts and tars; brief examination of historical developments; detailed study of properties and design of bituminous mixtures; and current research. Laboratory work includes standard tests on asphalts, tars and road oils; design, manufacture and testing of trial batches; and current research techniques. Khosla

CE 555 Highway and Airport Pavement Design. *Preq.: CE 406 or 443. 3(2-3) F.* Theoretical analysis and design of highway and airport pavements with critical evaluation of current design practices. Khosla

CE 561 Construction Planning and Scheduling. *Preq.: CE 463. 3(3-0) F.* Construction project planning, scheduling and control utilizing network methods. Both manual and computer techniques will be applied. Introduction to other quantitative management methods in construction. Utilizing the principles developed, students will bid, plan, schedule and manage a construction project under competitive conditions in a computer-simulated environment. Graduate Staff

CE 562 Construction Productivity. *Preq.: CE 463 or equivalent. 3(3-0) F.* Methods of collecting, assembling and analyzing construction productivity data in order to increase construction productivity. Applications of methods improvement techniques such as time-lapse photography, flow charts, process charts and time standards to the improvement of construction productivity. Safety and human factors in construction and their relation to construction productivity. Graduate Staff

CE 566 Building Construction Systems. *Preq.: CE 466 or CE 427 or grad. standing in ARC. 3(3-0) S.* Construction engineering of conventional and industrialized building systems. Emphasis in the areas of structural systems utilizing cast-in-place concrete, precast concrete, prestressed concrete, structural steel, cold-formed steel, masonry, timber, composite and mixed materials. Topics include mechanisms for resisting and transmitting loads, detailing, fabrication, transportation, erection, stability, shoring, quality control and integration of service systems. Johnston

CE (BAE, MB) 570 Sanitary Microbiology. *Preq.: MB 401 or equivalent. 3(2-3) S.* Fundamental aspects of microbiology and biochemistry are presented and related to problems of stream pollution, refuse disposal and biological treatment. Laboratory exercises present basic microbiological techniques and illustrate from a chemical viewpoint some of the basic microbial aspects of waste disposal. Chao

CE 571 Theory of Water and Waste Treatment. *Preq.: Grad. standing. 3(3-0) F.* Study of the basic physical and chemical processes underlying water and waste treatment, including mass transfer, equilibria, and kinetics. Galler

CE 572 Design of Water and Wastewater Facilities. *Preq.: CE 571. 3(3-0) S.* Theory and design of water and wastewater treatment plants. Chao

CE 573 Unit Operations and Processes in Waste Treatment. *Preq.: CE 486; Coreq.: CE 571. 3(1-6) F.* Unit operations and processes in water and wastes engineering, including sedimentation, thickening, chemical coagulation, vacuum filtration, carbon adsorption, biological treatment, and special projects. Chao, Galler

CE 575 Civil Engineering Systems. *Preq.: MA 405. 3(3-0) S.* An examination of civil engineering systems and their design optimization. The systems to be studied include water resources engineering, structural engineering, transportation engineering and construction. Galler

CE 576 Atmospheric Pollution. *Preq.: Grad. or advanced undergrad. standing. 3(3-0) S.* A survey of the problem of atmospheric pollution. Topics to be discussed include: pollutant sources; effects on man and other animals, vegetation, materials and visibility; meteorological factors, air sampling; control devices; air quality and emission standards; and legal, economic and administrative aspects. Graduate Staff

CE (BAE) 578 Agricultural Waste Management. *3(2-3) F.* (See biological and agricultural engineering.)

CE 580 Flow in Open Channels. *Preq.: CE 382. 3(3-0) F.* The theory and applications of flow in open channels, including dimensional analysis, momentum-energy principle, gradually varied flow, high-velocity flow, energy dissipators, spillways, waves, channel transitions and model studies. Amein

CE 582 Coastal Hydrodynamics. *Preq.: CE 382 or equivalent. 3(3-0) F.* Surface gravity waves, solitary waves, longwaves, impulsively generated waves, flow in inlets and estuaries, storm surge, wave refraction and diffraction, harbor oscillations. Overton

CE 583 Engineering Aspects of Coastal Processes. *Preq.: CE 382 or equivalent; Coreq.: MEA (CE) 541. 3(3-0) S.* Coastal environment, engineering aspects of the mechanics of sediment movement, littoral drift, beach profiles, beach stability, meteorological effects, tidal inlets, inlet stability, shoaling, deltas, beach nourishment, mixing processes, pollution of coastal waters, interaction between shore processes and man-made structures, case studies. Fisher

CE 585 Urban Stormwater Management. *Preq.: CE 383. 3(3-0) F.* Studies of stormwater management in urban areas emphasizing quantitative problems in flooding, sedimentation and water quality. Review and extension of design concepts involving channels and impoundments. Survey of hydrographic formation techniques and examination of common hydrologic models. Case studies of urbanizing watersheds. Malcom

CE 589 Special Topics in Civil Engineering. *3(3-0) F,S.* New or special course on recent developments in some phase of civil engineering. Specific topics and prerequisites are identified for each section and will vary from term to term. Graduate Staff

CE 591, 592 Civil Engineering Seminar. *11(1-0) F,S.* Discussions and reports of subjects in civil engineering and allied fields. Graduate Staff

CE 598 Civil Engineering Projects. *1-6 F,S.* Research- or design-oriented independent study and investigation of a specific civil engineering topic, which culminates in a final written report. A minimum of three credits required for the MCE degree.
Graduate Staff

FOR GRADUATES ONLY

CE 601 Transportation Planning. *Preq.: CE 502. 3(3-0) S.* The planning, administration, economics and financing of various transportation engineering facilities. Cribbins

CE 602 Advanced Transportation Design. *Preq.: CE 503. 3(2-3) F.* Design of major traffic and transportation engineering projects. Horn

CE 603 Airport Planning and Design. *Coreq.: CE 502. 3(2-3) F.* The analysis, planning and design of air transportation facilities. Cribbins

CE 604 Urban Transportation Planning. *Preq.: CE 502. 3(3-0) S.* Planning and design of urban transportation systems as related to comprehensive urban planning; principles of land use planning, urban thoroughfare planning and regional planning. Graduate Staff

CE 605 Traffic Flow Theory. *Preqs.: CE 502, ST 515. 3(3-0) F.* The theoretical techniques used to describe vehicular traffic movement on a street or highway network, including the use of differential-difference equations, hydrodynamic models, probabilistic models, and computer simulation. Graduate Staff

CE 614 Plasticity and Limit Analysis. *Preq.: CE 513 or 521. 3(3-0) S. Alt. yrs.* Stress-strain rate relationships and theorems of limit analysis and shakedown in plastic solids. Application to collapse load calculations in arches, rings, plates and axisymmetric shells. Introduction to slip-line field theory of plane plastic flow and to dynamic limit analysis.
Havner

CE 615 Finite Deformation of Materials I. *Preqs.: CE 511 or 513, MA 512. 3(3-0) F. Alt. yrs.* Application of the principles of classical continuum mechanics to the study of large deformation of solid materials. Finite strain geometry and kinematics, work-conjugate stress and stress-rate measures, rotating reference frames, local balance laws and jump conditions. Constitutive equations of nonlinearly elastic and inelastic behavior, general theorems for rate-type boundary value problems, conditions for bifurcation of solution.
Havner

CE 616 Finite Deformation of Materials II. *Preq.: CE 615. 3(3-0) S. Alt. yrs.* Continuation of the study of finite deformation of materials, with emphasis on metal plasticity. Analytical connections between constituent and aggregate behavior in heterogeneous solids. Kinematics of crystals, theories of slip-system hardening, existence of plastic potentials. Physical and mathematical justification for the normality postulate in polycrystalline plasticity. Considerations of experiment, analysis of various mechanical tests at finite strain.
Havner

CE 618 Optical Mechanics. *Preq.: CE 311. 3(2-3) S. Alt. yrs.* Concepts of crystal optics applied to continua deformed statically or dynamically by mechanical loading; optical interference and its use as a measuring technique of absolute and relative retardations in various types of interferometers; relative retardation measurements; deformation measurements with diffraction grating; Moire (mechanical) interference measurements.
Bingham

CE 619 Experimental Methods in Mechanics. *Preq.: CI. 3(2-3) S. Alt. yrs.* A study of specialized experimental techniques utilized in contemporary research in the areas of mechanics.
Bingham, Douglas

CE 620 Numerical Methods in Structural Mechanics. *Preqs.: CE 525 and CE 521 or CE 513. 3(3-0) F.* Finite difference and finite element methods in two- and three-dimensional elastic structures, including plates, plane stress and plane strain problems, axisymmetric solids. Analytical basis of approximations: series expansions; energy theorems; virtual work. Matrix decompositions and iteration techniques for digital computer solution. Introduction to nonlinear analysis.
Havner

CE 623 Theory of Plates and Shells. *Preq.: CE 513 or CE 521. 3(3-0) F.* Small and large deflection theories of thin plates; membrane analysis of shells. Various methods of analysis are discussed and illustrated by problems of practical interest.
Gupta

CE 624 Analysis and Design of Structural Shells and Folded Plates. *Preq.: CE 623. 3(3-0) S. Alt. yrs.* Treatment of roof structures in the form of folded and curved surfaces. Membrane and bending stress analysis of folded plates, shells of revolution, cylindrical and conical shells and free-form systems. Numerical and closed form solutions. Design criteria for concrete and metallic structures.
Gupta

CE 625, 626 Advanced Structural Design I, II. *Preqs.: (625): CE 427, CE 525; (626) CE 427; Coreqs.: (626) CE 525, 526. (625) 3(3-0) S. (626) 3(2-3) F. Alt. yrs.* Complete structural design of a variety of projects including comparative study of alternative solutions. Discussions of long span structural systems.
Graduate Staff

CE 627 Advanced Analysis and Design of Structures for Dynamic Loads. *Preq.: CE 527. 3(3-0) F. Alt. yrs.* Consideration of the following advanced topics in the analysis and design of structures for dynamic loads: eigenvalue routines and numerical integration techniques; response analysis through the frequency domain; investigation of damping; variational formulation of the equations of motion; analysis and design of continuous systems; approximate methods of analysis; and special topics.
Matzen

CE 628 Earthquake Structural Engineering. *Preq.: CE 527. 3(3-0) S.* Study of the effects of earthquakes on structures and of the design of structures to resist earthquake motions; earthquake mechanisms and ground motions; response of structures to earth-

quake motions; behavior of materials, structural elements and assemblages subjected to earthquakes; principles of earthquake-resistant design practice; soil-structure interactions; and special topics. Gupta, Nau

CE 632 Probabilistic Methods of Structural Engineering. *Preqs.: CE 525 and MA 421. 3(3-0) F. Alt. yrs.* Application of probability theory and stochastic processes to the study of safety of structures. Fundamentals of probability theory and stochastic processes; probabilistic modelings of structural loadings, material properties and risk. Reliability analysis of structures; reliability-based design criteria. Random vibration of simple structures; safety analysis of structures under dynamic loads. Tung

CE 635 Advanced Theory of Concrete Structures. *Preq.: CE 536. 3(3-0) S.* Inelastic theory of structural concrete members under flexure, axial load, combined flexure and axial compression, shear and torsion. Yield line theory of slabs. Limit analysis of beams and frames of reinforced and prestressed concrete. Ahmad, Zia

CE 641, 642 Advanced Soil Mechanics. *Preq.: Grad. standing. 3(3-0) F,S.* Theories of soil mechanics; failure conditions; mechanical interaction between solids and water, and problems in elasticity and plasticity pertaining to earthwork engineering. Wahls

CE 644 Ground Water Engineering. *Preq.: CE 543 or equivalent. 3(3-0) F.* Ground water problems as related to engineering works, ground water circulation and inventories, subsidence of the ground and its evaluation due to pumping, method of images applied to water circulation of wastes and salt water encroachment in coastal aquifers, transient flow systems in wells and earth dams and embankments. Leakage problems, practical ground water problems and their analysis by computers and electrical models. The legal aspects of ground water conservation and the implied technical and engineering phases.
R. C. Borden

CE 646 Dynamics of Soils and Foundations. *Preq.: CE 641. 3(3-0) S. Alt. yrs.* The application of vibration and wave propagation theories to soil media; the review of existing experimental data and empirical procedures for analysis of foundation vibrations, the prediction of soil responses to impulse loads, dynamic properties of soils and methods for their determination, design procedures for foundation subjected to dynamic forces.
Rahman, Wahls

CE 665 Construction Equipment Systems. *Preq.: CE 561 or CE 562 or equivalent. 3(3-0) S.* Analysis of earthmoving and other heavy construction processes as systems in order to optimize the selection and employment of construction equipment. Considerations in system design, cost and productivity estimation, operational procedures, safety, and maintenance. Computer applications utilizing analytical and simulation techniques.
Graduate Staff

CE 671 Advanced Water Management Systems. *Preq.: CE 484; Coreqs.: CE 571, 573. 4(3-3) F.* The application of systems analysis methods to the design, analysis and management of water and waste systems. Galler

CE 672 Advanced Water and Waste Treatment: Principles and Design. *Preq.: CE 571. 4(3-3) S.* Theory and design of physiochemical processes used to control phosphorus, nitrogen, trace metals and toxic organic substances in water. Galler

CE 673 Industrial Water Supply and Waste Disposal. *Coreq.: CE 571. 3(3-0) F.* Water requirements of industry and the disposal of industries wastes. Graduate Staff

CE 674 Stream Sanitation. *Coreq.: CE 571. 3(3-0) S.* Biological, chemical and hydrological factors that affect stream sanitation and stream use. Graduate Staff

CE 681 Behavior and Analysis of Ocean Structures. *Preq.: CE 527. 3(3-0) S. Alt. yrs.* Introduction to linear and random water waves, analysis of wave forces on small bodies, analysis of wave forces on large bodies, response of offshore structures to waves and earthquake loadings, mooring dynamics. Tung

CE 685 Design of Coastal Facilities. *Preqs.: CE 582 and CE 583. 3(3-0) F.* Types and functions of coastal structures, computation of wave forces on coastal structures, wave uprush, shore protection against waves and storms, planning and design of navigation channels, port development, harbor design, dredging technology, planning and design of offshore platforms, technology of disposal of wastes and heated discharge, consideration of environmental effects of waste disposal. Fisher

CE 687 Numerical Modeling for Nearshore Flow Systems. *Preq.: CE 580 or CE 582 or MEA (CE) 541 or equivalent. 3(3-0) S.* Basic concepts of finite difference methods, methods of characteristics, estuarine and inlet flow computations, implicit methods, surge on the open coast. Introduction to circulation in sounds and bays, modeling of ocean circulation, modeling of sediment movement, mixing processes, water quality modeling. Amein

CE 689 Advanced Topics in Civil Engineering. *3(3-0) F,S.* New or special course on advanced developments in some phase of civil engineering. Specific topics and prerequisites are identified for each section and will vary from term to term. Graduate Staff

CE 698 Advanced Reading in Civil Engineering. *Preq.: Grad. standing. 1-3 F,S.* Directed reading of advanced topics in some phase of civil engineering. Graduate Staff

CE 699 Civil Engineering Research. *Credits Arranged. F,S.* Independent investigation of an advanced civil engineering problem; a report of such an investigation is required as a graduate thesis. Graduate Staff

Computer Science

GRADUATE FACULTY

Professor R. E. Funderlic, *Head*

Professors: W. Chou, D. C. Martin, L. B. Martin, D. F. McAllister, W. J. Stewart, K.-C. Tai, A. L. Tharp; *Professor Emeritus:* P. E. Lewis; *Associate Professors:* E. W. Davis Jr., R. J. Fornaro, T. L. Honeycutt, H. G. Perros, W. E. Robbins, R. D. Rodman, C. D. Savage; *Visiting Associate Professors:* H. M. Abdel-Wahab, J. A. Bowen; *Assistant Professors:* D. R. Bahler, S. H. Bloomberg, N. M. Bengston, G. Y. Fletcher, E. F. Gehringer, J. Mauney, D. S. Reeves, M. F. M. Stallman, N. F. Williamson Jr.; *Visiting Assistant Professor:* M. A. Vouk; *Assistant Professor Emeritus:* J. W. Hanson

ASSOCIATE MEMBERS OF THE DEPARTMENT

Professor: C. D. Meyer Jr.; *Associate Professor:* W. J. Rasdorf

The Department of Computer Science offers a graduate program with emphasis areas in computer systems architecture, software systems, artificial intelligence, computer communications and computer performance evaluation. The program's core requirements emphasize a cooperative effort between computer science and engineering and reflect a narrowing gap between software and hardware. Faculty members from the Department of Electrical and Computer Engineering (ECE) participate in the program and are actively involved in teaching, research and advising in the various emphasis areas. Both the M.S. and Ph.D. degree programs are offered. The doctorate is a joint and cooperative program offered in conjunction with the ECE Department. Applicants should have a strong background in computer science, engineering, mathematics, statistics or the physical sciences, and a working knowledge of an appropriate higher-level programming language, such as PASCAL or PL/1. Students lacking necessary background will be required to take courses which eliminate the deficiencies in addition to their normal program of study. Research and teaching assistantships are available to qualified applicants. Cooperative master's and Ph.D. programs are also available with the Departments of Mathematics, Statistics and Operations Research.

The Department of Computer Science offers a minor program for graduate students majoring in other fields. For a candidate for a master's degree, three courses are required with at least one course at the 500 level or above. For a Ph.D. candidate, no specific courses are required, but the student is expected to achieve a high level of proficiency in at least one of these five areas of computer science: foundations, computer systems, numerical processing, programming languages (including compiler design) and information systems. The student's advisory committee, in conjunction with the computer science graduate administrator, will assist in selecting a meaningful sequence of courses.

Artificial Intelligence Minor

Graduate students from outside of the Computer Science Department wishing to minor in Artificial Intelligence should consult this catalogue under *Artificial Intelligence*. The following Computer Science/Computer Studies courses may be taken in partial fulfillment of the minor in Artificial Intelligence: CSE 502, CSE 511, ECE (CSE) 559, CSC (CSE, ECE, IE) 575, CSE 602, CSE 611, CSC (CSE, ECE, IE) 675.

SELECTED ADVANCED UNDERGRADUATE COURSES

CSC 412 Introduction to Computability, Languages and Automata. *Preq.: CSC 322. 3(3-0) F,S.*

CSC (MA) 416 Introduction to Combinatorics. *Preq.: MA 403 or CSC 322. 3(3-0) Alt. yrs.*

CSC 421 Introduction to Management Information Systems. *Preq.: CSC 311. 3(3-0) F.*

CSC (MA) 427 Introduction to Numerical Analysis I. *Preqs.: MA 301 or MA 312 and programming language proficiency. 3(3-0) F.*

CSC (MA) 428 Introduction to Numerical Analysis II. *Preqs.: MA 405 and programming language proficiency. 3(3-0) F.*

CSC 431 File Organization and Processing. *Preq.: CSC 311. 3(3-0) S.*

CSC 441 Introduction to Simulation. *Preqs.: Proficiency in a programming language, MA 202, ST 372. 3(3-0) F,S.*

CSC 451 Operating Systems. *Preqs.: CSC 202, 256, 311. 3(3-0) F.*

CSC 461 Computer Graphics. *Preqs.: MA 202 or MA 212; CSC 101 or CSC 111. 3(3-0) F.*

CSC 471 Programming Environments. *Preqs.: CSC 202, CSC 311. 3(3-0) F.*

CSC 495 Special Topics in Computer Science. *Preq.: CI. 1-6 F,S.*

CSC 499 Undergraduate Research in Computer Science. *Preq.: CI. 1-6 F,S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

CSC (CSE, ECE) 501 Design of Systems Programs. *3(3-0) F.* (See computer studies.)

CSC 504 Application of Linguistic Techniques to Computer Problems. *Preq.: CSE 502. 3(3-0) S.* Semiotics and programming languages. Comparison of semantic theories. Representation, classification and interpretation of scenes and other multidimensional illustrations. Design of a formal language for describing two-dimensional geometric figures, such as flowcharts, chemical structures and logic diagrams. Characterization of programming languages according to the theory of transformational grammar.

CSC (CSE, ECE) 506 Digital Systems Architecture. *3(3-0) F.* (See computer studies.)

CSC (CSE, ECE) 510 Software Engineering. *3(3-0) F.* (See computer studies.)

CSC (CSE, ECE) 512 Compiler Construction. *3(3-0) S.* (See computer studies.)

CSC (CSE, ECE) 518 Computer Graphics. *3(3-0).* (See computer studies.)

CSC 541 Advanced Data Structures. *Preq.: CSC 311 or CSE 453. 3(3-0) F.* Complex and specialized data structures relevant to the design and development of effective and efficient software. Hardware characteristics of storage media. Primary file organizations. Hashing functions and collision resolution techniques. Low level and bit level structures including signatures, superimposed coding, disjoint coding and Bloom filters. Tree and related structures including AV1 trees, B-trees, tries and dynamic hashing techniques.

CSC (CSE, ECE) 542 Database Management. *3(3-0) F.* (See computer studies.)

CSC (CSE, ECE, IE, OR) 562 Computer Simulation Techniques. *3(3-0) F.* (See computer studies.)

CSC (CSE, ECE) 571 Data Transmission/Communications. *3(3-0) S.* (See computer studies.)

CSC (CSE, ECE) 572 Computer Communications. *3(3-0) F.* (See computer studies.)

CSC (CSE, ECE) 573 Introduction to Computer Performance Modelling. *3(3-0) F.* (See computer studies.)

CSC (CSE, ECE) 574 Real Time Computer Systems. *3(3-0) S, Alt. yrs.* (See computer studies.)

CSC (CSE, ECE, IE) 575 Voice Input/Output Communication Systems. *3(3-0) F.* (See industrial engineering.)

CSC (MA) 582 Numerical Linear Analysis. *Preqs.: MA 405 or equivalent and a knowledge of computer programming. 3(3-0) F.* A mathematical and numerical investigation of direct iterative and semi-iterative methods for the solution of linear systems. Methods for the calculation of eigenvalues and eigenvectors of matrices.

CSC (MA) 583 Numerical Solution of Ordinary Differential Equations. *Preq.: Knowledge to the level of CSC 427. 3(3-0) S.* Numerical methods for initial value problem including predictor-corrector, Runge-Kutta, hybrid and extrapolation methods; stiff systems; shooting methods for two-point boundary value problems; weak, absolute and relative stability results.

CSC (MA) 584 Numerical Solution of Partial Differential Equations—Finite Difference Methods. *Preq.: Knowledge to the level of CSC 427-428. 3(3-0) F,S.* Numerical methods for the solutions of parabolic, elliptic and hyperbolic partial differential equations including stability and convergence results.

CSC (MA, OR) 585 Graph Theory. *Preq.: MA 405. 3(3-0) F.* Basic concepts of graph theory. Trees and forests. Vector spaces associated with a graph. Representation of graphs by binary matrices and list structures. Traversability. Connectivity. Matching and assignment problems. Planar graphs. Colorability. Directed graphs. Applications of graph theory with emphasis on organizing problems in a form suitable for computer solution.

CSC (MA) 587 Numerical Solution of Partial Differential Equations—Finite Element Method. *3(3-0) S.* (See mathematics.)

CSC 595 Special Topics. *Preq.: CI. 1-6 F,S.* Topics of current interest in computer science not covered in existing courses.

FOR GRADUATES ONLY

CSC (CSE, ECE) 671 Advanced Computer Performance Modelling. *3(3-0) S. Alt. yrs.* (See computer studies.)

CSC (CSE, ECE, IE) 675 Advances in Voice Input/Output Communications Systems. *3(2-3) S.* (See industrial engineering.)

Computer Studies

GRADUATE FACULTY

Professor Wushow Chou, *Program Director*

Professor W. J. Stewart, *Associate Director*

Professors: D. P. Agrawal, W. E. Alexander, R. E. Funderlic, W. S. Galler, H. J. Gold, D. C. Martin, L. B. Martin, D. F. McAllister, H. T. Nagle Jr., A. A. Nilsson, J. B. O'Neal Jr., R. J. Plemmons, R. S. Sowell, R. E. Stinner, K.-C. Tai, A. L. Tharp, H. J. Trussell; *Adjunct Professor:* J. R. Suttle; *Professor Emeritus:* P. E. Lewis; *Associate Professors:* S. T. Alexander, E. W. Davis Jr., R. J. Fornaro, T. L. Honeycutt, H. D. Levin, R.-C. Luo, H. G. Perros, S. A. Rajala, W. E. Robbins, R. D. Rodman, C. D. Savage, J. C. Smith, W. E. Snyder, H. J. Trussell; *Visiting Associate Professors:* H. M. Abdel-Wahab, J. A. Bowen;

Assistant Professors: D. R. Bahler, N. M. Bengtson, S. H. Bloomberg, G. Y. Fletcher, E. F. Gehringer, W.-T. Liu, J. Mauney, T. K. Miller III, D. S. Reeves, M. F. M. Stallmann, N. F. Williamson; *Visiting Assistant Professor:* M. A. Vouk

ASSOCIATE MEMBERS OF THE DEPARTMENT

Professor: C. D. Meyer Jr.; *Associate Professor:* W. J. Rasdorf

The computer studies program is an interdisciplinary graduate program which is administered by the Department of Computer Science, with participation by faculty members primarily from computer science, electrical and computer engineering and operations research.

The program integrates the computer software oriented curriculum of the Department of Computer Science and the computer hardware oriented curriculum from the Department of Electrical and Computer Engineering into a single curriculum. This is in contrast to the traditional arrangement in which the curriculum in an independent computer science department emphasizes software systems and computing theory while the computer engineering curriculum in an electrical and computer engineering department emphasizes hardware systems. The need for the merging of these two types of curricula has been recognized by several other schools through cross-listed courses and joint degree programs. North Carolina State University takes a more positive step by creating a single administrative unit to incorporate the curricula at the graduate level.

Although courses and thesis topics may be chosen in a variety of fields, this program's unique strength lies with the fields combining computer science and computer engineering. These fields include: computer system architecture and design, computer communications and numerical and optimization techniques.

The field of computer system architecture and design deals with the specification, design and analysis of digital systems, including the study of system architecture, design algorithms and automation, fault tolerant design and simulation. The field of computer communications deals with the methodology of utilizing the state-of-the-art capability of computers and telecommunications for reliable, economic and responsive transfer of digitized information among data transmission equipment, which may be various computers, terminals or telephones with digitized voices. The field of numerical and optimization techniques is concerned with the study of the structure and properties of systems with large numbers of interdependent variables, and with the methodology and application of numerical analysis, dynamical systems theory and systems analysis and mathematical programming of such systems.

For students pursuing a master's degree in computer studies, there are two options: the thesis option, the Master of Science in computer studies and the non-thesis option, the Master of Computer Studies.

Remedial Courses

The immigration modules, CSE 452 through CSE 456, are the remedial courses that are structured primarily for students with a bachelor's degree in one of the quantitative sciences, but with little computer background. However,

proficiency in a high-level programming language is assumed. Each module provides in a condensed format the prerequisite knowledge for most first year graduate courses in the program. Each entering student would select, upon advice of the program faculty, those immigration modules necessary to eliminate deficiencies relevant to the program of study. Credit toward satisfying degree requirements for computer studies majors would not be allowed for the immigration modules.

Core Courses

Three core courses, CSE (CSC, ECE) 501, Design of Systems Programs, CSE. 505, Design and Analysis of Algorithms and CSE (CSC, ECE) 506, Digital Systems Architecture, are intended to provide a thorough basic knowledge upon which the elective courses may be built. For the non-thesis option, all three are required. For the thesis option, CSE (CSC, ECE) 506 is required and a student may elect either CSE (CSC, ECE) 501 or CSE 505 as the second core course.

Elective Courses

All other courses listed below are elective courses. For classification of the elective courses according to subject areas and for further details, refer to the computer studies brochure.

Artificial Intelligence Minor

Graduate students from outside of the Computer Studies Department wishing to minor in Artificial Intelligence should consult this catalogue under *Artificial Intelligence*. The following Computer Studies courses may be taken in partial fulfillment of the minor in Artificial Intelligence: CSE 502, CSE 511, ECE (CSE) 559, CSC (CSE, ECE, IE) 575, CSE 602, CSE 611, CSC (CSE, ECE, IE) 675.

SELECTED ADVANCED UNDERGRADUATE COURSES

CSE 452 Assembly Language and Basic Computer Organization. *Preqs.: Higher level programming language and CI. 1(1-0) F,S,Sum.*

CSE 453 Data Structures. *Preqs.: Higher level programming language and CI; Coreq.: CSE 452 or equivalent. 1(1-0) F,S,Sum.*

CSE 454 Computer Organization and Logic. *Preqs.: CSE 452 or equivalent and CI. 1(1-0) F,S,Sum.*

CSE 455 Applied Algebraic Structures. *Preqs.: MA 201, higher level programming language and CI. 1(1-0) F.*

CSE 456 Introduction to Computability. *Preqs.: CSE 455 or equivalent and CI. 1(1-0) S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

CSE (CSC, ECE) 501 Design of Systems Programs. *Preqs.: CSE 452 and CSE 453. 3(3-0) F,S.* Fundamentals of translators, operating systems and file management systems. Assemblers, macro processors, linkers and loaders. Sequential and concurrent processes, processor and memory management. File structures and file indexing techniques, including hashing, B-trees, AVL trees and tries.

CSE 502 Computational Linguistics. *Preq.: CI. 3(3-0) F.* Natural language processing by computer. Finite-state, context-free, context-sensitive and transformational grammars. Parsing mechanisms including augmented transition networks. Analysis of complex English sentences. Question-answering systems.

CSE 505 Design and Analysis of Algorithms. *Preq.: CSC 311 or CSE 453. 3(3-0) F,S.* Study of techniques for the design of algorithms. Complexity and analysis of algorithms. Study of algorithms for certain classical problems that include sorting, searching, graphs, numerical algorithms and pattern matching.

CSE (CSC, ECE) 506 Digital Systems Architecture. *Preq.: ECE 340 or CSC 312 or CSE 454. 3(3-0) F,S.* Digital systems architecture is the middle ground on which the interests of software, hardware and firmware come together. Among the topics considered are: architectural descriptions, storage systems, I/O systems, stack machines and parallelism. The structure of digital systems implementation will also be considered as it relates to architecture.

CSE (CSC, ECE) 510 Software Engineering. *Preqs.: CSC 311 and CSC 322 or CSE 453 and CSE 455 or equivalent. 3(3-0) F.* The course will introduce the principles and methods for the design, coding and validation of software systems. Among the topics covered are: software design techniques, programming methodology, program testing, proofs of program correctness, software reliability and software management.

CSE 511 Artificial Intelligence I. *Preq.: CSC 311 and either CSC 322 or PHI 201 or PHI 335 or background in symbolic logic. 3(3-0) F.* Introduction to and overview of artificial intelligence. Study of an AI programming language such as LISP or PROLOG. Elements of AI problem-solving techniques. State spaces and search techniques. Logic, theorem proving and associative databases. Introduction to knowledge representation, expert systems and selected topics including natural language processing, vision and robotics.

CSE (CSC, ECE) 512 Compiler Construction. *Preq.: CSC 311 or CSE 453. 3(3-0) S.* This course is intended to provide a detailed understanding of the techniques used in the design and implementation of compilers. Introduction to formal grammars and relations concerning a grammar. Detailed study of algorithms for lexical scanners, top-down recognizers, bottom-up recognizers for simple precedence grammars, operator precedence grammars, high order precedence grammars and bounded-context grammars. Runtime storage organization for a compiler including symbol tables, internal forms for source programs, semantic routines, error recovery and diagnostics, code generation and optimization and interpreters.

CSE (ECE) 513 Digital Signal Processing. .'t 023(3-0) F. (See electrical and computer engineering.)

CSE (ECE) 514 Random Processes. *3(3-0) F.* (See electrical and computer engineering.)

CSE (CSC, ECE) 518 Computer Graphics. *Preqs.: MA 405, knowledge of FORTRAN and PASCAL. 3(3-0) F.* Clipping, windowing, transformations, projections, hiddenline and surface removal, smooth shading, shadowing, translucence, reflection, refraction, curve and surface representation.

CSE (ECE) 520 Fundamentals of Logic Systems. *3(3-0) F.* (See electrical and computer engineering.)

CSE (ECE) 521 Digital Computer Technology and Design. *3(3-0) F,S.* (See electrical and computer engineering.)

CSE 522 Formal Languages and Syntactic Analysis. *Preq.: CSC 412 (CSE 512 recommended). 3(3-0) F.* Detailed study of formal languages and their relation to automata: languages and their representation, grammars, finite automata and regular grammars, context-free grammars and pushdown automata, type grammars and Turing machines, the Halting Problem, context-sensitive grammars and linear bounded automata and operations of languages.

CSE (MA) 529, 530 Numerical Analysis I, II. *3(3-0) F,S.* (See mathematics.)

CSE (ECE) 533 Digital Electronics. *3(3-0) S.* (See electrical and computer engineering.)

CSE (CSC, ECE) 542 Database Management. *Preq.: CSC 431 or CSE (CSC, ECE) 501. 3(3-0) F.* The course covers the fundamentals of the area of database management. Basic topics include: general architecture for database management systems; current data models such as network, relational, hierarchical; security and integrity; discussion of current implemented systems.

CSE (ECE) 558 Image Processing. *3(3-0) Every yr.* (See electrical and computer engineering.)

CSE (ECE) 559 Pattern Recognition. *3(3-0) S.* (See electrical and computer engineering.)

CSE (CSC, ECE, OR, IE) 562 Computer Simulation Techniques. *Preqs.: ST 516 and a scientific programming language. 3(3-0) F.* Basic discrete event simulation methodology: random number generators, simulation designs, validation, analysis of simulation output. Applications to various areas of scientific modeling. Simulation language such as SLAM and GPSS. Computer assignments and projects.

CSE (CSC, ECE) 571 Data Transmission/Communications. *Preqs.: CSE 454 or CSC 312 or ECE 340; CSE 459 or ECE 301. 3(3-0) S.* Deals with the principles and techniques of moving digital data through transmission facilities. To be covered: digital information representation; characteristics of channels; modulation and demodulation (MODEM) techniques; error detection and correction; line control procedure; circuit, message and packet switching; multiplexors and concentrators.

CSE (CSC, ECE) 572 Computer Communications. *Preq.: CSC 312 or ECE 340 or CSE 454; Coreq.: B average in technical subjects. 3(3-0) F.* The purpose of this course is to enable the student to understand the principles, the control and operations and the potential of computer communication systems; to present techniques for topological design and analytic modeling of such systems; and to provide the foundation for more detailed studies and research. The courses are self-contained and focus on practical applications of state-of-art techniques.

CSE (CSC, ECE) 573 Introduction to Computer Performance Modelling. *Preqs.: CSE 454, MA 421; Coreq.: CSE 501. 3(3-0) F.* Workload characterization, collection and analysis of performance data, instrumentation, tuning, analytic models including queueing network models and operational analysis, economic considerations.

CSE (CSC, ECE) 574 Real Time Computer Systems. *Preq.: CSC 405 or CSE (CSC, ECE) 501. 3(3-0) S. Alt. yrs.* Hardware and software characteristics of computer systems designed to meet specific response time requirements are studied. Topics include allocation of system resources including processor memory, disk, support I/O devices; synchronous and asynchronous event scheduling; effect of interrupts; static and dynamic priorities; implementation of queues; measurement of performance, especially scheduling and response accuracy.

CSE (CSC, ECE, IE) 575 Voice Input/Output Communication Systems. *3(3-0) F.* (See industrial engineering.)

CSE 591 Special Topics in Computer Studies. *Preqs.: B average in technical subjects and CI. 3(3-0) F,S.* Topics of current interest in computer studies not covered in existing courses.

FOR GRADUATES ONLY

CSE 602 Computational Semantics. *Preqs.: CSE 502 and CSC 322 or equivalent. 3(3-0) F.* An examination of how to represent meaning in natural language to a computer. Logical systems for representing meaning. Other systems for representing meaning such as conceptual dependencies. Generating natural language output from data bases representing knowledge. Reading of advanced material in such areas as natural language dialogue processing.

CSE (OR) 605 Large Scale Linear Programming Systems. *3(3-0) S. Alt. yrs.* (See operations research.)

CSE 611 Artificial Intelligence II. *Preq.: CSE 511. 3(3-0) S.* This is a second course in artificial intelligence emphasizing advanced concepts of AI including logic programming, automatic programming, natural language understanding, visual perception by machine, learning and inference, intelligent computer-aided instruction, knowledge representation, robotics and other topics to be chosen by the instructor. Students will be asked to write programs in an AI programming language such as LISP and PROLOG.

CSE (ECE) 640 Advanced Logic Systems. *3(3-0) S.* (See electrical and computer engineering.)

CSE (ECE) 641 Sequential Machines. *3(3-0) F.* (See electrical and computer engineering.)

CSE (ECE) 651 Statistical Communication Theory. *3(3-0) S.* (See electrical and computer engineering.)

CSE (ECE) 652 Information Theory. *3(3-0) F.* (See electrical and computer engineering.)

CSE (ECE) 659 Computer Vision. *3(3-0) F.* (See electrical and computer engineering.)

CSE (IE,OR) 662 Stochastic Simulation Design and Analysis. *Preqs.: CSE (CSC, ECE, IE, OR) 562 and ST 516. 3(3-0) S.* Advanced topics in stochastic system simulation are covered, including random variate generation, output estimation for stationary and nonstationary models, performance optimization techniques, variance reduction approaches. Students apply these techniques to actual simulations. A paper written on a current research topic is required.

CSE (CSC, ECE) 671 Advanced Computer Performance Modelling. *Preqs.: CSE (CSC, ECE) 573 or OR (IE) 561. 3(3-0) S. Alt. yrs.* In-depth study of computer performance modelling techniques such as exact and approximate analysis of queueing networks and direct and iterative numerical solutions of queueing systems.

CSE (CSC, ECE, IE) 675 Advances in Voice Input/Output Communications Systems. *3(2-3) S.*. (See industrial engineering.)

CSE 691 Advanced Topics in Computer Studies. *Preqs.: Grad. standing, CI. 3(3-0) F,S.* Advanced topics of current interest in computer studies not covered by existing courses.

CSE 693 Individual Topics in Computer Studies. *Preqs.: Grad. standing, CI. 1-3 F,S.* An opportunity for an individual graduate student to investigate special topics of interest under the direction of members of the graduate faculty.

CSE 695 Seminar in Computer Studies. *Preqs.: Grad. standing, CI. 1(1-0) F,S.* Seminar discussion of problems of current research interests in computer studies. Seminar speakers consist of advanced graduate students, faculty, and invited speakers.

CSE 699 Computer Studies Research. *Preqs.: Grad. standing, CI. Credits Arranged. F,S.* Individual research by graduate students minoring and majoring in computer studies. Research may be done under the supervision of CSE faculty members meeting the interest and need of the student.

Counselor Education

For a listing of graduate faculty and departmental information, see counselor education under education.

Crop Science

GRADUATE FACULTY

Professor B. E. Caldwell, *Head*

Professor D. A. Emery, *Coordinator of Graduate Programs*

Professors: D. S. Chamblee, H. D. Coble, W. K. Collins, F. T. Corbin, E. J. Dunphy, W. T. Fike, M. M. Goodman, J. T. Green Jr., H. D. Gross, W. M. Lewis, R. C. Long, J. P. Mueller, R. P. Patterson, G. F. Peedin, T. J. Sheets, G. A. Sullivan, D. H. Timothy, J. B. Weber, W. W. Weeks, E. A. Wernsman, A. D. Worsham, J. C. Wynne; *Professors (USDA):* J. C. Burns, J. W. Burton, G. R. Gwynn, S. C. Huber, D. E. Moreland, H. Seltmann, R. F. Wilson; *Adjunct Professors:* D. T. Patterson, L. Thompson Jr.; *Professors Emeriti:* C. T. Blake, C. A. Brim, J. F. Chaplin, W. A. Cope, D. U. Gerstel, W. B. Gilbert, W. C. Gregory, P. H. Harvey, G. L. Jones, J. A. Lee, R. P. Moore, L. L. Phillips, D. L. Thompson, J. A. Weybrew; *Associate Professors:* J. R. Anderson Jr., D. T. Bowman, J. M. DiPaola, R. D. Keys, H. M. Linkler, H. T. Stalker Jr., A. C. York; *Associate Professors (USDA):* T. E. Carter Jr., J. E. Miller; *Assistant Professors:* A. H. Bruneau, D. A. Danehower, J. P. Murphy, S. M. Reed, R. C. Rufty, W. D. Smith, M. G. Wagger, G. G. Wilkerson; *Assistant Professors (USDA):* J. M. Anderson, K. O. Burkey, D. Fisher, P. Kwanyuen, T. W. Rufty Jr., P. H. Sisco Jr.

The Department of Crop Science offers instruction leading to the Master of Science and Doctor of Philosophy degrees in the fields of plant breeding, crop production and physiology, forage crops ecology, weed control and plant chemistry. For students who wish general training, the Master of Agriculture is offered.

Excellent facilities for graduate training are available. Many special facilities such as preparation rooms for plant and soil samples, cold storage facilities for plant material, greenhouse space, growth control chambers and access to computer facilities and the plant environment laboratory (Phytotron) are provided if required. Sixteen farms are owned and operated by the State for research investigations. Research farms are located throughout North Carolina and include a variety of soil and climatic conditions needed for experiments in plant breeding, crop management, forage ecology and weed control.

Strong supporting departments increase opportunities for broad and thorough training. Among the departments in which graduate students in crop science work cooperatively or obtain instruction are Biochemistry, Botany, Chemistry, Computer Science, Entomology, Horticultural Science, Genetics, Mathematics, Microbiology, Plant Pathology, Soil Science and Statistics.

In North Carolina, a state which derives a major portion of its agricultural income from farm crops, the opportunities for the well-trained agronomist are great. Recipients of advanced degrees in crop science at North Carolina State University are found in positions of leadership in research and education throughout the nation and the world.

SELECTED ADVANCED UNDERGRADUATE COURSES

CS 411 Environmental Aspects of Crop Production. *Preq.: BO 421. 2(2-0) F.*

CS 413 Plant Breeding. *Preq.: GN 411. 2(2-0) S.*

CS 414 Weed Science. *Preq.: CH 220. 4(3-2) F.*

CS (SSC) 462 Soil-Crop Management Systems. *Preqs.: CS 211, CS 414, SSC 341, SSC 342, SSC 352, Sr. standing. 3(2-3) S.*

CS 490 Senior Seminar in Crop Science. *Preq.: Sr. in crop science or related field. 1(1-0) S.*

CS (HS) 492 Topics in Plant Breeding. *1(0-2) S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

CS 511 Tobacco Technology. *Preq.: BO 421 or equivalent. 3(3-0) S.* A study of special problems concerned with the tobacco crop. The latest research problems and findings dealing with this important cash crop will be discussed. Peedin

CS 513 Physiological Aspects of Crop Production. *Preq.: BO 421. 3(3-0) S. Alt. yrs.* Discussion will emphasize pertinent physiological processes associated with crops and crop management such as plant growth, maturation, respiration and photoperiodism. Relationship of the environment to maximum crop yields will be discussed. Fike

CS (HS) 514 Principles and Methods in Weed Science. *Preq.: CS 414 or equivalent. 3(2-2) S.* Studies of the losses caused by the ecology of weeds, biological control, basic concepts of weed management, herbicide-crop relationships and herbicide development. Introduction to greenhouse and bioassay techniques and field research techniques. Monaco

CS (BO, ENT, PM, PP) 525 Biological Control. *4(3-3) Alt. F.* (See pest management.)

CS (GN, HS) 541 Plant Breeding Methods. *Preqs.: GN 506, ST 511. 3(3-0) F.* An advanced study of methods of plant breeding as related to principles and concepts of inheritance. Murphy, Wehner

CS (GN) 545 Origin and Evolution of Cultivated Plants. *Preq.: GN 505 or GN (ZO) 540. 3(3-0) S. Alt. yrs.* Review of progression to modern evolutionary thought; concepts of speciation and classification; origin of variation in plants; theories relating to origins of cultivation and spread of agriculture variation patterns and special attributes of cultigens; interactions of crops and environments; evolution under domestication; modern aspects of evolution as related to breeding. Stalker

CS (BO, GN, HS) 547 Cell and Tissue Techniques in Plant Breeding. *Preqs.: GN 505B and GN 506B or equivalent. 3(1-4) F. Alt. yrs.* Applications of tissue culture and cytogenetic techniques for plant improvement. Callus and suspension cultures, plant regeneration, *in vitro* selection, haploidy, polyploidy, aneuploidy, wide hybridization and embryo rescue. Practical lab experiences in tissue culture and cytogenetic techniques. Reed, Stalker

CS 591 Special Problems. *Preq.: CI. Credits Arranged. F,S,Sum.* Special problems in various phases of crop science. Problems may be selected or will be assigned. Emphasis will be placed on review of recent and current research. Graduate Staff

FOR GRADUATES ONLY*

CS 611 Metabolism and Crop Productivity. *Preqs.: BCH 451; BO 551 or 552. 3(3-0) S. Alt. yrs.* A comprehensive examination of bnasic metabolic processes related to germination, cell wall formation, carbon and nitrogen utilization, and macromolecular biosynthesis and partitioning, and how these processes interact with plant genotype and environment to affect growth, development and dry matter accumulation in crop plants. Long

CS (HS, SSC) 614 Herbicide Behavior in Plants and Soils. *Preqs.: BO 551 and CH 223 or CI. 3(3-0) F. Alt. yrs.* The chemical and physiological processes involved in the behavior of herbicides in plants and soils will be examined. Topics to be discussed include absorption, translocation, metabolism and mechanisms of action of herbicides on plants; reactions, movement and degradation of herbicides in the soil; and interactions among herbicides and other pesticides. Weber

CS (GN, HS) 615 Quantitative Genetics in Plant Breeding. *Preqs.: CS (GN, HS) 541, ST 512, course in quantitative genetics recommended. 1(1-0) S. Alt. yrs.* Theory and principles of plant quantitative genetics. Experimental approaches of relationships between type and source of genetic variability, concepts of inbreeding, estimations of genetic variance and selection theory. Burton

CS (GN, HS) 616 Breeding Methods. *Preqs.: CS (GN, HS) 541, ST 512. 2(2-0) S. Alt. yrs.* Theory and principles of plant breeding methodology including population improvement, selection procedures, genotypic evaluation, cultivar development and breeding strategies. Wynne

CS (GN, HS) 617 Nonconventional Plant Breeding. *Preq.: CS (GN, HS) 541. 1(1-0) F. Alt. yrs.* Theory and principles of molecular and nonconventional plant breeding. Experimental approaches to induce genetic change, cytoplasmic recombination, haploid utilization and potentials of molecular techniques for solving breeding problems. Sisco

CS (GN, HS, PP) 618 Breeding for Pest Resistance. *Preqs.: CS (GN, HS) 541, PP 315, ST 512. 2(2-0) F. Alt. yrs.* Theory and principles of breeding for pest resistance. Experimental approaches for examining genetics of host-parasite interactions, expression and stability of pest resistance and breeding strategies for developing pest-resistant cultivars. Rufty

*Students are expected to consult with the instructor before registration.

CS 690 Seminar. *Preq.: Grad. standing. 1(1-0) F,S.* A maximum of two credits is allowed toward the master's degree; however, additional credits toward the doctorate are allowed. Scientific articles, progress reports in research and special problems of interest to agronomists are reviewed and discussed. Graduate Staff

CS 699 Research. *Preq.: Grad. standing. Credits Arranged.* A maximum of six credits is allowed toward the master's degree, but no restrictions toward the doctorate. Graduate Staff

Curriculum and Instruction

For a listing of graduate faculty and departmental information, see education.

Design

For a listing of graduate faculty and departmental informtion, see architecture, landscape architecture, product design.

SELECTED ADVANCED UNDERGRADUATE COURSES

DN 400 Design Studio. *Preq.: DF 102 or written approval of dept. head. 6(0-9) F,S.*

DN 411 Advanced Visual Laboratory. *Preqs.: DF 102 or both DF 111 and DF 112. 3(0-6) F,S.*

DN 412 Advanced Photography. *Preq.: DN 312. 3(1-4) S.*

DN 413 Synthetic Drawing. *Preq.: DF 102. 3(2-3) F.*

DN 414 Color and Light Laboratory. *Preq.: DF 102. 3(3-0) F,S.*

DN 415 Microcomputer Graphics for Designers. *3(3-0) S.*

DN 419 Multi-Media in Design. *Preq.: DN 212. 3(1-4) S.*

DN 421 Environmental Cognition for Designers. *3(3-0) F.*

DN 423 Concepts of Space. *3(3-0) F.*

DN 445 Aesthetics and Design. *Preq.: DN 141 or DN 142. 3(3-0) F.*

DN 454 Geometry for Designers. *Preq.: Jr. standing. 3(3-0) S.*

DN 491 Special Seminar in Design. *1-3 F,S.*

DN 492 Special Topics in Design. *1-3 F,S.*

DN 494 Internship in Design. *Preqs.: Jr. standing, 3.0 GPA or better, approval of dept. head. 3-6 (Max. 6) F,S.*

DN 495 Independent Study in Design. *Preqs.: Jr. standing, 3.0 GPA or better, approval of dept. head. 1-3 (Max. 6) F,S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

DN 541 Seminar on Ideas in Design. *Preq.: Grad. standing. 2-3 F,S.* An examination of aesthetics and the relationships of philosophic thought to design.

FOR GRADUATES ONLY

DN 611 Advanced Visual Laboratory. *Preq.: Grad. standing; may be taken for a maximum of 12 credit hours. 2-4 F,S.* Advanced experimental studies in visual phenomena related to design.

DN 698 Design Research and Service Learning Projects. *Preqs.: Grad. standing, consent of program director and graduate committee. 2-6 F,S,Sum.* Problems relevant to design will provide the subjects for graduate study based upon research, service learning projects, on- and off-campus internships and individual investigations will be under the direction of faculty advisors.

Ecology

GRADUATE FACULTY

Professor A. G. Wollum II, *Chairman*

Professors: D. A. Adams, S. P. S. Arya, R. C. Axtell, K. R. Barker, D. M. Benson, U. Blum, J. R. Bradley Jr., S. W. Buol, D. S. Chamblee, A. W. Cooper, B. J. Copeland, P. D. Doerr, G. H. Elkan, D. J. Frederick, L. F. Grand, H. D. Gross, F. E. Guthrie, F. P. Hain, D. Kamykowski, G. G. Kennedy, J. M. Miller, T. O. Perry, K. H. Pollock, E. D. Seneca, D. L. Solomon, R. E. Stinner, H. R. van der Vaart, T. G. Wolcott, A. D. Worsham; *Professor (USDA):* J. C. Burns; *Professor (USDI):* M. T. Huish; *Professor Emeritus:* D. W. Hayne; *Associate Professors:* K. P. Burnham, L. B. Crowder, J. M. DiPaolo, F. L. Gould, B. C. Haning, R. A. Lancia, S. C. Mozley, R. A. Powell, L. A. Real, J. R. Walters, T. R. Wentworth; *Associate Professor (USDA):* K. P. Burnham; *Assistant Professors:* C. Brownie, G. J. House, L. A. Levin

Ecology is the science concerned with the interactions of organisms with each other and with their environment. It is an integrative science through which one gains an understanding of biological and physical interrelationships and predicts the consequences of altering one or several components of an ecosystem.

Students in a number of basic and applied curricula may elect to major in ecology at the master's level leading to an M.S. degree or minor in ecology at the master's and Ph.D. levels. The minor provides an opportunity for a coherent picture of the field of ecology but does not usurp the normal prerogatives of graduate advisory committees in structuring graduate programs.

The ecology minor is an interdepartmental program drawing faculty from the botany, crop science, entomology, forestry, marine, earth and atmospheric sciences, microbiology, plant pathology, soil science, statistics and zoology departments. The program is administered by the Ecology Advisory Committee. Additional information about the program may be obtained by writing to one of the faculty members listed above or to Chairman, Ecology Faculty, P. O. Box 7619, North Carolina State University, Raleigh, North Carolina 27695-7619.

The following courses are recognized as ecological and have been grouped into certain related areas. (For course descriptions, see respective departmental listings.)

General Ecology: BO (ZO) 560 Principles of Ecology; BO 565 Plant Community Ecology; BO (ZO) 660 Advanced Topics in Ecology I; ZO (BO) 661 Advanced Topics in Ecology II.

Population Ecology: ZO 517 Population Ecology; ENT 531 Insect Ecology.

Limnology and Marine Science: ZO 419 Introduction to Limnology; ZO (ENT) 509 Ecology of Stream Invertebrates; ZO (MEA) 520 Principles of Biological Oceanography; ZO 619 Advanced Limnology.

Behavior: ZO 410 Introduction to Animal Behavior; ZO 501 Ornithology; ZO 691 Topics in Animal Behavior.

Microbial Ecology: MB 501A,B,C Advanced Microbiology I (A-Metabolism; B-Physiology; C-Immunology); MB 503 Microbial Ecology; SSC (MB) 532 Soil Microbiology; PP 611 Advanced Plant Nematology; PP (BO) 625 Advanced Mycology.

Terrestrial Ecology: BO 544 Plant Geography; ZO 544 Mammalogy; SSC 551 Soil Morphology, Genesis and Classification; MEA 555 Meteorology of the Biosphere.

Physiological Ecology: ZO (PHY) 513 Comparative Physiology; ZO (FW) 515 Growth and Reproduction of Fishes; BO 561 Physiological Ecology.

Mathematical Biology and Ecology: ZO (FW) 553 Principles of Wildlife Science; BO 570 Quantitative Ecology; BMA (MA, ST) 571, 572 Biomathematics I, II.

Applied Ecology: CS 411 Environmental Aspects of Crop Production; ZO (FW) 420 Fishery Science; ZO 441 Ichthyology; FOR 452 Silvics; FOR 472 Renewable Resource Policy and Management; SSC 472 Forest Soils; HS (CS) 514 Principles and Methods in Weed Science; TOX 515 Environmental Toxicology; ENT 550 Fundamentals of Insect Control; ZO (FW) 554 Wildlife Field Studies; ENT 562 insect Pest Management in Agricultural Crops; ENT (ZO) 582 Medical and Veterinary Entomology; FOR 613 Special Topics in Silviculture; FOR 614 Advanced Topics in Administration of Forest Resources; BO 662 Applied Coastal Ecology.

The requirements for a major in Ecology are:

Master of Science Degree: Six courses including BO (ZO) 560 (or its equivalent), either BO 565, BO (ZO) 660 or ZO(BO) 661, ST 511, ECO 690 and one course from each of two designated areas (population ecology, limnology and marine science, etc.). The latter two courses should not be in the same department as the major professor.

The requirements for a minor in Ecology are:

Master of Science Degree: Three ecological courses, including BO (ZO) 560 (or its equivalent) and either BO 565, BO (ZO) 660 or ZO (BO) 661. The third course should not be in the same department as the major.

Ph.D. Degree: Four ecological courses, including BO (ZO) 560 (or its equivalent) and at least one other course from the general ecology area. One course outside the general ecology area is required. If more than one course is taken from outside the general ecology area, these courses must come from different designated areas (*i.e.*, population ecology, limnology and marine science, etc.). Courses outside the general ecology area should not be from the same department as the major.

Incoming students may apply equivalent courses toward these requirements at the discretion of their graduate committees. Students minoring in ecology, particularly at the Ph.D. level, are encouraged to take courses in mathematics and sttistics, at least ST 511 and ST 512.

FOR GRADUATES ONLY

ECO 690 Ecology Seminar. *Preq.: Grad. standing. 1(1-0) F.* Scientific articles, progress reports and special problems of interest to ecologists are reviewed and discussed. Minimum of one seminar presentation required for credit.

ECO 693 Special Problems in Ecology. *Preq.: Grad. standing. 1-6 F,S,Sum.* Investigation of special problems in ecology of particular interest to advanced students under the direction of a faculty member. Directed research in some specialized phase of ecology other than a thesis problem, but designed to provide experience and training in research.

Economics and Business

GRADUATE FACULTY

Professor D. M. Hoover, *Head*

Professor C. R. Knoeber, *Graduate Administrator*

Associate Professor S. E. Margolis, *Program Director of Management*

Graduate Advisor and Program Assistant B. L. Puryear

aduate Administrator

Professors: S. G. Allen, G. A. Carlson, R. L. Clark, A. J. Coutu, R. D. Dahle, L. E. Danielson, J. E. Easley Jr., E. W. Erickson, R. M. Fearn, D. Fisher, A. R. Gallant, T. J. Grennes, D. L. Holley Jr., D. M. Holthausen Jr., D. N. Hyman, L. A. Ihnen, P. R. Johnson, T. Johnson, C. P. Jones, R. A. King, C. J. Messere, C. L. Moore Sr., E. C. Pasour Jr., R. J. Peeler, R. K. Perrin, R. A. Schrimper, J. J. Seater, V. K. Smith, D. A. Sumner, R. E. Sylla, C. B. Turner, M. L. Walden; *Extension Professors:* H. L. Liner, R. C. Wells; *Professors Emeriti:* R. C. Brooks, T. E. Nichols Jr., B. M. Olsen, C. R. Pugh, J. A. Seagraves, R. L. Simmons, J. G. Sutherland, W. D. Toussaint, J. C. Williamson Jr.; *Associate Professors:* D. S. Ball, D. L. Baumer, G. A. Benson, J. C. Dutton Jr., E. A. Estes, D. J. Flath, K. B. Frazier, J. D. Hess, J. S. Lapp, S. J. Liebowitz, M. B. McElroy, R. B. Palmquist, D. K. Pearce, J. C. Poindexter Jr., J. W. Rockness, R. J. Rossana, C. D. Safley, W. J. Wessels, P. F. Williams, J. W. Wilson, M. K. Wohlgenant, G. J. Zuckerman; *Associate Professors Emeriti:* H. C. Gilliam Jr., C. W. Harrell Jr.; *Assistant Professors:* B. Babcock, R. N. Collender, E. F. Cox, P. L. Fackler, L. B. Ferreri, E. Gerstner, A. R. Hall, S. A. Hatchell, A. E. Headen, D. L. Hoag, P. H. Kupiec, E. A. McDermed, A. J. McKee Jr., K. Mitchell, C. M. Newmark, R. R. Rucker, W. N. Thurman, K. D. Zering

The Department of Economics and Business offers programs of study leading to the Master of Economics, the Master of Arts in economics, the Master of Science in agricultural economics, the Master of Science in management (in conjunction with other departments) and the Ph.D. degree in economics. Emphasis is placed on economic theory and quantitative economic analysis and their application to economic problems. Special seminars and workshops are available to students as a means of pursuing topics of special interest.

The Master of Economics and the Master of Arts in economics require a minimum of 30 hours of course work. Flexible course requirements permit a student, in consultation with a graduate advisory committee, to develop a program to meet individual academic and career objectives. Price Theory (EB 501), Income and Employment Theory (EB 502) and a nine-hour minor in a discipline outside the department are required. The most popular minor discipline is statistics, but many departments offer minor programs, including Industrial Engineering, Operations Research, Mathematics, and Political Science and Public Administration. The remaining course work (fifteen hours) is selected from the varied departmental offerings below. The Master of Arts in economics differs from the Master of Economics only in that the former substitutes six hours of thesis research for six hours in the major.

The Master of Science in agricultural economics also requires a minimum of 30 hours of course work. EB 501, EB 502, one course from the agricultural economics offerings and a nine-hour minor from outside the department are required. The statistics minor is often chosen since six hours of statistics are required for this degree. A thesis is required and six hours of research study toward the thesis can be included in the program. The remaining course work is selected from such areas as agricultural production economics, agricultural policy, agricultural markets, managerial finance, natural resources and so forth, according to the student's interests.

Prerequisites for any of these programs include one semester each of intermediate microeconomics and macroeconomics and a minimum of one semester of calculus. A full year of calculus is advised. Domestic students may complete these prerequisite courses by registering through the Division of Lifelong Education in a special part-time preparatory program, Post-baccalaureate Studies (PBS). GRE scores are not required of applicants but are recommended.

The Master of Science in management (MSM) degree emphasizes the application of quantitative techniques and economic analyhsis to management decision making. This unique program is the result of the combined efforts of seven departments and provides students an opportunity to concentrate in a field of study offered by any of these departments. This concentration is known as the student's technical option and can be completed in: Civil Engineering, Computer Studies, Economics and Business, Industrial Engineering, Operations Research, Statistics, and Textile Management and Technology. See the complete description of this program, including the core management and economics course work in this bulletin, listed under Management.

The Ph.D. program has no specific hour requirements; however, at least six semesters of work beyond the bachelor's degree are required, of which at least two consecutive semesters must be in residence. Candidates take course work and written examinations in economic theory and a minor of their choice. In addition,

each student chooses a field of study within the department (*e.g.*, agricultural economics, econometrics, applied macroeconomics, international trade, resource and environmental economics, labor economics and human resources, or managerial economics). A minimum of two semesters of differential and integral calculus and a master's degree are prerequisites for the Ph.D. program. Students possessing only a bachelor's degree may enter one of the department's master's programs and complete courses which may be applied toward the Ph.D. There is no foreign language requirement for the Ph.D. GRE scores are not required of applicants but are recommended.

The department maintains microcomputer, mainframe computer access and library facilities available to students for course work and research uses. The Microcomputer Instructional Laboratory consists of twenty IBM personal computers linked to printers and memory devices in a local area network. In addition, the Programming Applications Laboratory provides technically trained programming personnel to assist in the preparation of work for mainframe computing. Computer terminals providing access to the mainframe are available in the department and throughout the campus. A well-equipped departmental library, the D. H. Hill Library and library facilities of two nearby major universities are readily available for graduate student use. Graduate students on financial support are provided study carrels or office space.

The services of the University's Career Planning and Placement Center are available to all students. In addition, the department employs a placement counselor to serve its current students and recent graduates.

For additional information, contact Bobby L. Puryear, Graduate Advisor, Department of Economics and Business, Box 8109, North Carolina State University, Raleigh, NC 27695-8109, phone (919) 737-7157.

SELECTED ADVANCED UNDERGRADUATE COURSES

ACC 480 Accelerated Survey of Financial and Management Accounting. *Credit may not be received for both ACC 480 and ACC 220, 280 or 469. Intended for graduate students and advanced undergraduates not in Economics and Business. 3(3-0) F.*

EB 401 Economic Analysis for Nonmajors. *Preq.: EB 201 or 212. 3(3-0) F,S.*

EB 404 Money, Financial Markets, and the Economy. *Preq.: EB 302. 3(3-0) F,S.*

EB 410 Public Finance. *Preq.: EB 301. 3(3-0) F.*

EB 413 Competition, Monopoly and Public Policy. *Preq.: EB 301. 3(3-0) S.*

EB 415 Farm Appraisal and Finance. *Preq.: EB 303 or 310. 3(2-2) F.*

EB 420 Corporation Finance. *Preqs.: EB 201 or 212 and ACC 260 or 265. 3(3-0) F,S.*

EB 422 Investments and Portfolio Management. *Preqs.: EB 350 or ST 311 and EB 420. 3(3-0) F,S.*

EB 430 Agricultural Price Analysis. *Preq.: EB 301. 3(3-0) F.*

EB 431 Labor Economics. *Preq.: EB 301. 3(3-0) F,S.*

EB 435 Urban Economics. *Preq.: EB 301. 3(3-0) F,S.*

EB 436 Environmental Economics. *Preq.: EB 301. 3(3-0) S.*

EB 442 Evolution of Economic Ideas. *Preq.: EB 202 or 212. 3(3-0) F.*

EB 448 International Economics. *Preq.: EB 301. 3(3-0) F,S.*

EB 451 Introduction to Econometrics. *Preqs.: EB 301, 302, 350. 3(3-0) F.*

EB (HI) 470 The Japanese Economy. *Preqs.: EB 301; 3 hours HI. 3(3-0) S.*

EB 475 Comparative Economic Systems. *Preq.: EB 201 or 212. 3(3-0) F,S.*

EB (TX) 482 Textile Marketing Management. *Preqs.: EB 301, EB 313, TX 380. 3(2-2) F,S.*

EB (WPS) 485 Management Development Seminar. *Preq.: EB 201 or 212.* This course may not be used for credit toward an economics minor for any graduate degree. 3(3-0) S.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ACC 520 Advanced Management Accounting. *Preqs.: ACC 480, EB (ST) 350 and EB 501. 3(3-0) S.* Uses of accounting data for management decisions within the firm; applications of formal analytical models including decision theory, statistical analysis of cost behavior and optimization models; management and control of decentralized operations; and design and evaluation of accounting systems. Graduate Staff

EB 501 Price Theory. *Preqs.: MA 113 and EB 301. 3(3-0) F,S.* An intensive analysis of the determination of prices and of market behavior, including demand, cost and production, pricing under competitive conditions and pricing under monopoly and other imperfectly competitive conditions. Graduate Staff

EB 502 Income and Employment Theory. *Preqs.: EB 301, EB 302, EB (ST) 350, MA 113. 3(3-0) F,S.* Determinants of national income, employment, wages, the interest rate and inflation. Emphasis on the real (as opposed to monetary) determinants of these variables and on the microfoundations of modern macroeconomics. Discussion of monetary and fiscal policy and stochastic elements in income determination. Graduate Staff

EB (RRA) 503 Economics of Recreation. 3(3-0) F. (See recreation resources administration.)

EB 504 Monetary and Financial Macroeconomics. *Preq.: EB 502. 3(3-0) S.* Financial and monetary determinants of national income and employment and the levels of wages, the interest rate and inflation. Emphasis on the money supply and the banking system. Special topics include banking regulation, budgetary deficits and the dynamics of money stock determination. D. Fisher, Pearce, Poindexter

EB 512 Law and Economics. *Preq.: EB 301 or EB 401. 3(3-0) F. Alt. yrs.* An economic analysis of the sources and effects of law, including common law, statutory law and regulation. Topics discussed include property rights and contracts, liability rules, crime and punishment, statutory enactment, bureaucratic behavior and institutional reform. Baumer, Knoeber

EB 513 Research Methods in Marketing. *Preqs.: EB 313, EB 350, EB 501. 3(3-0) S.* A systematic approach to the structure, implementation and analysis of marketing research for decision making. Models of consumer demand and firm behavior analyzed in a marketing context. Gerstner, Liebowitz

EB 515 Environmental and Resource Policy. *Preq.: EB 301 or EB 401. 3(3-0) F. Alt. yrs.* Application of price theory and benefit-cost analysis to public decisions related to resources and the environment. Emphasis on evaluation of water supply and recreation investments, water quality management alternatives, public-sector pricing, common property resources and optimum management of forest and energy resources.
Palmquist, Rucker

EB 520 Managerial Finance: Theory and Applications. *Preqs.: EB 420 and EB 301 or 401. 3(3-0) S.* The foundations of finance theory and the empirical evidence available regarding the theory. Applications of basic finance theory, including capital budgeting, markets, valuation, cost of capital, financing alternatives, dividend policy and management of liquid assets. The micro-finance decisions made by a firm, primarily the investment, financing and dividend decisions. Jones, Kupiec, Mitchell

EB 521 Markets and Trade. *Preq.: EB 301 or 401. 3(3-0) F.* This course emphasizes the space, form and time dimensions of market price and the location and produce combination decisions of firms. Consideration is given to the way in which non-price factors and public policy choices influence firm behavior and the efficiency of marketing systems. Application of these models to agricultural, industrial and public service questions is emphasized, including the relationships between resource availability and the spatial arrangement of economic activity. Dahle, King

EB 522 Portfolio and Capital Market Theory. *Preqs.: EB 501 and EB 350 or ST 311. 3(3-0) F.* Portfolio theory and its applications, plus capital market theory and the equilibrium pricing of financial assets. The role of securities, utility theory and analysis of secondary markets and their efficiency and the definition and measurement of returns and risks. Valuing securities, including options contracts. Jones, Kupiec, Mitchell

EB 523 Planning Farm and Area Adjustments. *Preqs.: EB 301, 303 or 401. 3(2-2) S.* The application of economic principles to production problems on typical farms in the state; methods and techniques of economic analysis of the farm business; application of research findings to production decisions; development of area agricultural programs.
Graduate Staff

EB 524 Financial Markets. *Preq.: EB 501. 3(3-0) S. Alt. yrs.* The economic characteristics of financial markets and instruments: determination of interest rates; structure of domestic financial markets; flow of funds; nature of financial institutions; nature of financial instruments; and financial market behavior. Jones, Kupiec, Mitchell

EB 525 Managerial Economics. *Preq.: EB 301 or 401. 3(3-0) S. Alt. yrs.* Applications of economic theory to the study of selected business practices in realms of finance, marketing, and management decision making. Specific topics have included: capital budgeting, financial structure, government regulation of industry, pricing strategies, tie-in sales, contractual arrangements between manufacturers and retailers, comparisons of managerial behavior in nonprofit or government enterprise to that in for-profit firms.
Holthausen, Margolis

EB 526 Human Resource Management. *Preq.: EB 301. 3(3-0) F.* Application of decision-making techniques and economic models to problems of human resource management. Problems, causes and solutions analyzed in relationship to maximizing profits. Nature and impact of government regulations on human resource management.
Allen, Clark, Wessels

EB 532 Economics of Trade Unions. *Preq.: EB 301 or 401. 3(3-0) F. Alt. yrs.* An examination of the growth of the trade union movement in the United States. Primary consideration is given to the impact of unions on the economy through their influence on wages, prices, employment and resource allocation. Other topics include the relationship between the government and unions, the changing compensation mix and the recent growth in public employee unionism. Allen, Clark

EB 533 Economics of World Food and Agricultural Policy. *Preq.: EB 301 or 401. 3(3-0) S.* Economic analysis of the causes and effects of agricultural policies commonly applied in developed, developing and planned economies. Emphasis on economic models of policy analysis. Examination of the impact of commodity, farm imput, international trade, consumer and general economic policies on agriculture and the whole economy. Effects of policy on income distribution and economic development. Hoover, P. Johnson, Sumner

EB 540 Economic Development. *Preq.: EB 301 or 401. 3(3-0) S. Alt. yrs.* An examination of the problems encountered in promoting regional and national economic development. Consideration is given to the structural changes required for raising standards of living. Some basic principles of economics are applied to suggest ways of achieving development goals. Topics include planning strategies, policies and external assistance. Sumner

EB 551 Agricultural Production Economics. *Preqs.: MA 113 and EB 301 or EB 401. 3(3-0) S.* An economic analysis of agricultural production including: production functions, cost functions, programming and decision-making principles. Applications of these principles to farm and regional resources allocation, and to the distribution of income to and within agriculture. Carlson, Perrin

EB (ST) 561 Intermediate Econometrics. *Preqs.: EB 501 and ST 513. 3(3-0) S.* The formalization of economic hypotheses into testable relationships and the application of appropriate statistical techniques will be emphasized. Major attention will be given to procedures applicable for single equation stochastic models expressing microeconomic and macroeconomic relationships. Statistical considerations that are relevant in working with time series and cross sectional data in economic investigations will be covered. Survey of simultaneous equation models and the available estimation techniques.
McDermed, Thurman

EB 570 Analysis of American Economic History. *Preq.: EB (HI) 371 or grad. standing or PBS status. 3(3-0) S. Alt. yrs.* Stresses the application of economic analysis to the formulation and testing of hypotheses concerning economic growth and development in the historical context. Problems selected for analysis will be drawn primarily from American economic history. Sylla

EB (SOC) 574 The Economics of Population. *Preq.: EB 301 or 401. 3(3-0) S.* A review of population theories from the pre-Malthusian to the contemporary. An introduction to demographic data sources and analysis. Microeconomic models of fertility are intensively treated, and macroeconomic demographic models also are examined. The public policy implications of these models are developed. Discussions include underpopulation, overpopulation, optimum growth rate and incentive schemes. Graduate Staff

EB (TX) 585 Market Research in Textiles. *3(3-0) S.* (See textile materials and management.)

EB 590 Special Economics Topics. *Preq.: CI. Maximum 6. F,S,Sum.* An examination of current vary as problems on a lecture-discussion basis. Course content will changing conditions require new approaches to deal with emerging problems. Graduate Staff

EB 598 Topical Problems in Economics. *Preq.: CI. 1-6. F,S,Sum.* An investigation of topics of particular interest to advanced students under faculty direction on a tutorial basis. Credits and content vary with student needs. Graduate Staff

FOR GRADUATES ONLY

EB 602 Advanced Price Theory. *Preqs.: EB 501, MA 212. 3(3-0) F.* Theory of consumer behavior. Derivation of individual and market demand curves. Consumer surplus. Derivation of firm and market supply curves. Equilibrium and price determination in a market economy. Consideration of alternative market structures. Hess, Holthausen

EB 601 Prices, Value and Welfare. *Preq.: EB 600. 3(3-0) S.* Production and duality theory. The demand for and supply of factors of production. Theories of capital and interest. Welfare economics topics, including externalities, compensation, public goods and the social welfare function. General equilibrium. Dutton, Thurman

EB 602 Advanced Income and Employment Theory. *Preq.: EB 502. 3(3-0) F.* An analysis of the forces determining the level of income and employment; a review of some of the theories of economic fluctuations; and a critical examination of a selected macroeconomic system. Rossana, Seater

EB 603 History of Economic Thought. *Preqs.: EB 501 and 502 or equivalent. 3(3-0) Sum. Alt. yrs.* A systematic analysis of the development and cumulation of economic thought, designed in part to provide a sharper focus and more adequate perspective for the understanding of contemporary economics. D. Fisher, McElroy

EB 604 Monetary Economics. *Preq.: EB 602. 3(3-0) S.* Consideration of the money market and portfolio management, the cost of capital, effects of monetary phenomena on investment and accumulation of wealth with emphasis throughout on problems arising from uncertainty; general equilibrium theory of money, interest, prices and output. D. Fisher, Lapp, Pearce

EB 606 Industrial Organization and Control. *Preq.: EB 501. 3(3-0) F.* Microeconomic theory is applied to the empirical analysis of public policies that affect the efficiency of resource allocation in the U. S. economy. Special attention is given to the interrelationships between industrial structure, conduct and performance. Flath, Margolis

EB 610 Theory of Public Finance. *Preq.: EB 501. 3(3-0) S.* An application of microeconomic theory and welfare economics to the public sector. Topics include externalities and public policy, the theory of public goods, collective choice, program budgeting and cost-benefit analysis, the theory of taxation and its application to tax policy, public debt, and fiscal federalism. Hyman

EB 615 Environmental and Resource Economics. *Preq.: EB 501. 3(3-0) S. Alt. yrs.* The theoretical tools and empirical techniques necessary for an understanding of resource and environmental economics, developed in both a static and dynamic framework. Discussions of the causes of environmental problems, possible policies and approaches to nonmarket valuation. Analysis of resource use over time using control theory for both renewable and exhaustible resources. Palmquist, Rucker, Smith

EB 625 Long Range Planning in Business and Industry. *Preq.: EB 501. 3(3-0) F.* Theory and practice of long range planning in business and industry. Case discussions and intensive readings dealing with techniques for identifying opportunities and risks in the environment of the firm, determining corporate strengths and weaknesses, specifying long range strategy. Special attention is given to the roles of management and the internal processes of large organizations as the organizations respond to changes in external conditions. Holthausen, Newmark

EB 630 Labor Economics. *Preqs.: EB 501 and one of the following: EB (ST) 561, ST 422, ST 512, ST 517. 3(3-0) S.* Application of microeconomic theory and econometric methods to labor market behavior in both static and dynamic contexts. Topics include labor demand analysis, labor force participation, hours of work, household production, human capital, distribution of earnings, information and search, and mobility. Allen, Wessels

EB 631 Policy and Research Issues in Labor Economics. *Preqs.: EB 501 and one of the following: EB (ST) 561, ST 422, ST 512, ST 517. 3(3-0) F.* Survey of current literature on policy-related issues in labor economics, including trade union behavior, unemployment, macroeconomic aspects of labor market adjustment, discrimination, regulation of wages and benefits and public-sector labor markets. Examples from labor markets in the U. S. and developing countries. Recent research developments in labor economics, topics to vary according to the interests and needs of students. Clark, Fearn

EB 640 Advanced Economic Development. *Preqs.: EB 501, 502, 540. 3(3-0) F. Alt. yrs.* An analysis of the factors determining the growth of poorer countries and regions of countries. Consideration is given to issues that have arisen in current theoretical and empirical bases for policy decisions. Included in the latter elements are the quantitative foundations for planned and programmed development. Applications of alternative planning methods are evaluated. King

EB 641 Agricultural Production and Supply. *Preqs.: EB 501 and ST 513. 3(3-0) F.* An advanced study in the logic of, and empirical inquiry into, producer behavior and choice among combinations of factors and kinds and qualities of output; aggregative consequences of individuals' and firms' decisions in terms of product supply and factor demand; factor markets and income distribution; and general interdependency among economic variables. Carlson, Perrin, Sumner

EB 642 Consumption, Demand and Market Interdependency. *Preqs.: EB 501 and ST 513. 3(3-0) S.* An analysis of the behavior of individual households and of consumers in the aggregate with respect to consumption of agricultural products; the impact of these decisions on demand for agricultural resources, the competition among agricultural regions and for markets; and the interdependence between agriculture and other sectors of the economy. Wohlgenant

EB 648 Theory of International Trade. *Preqs.: EB 501, 502. 3(3-0) S.* A consideration of the specialized body of economic theory dealing with the international movement of goods, services, capital and payments. Also, a theoretically oriented consideration of policy. Dutton, P. Johnson

EB 649 Monetary Aspects of International Trade. *Preq.: EB 502. 3(3-0) F.* Study of the macroeconomic problems of an open economy including the balance of payments adjustment mechanism, alternative exchange rate systems, external effects of monetary and fiscal policy, optimum currency areas and international monetary reform. Grennes

EB 650 Economic Decision Theory. *Preq.: EB 501. 3(3-0) S.* Study of general theories of choice. Structure of decision problems, the role of information; formulation of objectives. Current research problems. Hess, Holthausen

EB (ST) 651 Econometrics. *Preqs.: EB 600, ST 421, ST 502. 3(3-0) F.* The role and uses of statistical inference in economic research; the problem of spanning the gap from an economic model to its statistical counterpart; measurement problems and their solutions arising from the statistical model and the nature of the data; limitations and interpretation of results of economic measurement from statistical techniques. T. Johnson, Smith

EB (ST) 652 Topics in Econometrics. *Preq.: EB (ST) 651. 3(3-0) S.* Survey of current literature on estimation and inference in simultaneous stochastic equations systems. Techniques for combining cross section and time series data including covariance, error correlated and error component models. Lag models and inference in dynamic systems. Production functions, productivity measurement and hypotheses about economic growth. Complete and incomplete prior information in regression analysis. Nonlinear estimation in economic models. Gallant, Schrimper

EB 682 Advanced Macroeconomics. *Preq.: EB 602. 3(3-0) F. Alt. yrs.* Advanced study of macroeconomics. Emphasis is on business cycles and behavior of real variables. Topics include: real, incomplete information and disequilibrium theories of the business cycle; rational expectations; contract theory and indexation; investment; and the effects of government expenditure, taxes and debt. Rossana, Seater

EB 684 Monetary Theory. *Preqs.: EB 600, 601, 602, 604. 3(3-0) F. Alt. yrs.* Advanced study of microand macro-economic theories of the role of money in the economy. Primary emphasis on money demand and monetary growth models. Specific areas explored include: traditional and recent developments in both asset and transactions theory and rational

expectations and optimal policy. Discussion of the empirical record included for most topics. D. Fisher, Pearce

EB 699 Research in Economics. *Preq.: Grad. standing. Credits Arranged.* Individual research in economics under staff supervision and direction.

Graduate Staff

Education

GRADUATE FACULTY

Professor C. J. Dolce, *Dean*

Professor J. B. Kirkland, *Dean Emeritus*

The following master's degree programs are offered by the College of Education and Psychology:

Adult and Community College Education
Agricultural Education
Curriculum and Instruction
Educational Administration and Supervision
Guidance and Personnel Services
Industrial Arts Education
Mathematics Education
Middle Grades Education
Occupational Education
Psychology
Science Education
Special Education
Vocational Industrial Education

Students accepted into any of the above education programs may seek either the Master of Science degree or the Master of Education degree; students admitted to the Department of Psychology seek the Master of Science degree. The Master of Science degree is research-oriented and is preparation for further graduate study. The Master of Education is a professional degree which allows for wider latitude in the choice of course work than is allowed by the Master of Science program.

The College of Education and Psychology also offers certification programs at the intermediate (sixth-year) level in the following fields:

Agricultural Education
Curriculum and Instruction
Educational Administration and Supervision
School Counseling
Mathematics Education
Occupational Education
School Psychology
Science Education
Special Education
Vocational Industrial Education

The following doctoral programs are offered by the College of Education and Psychology:

Adult and Community College Education	Ed.D.
Curriculum and Instruction	Ed.D.
Educational Administration and Supervision	Ed.D.
Guidance and Personnel Services	Ed.D.
Industrial Arts Education	Ed.D.
Mathematics Education	Ph.D.
Occupational Education*	Ed.D.
Psychology	Ph.D.
Science Education	Ph.D.

All doctoral programs require a minimum of one year of full-time resident study.

Graduate programs are planned by the student and his or her committee in terms of the student's educational and career objectives, experience and previous preparation.

Prior to consideration of an application for admission, the following must have been received: completed application form, an official copy of current (not more than three years old) Graduate Record Examination (GRE) scores, official transcripts of all undergraduate and graduate courses taken and at least three completed recommendation forms. In most programs an interview is required. Psychology also requires the GRE Advanced Test and the Miller Analogies Test. Individual programs may have additional requirements for admission. In order to maintain personalized, quality graduate programs, each program can enroll only a limited number of students regardless of the qualifications of the applicants.

The College of Education and Psychology is housed in Poe Hall, a modern building with up-to-date research and instructional facilities, including:

Curriculum Materials Center—The Curriculum Materials Center, administered by the College of Education and Psychology, is located in Poe Hall. The center maintains a collection of educational materials with particular emphasis on teaching methods, research, administration and psychology and includes films, filmstrips, slides, audiotapes, video cassettes and simulation games. A special collection of materials about third world countries is also maintained. Audiovisual equipment is available for previewing materials in the center. Microcomputers for teaching and research are a part of this facility. The center acquires textbooks adopted by the State Board of Education for secondary level subjects as well as other selected textbooks and reference materials. The mission of the center is to support programs in the College of Education and Psychology, and the center's use by campus personnel outside of the College is limited.

Instructional Materials Production Center—Education, instruction and communication require the clear and effective presentation of content. The Instructional Materials Production Center (IMPC) aids this requirement through the design and production of instructional and informational materials in a range of formats. Although resources and personnel of the IMPC predominantly serve

*Students in agricultural education or industrial and technical education would seek the Ed.D. in occupational education.

faculty, students and projects of the College of Education and Psychology, increasing requests for materials from the University and beyond are met as possible on a contract basis.

The IMPC is directed by two instructional designers, faculty members of the College which is unique in having a production facility in which two persons of such training function full time as designers, producers and consultants. Other personnel in the facility serve as teaching assistants, graphic designers or are hired for the special needs of certain projects. Personnel work through the process of instructional design with those persons having a communicational need—faculty members, content specialists or project directors. Careful application of this process is necessary in order to determine what materials and strategies best serve the interrelated considerations of goals, objectives, content, users, audience, cost and available resources and is also necessary if final products are to be as lucid in design as in educational soundness. Formats in which materials are developed include: print, overhead transparencies, graphic imagery, displays and exhibits, signage, photography, slides, slide-tape presentations and in some cases videotape.

Office of Publications—This office prints and publishes instructional materials developed by faculty and students, as well as by public school teachers associated with various College programs.

The Computing Facility is a laboratory and two adjacent classrooms equipped with microcomputers and with terminals and televideos linked to University computing facilities and the Triangle Universities Computing Center (TUCC). The facility is used for faculty research and development, student projects, graphics instruction, in-service teacher training workshops and training.

Other Special Facilities—Poe Hall also houses an extensive variety of shops (metal, wood, ceramic, electrical and photography); counseling and testing centers; several laboratories for the study of human behavior; an animal room; and a standardized test library.

Adult and Community College Education

Adult and community college education is a component of both the College of Education and Psychology and the College of Agriculture and Life Sciences. For a listing of graduate faculty and departmental information, see adult and community college education.

Agricultural Education

GRADUATE FACULTY

Associate Professor L. R. Jewell, *Coordinator*

Professor: J. K. Coster; *Professor Emeritus:* C. C. Scarborough; *Associate Professors Emeriti:* C. D. Bryant, T. R. Miller; *Assistant Professors:* J. L. Flowers, B. J. Malpiedi

The agricultural education program offers study leading to the Master of Science and the Master of Education degrees and to the intermediate (sixth-year) certificate. Both master's programs require a minimum of 36 semester hours which reflect the student's background and career expectations and which meet the approval of the student's advisory committee. Graduate programs are designed to meet the needs of individual students for further study and research as well as to prepare them for educational leadership roles in teaching, administration, supervision and research in agricultural education.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ED 554 Planning Programs in Agricultural Education. *3(3-0) F,S.*

ED 565 Agricultural Occupations. *3(3-0) F,S.*

ED 566 Occupational Experience in Agriculture. *3(3-0) F,S.*

ED 568 Adult Education in Agriculture. *3(3-0) F,S.*

FOR GRADUATES ONLY

ED 664 Supervision in Agricultural Education. *3(3-0) F,S.*

Counselor Education

GRADUATE FACULTY

Professor D. C. Locke, *Head*

Professors: L. K. Jones, N. A. Sprinthall; *Professors Emeriti:* W. E. Hopke, C. G. Morehead; *Associate Professors:* H. A. Exum, E. R. Gerler Jr.; *Visiting Associate Professor:* T. H. Stafford Jr.; *Associate Professor Emeriti:* J. G. McVay, B. C. Talley Jr.; *Assistant Professor:* D. D. Saidla; *Visiting Assistant Professor:* C. L. Oglesby; *Adjunct Assistant Professor:* R. F. Anderson

The department offers work leading to the Master of Science, Master of Education and Doctor of Education degrees as well as to the sixth-year certificate, with a major in the field of guidance and personnel services. Each of these degrees is designed to prepare individuals for guidance and personnel positions at various levels in elementary and secondary schools, junior and community colleges, trade and technical schools and institutes, institutions of higher education and community agencies. The student may specialize in one of several areas depending upon individual career goals.

It is desirable for an applicant to have had undergraduate or graduate course work in humanities, social and behavioral sciences as well as work experience in a human development context. Students accepted into the department are those who anticipate devoting full- or part-time to guidance and personnel work.

Admission requirements for the department are a minimum of a B average in the junior and senior years of undergraduate work; satisfactory scores on the aptitude section of the Graduate Record Examination or the Miller Analogies Test; three satisfactory letters of recommendation in regard to previous education and employment experiences, personal characteristics and emotional maturity. An interview and work sample are also required for doctoral admission.

For descriptions of the guidance and personnel courses listed below, see education courses.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ED 520 Introduction to Guidance and Counseling. *3(3-0) F,Sum.*

ED 521 Internship in Guidance and Personnel Services. *Credits Arranged. F,S.*

ED 524 Career Counseling and Development. *3(3-0) S,Sum.*

ED 530 Theories and Techniques of Counseling. *3(3-0) F,S,Sum.*

ED 533 Group Counseling. *3(3-0) F,Sum.*

ED 534 Guidance in Elementary and Middle Schools. *3(3-0) F.*

ED 535 Student Personnel Work in Higher Education. *3(3-0) F.*

ED 553 Community Service Agencies. *3(3-0) F.*

ED 590 Special Problems in Guidance. *Maximum 6 F,S.*

FOR GRADUATES ONLY

ED 625 Cross Cultural Counseling. *3(3-0) S.*

ED 631 Vocational Development Theory. *3(3-0) F. Alt. yrs.*

ED 633 Development and Coordination of School Guidance Programs. *3(3-0) S.*

ED 636 Observation and Supervised Field Work. *1-3 F,S.*

ED 637 Seminar in Cognitive-Developmental Theory and Practice. *3(3-0) F. Alt. yrs.*

ED 638 Seminar in Cognitive-Developmental Research. *3(3-0) S. Alt. yrs.*

ED 640 Laboratory Experiences in Counseling. *3(3-0) F.*

ED 641A Practicum in Counseling. *2-6 S.*

ED 666 Supervision of Counseling. *3(1-8) F,S.*

ED 686 Professional Issues in Counseling. *1-3 F,S, Alt. yrs.*

Curriculum and Instruction

GRADUATE FACULTY

Professor P. H. Martorella, *Head*

Professor: B. M. Parramore; *Associate Professors:* J. F. Arnold, C. L. Crossland, D. A. Cullinan, B. J. Fox, C. W. Harper Jr., R. J. Pritchard; *Professor Emeritus:* C. C. Scarborough; *Visiting Associate Professor:* L. Thies-Sprinthall; *Associate Professor Emeritus:* P. J. Rust; *Assistant Professors:* H. S. Abernathy, H. C. Griffin, C. A. Pope, E. S. Vasu; *Adjunct Assistant Professors:* L. C. Aubrecht, D. D. Copeland, M. D. Durfee, N. D. LeVere, M. D. Siedow; *Assistant Professor Emeritus:* K. A. McCutchen

The department offers work leading to the Master of Education, Master of Science and Doctor of Education degrees. A sixth-year program leading to certification is also available. Those completing the master's program may qualify for a graduate teaching certificate in an area of specialization or for a supervisor's certificate.

Students may specialize in one of several areas:

Curriculum development and supervision
English and language arts education
Elementary education—intermediate grades
Instructional technology—computers
Middle years education
Reading education
Social studies education
Special education
Supervision

Graduate programs are designed for those who plan to qualify as supervisors, instructional specialists, curriculum developers, teacher educators and consultants at preschool through university levels. Graduates may enter positions in public schools, service agencies, higher education institutions and industries.

In addition to meeting the requirements of the Graduate School, applicants must provide evidence of satisfactory scores on the Graduate Record Examination and/or Miller Analogies Test; submit a written statement of professional goals; and arrange for a departmental interview upon request.

SELECTED ADVANCED UNDERGRADUATE COURSE

ED 483 An Introduction to Instructional Media. *Preq.: Advanced undergrad. standing. 3(3-0) F,S,Sum.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ED 501 Computer Applications in Instruction. *3(3-0) F,S.*

ED 502 The School Curriculum. *3(3-0) F.*

ED 504 Social Studies in the Elementary School. *3(3-0) F.*

ED 506 Education of Exceptional Children. *3(3-0) F.*

ED 507 Foundations of Middle Years Education. *3(3-0) F.*

ED 508 Education of Severely Handicapped. *3(3-0) F.*

ED 509 Methods and Materials Teaching Retarded Children. *3(3-0) S.*

ED 513 Introduction to Issues and Techniques in Visual Impairments. *3(3-0) F.*

ED 519 Early Childhood Education. *3(1-4) S.*

ED 523 Orientation and Mobility of the Visually Impaired. *3(3-0) F.*

ED 531 Mental Retardation. *3(3-0) F.*

ED 536 Structure and Function of the Eye and Use of Low Vision. *3(3-0) F.*

ED 540 Career/Vocational Education for the Handicapped. *3(3-0) S.*

ED 542 Contemporary Approaches in the Teaching of Social Studies. *3(3-0) S.*

ED 544 The Teaching of Composition. *3(3-0) S.*

ED 545 Reading in the Elementary School. *3(3-0) F. Alt. yrs.*

ED 546 Reading in the Content Areas. *3(3-0) S,Sum.*

ED 547 Language Arts in the Elementary School. *3(3-0) S.*

ED 548 Development of Microcomputer Software for Instruction. *3(3-1) F.*

ED 551 Principles and Practices of Supervision. *3(3-0) S.*

ED 556 Learning Disabilities. *3(3-0) F.*

ED 557 Methods and Materials in Learning Disabilities. *3(3-0) S.*

ED 558 Resource Teaching in Special Education. *3(3-0) F.*

ED 560 Teaching Through the Arts. *3(3-0) S.*

ED 561 Educational Diagnosis and Prescription for Exceptional Children. *3(3-0) S.*

ED 562 Communication Disorders in the Classroom. *3(3-0) S. Alt. yrs.*

ED 563 Effective Teaching. *3(3-0) F.*

ED 564 Classroom Management in Special Education. *3(3-0) S.*

ED 571 Introduction to the Gifted Individual. *3(3-0) F.*

ED 572 Methods for Teaching the Gifted. *3(3-0) S.*

ED 573 Behavior Disorders. *3(3-0) F.*

ED 574 Methods and Materials Behavior Disorders. *3(3-0) S.*

ED 576 Teaching/Learning Approaches for Emerging Adolescents. *3(3-0) S.*

ED 582 Teaching Braille and Communication Skills. *3(3-0) S.*

ED 583 Design and Evaluation of Instructional Materials. *3(3-0) S.*

ED 586 Methods and Materials in Visual Impairments. *3(3-0) S.*

ED 591 Teaching Literature for Young Adults. *3(3-0) S. Alt. yrs.*

ED 598 Special Problems in Curriculum and Instruction. *1-6 F,S,Sum.*

FOR GRADUATES ONLY

ED 602 Curriculum Theory and Development. *3(3-0) F.*

ED 606 Remediation of Reading Disabilities. *3(3-0) S. Alt. yrs.*

ED 634 Diagnosis of Reading Disabilities. *3(3-0) F. Alt. yrs.*

ED 641B Diagnostic-Prescriptive Practicum in Reading. *3(3-0) S.*

ED 641C Practicum in Special Education. *1-6 F,S.*

ED 641G Practicum in Middle Years Education. *3-6 F,S.*

ED 641K Practicum in Supervision. *3-6 F,S.*

ED 641M Practicum in Instructional Technology—Computers. *3-6 F,S.*

ED 642 Research Applications in Curriculum and Instruction. *3(3-0) S.*

ED 648 Theory and Process in Reading and Language Arts. *3(3-0) S. Alt. yrs.*

ED 665 Supervising Student Teachers. *3(3-0) F,S.*

ED 687 Seminar in Curriculum and Instruction. *1-3 S.*

Educational Administration and Supervision

GRADUATE FACULTY

Professor R. G. Taylor Jr., *Head*

Professor: C. J. Dolce; *Visiting Professor:* A. A. Glatthorn; *Adjunct Professor:* C. R. Coble; *Associate Professors:* B. G. Beezer, W. B. Harvey, E. MacPhail-Wilcox, J. C. Marshall, R. C. Serow; *Visiting Associate Professor:* R. H. Forbes; *Adjunct Associate Professor:* J. S. Pressley; *Lecturer:* R. T. Williams

The graduate programs in educational administration and supervision have a multidisciplinary emphasis which includes courses in economics, politics, psychology and sociology as well as in professional education. Within the constraints required for certification, programs are planned individually, based on an analysis of the student's career objectives and competencies. In addition to formal courses, planned non-credit experiences are offered to enhance the student's professional development.

The master's degree programs (M.S., M.Ed.), which require a minimum of 30 or 36 credit hours, are designed to prepare individuals for entry-level administrative positions in public schools, colleges and other educational agencies. The master's program must be completed within four years from the semester of admission. An intermediate (sixth-year certificate) program, which leads to the second level of certification, is also available for public school personnel.

The doctoral degree program (Ed.D.), which requires extensive work in research and clinical practice (internship), is designed to prepare individuals for advanced administrative and supervisory positions in public schools, education service agencies, education policy positions and higher education. One academic year of full-time residency is required. The doctoral program must be completed within six years from the semester of admission. In addition, an Ed.D. degree in elementary and secondary administration is offered in Greenville, NC, in cooperation with East Carolina University.

In addition to admission requirements of the Graduate School, there are two additional requirements: a recent Graduate Record Examination score (both verbal and quantitative), a Miller's Analogy Test and a narrative statement which describes in detail the applicant's career objectives and specific objectives for enrolling in the graduate program.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ED 514 Formative Ideas in American Education. *3(3-0) F.*

ED 515 Education and Social Diversity. *3(3-0) S. Alt. yrs.*

ED 518 Introduction to Education Law. *3(3-0) S.*

ED 532 Introduction to Educational Inquiry. *3(3-0) F,S,Sum.*

ED 541B Practicum in Education Administration. *1-6 F,S.*

ED 550 Principles of Educational Administration. *3(3-0) F,S.*

ED 569 The Principalship. *3(3-0) S. Alt. yrs.*

ED 578 Law and Higher Education. *3(3-0) S. Alt. yrs.*

ED 580 Evaluation Theory and Practice in Education. *3(3-0) F.*

FOR GRADUATES ONLY

ED 614 Contemporary Educational Thought. *3(3-0) Alt. S.*

ED 616 History of Higher Education in the United States. *3(3-0) F. Alt. yrs.*

ED 618 School Law for the Administrator. *3(3-0) S. Alt. yrs.*

ED 620 Cases in Educational Administration. *3(3-0) S. Alt. yrs.*

ED 632 Applied Research Methods in Education. *3(1-4) S.*

ED 697 Problems of Research Design in Education. *1-3 S. Alt. yrs.*

Industrial and Technical Education

GRADUATE FACULTY

Associate Professor E. I. Farmer, *Coordinator*

Professors Emeriti: D. M. Hanson, J. T. Nerden; *Associate Professor Emeritus:* F. S. Smith; *Assistant Professor Emeritus:* T. C. Shore Jr.

The program in industrial and technical education provides graduate work leading to the degrees of Master of Science and Master of Education and to the intermediate (sixth-year) certificate in vocational industrial education. The rapid development of industrial and technical education in North Carolina and throughout the nation provides opportunities for teachers, supervisors and administrators who have earned advanced degrees.

The facilities at the University allow supporting courses at the graduate level in the related fields of computer science, economics and business, engineering, guidance and personnel services, mathematics, psychology, sociology and statistics. The prerequisite for graduate work in the programs in industrial and technical education is a proficiency in the undergraduate courses required for the bachelor's degree in industrial or technical education or a substantial equivalent.

SELECTED ADVANCED UNDERGRADUATE COURSES

ED 421 Principles and Practices in Industrial Cooperative Training. *Preqs.: ED 327, 344, 305. 3(3-0) F.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES*

ED 525 Advanced Trade Analysis and Course Construction. *3(3-0) F.*

FOR GRADUATES ONLY

ED 609 Planning and Organizing Industrial and Technical Education Programs. *3(3-0) F.*

*For other courses, see occupational education.

Industrial Arts Education

GRADUATE FACULTY

Associate Professor R. E. Peterson, *Coordinator*

Professor Emeritus: D. W. Olson; *Associate Professors:* R. E. Peterson, R. E. Wenig; *Associate Professor Emeritus:* T. B. Young; *Assistant Professors:* V. W. DeLuca, W. J. Haynie III

The industrial arts education program offers graduate work leading to the degrees of Master of Science, Master of Education and Doctor of Education. Graduate programs are designed for teachers who wish to develop their instructional competencies and for those who wish to be supervisors and administrators of industrial arts programs.

SELECTED ADVANCED UNDERGRADUATE COURSE

IA 480 Modern Industries. *Preq.: Jr. standing. 3(3-0) S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

IA 510 Design for Industrial Arts Teachers. *Preqs.: Six hours of drawing, IA 231 or equivalent. 3(2-2) Sum.* A study of new developments in the field of design with emphasis on the relationship of material and form in the selection and designing of industrial arts projects. Graduate Staff

IA 560 New Developments in Industrial Arts Education. *Preqs.: Twelve hours of education and teaching experience. 3(3-0) F,S,Sum.* This course is a study of the new developments in industrial arts education. It is designed to assist teachers and administrators in developing new concepts and new content based on the changes in technology.
Graduate Staff

IA 582 Visual Communications in Industrial Arts Education. *Preq.: Advanced standing in IAE or CI. 3(2-2) S. Alt. yrs.* Designed to enable teachers to understand key technical developments in the area of visual communications. Emphasis is upon developing pilot testing and evaluating a sequence of laboratory activities for school environment.
Peterson

ED 588 Advanced Teaching Methods in Industrial Arts Education. *3(2-2) F,Sum.*

IA 590 Laboratory Problems in Industrial Arts. *Preqs.: Sr. standing, CI. Maximum 6. F,S,Sum.* Courses based on individual problems and designed to give advanced majors in industrial arts education the opportunity to broaden or intensify their knowledge and abilities through investigation and research in the various fields of industrial arts, such as metals, plastics, ceramics or electricity-electronics. Graduate Staff

IA 595 Industrial Arts Workshop. *Preq.: One or more years of teaching experience. 3(3-0) Sum.* A course for experienced teachers, administrators and supervisors of industrial arts. The primary purpose will be to develop sound principles and practices for initiating, conducting and evaluating programs in this field. Enrollees will pool their knowledge and practical experiences and will do intensive research work on individual and group problems. Graduate Staff

FOR GRADUATES ONLY

ED 630 Philosophy of Industrial Arts. *2(2-0) F,S.*

ED 635 Administration and Supervision of Industrial Arts. *2(2-0) F,S.*

IA 645 Technology and Industrial Arts. *Preqs.: IA 560, ED 630. 3(3-0) F,S.* Technology: its nature, origins, advance. Impact of technological advance on man and culture. Technology as the material culture. Changing concepts of work, skill, occupations, discretionary time. Technology and its relation to industrial arts education. Graduate Staff

ED 692 Seminar in Industrial Arts Education. *1(1-0) F,S.*

Mathematics and Science Education

GRADUATE FACULTY

Professor A. C. Howe, *Head*

Professors: N. D. Anderson, L. M. Clark, J. R. Kolb; *Professor Emeritus:* H. E. Speece; *Associate Professors:* W. M. Waters Jr., L. W. Watson, J. H. Wheatley; *Associate Professor Emeritus:* H. A. Shannon; *Assistant Professor:* L. V. Stiff; *Visiting Assistant Professor:* J. C. Park

The Department of Mathematics and Science Education offers graduate work leading to the degrees of Master of Science, Master of Education and Doctor of Philosophy with majors in mathematics education or in science education and intermediate level certification in both fields. Each student's program is individually planned by a graduate committee and will reflect the student's undergraduate and graduate preparation, teaching experience and future professional plans. Students take courses in both professional education and in their teaching specialties. Areas of specialization include mathematics, biological sciences, earth science, chemistry and physics.

Doctoral students are required to have a reading knowledge of one modern foreign language. Additional communication skills may be required by the advisory committee. Independent reading and participation in seminars are an indispensable part of the doctoral program. The heart of the program is the dissertation, a document based on original research that makes a significant contribution to science education or mathematics education.

Applicants must meet the admissions requirements of the Graduate School and have departmental approval.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ED 511 Implications of Mathematical Content, Structure, and Processes for the Teaching of Mathematics in the Elementary School. *3(3-0) S,Sum. Alt. yrs.*

ED 512 Teaching Mathematics in Elementary and Junior High School. *3(3-0) S,Sum. Alt. yrs.*

ED 526 Teaching in College. *3(3-0) Sum.*

ED 570 Foundations of Mathematics Education. *3(3-0) S,Sum. Alt. yrs.*

ED 575 Foundations of Science Education. *3(3-0) S,Sum., Alt. yrs.*

ED 577 Improving Classroom Instruction in Science. *3(3-0) S.*

ED 592 Special Problems in Mathematics Teaching. *1-3 F,S,Sum.*

ED 594 Special Problems in Science Teaching. *1-6 F,S,Sum.*

FOR GRADUATES ONLY

ED 603 Teaching Mathematics and Science in Higher Education. *3(3-0) S.*

ED 604 Curriculum Development and Evaluation in Science and Mathematics. *3(3-0) S.*

ED 605 Education and Supervision of Teachers of Mathematics and Science. *3(3-0) S.*

ED 641D Practicum in Science and Mathematics Education. *1-6 F,S.*

ED 690 Seminar in Mathematics Education. *2(2-0) F,S.*

ED 695 Seminar in Science Education. *2(2-0) F,S.*

Occupational Education

GRADUATE FACULTY

Associate Professor J. R. Clary, *Head*

Associate Professor: L. R. Jewell, *Graduate Administrator*

Professor: J. K. Coster; *Professors Emeriti:* D. M. Hanson, J. T. Nerden, D. W. Olson, C. C. Scarborough; *Associate Professors:* J. L. Burrow, L. S. Dillon, E. I. Farmer, R. E. Peterson, R. E. Wenig; *Associate Professors Emeriti:* C. D. Bryant, W. L. Cox Jr., T. R. Miller, F. S. Smith; *Assistant Professors:* J. L. Crow, V. W. DeLuca, J. L. Flowers, W. J. Haynie III, B. J. Malpiedi, R. M. Patterson, W. J. Vander Wall; *Visiting Assistant Professor:* M. M. Turnbull; *Adjunct Assistant Professors:* C. B. Belcher, B. M. Patterson; *Assistant Professor Emeritus:* T. C. Shore Jr.

The Department of Occupational Education includes programs leading to advanced degrees in the program areas of agricultural education, health occupations education, industrial and technical education, and industrial arts education. For descriptions of the advanced degree programs in these areas, see earlier sections in education. In addition, the department offers advanced degree programs in occupational education and courses leading to certification in the teaching of middle grades occupational exploration.

This section of the catalog describes the advanced programs in occupational education *per se*; that is, programs in which the major is occupational education.

The department offers leadership development programs in occupational education for the Master of Education and Master of Science degrees, the Intermediate (Sixth-Year) Program, and Doctor of Education degree.

The master's programs are designed to prepare persons for entry-level administrative and supervisory positions in occupational education. However, students may prepare for other careers, such as master teachers of career exploration programs.

The master's programs require a minimum of 36 semester hours of graduate work, including 27 hours in the major. Additional hours will be specified by the student's advisory committee for those who do not have a baccalaureate degree in an occupational education field. Students who elect the Master of Science substitute the thesis for part of the course load.

The Intermediate (Sixth-Year) Program requires a minimum of 60 semester hours of graduate work, including 48 hours in the major.

The primary purpose of the doctoral program is to prepare persons for advanced positions in occupational education. Students may elect to prepare for such positions as administrator, research specialist, curriculum development specialist or teacher educator in occupational education. A minimum number of 90 semester hours of graduate work beyond the baccalaureate degree is specified for the doctoral program. Emphasis is placed on developing competencies, and students may be advised to supplement their course work.

Applicants to the graduate level programs must take the Graduate Record Examination or the Miller Analogies Test and submit a resume of work experience with a statement of career goals. Application processes must be completed within six months of the date the application is received.

All doctoral programs require a minimum of one year of full-time resident status devoted to the program and programs must be completed within six years from the beginning of the semester in which the student is initially enrolled in the doctoral classification. Other department policies should be requested from the graduate administrator.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ED 516 Analysis of Occupational Information, Trends and the Labor Market. *3(3-0) S.*

ED 522 Career Exploration. *3(3-0) F,S,Sum.*

ED 527 Philosophy of Occupational Education. *3(3-0) F,S.*

ED 528 Cooperative Occupational Education. *3(3-0) F,S.*

ED 529 Curriculum Materials Development. *3(3-0) F,S.*

ED 541A Practicum in Occupational Education. *1-6 F,S.*

ED 593 Special Problems in Occupational Education. *1-6 F,S,Sum.*

FOR GRADUATES ONLY

ED 609 Planning and Organizing Industrial and Technical Education Programs. *3(3-0) F. Alt. yrs.*

ED 610 Administration of Occupational Education. *3(3-0) S. Alt. yrs.*

ED 611 Laws, Regulations and Policies Affecting Occupational Education. *3(3-0) S.*

ED 612 Finance, Accounting, and Management of Occupational Education Programs. *3(3-0) S. Alt. yrs.*

ED 688 Research Application in Occupational Education. *3(3-0) F,S.*

ED 693 Advanced Special Problems in Occupational Education. *1-6 F,S,Sum.*

Health Occupations Education

Assistant Professor J. A. Davis, *Coordinator*

The master's degree level program track in health occupations teacher education has been established in response to an increasing need for accountability in professional education and for qualified educators in the health fields. The program is designed to provide a broad comprehension of the health care delivery system and the education of future providers of service and to develop competency in curriculum and instruction planning and implementation. Students desiring to move into administrative and supervisory roles are encouraged to design a plan of study consistent with their personal goals. Students must hold credentials in one of the health disciplines and have knowledge of the health care system.

Students will be encouraged to participate in the interinstitutional cooperative program that exists between the Graduate Schools of North Carolina State University, Duke University and the University of North Carolina at Chapel Hill which makes available a vast array of offerings in the health field from which to select courses.

SELECTED ADVANCED UNDERGRADUATE COURSE

ED 433 Health Occupations Specialty Practicum. *Preq.: Current credential in a recognized health discipline. 6 Arranged. F,S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ED 555 Issues and Trends in Education for the Allied Health Professions. *3(3-0) Alt. yrs.*

ED 581 Curriculum and Instruction in the Allied Health Professions. *3(3-0) Alt. yrs.*

ED 584 Health Care Delivery Systems and Environments. *3(3-0) Alt. yrs.*

FOR GRADUATES ONLY

ED 641J Practicum in Health Occupations. *3(3-0) Alt. yrs.*

Training and Development

Associate Professor L. S. Dillon, *Coordinator*

Human resource development is a field which deals with the quality of work life, productivity and the satisfaction and development of human resources. Within this field, nine distinct areas may be defined: organization development, organization and job design, planning, selection and staffing, personnel research, compensation and benefits, employee assistance, union and labor relations, and training and development. The focus of training and development is to identify and, through planned learning activities, help to develop the key competencies which enable individuals to perform current or future jobs.

Students may pursue either the Master of Education or the Master of Science degree. Both degrees require a minimum of 36 hours.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ED 587 Organization and Operation of Training and Development Programs. *3(3-0) F.*

ED 595 Methods and Techniques of Training and Development. *3(3-0) S.*

Psychology

For a listing of departmental faculty and courses, see psychology.

Education Courses

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ED 500 Community College and Two-year Postsecondary Education. *Preq.: Grad. standing or PBS status. 3(3-0) F,S.* Comprehensive community colleges and technical institutes and the state systems of which they are a part: underlying concepts, educational needs they are designed to serve, role in meeting these needs, historical development, issues in the establishment and operation of state systems and individual institutions, unresolved issues and emerging trends. Graduate Staff

ED 501 Computer Applications in Instruction. *Preq.: Six hrs. ED or PSY or CI. 3(3-0) F,S.* Emphasis is on the use and evaluation of existing educational software and research findings with respect to the uses of computers in instruction. Martorella, Vasu

ED 502 The School Curriculum. *Preq.: 12 semester hours ED and PSY or CI. 3(3-0) F.* A study of the origin, development, and current status of the elementary and secondary school curriculum and an evaluation of the trends and issues likely to influence the curriculum in the future. Parramore

ED 503 The Programming Process in Adult and Community College Education. *Preqs.: ED 501, CI. 3(3-0) F,S.* The principles and processes involved in programming, including basic theories and concepts supporting the programming process. Attention will be given to the general framework in which programming is done, the organization needed and the program roles of both professional and lay leaders. Boone

ED 504 Social Studies in the Elementary School. *Preq.: Six hours in ED. 3(3-0) F.* Advanced professional training in the teaching of social studies for middle grades and elementary teachers, including an in-depth introduction to research-based teaching strategies, instructional resources and the literature of the field. Martorella

ED 505 Public Area Schools. *Preq.: Grad. standing or PBS status. 3(3-0) F.* Junior and community colleges, technical institutes, vocational schools and branches of universities: their development, status and prospects, policy and policy-making, clientele, purposes, evaluation programs, personnel, organization administration, financing, facilities, research and development functions. Graduate Staff

ED 506 Education of Exceptional Children. *Preq.: 9 hours of ED or PSY. 3(3-0) F,S,Sum.* An introduction to the field of Special Education. The course focuses on the historical overview, definitions and terminology in the basic areas of exceptionality; etiological factors in exceptionality; developmental and learning characteristics of each area of exceptionality; and educational settings and strategies employed in special education. A review is given of current educational laws and policies affecting special education. Graduate Staff

ED 507 Foundations of Middle Years Education. *Preq.: 6 hours of ED and PSY. 3(3-0) F,S.* Five major aspects of middle years education are examined: (a) the history and purposes of middle/junior high school, (b) pre- and early adolescent needs, interests and abilities, (c) curriculum design and content, (d) teaching methods and (e) school organization. Both theoretical understandings and effective classroom strategies will be emphasized. Arnold

ED 508 Education of Severely Handicapped. *Preq.: ED 531 or ED 574 or CI. 3(3-0) F.* A study of severe and profound mental retardation and autism, including assessment procedures, educational and social/vocational programs, instructional strategies and evaluation. Legal and ethical issues involved in working with the severely handicapped are examined. Graduate Staff

ED 509 Methods and Materials—Teaching Retarded Children. *Preqs.: ED 506 and ED 531 or CI. 3(3-0) S.* A study of the methods and materials related to teaching mentally retarded school age children. Course will include the study of the learning and behavioral characteristics and educational programs for the mentally retarded in the areas of motor, communications, social, academic and vocational development. Crossland

ED 510 Adult Education: History, Philosophy, Contemporary Nature. *Preqs.: Advanced undergrad., CI. 3(3-0) F,S.* A study of the historical and philosophical foundations of adult education from ancient times to the present, giving attention to key figures, issues, institutions, movements and programs, including consideration of the relationship between adult education's historical development and prevailing intellectual, social, economic and political conditions. Consideration of adult education's contemporary nature, present-day schools of thought on its objectives and trends. Carter

ED 511 Implications of Mathematical Content, Structure, and Processes for the Teaching of Mathematics in the Elementary School. *Preq.: Bachelor's degree in elementary education or CI. 3(3-0) S,Sum. Alt. yrs.* Designed for teachers and supervisors of mathematics in the elementary or middle school. Special emphasis on implications of mathematical content, structure, and processes in teaching arithmetic and geometry. Waters, Watson

ED 512 Teaching Mathematics in Elementary and Junior High School. *Preq.: ED 471 or equivalent. 3(3-0) S,Sum. Alt. yrs.* Comprehensive study of teaching mathematics in elementary and junior high schools. Major emphasis on building skills in teaching arithmetic, elementary algebra and intuitive geometry. Thorough search of the literature relative to the mathematics curricula will be conducted, designing and sequencing of

learning activities, teaching mathematical concepts and relationships, building skill in computation, reading mathematics, problem solving and measurement will be covered.
Kolb, Watson

ED 513 Introduction to Issues and Techniques in Visual Impairments. *Preq.: ED 506. 3(3-0) F.* Addresses historical developments, trends, issues and basic skill techniques for the visually impaired. Includes societal perceptions, societal integration, effects of a visual impairment on development, psychosocial adjustment and Braille transcription skills.
Graduate Staff

ED 514 Formative Ideas in American Education. *Preq.: Six hours ED or PSY or CI. 3(3-0) F.* A consideration of the theory and practice of American education as an extension of the philosophical climate of opinion of different intellectual ages and how the present status of our educational system is grounded in the thought of the past. Beezer

ED 515 Education and Social Diversity. *Preq.: Six hours ED, PSY and/or social science. 3(3-0) Alt. S.* An overview of the role of education within a culturally diverse society. Major attention is directed to racial, ethnic, socioeconomic and regional subpopulations. Among the issues to be discussed are the subcultural influences on public school performances, equality of educational opportunity, social stratification and mobility and the impact of schooling on intergroup relations. Serow

ED 516 Analysis of Occupational Information, Trends and the Labor Market. *Preq.: Six hrs. of ED. 3(3-0) S.* Overview of federal, state and local sources of labor market information. Analysis of labor market concepts and applications for career exploration and decision making. Use of community surveys in vocational program planning.
Graduate Staff

ED 517 Administrative Technology in Education. *Preqs.: ED 550 or equivalent and ED 532 or equivalent or CI. 3(3-0) S. Alt. yrs.* Designed to provide professional educators and human service planners with planning and management techniques using current information and communication technologies. Students use both equipment and procedural applications for financial planning, data base management, case management, scheduling, modeling and other management techniques. Ballenger, MacPhail-Wilcox

ED 518 Introduction to Education Law. *Preq.: Six hours graduate credit. 3(3-0) S.* A study of constitutional, statutory and case law as it relates to the elementary and secondary public school settings, particularly in the areas of students, teachers and liability. Particular emphasis is placed on North Carolina and federal law. Beezer

ED 519 Early Childhood Education. *Preq.: PSY 475 or PSY 576. 3(1-4) S.* Planning, selecting and using human resources, activities, materials and facilities in the education of young children. Student observation, participation and evaluation of educational experiences for the developmental level of individual children for an optimum learning environment. A synthesis of the student's knowledge of human development, learning theory and research findings as related to classroom application. Graduate Staff

ED 520 Introduction to Guidance and Counseling. *Preq.: Six hours in ED or PSY. 3(3-0) F,S,Sum.* An introduction to the philosophies, theories, principles and issues of guidance and counseling services, with major emphasis on guidance at the secondary school level. Graduate Staff

ED 521 Internship in Guidance and Personnel Services. *Preqs.: Eighteen hours in department and CI. Credits Arranged. F,S.* A continuous full-time internship of at least one-half semester. Framework of school and community. Work with students, teachers, administrators, guidance and pupil personnel workers, parents and resource personnel in the community. Supervision of intern by guidance personnel in school as well as by course instructors. Graduate Staff

ED 522 Career Exploration. *Preq.: 12 hours ED or CI. 3(3-0) F,S,Sum.* This course is designed for teachers in the public schools of North Carolina who teach in "Career Exploration" programs. The course emphasizes the philosophy of career exploration, theories supporting career exploration, the place of exploration programs in the overall school curriculum, correlation of occupational information in academic subjects, sources of occupational information and its use and approaches to teaching in a career exploration program. Clary, Dillon

ED 523 Orientation and Mobility of the Visually Impaired. *Preq.: CI. 3(3-0) F.* The sensory processes and sensory cues on which independent mobility depends for the visually impaired person. Various techniques and modes of travel considered. Emphasis given to instruction and background which will enable person not teaching orientation mobility as a skill to reinforce the learning that takes place in other situations. Graduate Staff

ED 524 Career Counseling and Development. *Preq.: Six hours of ED or PSY. 3(3-0) S,Sum.* Knowledge and skills needed to: (a) provide professional career counseling to individuals and (b) design, implement and evaluate career development programs for particular groups. Areas of study include: theories of career development and decision making; career guidance programs in educational, agency and industrial setting; career information sources and delivery systems; and assessment in career counseling. Gerler, Jones

ED 525 Advanced Trade Analysis and Course Construction. *Preq.: 12 hours ED or CI. 3(3-0) F.* Principles and practices in analyzing occupations for the purpose of determining teaching content. Practice in the principles underlying industrial course organization based on occupational analysis covering instruction skills and technology and including course outlines, job sequences, the development of industrial materials and instructional schedules. Graduate Staff

ED 526 Teaching in College. *3(3-0) Sum.* This course focuses on the development of competencies to perform the fundamental tasks of a college teacher as well as consideration of more long-range tasks such as course development and the university responsibilities of a professor. In addition to attending lectures and other types of presentations, students will make video tapes of their teaching, develop tests, design introductory courses in their teaching fields and consider current issues related to university and college teaching. Anderson

ED 527 Philosophy of Occupational Education. *Preq.: 12 hours ED or CI. 3(3-0) F,S.* An historical and philosophical investigation into the social and economic aspects of occupational education; an overview of the broad field of occupational education for youth and adults, with emphasis upon the trends and problems connected with the conduct of occupational education under federal and state guidance. An overview study of federal and state legislation pertaining to occupational education. Malpiedi

ED 528 Cooperative Occupational Education. *Preq.: Grad. standing or PBS status. 3(3-0) F,S.* Designed for individuals preparing to be directors, administrators or supervisors of occupational education programs at the local, state and/or national levels. Emphasis on organization and operation of cooperative occupational education programs. Covers the entire field of cooperative occupational education on secondary, postsecondary and adult levels with references to accepted essentials of cooperative education so details of planning, organization, establishment and operation of cooperative occupational programs will be practical and meaningful. Student visitations to existing quality programs in cooperative occupational education to study on-site conditions in specialized areas. Dillon

ED 529 Curriculum Materials Development. *Preqs.: Grad. standing and ED 527 or ED 630 or equivalent. 3(3-0) S.* Selection and organization of curricula and instructional materials in occupational education. Dillon

ED 530 Theories and Techniques of Counseling. *Preq.: Six hours of ED or PSY; Coreq.: ED 520 or equivalent. 3(3-0) F,S,Sum.* A combination of the study of theory and philosophy in counseling with techniques of counseling. Topics to be examined include behavioral approaches, psychoanalytic approaches, client-centered counseling, existential counseling and relationship models, and their relation to counseling. For each theory, the techniques are related to the theoretical concepts and principles. Locke

ED 531 Mental Retardation. *Preq.: ED 506 or CI. 3(3-0) F.* The definitions, classifications, diagnostic and treatment procedures for mental retardation are examined from medical, sociological and educational points of view. Categories of retardation examined include mild, moderate, severe and profound. Graduate Staff

ED 532 Introduction to Educational Inquiry. *Preq.: Grad. standing or PBS status. 3(3-0) F,S,Sum.* A survey of basic concepts and methods of educational inquiry. Emphasis is on the logic underlying various approaches to problem definition and solution and on the tools of the investigator, as well as on sources and interpretation of research information related to the student's particular area of study. Marshall

ED 533 Group Counseling. *Preq.: ED 530. 3(3-0) F,Sum.* A study of the theory and principles of effective group work and the skills necessary for using specific counseling techniques, for the planning and organization of group counseling activities in the elementary school, secondary school or other institutions. Supervised experience provides, to a limited extent, practice in the use of various techniques of group leadership in the area of interest for each student. Gerler, Locke

ED 534 Guidance in Elementary and Middle Schools. *Preq.: Six hours in ED or PSY. 3(3-0) F.* Introduces teachers, counselors and school administrators to the theory, practice and organization of elementary and middle school guidance programs. Gerler

ED 535 Student Personnel Work in Higher Education. *Preq.: Nine hours PSY or CI. 3(3-0) F.* Examines practices in various areas of student personnel work. Studies both structure and function of student personnel programs in higher education. Saidla

ED 535 Structure and Function of the Eye and Use of Low Vision. *Preq.: CI. 3(3-0) F.* Special institute for participants to spend minimum of 45 hours in class and class related activities. Medical and educational consultants discuss structure and function of the eye, eye anomalies affecting children with low vision, methods of teaching children to use minimal vision effectively. Graduate Staff

ED 537 The Extension and Public Service Function in Higher Education. *Preq.: ED 510. 3(3-0) S.* An examination of the background, history, philosophy and contemporary nature of the extension and public service function of institutions of higher education in the United States. Emphasis is placed on the adult education role of public and private universities and colleges. Specific focus is on: general extension, industrial extension, engineering extension, cooperative extension and continuing education. Graduate Staff

ED 538 Instructional Strategies in Adult and Community College Education. *Preq.: Grad. standing or PBS status. 3(3-0) F.* This course examines forms of instruction appropriate for the teaching of adults. Special emphasis will be placed upon methods which maximally involve the adult learner. The study of concepts, theories and principles relevant to the selection, utilization and evaluation of instructional strategies will focus on the integration of theory into practice. Through participation in classroom exercises, the student will develop proficiency in using teaching techniques which are applicable in adult and community college education. Fingeret

ED 539 Educational Gerontology. *Preq.: Six hours in ED, SOC or PSY. 3(3-0) F.* A broad overview of factors associated with the education of older adults. Various sociological, physiological, psychological and economic aspects of aging are explored in terms of

their educational implications. Attention is given to knowledge and skills required for the development of educational programs for the aging population. Glass

ED 540 Career/Vocational Education for the Handicapped. *Preqs.: ED 506 and ED 527 or CI. 3(3-0) S.* Relevant definitions and current legislation and policies are reviewed. Appropriate curriculum, methods and materials are studied. Topic areas include program development, vocational evaluation, job placement and support services for the handicapped. Clary

ED 541A Practicum in Occupational Education. *Preq.: Grad. standing or PBS status. 1-6 F,S.* Under a faculty-supervised practicum in an educational, industrial or governmental setting, the student participates in and analyzes activities associated with the planning, implementation and evaluation of instructional programs or services in vocational education. A unique plan is developed by the student and approved by the supervisor. Clary

ED 541B Practicum in Education Administration. *Preqs.: ED 550 and CI. 1-6 F,S.* Supervised experience in an appropriate educational setting to enable the student to gain practice in applying concepts, principles and theories of education administration. Graduate Staff

ED 542 Contemporary Approaches in the Teaching of Social Studies. *Preqs.: Advanced undergrad. or grad. standing. 3(3-0) S.* An analysis of the principles, strategies and application of new teaching approaches. Includes structured projects and practical experiences. Harper, Martorella

ED 543 Adulthood and Learning: The Later Years. *Preq.: ED 539 or CI. 3(3-0) S. Alt. yrs.* A study of basic sensory, attitudinal, intellectual and emotional changes that occur in individuals during the process of growing old and the implications of these changes for developing, implementing and evaluating educational programs for and with older adults. Glass

ED 544 The Teaching of Composition. *Preq.: 9 hours of ED, PSY and/or ENG. 3(3-0) S.* For classroom teachers. Offers practical field-tested ideas to help students improve as writers by focusing on composition as a process as well as a product. Activities for teaching prewriting, composing, revising, proofreading, grammar and evaluating will be practiced, with suggestions for individual group learning. Research related to effective composition teaching will be reviewed. Pritchard

ED 545 Reading in the Elementary School. *Preqs.: Six hours ED or PSY. 3(3-0) F. Alt. yrs.* Theoretical foundations of reading instruction and current methods and materials for teaching reading, with an emphasis on planning and implementing reading programs for children in kindergarten through grade six. Fox

ED 546 Reading in the Content Areas. *Preqs.: Six hours in ED or PSY. 3(3-0) S,Sum.* Methods in instruction for applying reading to content areas, with emphasis on means of improving comprehension, vocabulary and study skills in subject matter classrooms. Abernathy

ED 547 Language Arts in the Elementary School. *Preq.: Six hours in ED. 3(3-0) S. Alt. yrs.* Advanced professional training in the teaching of language arts for middle grades and elementary teachers, including an in-depth introduction to research-based teaching strategies, new instructional resources and the literature on the field. Fox

ED 548 Development of Microcomputer Software for Instruction. *Preq.: Six hrs. ED or PSY or CI. 3(3-1) F.* Course topics covered are the instructional design principles underlying the development of microcomputer-based instructional software and accompanying materials and programming principles and their implementation in courseware development. Additional topics include authoring languages, programming languages and graphics. Vasu

ED 549 Reading for the Middle Years. *Preq.: Twelve hours in ED or PSY. 3(3-0) Alt. S.* An investigation of issues related to middle years reading development, transition of reading skills to content areas and aspects of middle years reading program organization. Fox

ED 550 Principles of Educational Administration. *Preqs.: Grad. standing, CI. 3(3-0) F,S.* This course is designed as an introductory course in educational administration. Emphasizing basic principles of administration, the course will draw upon administrative theory, business and public administration models as well as theoretical constructs from various disciplines. MacPhail-Wilcox

ED 551 Principles and Practices of Supervision. *Preqs.: 6 semester hours ED/PSY graduate study and CI. 3(3-0) S.* Designed to provide the educational leader with an understanding of the nature of instructional supervision, skills needed in supervising educational programs and an analysis of promising practices for improving programs. Opportunity is provided for application of principles of supervision to one or more practical problems. Parramore

ED 553 Community Service Agencies. *Preq.: Six semester hours of ED, PSY or SOC or CI. 3(3-0). F.* An introduction to the issues, functions, and scope of the work being done in various human service agency programs; an overview of helping approaches with selected client populations; related professional concerns will be examined. Sprinthall

ED 554 Planning Programs in Agricultural Education. *Preq.: Grad. standing or PBS status. 3(3-0) F,S.* Consideration of the need for planning programs in education; objectives and evaluation of community programs; use of advisory group; organization and use of facilities. Graduate Staff

ED 555 Issues and Trends in Education for the Allied Health Professions. *Preq.: Grad. standing or CI. 3(3-0) Alt. yrs.* An analysis of educational and social factors influencing change in health professions education. Emphasis will be on problems of student selection and program articulation and the implications for health occupations education and health services of recent legislation regarding the handicapped. Patterson

ED 556 Learning Disabilities. *Preq.: ED 506 or CI. 3(3-0) F.* A study of the field of learning disabilities, including definitions, prevalence, etiology, characteristics and current educational trends for educating learning disabled students. Crossland

ED 557 Methods and Materials in Learning Disabilities. *Preq.: ED 556 or CI. 3(3-0) S.* A study of the current methods and materials for the teaching of learning disabled students in the elementary and/or secondary schools, including curriculum and instructional techniques. Course will focus on examination of commercial materials and the development of teacher-made materials for use with the learning disabled student. Crossland

ED 558 Resource Teaching in Special Education. *Preq.: ED 506 or CI. 3(3-0) F.* A study of resource teaching in the area of special education, with emphasis on resource teaching with the learning disabled and mentally retarded. Course will focus on types of resource programs, how to establish and maintain a program, selection of students, curriculum and materials. Graduate Staff

ED 559 The Adult Learner. *Preq.: Six hours in ED. 3(3-0) S.* Principles involved in adult education programs including theories and concepts undergirding and requisite to these programs. Emphasis will be given to interrelationship of the nature of adult learning, the nature of the subject matter and the setting in which learning occurs. The applicability of relevant principles and pertinent research findings to adult learning will be thoroughly treated. Graduate Staff

ED 560 Teaching through the Arts. *Preq.: 6 hrs. in ED and/or PSY. 3(3-0) F. Alt. yrs.* Examines the role of the arts in the teaching/learning process, emphasizing ways classroom teachers can use the arts to foster students' personal growth, creativity and academic achievement. Develops teaching skills through explorations in graphic arts, sculpture, dance/movement, drama, film, creative writing and poetry. Graduate Staff

ED 561 Educational Diagnosis and Prescription for Exceptional Children. *Preq.: ED 506 or CI. 3(3-0) S.* A study of the concept of educational diagnosis of exceptional students, including an examination of educational diagnostic procedures in current use in special education. Course will focus on the development of informal diagnostic techniques and procedures for adapting curriculum and instruction for the exceptional learner. Graduate Staff

ED 562 Communication Disorders in the Classroom. *Preq.: ED 506 or CI. 3(3-0) S. Alt. yrs.* A study of communication disorders which occur in the school age population, including types of disorders, prevalence, etiology, characteristics and corrective therapy. Course will focus on communication disorders among exceptional students and the classroom teacher's role in working with communication disorders. Crossland

ED 563 Effective Teaching. *Preq.: Twelve hours ED including student teaching. 3(3-0) F.* Analysis of the teaching-learning process; assumptions that underlie course approaches; identifying problems of importance; problem solution for effective learning; evaluation of teaching and learning; making specific plans for effective teaching. Graduate Staff

ED 564 Classroom Management in Special Education. *Preq.: ED 506 or CI. 3(3-0) S.* A study of the concepts and procedures involved in the design and implementation of techniques for managing exceptional students in a classroom setting. Course will focus on methods for increasing and maintaining appropriate classroom behaviors in exceptional learners. Graduate Staff

ED 565 Agricultural Occupations. *Preq.: 12 hours ED or CI. 3(3-0) F,S.* The theory of education and work is related to the expanding field of agricultural occupations. Career development in agricultural occupations is associated with curriculum development needs. Occupational experience in agriculture is seen in relation to the curriculum and the placement in agricultural occupations. Graduate Staff

ED 566 Occupational Experience in Agriculture. *Preq.: Grad. standing or PBS status. 3(3-0) F,S.* A major and critical element in all programs of vocational education is the provision for appropriate student learning experiences in a real and simulated employment environment. Due to recent developments in education and agriculture, new and expanded concepts of occupational experience have been devised. Current research substantiates the need and desire of teachers of agriculture for assistance in implementing the new concepts. The course is designed not only to provide this aid but to develop a depth of understanding of the theoretical foundations underlying the new developments in occupational experiences to stimulate individual growth and creativity in implementing further developments. Graduate Staff

ED 567 Education of Special Adults Populations. *3(3-0) S, Sum.* Analyzing and developing adult education responses to the needs and characteristics of special adult populations such as nonliterate, unemployed, handicapped and older adults. Fingeret

ED 568 Adult Education in Agriculture. *Preq.: Grad. standing or PBS status. 3(3-0) F,S.* Designed to meet the needs of leaders in adult education. Opportunity to study some of the basic problems and values in working with adult groups. Attention will be given to the problem of fitting the educational program for adults into the public school program and other educational programs as well as to the methods of teaching adults. Flowers

ED 569 The Principalship. *Preq.: ED 550 or CI. 3(3-0) S. Alt. yrs.* A survey course covering the major responsibilities and tasks of a school principal, *e.g.*, curriculum and instructional leadership, teacher recruitment and selection, fiscal record keeping, pupil schedules, plant management. Students will combine findings from their readings with present practices to develop workable solutions to managerial and instructional problems. MacPhail-Wilcox

ED 570 Foundations of Mathematics Education. *Preq.: ED 471 or equivalent. 3(3-0) Sum.* A course on the current status of mathematics education with special emphasis on the study and critical analysis of current practices in mathematics instruction from elementary school through college. Graduate Staff

ED 571 Introduction to the Gifted Individual. *Preq.: ED 506 or CI. 3(3-0) F.* A study of theories and concepts of giftedness and procedures in identifying the gifted, with a consideration of factors influencing giftedness and ways it may be fostered. Aubrecht

ED 572 Methods for Teaching the Gifted. *Preq.: ED 571 or CI. 3(3-0) S.* A study of major approaches used in the education of the gifted, including an opportunity to develop a unit plan based upon one of these approaches. Aubrecht

ED 573 Behavior Disorders. *Preq.: ED 506 or CI. 3(3-0) F.* A study of definitions, etiology, characteristics, philosophies and approaches to educational programming for children and youth with behavior disorders, including the emotionally handicapped, autistic and socially maladjusted. Cullinan

ED 574 Methods and Materials: Behavior Disorders. *Preq.: ED 573 or CI. 3(3-0) S.* A study of curriculum materials, instructional strategies and behavior management techniques related to teaching behaviorally disordered children and youth, including individualized instruction, group process, organization and evaluation of classroom programs, parent involvement, community resources and teachers' personal and professional growth and development. Cullinan

ED 575 Foundations of Science Education. *Preq.: ED 475 or equivalent. 3(3-0) S,Sum. Alt. yrs.* Study and analysis of the philosophical, historical, sociological, political and economic factors affecting science education in the schools of the United States. Implications for science education of various learning theories are examined along with models for curriculum development and program planning. Critical analysis of current trends, issues and problems in science education in terms of multiple perspectives. Anderson, Wheatley

ED 576 Teaching/Learning Approaches for Emerging Adolescents. *Preqs.: ED 507 or equivalent; grad standing and CI. 3(3-0) S.* Exploration of teaching/learning approaches appropriate to emerging adolescents. Topics include learning styles; interdisciplinary inquiry; community-based curriculum; simulations and games; learning centers; minicourses; design of physical space; all-school activities. Arnold

ED 577 Improving Classroom Instruction in Science. *Preq.: ED 475 or equivalent. 3(3-0) S.* Application of major principles of education and psychology to the improvement of science teaching in elementary, middle and secondary schools. Emphasis on critical analysis of research and the development of research-based classroom applications. Topics include goals and objectives of science teaching, instructional strategies, development or selection of science materials, evaluation of achievement and elements of a desirable classroom climate. Graduate Staff

ED 578 Law and Higher Education. *Preq.: Six hours grad. credit. 3(3-0) S. Alt. yrs.* A study of constitutional, statutory and case law as it relates to higher education. Emphasis is on faculty, student and staff rights and tort liability. Beezer

ED 579 Concepts and Principles of Evaluation Applied to Non-formal Adult Education Programs. *Preq.: ED 503 or CI. 3(3-0) S.* Introduction to the evaluation of non-formal adult educational programs; course topics include the purposes of evaluation, alternative concepts and techniques, stake holders and their concerns, the specification of evidence, selection of standards for making judgments, gathering and analysis of data, use and dissemination of results and handling problems in evaluation. Graduate Staff

ED 580 Evaluation Theory and Practice in Education. *Preq.: ED 532 or equivalent. 3(3-0) F.* A review of educational program evaluation with emphasis on (1) theory and conceptual models of evaluation, (2) evaluation design, and (3) environmental practical factors influencing the design and implementation of evaluation studies. Marshall

ED 581 Curriculum and Instruction in the Allied Health Professions. *Preqs.: Advanced undergrad. or grad. standing and CI. 3(3-0) Alt. yrs.* A study of the elements of curriculum design and theoretical considerations for the development of curricula in the health occupations. Identification, analysis and evaluation of instructional strategies appropriate for clinical and classroom teaching. Patterson

ED 582 Teaching Braille and Communication Skills. *Preqs.: ED 513 and ED 545 or equivalent. 3(3-0) S.* Information-access methods for visually impaired learners. Methods and materials for teaching Braille reading and selecting and teaching the use of electronic aids. Graduate Staff

ED 583 Design and Evaluation of Instructional Materials. *Preq.: Grad. standing. 3(3-0) S.* Emphasis is upon the characteristics and selection of various media for instruction and their use in educational settings. Instructional materials will be designed and produced. Analysis of the research in the field is conducted. Projects and assignments are individualized. Application of grounded research and theory concerning learning to the design of instructional materials. Structured projects and practical experiences are used to transfer design principles and evaluate instructional products. Martorella

ED 584 Health Care Delivery Systems and Environments. *Preqs.: Grad. standing and CI. 3(3-0) Alt. yrs.* Organization of the health care delivery system, services and resources. Focus on the major social, economic, political and professional factors which contribute to shaping the system and influence change. Organizations and environments are analyzed in regard to the demand for health manpower and the implications for health occupations education. Patterson

ED 585 Qualitative Research in Adult and Community College Education. *Preq.: Grad. standing. 3(3-0) F.* Designing qualitative studies, conducting field work including open-ended interviews and participant observation, analyzing data and understanding theoretical and philosophical background of this research approach. Fingeret

ED 586 Methods and Materials in Visual Impairments. *Preqs.: ED 506, ED 513. 3(3-0) S.* A study of current methods and materials for teaching visually impaired learners. Includes curriculum and materials development, adaptation, instructional techniques, educational assessment and diagnosis. Graduate Staff

ED 587 Organization and Operation of Training and Development Programs. *3(3-0) F.* Overview of occupational education as it is practiced in business and industrial settings. Roles common to training and development specialists are presented, including managerial concerns related to organizing, operating and financial training and development programs. Dillon

ED 588 Advanced Teaching Methods in Industrial Arts Education. *Preq.: ED 362 or equivalent. 3(2-2) F,Sum.* An intensive examination of the teaching-learning process applicable to laboratory-classroom instruction. Instructional technology, evaluation, classroom control and management will be given attention. Wenig, Graduate Staff

ED 589 Central Office Administration. *Preq.: ED 550 or equivalent. 3(3-0) F. Alt. yrs.* A course covering the major responsibilities (except curriculum) of central office administrators in public school districts, *e.g.*, pupil assignments, business affairs, personnel administration, construction and maintenance. Students will combine findings from their readings with present practices to develop workable procedures for solving managerial problems.
McPhail-Wilcox

ED 590 Special Problems in Guidance. *Preqs.: Six hours grad. work in department or equivalent and CI. Maximum 6 F,S.* Intended for individual or group studies of one or more of the major problems in guidance and personnel work. Problems will be selected to meet the interests of individuals. The workshop procedure will be used whereby special projects, reports and research will be developed by individuals and by groups. Graduate Staff

ED 591 Teaching Literature for Young Adults. *Preq.: Sr. or grad. standing or PBS status. 3(3-0) S. Alt. yrs.* Designed to acquaint in-service and pre-service teachers with the breadth and diversity of contemporary literature for adolescents, with an emphasis on teaching young adult literature. Addresses the history and themes of young adult literature, readability of materials, reading preferences, literary merit, skills that can be taught through literature, censorship, motivating students to read and organizing literature units.
Pritchard

ED 592 Special Problems in Mathematics Teaching. *Preq.: ED 471 or equivalent. 1-3 F,S,Sum.* An in-depth investigation of topical problems in mathematics teaching chosen from the areas of curriculum, methodology, technology, supervision and research.
Graduate Staff

ED 593 Special Problems in Agricultural Education. *Preqs.: Six hours grad. credit in agricultural education and CI. Credits Arranged. F,S,Sum.* Opportunities for students to study current problems under the guidance of the staff. Graduate Staff

ED 594 Special Problems in Science Teaching. *Preq.: ED 476 or equivalent. 1-6 Sum.* An in-depth investigation of topics in science education not covered in existing courses. Includes critical analysis of research and may include field work. May be offered on individual basis or as a class. Anderson, Howe, Wheatley

ED 595 Methods and Techniques of Training and Development. *3(3-0) S.* Methods and techniques common to model occupational education programs in business and industrial settings will be discussed. Course focuses on how to design and evaluate effective learning programs and instructional methodologies. Dillon

ED 596 Topical Problems in Adult and Community College Education. *Preq.: Grad. standing or PBS status. Credits arranged. F,S,Sum.* Study and scientific analysis of problems in adult education and preparation of a scholarly research type of paper.
Graduate Staff

ED 597 Special Problems in Education. *Preq.: Grad. standing or PBS status. 1-3 F,S,Sum.* Designed to provide graduate students in education opportunity to study problem areas in professional education under the direction of a member of the graduate faculty.
Graduate Staff

ED 598 Special Problems in Curriculum and Instruction. *Preqs.: Six hours of ED or PSY and CI. 1-6 F,S,Sum.* Designed to provide an in-depth study of topical problems in curriculum and instruction selected from the areas of current concern to practitioners in education. Graduate Staff

ED 599 Research Projects in Education. *Preqs.: CI; ED 532 or equivalent. 1-3 F,S,Sum.* A project or problem in research in education for graduate students, supervised by members of the graduate faculty. The research will be chosen on the basis of individual students' interests and is not to be part of thesis or dissertation research. Graduate Staff

FOR GRADUATES ONLY

ED 600 Organizational Concepts and Theories Applied to Adult and Community College Education. *Preqs.: ED 503, PS 502, SOC 541. 3(3-0) F.* This course is designed for present and potential administrators interested in increasing their understanding of organization as a basis for administering effective adult and community college education programs. Shearon

ED 601 Administrative Concepts and Theories Applied to Adult and Community College Education. *Preq.: ED 600 or a comparable course(s) on organizational theory. 3(3-0) S.* Designed for persons interested in building a more consistent philosophy of educational administration, extending and strengthening their understanding of administrative concepts and processes, improving their comprehension of the theoretical and research foundations upon which administrative processes are predicated, and increasing their ability to apply administrative concepts, theories and principles to the management of the complex education system. Graduate Staff

ED 602 Curriculum Theory and Development. *Preqs.: 9 semester hours graduate PSY, ED 502, ED 514 or CI. 3(3-0) F.* A study of theory and research in the behavioral sciences and education designed to provide the theoretical background for the development of elementary and secondary curricula. The knowledge base and skills for critical review of curricula and instructional materials are explored and an opportunity to apply these is provided. Arnold, Parramore

ED 603 Teaching Mathematics and Science in Higher Education. *Preqs.: ED 570, 592 or 594, grad. standing, CI. 3(3-0) S.* Collegiate mathematics and science instruction is examined with respect to goals and objectives, design of courses and curricula, innovative programs and facilities, and methods and materials for instruction. Graduate Staff

ED 604 Curriculum Development and Evaluation in Science and Mathematics. *Preqs.: 500-level statistics, ED 615 or PSY 535, CI. 3(3-0) S.* A critical study of the elements of curriculum design and theory in mathematics education and science education and the examination of evaluation procedures for assessing educational innovations. Graduate Staff

ED 605 Education and Supervision of Teachers of Mathematics and Science. *Preqs.: ED 470 or 475 or equivalent, ED 570 or 592 or 594. 3(3-0) S.* Critical analysis of theories, programs and techniques designed to promote interpersonal interactions that will lead to more effective teaching of science and mathematics. Graduate Staff

ED 606 Remediation of Reading Disabilities. *Preq.: ED 547 or CI. 3(3-0) S. Alt. yrs.* Advanced approaches to reading remediation are examined including theory and research related to remedial instructional strategies, analyses of instructional designs and evaluations of the effectiveness of intervention programs. Fox

ED (PS) 607 The Politics of Higher Education. *3(3-0).* (See political science and public administration.)

ED 609 Planning and Organizing Industrial and Technical Education Programs. *Preqs.: ED 516 and grad. standing. 3(3-0) F.* In this course a study will be made of the influences which impinge upon the development of programs of occupational education. Adequate opportunity will also be provided to examine in detail steps that may be taken to analyze needs for occupational education, to organize for its provision, to study its offerings and to evaluate its results. Graduate Staff

ED 610 Administration of Occupational Education. *Preq.: ED 527 or ED 630. 3(3-0) S. Alt. yrs.* An intensive study of the major elements of administrative practice applied to occupational education, as it is being conducted in comprehensive high schools, comprehensive community colleges, technical institutes and area vocational centers. Emphasis is

placed upon leadership, personnel management, instructional program management and evaluation, public relations and financial management, in connection with preparatory, part-time, supplementary, extension and adult education program of occupational education. Clary

ED 611 Laws, Regulations and Policies Affecting Occupational Education. *Preq.: ED 527 or ED 630. 3(3-0) S.* A detailed study of legislation (national and state) which applies directly to occupational education. Basic social issues and economic conditions which precipitated the legislation will be studied in depth. A review will also be made of the organizational structure and policies under which national legislation is converted into programs of occupational education. Farmer

ED 612 Finance, Accounting and Management of Occupational Education Programs. *Preq.: ED 610. 3(3-0) S. Alt. yrs.* A study of the steps which must be taken in financing a new occupational enterprise, following the determination of curriculum by area study. All financial transactions such as costs of operation, equipment purchase procedures and costs for construction will be investigated in detail. Belcher

ED 614 Contemporary Educational Thought. *Preqs.: Twelve hours ED; CI. 3(3-0) S. Alt. yrs.* This course will be based on a reading and discussion of twentieth-century works in educational philosophy. Such movements as pragmatism, reconstruction, perennialism and existentialism will be considered. Graduate Staff

ED 616 History of Higher Education in the United States. *Preqs.: Six hours of grad. ED courses and CI. 3(3-0) S. Alt. yrs.* A study of the history of higher education from the colonial period to the present. Emphasis is on how philosophic, political, social and economic forces influence the function and structure of higher education. Harvey

ED 618 School Law for the Administrator. *Preq.: ED 518 or equivalent. 3(3-0) S. Alt. yrs.* A comprehensive study of constitutional, statutory and case law as it relates to elementary and secondary school administration. Emphasis is on legal issues associated with governance, finance, property, personnel and curriculum. Beezer

ED 620 Cases in Educational Administration. *Preqs.: Grad. standing and CI. 3(3-0) S. Alt. yrs.* This course utilizes the case study and case simulation approach to the study of school administration. Administrative concepts will be developed and applied to simulated situations and to actual case histories. The administrative process is viewed as a decision-making process. The student will be expected to make decisions after considering alternative courses of action and after projecting probable consequences. Dolce

ED 621 Internship in Education. *Preqs.: Nine credit hours in grad. level courses and CI. 3-9 F,S,Sum.* Utilizing the participant-observer role, this course requires participation in selected educational situations with emphasis upon development of observational skills, ability to record relevant observations by means of written journals, skills in analyzing experiences identifying critical incidents and projection of events and consequences. The student is required to develop possible alternative courses of action in various situations, select one of the alternatives and evaluate the consequences of the course of action selected. Graduate Staff

ED 625 Cross Cultural Counseling. *Preqs.: ED 530; 9 semester hrs. grad.-level ED. 3(3-0) S.* Theory and practice of counseling culturally different clients. Client populations include African-Americans, Asian-Americans, American Indians and Hispanics. Topics include cultural assumptions, cultural values, counselor credibility, prejudice and racism in the context of counseling. Locke

ED 630 Philosophy of Industrial Arts Education. *Preq.: Twelve hours in ED. 3(3-0) S. Alt. yrs.* Origins, development of industrial arts education. Philosophical foundations, derivation of objectives and criteria for evaluation. Contributions of the heritage to contemporary concepts of industrial arts education. Young

ED 631 Vocational Development Theory. *Preq.: Grad. standing or PBS status. 3(3-0) F. Alt. yrs.* A study of the major theories and constructs of vocational development with implications for counseling and career planning. Jones

ED 632 Applied Research Methods in Education. *Preqs.: ST 507 and ED 532 or equivalent; Coreq.: ST 508 or CI. 3(1-4) S.* Through the use of simulated educational settings consideration will be given to the development of research proposals or plans, selection and/or development of appropriate measurement instruments and the purposes and functions of various statistical designs and procedures. Simulated data will be prepared and analyzed using computer-based statistical packages, the results will be interpreted and a research report will be produced. Marshall

ED 633 Development and Coordination of School Guidance Programs. *Preq.: Grad. standing or PBS status. 3(3-0) S.* A study of the tasks of organizing, coordinating, evaluating and changing school guidance programs by school counselors. Included are the study of goals, objectives, values, functions and evaluations as they are related to program development in the secondary and elementary school. Graduate Staff

ED 634 Diagnosis of Reading Disabilities. *Preq.: ED 545 or ED 546, 3(3-0) F. Alt. yrs.* Formal and informal instruments for diagnosing reading disabilities including the completion of a diagnostic case study describing the reading performance of a disabled reader. Fox

ED 635 Administration and Supervision of Industrial Arts. *Preq.: Twelve hours in ED. 2(2-0) F,S.* Study of the problems and techniques of administration and supervision of industrial arts in schools and universities. Selection of teachers, teacher improvement methods, public relations, facilities planning and specification. Graduate Staff

ED 636 Observation and Supervised Field Work. *Preq.: CI. Maximum 3 F,S.* Provides opportunity for observation and practice of guidance and personnel services in schools, institutions of higher education, agencies, business and industry. Graduate Staff

ED 637 Seminar in Cognitive-Developmental Theory and Practice. *Preqs.: Advanced grad. standing and CI. 3(3-0) F. Alt. yrs.* Analysis of major contemporary theories of cognitive development (Erikson, Kohlberg, Loevinger, Hunt, Perry) as a basis for deliberate counseling and curricular interventions. Sprinthall

ED 638 Seminar in Cognitive-Development Research. *Preqs.: Grad. standing; ED 637; CI. 3(3-0) S. Alt. yrs.* A review of current systems of cognitive-developmental assessment; methods for measuring psychological growth will be included. Specific research design models will be reviewed as a basis for action-research. Sprinthall

ED 640 Laboratory Experiences in Counseling. *Preqs.: ED 520 or equivalent; PSY 535; Coreq.: ED 530. 3(3-0) F.* The identification and practice of fundamental skills needed for a person to function as an effective counselor. Emphasized is development of specific skills in: counseling, testing, human relations, identification of client problems and the design of counseling strategies. Graduate Staff

ED 641A Practicum in Counseling. *Preqs.: Advanced grad. standing, CI. 2-6 S.* A practicum course in which the student participates in actual counseling experience under supervision in a school, college or agency setting. Graduate Staff

ED 641B Diagnostic-Prescriptive Practicum in Reading. *Preqs.: ED 545 or ED 546 and ED 547 and CI. 3(3-0). S.* Supervised teaching experience where students use diagnostic test data to prescribe remedial programs for reading-disabled individuals, implement instructional prescriptions and evaluate the success of remedial plans. Graduate Staff

ED 641C Practicum in Special Education. *Preq.: CI. 1-6 F,S.* Practicum will be designed to meet the individual needs of the students enrolled in the course. The practicum may involve diagnosis of exceptional students, writing educational prescriptive plans for exceptional students, or it may focus on an individual topic that involves working directly with exceptional learners. Graduate Staff

ED 641D Practicum in Science and Mathematics Education. *Preq.: ED 570 or ED 575. 1-6 F,S.* Supervised practicum in appropriate settings both on- and off-campus. Provides an opportunity for development, implementation and evaluation in science and mathematics in a clinical environment under faculty supervision. Graduate Staff

ED 641G Practicum in Middle Years Education. *Preqs.: ED 507 or equivalent; grad. standing and CI. 3-6 F,S.* Designed to provide practical experience in schools and area agencies concerned with middle and junior high school education. Arnold

ED 641J Practicum in Health Occupations. *Preqs.: 21 hrs. grad. work including ED 581 and CI. 3(3-0) Alt. yrs.* Based upon the participants' professional objectives, a practicum in a teaching or an administrative context will be designed appropriate to the individual's particular discipline and area of function. Program will be designed by the student in cooperation with the preceptor and course instructor. Davis

ED 641K Practicum in Supervision. *Preq.: ED 551 or equivalent. 3-6 F,S.* Practical experience in schools, school systems and area educational agencies concerned with instructional supervision. Parramore

ED 641M Practicum in Instructional Technology—Computers. *Preq.: 12 semester hours in instructional technology—computers. 3-6 F,S.* Designed to provide practical experience in schools and area agencies concerned with integrating the computer into the curriculum. Martorella, Vasu

ED 642 Research Applications in Curriculum and Instruction. *Preq.: ST 507 or equivalent. 3(3-0) S.* Focus on selected methodological issues and research findings in the areas of curriculum development and supervision, instructional technology, English education, language arts, middle grades education, reading education, social studies and special education. Vasu

ED 648 Theory and Process in Reading and Language Arts. *Preqs.: ED 545 and CI. 3(3-0) S. Alt. yrs.* Advanced study of theoretical models of reading, research issues in reading and in other language processes. Theoretical models of reading are studied in depth. Emphasis is placed on critical examination and analysis of research investigating reading acquisition, mature reading behavior and related language processes. Fox

ED 660 Industrial Arts Curriculum. *Preq.: IA 645. 3(3-0) F,S,Sum.* Industrial arts curriculum origins, analysis, organization, evaluation, revision. Subject matter deviation and classification applicable to all levels of instruction. Relationships among curriculum, philosophy and methdology. (Also see ED 608, ED 610, ED 630, ED 635 and ED 692.) Graduate Staff

ED 664 Supervision in Agricultural Education. *Preq.: ED 554. 3(3-0) F,S.* Organization, administration, evaluation and possible improvement of supervisory practice; theory, principles and techniques of effective supervision in agricultural education at different levels. Graduate Staff

ED 665 Supervising Student Teaching. *Preq.: Twelve hours of ED. 3(3-0) F,S.* A study of the program of student teaching in teacher education. Special consideration will be given the role of the supervising teacher, including the following areas: planning for effective student teaching, observation and orientation, school community study, analysis of situation, evaluating student teachers and coordination with North Carolina State University. Graduate Staff

ED 666 Supervision of Counseling. *Preq.: CI. 3(1-8) F,S.* A supervised practicum for doctoral students in assisting with the supervision of first-year students in laboratory and practicum experiences in individual or group counseling. Graduate Staff

ED 686 Professional Issues in Counseling. *Preq.: Doctoral standing. 1-3 F,S. Alt. yrs.* Consideration of contemporary issues, trends and recent research in the field of counseling. Locke

ED 687 Seminar in Curriculum and Instruction. *Preqs.: Doctoral standing; ED 602 or CI. 1-3 S.* Consideration of contemporary issues, trends and recent research and development findings in curriculum and instruction. Graduate Staff

ED 688 Research Application in Occupational Education. *Preq.: ED 532. 3(3-0) F,S.* This course will be concerned with methodology, application, analysis and synthesis of research in occupational education. A review of current occupational education studies, clustered by areas, will be made with attention to statistical techniques, data collecting, data handling, and the audience and impact of particular projects and research organizations. The class activities in research application are designed to bridge the gap between the theories of research methodology and the student's independent research projects. Coster, Graduate Staff

ED 690 Seminar in Mathematics Education. *Preq.: Departmental major or CI. 2(2-0) F,S.* An in-depth examination and analysis of the literature and research in a particular topic(s) in mathematics education. Graduate Staff

ED 692 Seminar in Industrial Arts Education. *Preq.: Grad. standing. 1(1-0) F,S.* Reviews and reports on special topics of interest to students in industrial arts education. Graduate Staff

ED 693 Advanced Problems in Agricultural Education. *Preqs.: Six hours grad. credit, including one 600-level course in agricultural education and CI. Credits Arranged. F,S.* Study of current and advanced problems in the teaching and administration of educational programs, evaluation of procedures and consideration for improving. Graduate Staff

ED 695 Seminar in Science Education. *Preq.: Department major or CI. 2(2-0) F,S.* An in-depth examination and analysis of the literature and research in a particular topic(s) in science education. Graduate Staff

ED 696 Seminar in Adult and Community College Education. *Preq.: Grad. standing. 1-3 F,S.* Identification and scientific analysis of major issues and problems relevant to adult education. Credit for this course will involve the active participation of the student in a formal seminar and scientific appraisal and solution of a selected problem. The course is designed to help the student acquire a broad perspective of issues confronting adult educators and to acquire experiences in the scientific analysis and solution of specific issues. Graduate Staff

ED 697 Problems of Research Design in Education. *Preqs.: ED 632 and CI. 1-3 S. Alt. yrs.* Provides the student with an individualized but structured investigation of alternative problem definitions, research methodologies and statistical analyses for a problem of his/her choosing, usually associated with thesis or dissertation. In small groups or individually with the instructor, the student considers research design, measurements and statistical analysis necessary to conduct research. Marshall

ED 698 Seminar in Occupational Education. *Preq.: ED 527 or ED 630. 3(3-0) F,S.* This course will be designed as a seminar-type course, with topics selected each semester. Attention will be given to the broad concepts of occupational education as manifested in the Vocational Education Act of 1963 and its amendments, and to the problems and issues underlying the development of and implemention of programs of occupational education at elementary, junior high, senior high and postsecondary levels. Coster, Graduate Staff

ED 699 Thesis and Dissertation Research. *Preqs.: 15 hours of education; CI. Credits Arranged. F,S,Sum.* Individual research on a thesis or dissertation problem.
Graduate Staff

Electrical and Computer Engineering

GRADUATE FACULTY

Professor N. A. Masnari, *Head*

Associate Professor W. T. Easter, *Associate Head*

Professor T. H. Glisson Jr., *Graduate Administrator*

Professors: D. P. Agrawal, W. E. Alexander, S. M. Bedair, W. Chou, J. W. Gault, J. J. Grainger, J. R. Hauser, S. K. Khorram, M. A. Littlejohn, N. F. J. Matthews, L. K. Monteith, H. T. Nagel Jr., A. A. Nilsson, J. B. O'Neal Jr., C. M. Osborn, A. Reisman, D. R. Rhodes, R. J. Trew, H. J. Trussell, A. Vanderlugt, J. J. Wortman; *Adjunct Professors:* E. Christian, J. B. Suttle; *Visiting Professor:* H. W. Etzel; *Professors Emeriti:* W. J. Barclay, A. R. Eckels, A. J. Goetze, G. B. Hoadley, W. D. Stevenson Jr.; *Associate Professors:* S. T. Alexander, G. F. Bland, J. F. Kauffman, R. M. Kolbas, S. A. Rajala, W. E. Snyder, M. W. White; *Adjunct Associate Professor:* S. H. Lee; *Associate Professors Emeriti:* N. R. Bell, E. G. Manning, W. C. Peterson; *Assistant Professors:* R. S. Colby, M. E. Elbuluk, E. F. Gehringer, R. S. Gyurcsik, A. W. Kelley, W.-t. Liu, D. L. Lubkeman, R.-C. Luo, T. K. Miller III, J. J. Paulos, D. R. Reeves, G. A. Ruggles, M. B. Steer; *Visiting Assistant Professors:* S. H. Ardalan, M. Chow; *Lecturer:* P. T. Hutchinson

The Department of Electrical and Computer Engineering offers programs leading to the Master of Science (M.S.) with thesis, the Master of Science without thesis, and the Doctor of Philosophy (Ph.D.) in both electrical engineering and computer engineering. The computer engineering degree track is a joint program in which faculty from both the Department of Electrical and Computer Engineering and the Computer Science Department participate in teaching, research, and advising.

All students admitted to the M.S. program are admitted initially to the non-thesis program. Permission to pursue the M.S. with thesis is granted when the student identifies a suitable subject for research and a member of the ECE graduate faculty agrees to direct the research.

Requirements for the M.S. degree include thirty credits (semester hours) or work beyond the B.S. At least eighteen of the thirty credits must be in 500- and 600-level ECE courses and nine to twelve must be in a minor area (e.g., mathematics or physics). For the M.S. with thesis, six of the thirty credits must be in ECE 699, Thesis Research. For the M.S. without thesis, six of the thirty credits must be in 600-level courses and nine of the thirty credits must be selected from a list of core courses.

In both the electrical engineering track and the computer engineering track, the department offers a non-thesis option in telecommunications. A student pursuing this option must satisfy all requirements for a non-thesis M.S. degree,

but with additional restrictions on courses selected in fulfillment of those requirements. Additional information on the telecommunications option can be obtained from the Graduate Administrator.

Requirements for the Ph.D. degree include either thirty credits (semester hours) of graduate-level work beyond the M.S. or sixty credits beyond the B.S. Usually, nine of the credits beyond the M.S. will be taken in ECE 699, Thesis Research, and nine to twelve will be taken in a minor area.

Each M.S. and Ph.D. student must pass a comprehensive final oral examination administered by the student's advisory committee. Additionally, each Ph.D. student must pass the departmental qualifying examination and a preliminary examination which has a written component and an oral component.

A student pursuing the M.S. with thesis program or the Ph.D. must identify an area of concentration within either electrical engineering or computer engineering. The areas within electrical engineering in which a Ph.D. student or an M.S. student may concentrate include circuits, electromagnetics and microwave systems, signal processing, communications, solid state, and power systems. The areas within computer engineering in which a Ph.D. student or an M.S. student may concentrate are digital systems, computer communications, system software, and applied software engineering. The department has modern, well-equipped laboratories in which faculty members and graduate students are conducting research in the areas of concentration named above. These areas of concentration are somewhat broad and change from time to time with faculty interests. Upon request, the Graduate Administrator will furnish an up-to-date list of research areas, specific research topics and associated faculty to interested and qualified applicants.

The department, the College of Engineering, the Graduate School and several industrial companies can offer financial assistance of various kinds to qualified students and applicants. The Graduate Administrator will furnish a more detailed description of financial-assistance programs to interested and qualified applicants.

SELECTED ADVANCED UNDERGRADUATE COURSES

ECE 401 Introduction to Signal Processing. *Preqs.: ECE 301, ECE 302. 3(3-0) F,S.*

ECE 409 Introduction to Telecommunications Engineering. *Preq.: ECE 301. 3(3-0) F.*

ECE 431 Electronics Engineering. *Preq.: ECE 314. 3(2-3) F,S.*

ECE 432 Communications Engineering. *Preqs.: ECE 301, ECE 314. 3(2-3) S.*

ECE 435 Elements of Control. *Preqs.: ECE 305, ECE 314. 3(2-3) F.*

ECE 436 Digital Control Systems. *Preq.: ECE 435. 3(3-0) S.*

ECE 439 Integrated Circuit Technology and Fabrication. *Preq.: ECE 441. 3(2-2) S.*

ECE (CSC) 440 Digital Systems Interfacing. *Preq.: CSC 312 or ECE 340. 3(2-2) S.*

ECE 441 Introduction to Solid-State Devices. *Preqs.: ECE 303, ECE 314. 3(3-0) F.*

ECE 444 Computer Control of Robots. *Preqs.: ECE 314; and ECE 340 or ECE 212. 3(2-3) F,S.*

ECE 446 VLSI Systems Design. *Preqs.: ECE 314 and ECE 340 or ECE 212. 4(3-2) F,S.*

ECE 448 Microwave Antennas, Radars and Communication Systems. *Preq.: ECE 303. 3(3-0) F.*

ECE 451 Power System Analysis. *Preq.: ECE 305. 3(3-0) F.*

ECE 452 Power Systems Protection. *Preq.: ECE 451. 3(3-0) S.*

ECE 454 Electrical Machinery. *Preq.: ECE 305. 3(3-0) S.*

ECE 455 Computer Control of SCR Motor Drives. *Preq.: ECE 305 or ECE 331. 3(1-4) F,S.*

ECE 457 Semiconductor Power Conversion. *Preq.: ECE 314. 3(3-0) F.*

ECE 492 Special Topics in Electrical and Computer Engineering. *Preq.: CI. 1-4 F,S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ECE (CSC, CSE) 501 Design of Systems Programs. *3(3-0) F.* (See computer studies.)

ECE 504 Introduction to the Design of Transmission Networks. *Preqs.: ECE 301, B average in ECE and MA. 3(3-0) S.* Introduction to modern design methods of transmission networks for specified loss, phase, delay or time specifications. To be discussed will be passive, active-RC and digital networks. Design methods will make extensive use of canned computer programs. This course is intended: (a) for engineers who may have to design transmission networks occasionally, (b) for those who specify such networks, (c) as a first introduction for further studies. Graduate Staff

ECE (CSC, CSE) 506 Digital Systems Architecture. *3(3-0) F.* (See computer studies.)

ECE (CSC, CSE) 510 Software Engineering. *3(3-0) F.* (See computer studies.)

ECE 511 Analog Electronics. *Preqs.: ECE 431, grad. standing or B average in ECE and MA. 3(2-3) S.* A study of analog integrated circuits and analog integrated circuit design techniques. Review of basic device and technology issues. Comprehensive coverage of MOS and Bipolar operational amplifiers. Brief coverage of analog-to-digital conversion techniques and switched-capacitor filters. Strong emphasis on the use of computer modeling and simulation as a design tool. Students are required to complete an independent design project. Paulos

ECE (CSC, CSE) 512 Compiler Construction. *3(3-0) S.* (See computer studies.)

ECE (CSE) 513 Digital Signal Processing. *Preqs.: ECE 401, B average in ECE and MA or CI. 3(3-0) F.* Digital processing of analog signals. Offline and real-time processing for parameter, waveshape and spectrum estimation. Digital filtering and applications in speech, sonar, radar, data processing, and two-dimensional filtering and image processing. W. Alexander, Rajala, Trussell

ECE (CSE) 514 Random Processes. *Preqs.: ECE 301, B average in ECE and MA. 3(3-0) F.* Probabilistic descriptions of signals and noise, including joint, marginal and conditional densities, autocorrelation, cross-correlation and power spectral density. Linear and nonlinear transformations. Linear least-squares estimation. Signal detection.
T. Alexander, O'Neal

ECE 515 Telecommunications Transmission Systems. *Preq.: Grad. standing. 3(3-0) S.* Analysis of the components of a large telecommunications system with direct dialing. A detailed study of high-capacity digital (baseband, carrier and optical) and analog (carrier) systems. Includes multiplexers, protection switching, diversity, microwave antennas and propagation, and noise in digital and analog systems. Hutchison, O'Neal

ECE 516 System Control Engineering. *Preq.: ECE 435 or ECE 301. 3(3-0) F.* Introduction to analysis and design of continuous and discrete-time dynamical control systems. Emphasis on linear, single-input, single-output systems using state variable and transfer function methods. Topics include open and closed-loop representation; analog and digital simulation; time and frequency response; stability by Routh-Hurwitz, Nyquist and Liapunov methods; performance specifications; cascade and state variable compensation. Assignments utilize computer-aided analysis and design programs. Chow

ECE (CSC, CSE) 518 Computer Graphics. *3(3-0).* (See computer studies.)

ECE (CSE) 520 Fundamentals of Logic Systems. *Preqs.: ECE 318, B average in ECE and MA. 3(3-0) F.* A study of algebraic structures as related to logic systems, models for switching circuit behavior and their relation to hardware implementation. Includes theoretical treatment of both combinational and sequential logic systems concepts.
W. ALexander

ECE (CSE) 521 Digital Computer Technology and Design. *Preq.: ECE 342. 3(3-0) F,S.* A study of the internal structure and organization of digital systems with the computer as a primary focus. The emphasis is on problem description and modeling as required in the design process. The design of all major components in digital systems, including memory, input-output and control utilizing current technology, will be discussed. Miller

ECE 530 Physical Electronics. *Preqs.: ECE 303, B average in ECE and MA. 3(3-0) F.* A study of the properties of charged particles under the influence of fields and in solid materials. Quantum mechanics, particle statistics, semi-conductor properties, fundamental particle transport properties and lasers. Ruggles

ECE 531 Principles of Transistor Devices. *Preq.: ECE 441. 3(3-0) S.* An analysis of the operating principles of transistor structures. Basic semiconductor physics are reviewed and used to provide an explanation of transistor characteristics. Device-equivalent circuits are developed and used to interpret semiconductor-imposed limitations on device performance. Devices analyzed include MESFET'S, HEMT'S, Bipolar transistors, PBT'S, heterojunction BJT'S and SIT's Trew

ECE 532 Principles of Microwave Circuits. *Preq.: Grad. standing or B average in ECE and MA. 3(3-0) F.* Principles required to understand the behavior of electronic circuits operating at microwave frequencies. This course starts with a review of electromagnetic theory and establishes the millimeter techniques required for working with electronic circuits at microwave and millimeter-wave frequencies. Circuit components that operate at these frequencies are discussed. Trew

ECE (CSE) 533 Digital Electronics. *Preqs.: ECE 314, grad. standing or B average in ECE and MA. 3(3-0) S.* A study of digital integrated circuits and digital integrated circuit design techniques. The following topics are covered: semiconductor, devise and technology issues; bipolar logic circuits including TTL, ECL and IIL; static and dynamic MOS logic circuits; and semiconductor memory circuits. A strong emphasis is placed on the use of computer modeling and simulation as a design tool. The completion of three design projects is required. Gyurcsik

ECE 537 Microwave Device Characterization Techniques. *Preq.: ECE 448. 3(1-5) F.* A laboratory in principles of microwave characterization and operation of microwave test

equipment such as spectrum analyzers, power meters, detectors and network analyzers. Measurements of impedance noise figure, equivalent circuit parameters and frequency response will be performed on various circuit elements and devices. Graduate Staff

ECE 539 Integrated Circuit Technology and Fabrication. *Preq.: ECE 441. 3(2-2) S.* A study of semiconductor device and integrated circuit processing and technology. Covers sample preparation and specification, oxidation, diffusion, ion implantation, photolithography, design rules and measurement techniques. Osburn, Wortman

ECE 540 Electromagnetic Fields. *Preq.: ECE 448. 3(3-0) S.* A brief review of Maxwell's Equations, constitutive relations and boundary conditions. Power and energy relations for plane waves in isotropic and anisotropic media. Analysis of transmission lines, hollow metallic wave guides and dielectric waveguides. Green functions and applications to radiation and scattering. Electromagnetics and special relativity. Kauffman

ECE (CSC, CSE) 542 Database Management. *3(3-0) F.* (See computer studies.)

ECE 545 Introduction to Radio Wave Propagation. *Preqs.: ECE 303, B average in ECE and MA. 3(3-0) F.* Characteristics of plane electromagnetic waves in homogeneous and nonhomogeneous media with application to tropospheric and ionospheric propagation. Relationships between electron density, collision frequency and complex refractive index, theory of the formation and dynamics of ionospheric layers and theorems for the prediction of ionospheric propagation. Kauffman

ECE 546 VLSI Systems Design. *Preq.: ECE 342. 3(3-0) F.* Digital systems design in CMOS VLSI technology: CMOS devise physics, fabrication, primitive components, design and layout methodology, integrated system architectures, timing, testing future trends of VLSI technology. Graduate Staff

ECE 547 VLSI Architecture. *Preqs.: ECE 401, ECE 446. 3(3-0) F.* Study of algorithms and special purpose architectures for applications that require high performance systems such as digital signal and image processing. Topics include computer arithmetic, systolic arrays, DSP chips, wavefront processors and VLSI system design. Graduate Staff

ECE 550 Power System Operation and Control. *Preqs.: ECE 305 or ECE 331, B average in ECE and MA. 3(3-0) F.* Fundamental concepts of economic operation and control of power systems. Real and reactive power balance. System components, characteristics and operation. Steady state and dynamic analysis of interconnected systems. Tieline power and load-frequency control with integrated economic dispatch. Grainger

ECE (PY) 552 Introduction to the Structure of Solids. *3(3-0) S.* (See physics.)

ECE (CSE) 558 Digital Image Processing. *Preqs.: ECE 401, ST 371, high-level programming capability. 3(3-0) Every yr.* Introduction to the basic techniques of image processing. Topics include image formation and perception, digitization, Fourier transform domain processing, restoration and tomographic reconstruction. Rajala, Trussell

ECE (CSE) 559 Pattern Recognition. *Preqs.: ECE (CSE) 514, ST 371, B average in ECE and MA. 3(3-0) S.* A study of image pattern recognition techniques and computer-based methods for scene analysis, including discriminate functions, fixture extraction, classification strategies, edge detection and Fourier image processing. Applications and current research results will be covered. Snyder

ECE (CSC, CSE, IE, OR) 562 Computer Simulation Techniques. *3(3-0) F.* (See computer studies.)

ECE (MAE) 565 Gas Lasers. *3(3-0) F,S.* (See mechanical and aerospace engineering.)

ECE (CSC, CSE) 571 Data Transmission/Communications. *3(3-0) S.* (See computer studies.)

ECE (CSC, CSE) 572 Computer Communications. *3(3-0) F.* (See computer studies.)

ECE (CSC, CSE) 573 Introduction to Computer Performance Modelling. *3(3-0) F.* (See computer studies.)

ECE (CSC, CSE, IE) 575 Voice Input/Output Communication Systems. *3(3-0) F.* (See industrial engineering.)

ECE (CSC, CSE) 574 Real Time Computer Systems. *3(3-0) Alt. S.* (See computer studies.)

ECE 591, 592 Special Topics in Electrical Engineering. *Preq.: B average in technical subjects. 3(3-0) F,S.* A two-semester sequence to develop new courses and to allow qualified students to explore areas of special interest. Graduate Staff

ECE 593 Individual Topics in Electrical Engineering. *Preq.: B average in technical subjects. 1-3 F,S.* A course providing an opportunity for individual students to explore topics of special interest under the direction of a member of the faculty. Graduate Staff

FOR GRADUATES ONLY

ECE 601 Analog VLSI. *Preq.: ECE 511. 3(3-0) S.* A survey of advanced topics in very large-scale analog circuits (VLSI). The course provides in-depth coverage of analog-to-digital and digital-to-analog conversion, and switched-capacitor and other monolithic filtering techniques. Brief coverage is provided of special circuits for telecommunications and biomedical applications.

ECE 603 Computer-aided Circuit Analysis. *Preq.: ECE 511. 3(3-0) F.* Steady state and transient analysis of circuits with emphasis on circuit theory and computer methods. Many analysis techniques are considered, including linear nodal, signal flow graph, state equation, time-domain and functional simulation and analysis of sampled data systems. Also included are sensitivity and tolerance analysis, macromodeling of large circuits, and nonlinear circuit theory. Steer

ECE 613 Advanced Feedback Control. *Preq.: ECE 516. 3(3-0) S.* The study of advanced topics in dynamical systems and multivariable control. Current research and recent developments in the field will be treated. Chow

ECE 619 Microwave Circuits Design. *Preq.: ECE 532. 3(3-0) S. Alt. yrs.* Techniques for the design of microwave and millimeterwave systems and components. Radar and radiometer systems are introduced and discussed. System-imposed constraints upon component performance are introduced. Component function and design are analyzed. Specific topics include mixer, oscillator and amplifier performance and design. Students are required to design d a selected component. Modern computer-aided design techniques are used. Trew

ECE 622 Electronic Properties of Solid-State Materials. *Preq.: ECE 530. 3(3-0) S.* A review of energy bands in semiconductors. Detailed treatment of thermal and electrical transport phenomena, equilibrium and non-equilibrium semiconductor statistics. Also optical properties and hot electron effects in solid-state materials. Kolbas

ECE 623 Optical Properties of Semiconductors. *Preq.: ECE 530. 3(3-0) F. Alt. yrs.* Materials and device-related properties of compound optical semiconductors are studied. Included topics are: optical constants, absorption and emission processes in semiconductors, photodetectors, LED's semiconductor lasers. Kolbas

ECE 624 Electronic Properties of Solid-State Devices. *Preq.: ECE 530. 3(3-0) S.* A study of the basic physical phenomena responsible for the operation of solid-state devices. The semiconductor equations are examined and utilized to explain basic principles of

operation. Rectifying and ohmic contacts are examined. Various state-of-the-art devices are studied in detail. Wortman

ECE 625 Advanced Solid-State Device Theory. *Preq.: ECE 624. 3(3-0) F.* A study of the latest developments in solid-state devices. Topics are selected from subjects of current interest and state-of-the-art results are discussed. Emphasis is on the basic fundamental physical principles of operation as opposed to circuit applications. Wortman

ECE (PY) 627 Semiconductor Thin Films Technology. *Preq.: ECE 530. 3(3-0) S. Alt. yrs.* Techniques and processes encountered in the growth and characterization of epitaxial semiconductor films. Examples of growth tech&$.niques to be considered are: solution growth, chemical vapor deposition, molecular beam epitaxy and sputtering. Film characterization includes electrical characterization using Hall techniques, optical characterization using x-ray and electron microscopy techniques, surface and thin film analysis such as auger and secondary ion mass-spectrometer. Bedair

ECE 628 Preparation of Electronic Materials. *Preq.: ECE 530. 3(3-0) S. Alt. yrs.* A study of the principles governing the preparation of the electronic materials from the solid, liquid and gaseous states. Emphasis will be given to the experimental methods and to factors which affect the electronic behavior of materials, such as non-stoichiometry, charged and uncharged defects. Reisman

ECE 629 Chemical Vapor Transport of Thin Films. *Preq.: ECE 530. 3(3-0) S. Alt. yrs.* Practical and basic aspects of single and polycrystal growth using chemical vapor transport processes. Emphasis on materials of interest in microelectronics and on experimental methods used to implement chemical vapor processes and to understand chemical vapor processes. Reisman

ECE 632 Power System Stability and Control. *Preqs.: ECE 451, ECE 516. 3(3-0) S.* Modeling of synchronous machines and their control systems. Coupled electric circuit approach, Park's transformations, additional rotor windings. Rudiments of dynamic and transient stability. Excitation systems, governor-control systems, power-system stabilizers. State space formulations for computer-based dynamic studies. Lubkeman

ECE 633 Computer Analysis of Large-Scale Power Systems. *Preq.: ECE 550. 3(3-0) F.* Computer-based matrix methods of analysis of large networks. Problem statements, algorithmic formulations and solution techniques emphasizing efficient use of the computer for short-circuit calculations, computations of power flows under normal and emergency conditions and stability studies. Linear programming and optimization methods in power system planning. Lubkeman

ECE (CSE) 640 Parallel Processing. *Preq.: CSE 506. 3(3-0) S.* Pipeline and vector computers, SIMD computers and performance enhancement, multiprocessing control and algorithms, example multiprocessors, data flow computer, VLSI-based architecture, recent research papers in parallel processing area. Agrawal

ECE (CSE) 641 Sequential Machines. *Preq.: ECE (CSE) 520. 3(3-0) F.* The study of finite automata, both synchronous and asynchronous. Machine equivalence and minimization, state identification and the state assignment problem. Flip-flop activation from the state diagram and other realization techniques. Graduate Staff

ECE 642 Automata and Adaptive Systems. *Preq.: ECE (CSE) 520. 3(3-0) S.* The study of neural nets in natural systems, artificial nerve nets, artificial intelligence, goal-directed behavior, the logic of automata and adaptive Boolean logic. Computability, Turing machines and recursive function theory. Graduate Staff

ECE 643 Advanced Computer Architecture. *Preq.: ECE 640. 3(3-0) F.* Multiprocessor interconnection and performance evaluation, multicomputer interconnections and associated problems, other architectural considerations, VLSI and computer architecture, application-directed architecture and case studies. Agrawal

ECE 647 Multidimensional Digital Signal Processing. *Preq.: ECE 513. 3(3-0) F.* A study of multidimensional signal processing techniques and algorithms. Topics include multidimensional transforms, multidimensional digital filters, computational structures for implementation of multidimensional systems and multidimensional filter design.
Rajala

ECE 650 Design Automation for VLSI. *Preq.: CSE 505. 3(3-0) S.* VLSI CAD (computer-aids-to-design) tools research: physical design automation—layout, module generator, silicon compiler; logical design automation—CAD language, synthesis; simulation—circuit level, switch level, logic level, functional level; optimization techniques: graph theory, simulated annealing. W. ALexander

ECE (CSE) 651 Statistical Communication Theory. *Preq.: ECE (CSE) 514 or MA (ST) 541. 3(3-0) S.* Waveform analysis including Fourier transforms, correlation functions and other statistical descriptions of stationary and non-stationary random processes. Weiner theory: prediction, estimation and smoothing of discrete and continuous signals; introduction to Kalman filtering; problems to illustrate the applications of the theory to speech, television and data communication systems. Graduate Staff

ECE (CSE) 652 Information Theory. *Preq.: ECE (CSE) 514. 3(3-0) F.* Definition of a measure of information and a study of its properties, information sources and their efficient representation, communication channels and their capacity, encoding and decoding of data for transmission over noisy channels, source encoding systems, error correcting codes, rate distortion bounds. (Offered alt. years.) Ardalan

ECE 658 Digital Image Processing. *Preqs.: ECE 513, ECE 514. 3(3-0) F,S.* Introduction to the basic techniques of image processing. Topics include image formation and perception, digitization, Fourier transform domain processing, restoration and tomographic reconstruction. Snyder

ECE (CSE) 659 Computer Vision. *Preqs.: MA 501 and MA 502. 3(3-0) F.* Analysis of images by computers. Specific attention is given to analysis of the geometric features of objects in images, such as region size, connectedness and topology. Topics covered include: segmentation, template matching, motion analysis, boundary detection, region growing, shape representation, 3-D object recognition including graph matchings. Luo, Snyder

ECE (CSC, CSE) 671 Advanced Computer Performance Modelling. *3(3-0) S.* (See computer studies.)

ECE (CSC, CSE, IE) 675 Advances in Voice Input/Output Communication Systems. *3(2-3) S.* (See industrial engineering.)

ECE 691, 692 Special Studies in Electrical Engineering. *3(3-0) F,S.* An opportunity for small groups of advanced graduate students to study topics in their special fields of interest under the direction of members of the graduate faculty. Graduate Staff

ECE 693 Individual Studies in Electrical Engineering. *Preq.: Grad. standing. 1-3 F,S.* The study of advanced topics of special interest to individual students under the direction of faculty members. Graduate Staff

ECE 695 Electrical Engineering Seminar. *Preq.: Grad. standing in ECE. 1(1-0) F,S.* A series of papers and conferences participated in by the instructional staff, invited guests and students who are candidates for advanced degrees. Graduate Staff

ECE 698 Electrical Engineering Design Project. *Preq.: Grad. standing in ECE. 3-6 F,S.* A course in which a student, or a group of students working as a team, will design and usually build, test, and evaluate an electrical device, system, or process. A written engineering report is required. The oral examination of a candidate for the degree of Master of Electrical Engineering will include questioning on this course. Graduate Staff

ECE 699 Electrical Engineering Research. *Preqs.: Grad. standing in ECE, consent of advisor. Credits arranged.* Graduate Staff

Engineering

These courses are designed for use by graduate students in any department in the School of Engineering.

(MA, OR) 531 Dynamic Systems and Multivariable Control I. *3(3-0) F.* (See operations research.)

E (MA, OR) 631 Dynamic Systems and Multivariable Control II. *3(3-0) S. Alt. yrs.* (See operations research.)

E (OR) 650 Algorithmic Methods in Optimal Control. *3(3-0) S. Alt. yrs.* (See operations research.)

English

GRADUATE FACULTY

Professor J. E. Bassett, *Head*

Associate Professor J. M. Grimwood, *Associate Head*

Professor M. S. Reynolds, *Director of the Graduate Program*

Professors: B. H. Baines, P. E. Blank Jr., L. S. Champion, J. D. Durant, M. Halperen, A. H. Harrison, M. T. Hester, A. S. Knowles, L. H. MacKethan, W. E. Meyers, J. J. Smoot, A. F. Stein, W. B. Toole III, J. N. Wall Jr., M. C. Williams, R. V. Young Jr.; *Adjunct Professor:* D. D. Short; *Professors Emeriti:* H. G. Kincheloe, B. G. Koonce Jr., F. H. Moore, R. G. Walser, P. Williams Jr.; *Associate Professors:* G. W. Barrax, L. J. Betts Jr., E. D. Clark Sr., J. W. Clark Jr., E. D. Engel, J. Ferster, H. A. Hargrave, L. T. Holley, K. F. C. Holloway, M. F. King, D. L. Laryea, C. R. Miller, C. E. Moore, C. A. Prioli, L. S. Rudner, L. Smith, N. G. Smith, H. C. West; *Associate Professor Emeritus:* E. P. Dandridge Jr.; *Assistant Professors:* M. P. Carter, D. H. Covington, C. G. Herndl, J. J. Kessel, L. S. Lomperis, D. C. Miller, D. B. Wyrick

The Department of English offers instruction leading to the Master of Arts in English, with coursework in English and American literature, rhetoric and composition, linguistics, and creative writing. The master's program can serve either as a complete course of study or as the first year of study toward a doctoral degree at another institution. A minimum of 30 semester hours of graduate credit is required, although some program options may require additional course work.

The M.A. program requires all students to take a distribution of four courses, one each in English literature before 1660, English literature after 1660, American literature, and a fourth category including composition theory, rhetoric, linguistics, and literary theory. In addition, all students must take an introduction to research and bibliography, pass a language requirement, take a compre-

hensive written examination, write a thesis, and pass an oral exam on the thesis research.

Beyond these basic requirements, the program permits several emphases. Students interested primarily in the study of literature take additional courses in literature for a total of eight courses. Students interested in creative writing may substitute a workshop in creative writing for one literature course and present a creative work or series of short works as their thesis. Students interested in the study and teaching of writing may take the composition concentration, which requires specific courses in composition, rhetoric, and linguistics; the thesis is on a topic in one of these areas.

The department offers two options for students who hold "A" certification from the N. C. Department of Public Instruction. The M.A. with Graduate ("G") Certification requires 30 semester hours of graduate credit in English, as outlined above, and 9 semester hours of graduate credit in education. The M.A. with Sixth-Year Certification requires 60 semester hours of graduate study beyond the bachelor's degree, with course work in English, education, and electives.

Teaching assistantships are available for promising students. These students take ENG 504 in the fall semester and, under the supervision of experienced teachers, devote half time in subsequent semesters to teaching freshman composition. ENG 504 gives graduate credit but does not count toward fulfillment of degree requirements.

Students and faculty in the Department of English are eligible for fellowships to participate in programs sponsored by the Folger Institute of Renaissance and Eighteenth-Century Studies, which is located in Washington, D.C., at the Folger Shakespeare Library. The Department also supports the publication of two journals edited by faculty members, *The John Donne Journal*, which publishes scholarship on Renaissance and seventeenth-century literature, and *Obsidian II: Black Literature in Review*, which publishes both creative and scholarly work.

Beginning in Fall 1988, the department will offer a Master of Science in technical communication, a 33-hour program designed to prepare professional communicators for advanced positions in industry and research organizations. The program requires four courses in English (in the fields of writing, rhetoric, and linguistics), one in communication, one in media, one in technical methods, and three electives selected to complement the student's professional goals, in addition to a 3-hour thesis based on research or an internship.

Admission to all programs requies GRE scores and a writing sample. Contact the Director of Graduate Programs for details on admission requirements for each program.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

NOTE: The prerequisite for all 500-level English courses is upper division or graduate standing.

ENG 504 Problems in College Composition. *Preq.: Grad. standing. 3(3-0) F.* Study of the history and theory of rhetoric; practice in writing and in literary analysis; preparation for the profession of teaching composition and literature. Required of all teaching assistants in English. Baines, Grimwood, MacKethan

ENG 521 Advanced Technical Writing and Editing. *Preqs.: ENG 214 and 321. 3(2-1) F.* Advanced study of specialized documents, technical editing and publications management for students planning careers in writing and editing. Course covers software documentation, manuals, indexing, style manuals, document design, legibility, readability testing, computerized production, on-screen documentation, desk-top publishing and publications management issues such as staffing, scheduling, cost-reduction, ethics and subcontracting. Covington

ENG 524 Introduction to Linguistics. *Preq.: Grad. standing or 12 hours in ENG. 3(3-0) F.* Introduction to theoretical linguistics, especially for students in language, writing and literature curricula. Phonology, syntax, semantics, history of linguistics; relation of linguistics to philosophy, sociology and psychology; application of theory to analysis of texts. Fennell, Meyers

ENG 525 Variety in Language. *Preq.: Grad. standing or 12 hours in ENG. 3(3-0) S.* Variety in the use of language, with particular emphasis on American English. Regional dialects; sociolinguistic issues related to class and gender; bilingualism; language and ethnicity; Black English and Hispanic English; basics of discourse analysis. Fennell, Holloway

ENG 548 Black American Literature. *3(3-0) F,* Survey of black American literature and its relationships to culture from its beginnings to the present. Representative works from the oral tradition, slave narratives, Washington-DSuBois controversy and the Harlem Renaissance. Writers include Douglass, Washington, Dunbar, Chesnutt, DuBois, Johnson, Hughes, Toomer, Hurston, Wright and several more recent figures. Holloway, Laryea, MacKethan, Pettis

ENG 561 Milton. *3(3-0) S.* An intensive reading of Milton with attention to background materials in the history and culture of seventeenth-century England. Wall, Young

ENG 575 Southern Writers. *3(3-0) S.* A survey of the particular contribution of the South to American literature, with intensive study of selected major figures. Grimwood, Laryea, MacKethan

ENG 578 English Drama to 1642. *Preqs.: ENG 261 and upper division or grad. standing. 3(3-0) F. Alt. yrs.* Study of English drama from its beginnings in cycle plays to the closing of the theaters. Emphasis is placed on Elizabethan and Jacobean drama, excluding Shakespeare. Baines, Williams

ENG 579 Restoration and 18th-Century Drama. *3(3-0) S. Alt. yrs.* Intensive study of the English drama from 1660 to 1800. Durant

ENG 588 Fiction Writing Workshop. *Preq.: ENG 488 or ENG 489 and CI. 3(3-0) F.* Advanced work in techniques of writing fiction for students with substantial experience in writing. Workshop sessions with students commenting on each other's work. Kessell, L. Smith

ENG 589 Poetry Writing Workshop. *Preq.: ENG 488 or ENG 489 and CI. 3(3-0) S.* Advanced work in techniques of writing poetry for students with substantial experience in writing. Workshop sessions with students commenting on each other's work. Barrax

ENG 590 Literary Criticism. *3(3-0) S. Alt. yrs.* An examination of the critical process as it leads to the definition and analysis of literature, together with attention to the main literary traditions and conventions. Ferster, Holley, Lomperis, D. Miller

FOR GRADUATES ONLY

NOTE: The prerequisite for all 600-level English courses is graduate standing unless additional prerequisites are noted.

ENG 604 Writing: Theory and Research. *3(3-0) F.* Contemporary theory about the writing process, text structures and the functions of discourse. Attention to the assumptions and results of different research methods; cognitive, ethnographic and discourse analysis. Covers theories and research results relevant to audience, invention, coherence, revision, literacy, relations between oral and written discourse, content (including but not emphasizing the classroom context). Carter, Penrose

ENG 609 Old English Literature. *3(3-0) S. Alt. yrs.* An introduction to the language and literature of the Old English period (450-1100). Readings will be in the original and will include both poetry and prose. Ferster

ENG 610 Middle English Literature. *3(3-0) S. Alt. yrs.* A study of major works of medieval English literature (exclusive of Chaucer) in the light of dominant intellectual and artistic traditions: emphasis is on four works: *Piers Plowman, Pearl, Sir Gawain and the Green Knight,* and Malory's *Morte d'Arthur.* Ferster, Holley, Lomperis

ENG 615 American Colonial Literature. *3(3-0) S. Alt. yrs.* A study of American literature and thought from the beginning to the adoption of the Constitution. J. Clark, Prioli

ENG 620 16th-Century Non-Dramatic English Literature. *3(3-0) F.* A detailed survey of non-dramatic prose and verse of the sixteenth century against the background of Humanism with the consequent assimilation of classical and continental literary subjects and forms. Blank, Hester, Wall

ENG 621 Rhetoric of Science and Technology. *Preq.: Grad. standing or PBS. 3(3-0) S. Alt. yrs.* Study of the relationships among rhetoric, scientific knowledge and technological development and of changes in how these relationships have been understood historically. Practice in critical analysis of scientific and technical discourse. Consideration of scientific and technical language and of public controversy concerning science and technology. C. Miller

ENG 622 The Rhetoric of Written Discourse. *3(3-0) S.* Contemporary rhetorical theory and its development from classical rhetoric; emphasis on the differences between oral and written communication and the relevance of traditional theory to the purposes and constraints of writing. Special attention to current issues: the revival of invention, argumentation and truth, contributions of research in composition. Carter, C. Miller

ENG 624 Modern English Usage. *3(3-0) F. Alt. yrs.* An intensive study of English grammar, with attention to new developments in structural linguistics and with emphasis on current usage. Meyers

ENG 626 History of the English Language. *3(3-0) F. Alt. yrs.* A survey of the growth and development of the language from its Indo-European beginnings to the present. Meyers

ENG 630 17th-Century English Literature. *3(3-0) S.* A close examination of the literature of England from 1600 to 1700 with emphasis on major literary figures and movements, the development of important literary forms and genres, and the intimate relationship between the literature of this period and its philosophical, political and theological backgrounds. Hester, Wall, Young

ENG 650 English Romantic Period. *3(3-0) F.* A detailed study of the six major romantic poets—Blake, Wordsworth, Coleridge, Byron, Shelley, and Keats; some attention as well to the political, social and literary background and to a few minor writers and critics. Harrison, D. Miller

ENG 651 Chaucer. *Preqs.: ENG 451 or equivalent and grad. standing. 3(3-0) F.* An intensive study of the Chaucer canon requiring independent research. Ferster, Holley, Lomperis

ENG 655 American Romantic Period. *3(3-0) F.* A study of the selected works of Poe, Hawthorne, Melville, Emerson, and Thoreau, with emphasis on their varied contributions to the literature and thought of the American romantic movement.
Bassett, MacKethan, Stein, West

ENG 658 Studies in Shakespeare. *Preqs.: ENG 486 or ENG 487 or equivalent and grad. standing. 3(3-0) F,S.* An intensive study of a particular phase of the Shakespeare canon. Emphasis will normally be on one dramatic genre (tragedy, comedy, history), but occasionally the focus may be more limited. Students may register for credit for a maximum of six hours. Baines, Champion, Williams

ENG 660 Victorian Poetry and Critical Prose. *3(3-0) S.* Studies in the literature of Victorian England: 1837-1901; the major poets and essayists, movements and questions in their historical contexts, religious, political and aesthetic. Hargrave, Harrison, King

ENG 662 18th-Century English Literature. *3(3-0) F.* The major figures in English literature between 1660 and 1790 against the background of social, cultural and religious change. Durant, Moore, Wyrick

ENG 663 18th-Century English Novel. *3(3-0) S. Alt. yrs.* Selected British novels of the eighteenth century studied in relation to the history and development of the genre and in the light of available critical opinion past and present. Durant, Moore, Wyrick

ENG 664 Victorian Novel. *3(3-0) F. Alt. yrs.* The nineteenth-century British novel studied from the perspective of literary history and twentieth-century criticism.
Engel, King

ENG 665 American Realism and Naturalism. *3(3-0) S.* Concentration on Whitman, Dickinson, Twain, James and Dreiser, with briefer attention to Howells, Crane, Norris and other realists and naturalists. Bassett, MacKethan, Stein, West

ENG 670 20th-Century British Prose. *3(3-0) F. Alt. yrs.* An examination of the works of the major British writers and literary movements of this century and their historical context, religious, political and aesthetic. Halperen, Knowles, Reynolds

ENG 671 20th-Century British Poetry. *3(3-0) S. Alt. yrs.* The development of English poetry from the rebellion against Victorian and Pre-Raphaelite verse to the present post-war scene; special attention to Hardy, Yeats, Eliot, Auden and Thomas.
Halperen, Knowles, Reynolds

ENG 675 20th-Century American Prose. *3(3-0) F. Alt. yrs.* An examination of representative American writers of the novel and short fiction.
E. Clark, Halperen, Knowles, Reynolds

ENG 676 20th-Century American Poetry. *3(3-0) S. Alt. yrs.* The development of modern American poetry from the rebellion against the romantic and genteel verse of the 1890's; special attention to Robinson, Frost, Pound, Williams, Stevens and Ransom.
Bassett, Halperen, Knowles, Reynolds

ENG 680 20th-Century British Drama. *3(3-0) F. Alt. yrs.* A survey of modern British drama from its beginnings at the turn of the century to the present. Halperen, Knowles

ENG 681 20th-Century American Drama. *3(3-0) F. Alt. yrs.* A survey of modern American drama centering on major figures. Halperen, Knowles

ENG 691 Special Topics in Written Communication. *Preq.: One 200-level writing course. 3(3-0) S.* Intensive study of issues in written communication, with special emphasis on application of theory to problems in a variety of areas. Seminar discussions and independent research. Graduate Staff

ENG 692 Special Topics in American Literature. *Preq.: Consent of seminar chairman. 3(3-0) F,S.* An intensive study, involving independent research and centering on some limited topics from American literature. Graduate Staff

ENG 693 Special Topics in English Literature. *Preq.: Consent of seminar chairman. 3(3-0) F,S.* An intensive study, involving independent research and centering on some limited topic from English literature. Graduate Staff

ENG 698 Bibliography and Methodology. *1-3.* Intensive study of the bibliography and methodology of literary research. Required of all graduate students in English. Graduate Staff

ENG 699 Research in Literature (Thesis). *Preq.: Consent of graduate adviser. Credits Arranged. F,S.* Independent investigation of an advanced literary or linguistic problem leading to the writing of a master's thesis. Thesis Director

Entomology

GRADUATE FACULTY

Professor R. J. Kuhr, *Head*

Professors: J. T. Ambrose, C. S. Apperson, R. C. Axtell, J. S. Bacheler, J. R. Baker, J. R. Bradley Jr., W. M. Brooks, W. V. Campbell, W. C. Dauterman, M. H. Farrier, F. E. Guthrie, F. P. Hain, E. Hodgson, G. G. Kennedy, H. B. Moore Jr., H. H. Neunzig, G. C. Rock, T. J. Sheets, K. A. Sorensen, R. E. Stinner, J. W. Van Duyn, C. G. Wright; *Adjunct Professors:* J. R. Bend, A. L. Chasson, J. R. Fouts, J. E. Gibson, F. L. Hastings, R. A. Neal, R. M. Philpot; *Professors Emeriti:* W. J. Mistric Jr., R. L. Rabb, R. L. Robertson, D. A. Young Jr.; *Associate Professors:* J. J. Arends, L. L. Deitz, F. L. Gould, R. C. Hillmann, E. P. Lampert, J. R. Meyer, B. M. Parker, P. S. Southern; *Associate Professor (USDA):* D. M. Jackson; *Adjunct Associate Professors:* C. Y. Kawanishi, H. B. Matthews Jr.; *Assistant Professors:* R. L. Brandenburg, G. J. House, R. M. Roe, R. C. Smart, J. F. Walgenbach; *Assistant Professor (USDA):* D. W. Keever; *Adjunct Assistant Professor:* K.G. Wilson

ASSOCIATE MEMBERS OF THE DEPARTMENT

Associate Professor: B. C. Haning, *Assistant Professor:* H. M. Linker

The Department of Entomology* offers graduate training leading to the Master of Science, Master of Agriculture (non-thesis) and Doctor of Philosophy degrees. Major areas of specialization are acarology, agricultural entomology, apiculture, behavior, ecology, forest entomology, host-plant resistance, invertebrate pathology, medical and veterinary entomology, nutrition, pesticide analysis, pesticide fate in soil and water, pest management, physiology, population dynamics, soil entomology, systems analysis, taxonomy and toxicology.

Opportunities exist for training in both applied and fundamental phases of entomology. Population management concepts are emphasized in the applied entomology and pest management programs. The applied phases are influenced by the State's agriculture, in which corn, tobacco, cotton, peanuts, soybeans,

*This department does require GRE scores.

small grains, fruits, vegetables, livestock and forestry are important components. The rapidly expanding tourist industry and the diverse habitats of the State, extending from the mountains to the sea, provide unique opportunities for research on insects and related arthropods affecting man. A cooperative arrangement with the School of Forest Resources provides majors in forest entomology. The program in medical and veterinary entomology includes both applied and fundamental research and provides the opportunity for training at the School of Public Health, UNC, Chapel Hill. Students electing graduate work in entomology are expected to have strong backgrounds in biological sciences, chemistry and mathematics. Undergraduate preparation in entomology is not required.

Strong interdepartmental programs in ecology, physiology and toxicology include faculty members from the Department of Entomology and provide graduate training for entomology students desiring interdisciplinary graduate degrees. Additionally, interinstitutional courses are available on the nearby campuses of Duke University and the University of North Carolina at Chapel Hill. The presence of numerous federal and industry laboratories in the nearby Research Triangle Park further enhances entomology graduate training.

The departmental research, extension and training programs are housed in a complex of facilities including a pesticide residue research laboratory, biochemistry and toxicology laboratories, insect rearing rooms, greenhouses and field stations. An adjacent phytotron or bioclimatic facility provides an opportunity for ecological and behavioral studies under controlled conditions. Ultrastructural investigations are conducted in the electron microscope facility of the School of Agriculture and Life Sciences. Extensive computer facilities and statistical services are available in the department and on campus.

See a description of the Pesticide Residue Research Laboratory elsewhere in this bulletin.

SELECTED ADVANCED UNDERGRADUATE COURSES

ENT (ZO) 425 General Entomology. *Preq.: ZO 201 or equivalent. 3(2-3) F,Sum.*

Related Course:

PM 415 Principles and Systems of Integrated Pest Management. *Preqs.: BO (ZO) 360, PP 315, ENT 312; Coreq.: CS 414. 4(3-3) S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ENT 502 Insect Diversity. *Preq.: ENT 425 or equivalent. 4(2-4) F.* Surveys the diversity of insect biology and structure emphasizing the identification of adults; includes speciation, evolutionary relationships, approaches to classification, nomenclature, zoogeography and techniques of collection. Deitz

ENT 503 Functional Systems of Insects. *Preqs.: Twelve hours of biology, nine hours of CH, three hours of BCH. 4(3-3) S.* The morphology, histology and function of the organ systems of insects. Basic physiological principles are discussed in the context of insect growth and development. The laboratory is designed to give students practical experience with modern physiological techniques. Roe

ENT (ZO) 509 Ecology of Stream Invertebrates. *4(2-6) S.* (See zoology.)

ENT 520 Insect Pathology. *Preqs.: ENT 425 and MB 401 or equivalent. 3(2-3) S. Alt. yrs.* A treatment of the noninfectious and infectious diseases of insects, the etiological agents and infectious processes involved, immunological responses and applications. Brooks

ENT (BO, CS, PM, PP) 525 Biological Control. *4(3-3) F. Alt. yrs.* (See pest management.)

ENT 531 Insect Ecology. *Preqs.: ENT 425 and BO (ZO) 560 or equivalent. 3(2-2) F. Alt. yrs.* The interrelationships among insects and components of their effective environments which result in dynamic spatial and temporal patterns of particular species. Also, the diverse roles of insects in the structure and function of communities and ecosystems. Gould

ENT 541 Immature Insects. *Preq.: ENT 502 or equivalent. 3(1-4) F. Alt. yrs.* Biology and taxonomy of immature insects with emphasis on identification of the larval stage of holometabolous orders. A collection of immatures and associated reared adults is required. Neunzig

ENT 542 Acarology. *Preq.: ENT 301 or 312 or ZO 201. 3(2-3) S. Alt. yrs.* A systematic survey of the mites and ticks with emphasis on identification, biology and control of the more common and economic forms attacking material, plants and animals including man. Farrier

ENT 550 Fundamentals of Insect Control. *Preq.: ENT 312 or 301. 3(2-2) F.* The principles underlying modern methods for protecting food, clothing, shelter and health from insect attack. Lampert

ENT 562 Insect Pest Management in Agricultural Crops. *Preq.: ENT 550. 3(3-0) S. Alt. yrs.* Critical review of the biology and ecology of representative beneficial and injurious insects and arachnids of agricultural crops and the advantages and limitations of advanced concepts of their management in selected agroecosystems. Bradley, Kennedy, Rock

ENT (FOR) 565 Advanced Forest Entomology. *Preq.: ENT 301 or ENT 502 or CI. 3(2-2) S. Alt. yrs.* Covers the important insect pests of forest and shade trees including regeneration pests, defoliating insects, inner-bark borers, wood borers, sucking insects, and bud, twig and root feeding insects. Also includes concepts in forest pest management and population dynamics. Hain

ENT (ZO) 582 Medical and Veterinary Entomology. *Preqs.: ENT 312 or 425 and ZO 315 or equivalent. 3(2-3) S. Alt. yrs.* The morphology, taxonomy, biology and control of the arthropod parasites and disease vectors of man and animals. The ecology and behavior of vectors in relation to disease transmission and control. Axtell

ENT 590 Special Problems. *Preq.: CI. Credits Arranged. F,S.* Original research on special problems in entomology not related to a thesis problem. Provides experience and training in research. Graduate Staff

ENT 592 Agricultural Entomology Practicum. *Preq.: Economic entomology (ENT 562 recommended). 3(0-9) Sum. Alt. yrs.* Practical experience in research, extension and commercial aspects of insect pest management on a broad range of agricultural crops under actual field conditions. Class meets 9 hours each Friday for 10 weeks from early June to mid August. Students should register for second summer session. Bradley

FOR GRADUATES ONLY

ENT 622 Insect Toxicology. *Preqs.: ENT 550, BCH 551 or equivalent. 3(2-3) S. Alt. yrs.* The relation of chemical structure to insect toxicity, the mode of action of toxicants used to

kill insects, the metabolism of insecticides in plant and animal systems, the selectivity within the cholinesterase inhibitors and other selective mechanisms and the analysis of insecticide residues will be discussed. Dauterman

ENT 690 Seminar. *Preq.: Grad. standing in ENT or closely allied fields. 1(1-0) F,S.* Discussion of entomological topics selected and assigned by seminar chairman. Graduate Staff

ENT 699 Research. *Preq.: Grad. standing. Credits Arranged. F,S.* Original research in connection with thesis problem in entomology. Graduate Staff

Fiber and Polymer Science

ASSOCIATED GRADUATE FACULTY

Professor W. K. Walsh, *Chairman and Program Director*

Professors: R. L. Barker, S. K. Batra, D. R. Buchanan, J. A. Cuculo, A. H. M. El-Shiekh, R. E. Fornes, T. W. George, R. D. Gilbert, P. L. Grady, B. S. Gupta, S. P. Hersh, H. B. Hopfenberg, C. D. Livengood, P. R. Lord, R. McGregor, M. H. M. Mohamed, H. G. Olf, V. T. Stannett, W. C. Stuckey Jr., M. H. Theil, C. Tomasino, P. A. Tucker, C. F. Zorowski; *Adjunct Professors:* J. E. Hendrix, H. F. Mark; *Professors Emeriti:* J. F. Bogdan, D. M. Cates, D. W. Chaney, D. S. Hamby, H. A. Rutherford, W. M. Whaley, R. W. Work; *Associate Professors:* K. R. Beck, T. J. Little, G. N. Mock, C. B. Smith; *Associate Professors Emeriti:* T. H. Guion, T. G. Rochow; *Assistant Professors:* P. Banks-Lee, A. C. Clapp, T. G. Clapp, H. Hamouda, J. W. Rucker

Fiber and polymer science is a multidisciplinary program bringing together the disciplines of mathematics, chemistry and physics and the application of engineering principles for the development of independent scholars versed in the field of fiber materials science. The program is administered by the School of Textiles and leads to the degree of Doctor of Philosophy. Students majoring in the physical sciences, mathematics, textiles or engineering and having at least a "B" grade in their undergraduate major will normally qualify for admission.

Fiber and polymer science is concerned with polymeric materials, fibers produced from them, fiber assemblies in one-, two-and three-dimensional forms and chemical modification of fiber assemblies. This broad field of study permits a wide range of useful concentrations. The candidate is expected to penetrate deeply into one area of specialization and to acquire a reasonable perspective in other relevant subject matter. Generally specialization occurs within the area of (1) polymer chemistry and synthesis, (2) fiber and polymer physics and physical chemistry, (3) structural mechanics of textile materials, (4) formation of fibers and fibrous textile structures or (5) dyeing and chemical modification of textile materials. The student's research is based within one of these areas.

Ample laboratory space is available and there are a number of specialized laboratories equipped to support doctoral investigations. Other facilities and research equipment which may be used in fiber and polymer science research programs are available in cooperating departments on campus. The Burlington Textiles Library houses one of the most complete collections of polymer, fiber and textile literature.

DEGREE REQUIREMENTS

Doctor of Philosophy—An advisory committee chaired by a member of the fiber and polymer science faculty is formed as soon as possible to develop with the student a plan of study designed to enable one to acquire the comprehensive knowledge required to pass the qualifying cumulative examinations.

There are no definite requirements in credit hours for the Doctor of Philosophy degree. A student's program of study is designed around the student's special interests, while maintaining the coherence and breadth essential for professional development and excellence in research. A reading knowledge of one foreign language is required.

Doctor of Philosophy Minor—Ph.D. candidates who designate a named minor in fiber and polymer science will be required to take nine credit hours in related courses approved by the minor representative on the student's advisory committee.

Communications concerning this program should be directed to the Chairman of the Committee for the Fiber and Polymer Science Program, School of Textiles, North Carolina State University.

COURSE OFFERINGS*

(See departmental listing for descriptions.)

GENERAL COURSES

T 402 Introduction to the Theory and Practice of Fiber Formation.

TC (CH) 461 Introduction to Fiber-Forming Polymers.

TC 504 Fiber Formation—Theory and Practice.

TC (CH) 562 Physical Chemistry of High Polymers—Bulk Properties.

TES (TMT) 561 Mechanical and Rheological Properties of Fibrous Material.

TES (TMT) 563 Characterization of Structure of Fiber Forming Polymers.

TC 591 Special Topics in Textile Science.

COURSES IN AREAS OF SPECIALIZATION

Polymer Chemistry and Synthesis

TC 520 Chemistry of Dyes and Color.

TC 521 Dye Synthesis Laboratory.

*Extensive use may be made of graduate course offerings in other schools on campus when developing the minor field.

TC 530 The Chemistry of Textile Auxiliaries.

TC 561 Organic Chemistry of High Polymers.

TC (CHE) 671 Special Topics in Polymer Science.

Polymer Physics and Physical Chemistry

T 500 Fiber and Polymer Microscopy.

TC 504 Fiber Formation—Theory and Practice.

TC 505 Theory of Dyeing.

TC (CH) 562 Physical Chemistry of High Polymers—Bulk Properties.

TC 662 Physical Chemistry of High Polymers—Solution Properties.

TC (CHE) 569 Polymers, Surfactants and Colloidal Materials.

TC (CHE) 570 Radiation Chemistry and Technology of Polymeric Systems.

TC (CHE) 669 Diffusion in Polymers.

TES (TMT) 562 Physical Properties of Fiber Forming Polymers, Fibers and Fibrous Structures.

TES (TC) 691 Special Topics in Fiber Science.

Mechanics of Textile Materials and Processes

TES (TMT) 520 Yarn Processing Dynamics.

TMT 549 Warp Knit Engineering and Structural Design.

TES (TMT) 555 Production Mechanics and Properties of Woven Fabrics.

TES (TMT) 640 Physical and Mechanical Properties of Knitted Fabrics.

TES (TMT) 663 Mechanics of Twisted Structures.

TES (TMT) 664 Mechanics of Fabric Structures.

Food Science

GRADUATE FACULTY

Professor D. R. Lineback, *Head*

Professor V. A. Jones, *Graduate Administrator*

Professors: L. W. Aurand, H. R. Ball Jr., D. E. Carroll Jr., H. B. Craig, D. D.

Hamann, H. M. Hassan, H. N. Jacobson, H. E. Swaisgood, C. T. Young; *Extension Professors:* F. R. Tarver Jr., F. B. Thomas; *Professors (USDA):* H. P. Fleming, R. F. McFeeters, W. M. Walter Jr.; *Adjunct Professor:* R. A. Neal; *Professors Emeriti:* T. A. Bell, T. N. Blumer, E. S. Cofer, M. W. Hoover, I. D. Jones, W. M. Roberts, M. L. Speck, F. G. Warren; *Associate Professors:* G. L. Catignani, A. P. Hansen, T. R. Klaenhammer, T. C. Lanier, B. W. Sheldon, K. R. Swartzel, L. G. Turner; *Assistant Professors:* L. C. Boyd, E. A. Foegeding, P. M. Foegeding, D. K. Larick, S. J. Schwartz; *Assistant Professor (USDA):* M. A. Daeschel

Programs of study leading to the Master of Agriculture, Master of Life Sciences, Master of Science and Doctor of Philosophy degrees are offered by the Department of Food Science.

Areas of study and research include food chemistry, food microbiology, food engineering, nutrition and food process and product development. These areas involve all foods including dairy products, fruits, meats, poultry products, seafood, nutmeats and vegetables. Supporting course work and cooperative research are offered in areas such as biochemistry, chemistry, economics, engineering, genetics, microbiology, nutrition, toxicology, biotechnology and statistics.

Because of the diversity of disciplines and wide range of opportunities in food science, each student and his advisory committee are granted considerable flexibility in developing a graduate program tailored to the student's interests and research needs. Each program must conform to guidelines of the Graduate School (see Graduate Programs) and food science policies and procedures (available from the Department of Food Science). All graduate students are eligible for assignment as laboratory assistants in food science courses. The Master of Science program requires a minimum of 30 semester hours of work including a thesis. The Master of Agriculture and Master of Life Sciences programs require a minimum of 36 semester hours; no thesis is required, but at least four semester hours of special problems are required. There are no requirements for 600-level courses in the Master of Agriculture and Master of Life Sciences programs. The total semester hours of work for the Ph.D. degree are established by the advisory committee to meet the objectives of the student's program. No foreign language is required.

The department participates in interdepartmental graduate student training programs such as marine science, toxicology, biotechnology and nutrition.

Excellent laboratory, pilot plant, library and computer facilities, as well as graduate assistantships, are available to support qualified candidates.

SELECTED ADVANCED UNDERGRADUATE COURSES

FS 400 Foods and Nutrition. *Preq.: CH 220. 3(3-0) F.*

FS 402 Food Chemistry. *Preq.: CH 220 or CH 221. 3(2-3) F.*

FS (MB) 405 Food Microbiology. *Preq.: MB 401. 3(2-3) F.*

FS 416 Quality Control of Food Products. *Preqs.: FS 402, MB 401. 3(2-3) S.*

FS 421 Food Preservation. *Coreq.: MB 401. 3(2-3) F.*

FS 423 Muscle Food Technology. *Preqs.: FS 322, FS 421, FS 402. 3(2-3) S.*

FS 425 Processing Dairy Products. *Preqs.: FS 324, FS 421. 3(2-3) S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

FS 504 Food Proteins and Enzymes. *Preq.: FS 402 or BCH 451. 3(2-3) F. Alt. yrs.* An advanced course in food chemistry with emphasis on proteins and enzymes of particular importance to foods. Protein interactions and their effect on the physical-chemical characteristics of a product will be discussed. Particular emphasis will be given to the preparation and kinetic properties of immobilized enzymes and their use as biochemical reactors in processing operations or as specific electrodes for analytical purposes. Swaisgood

FS (MB) 506 Advanced Food Microbiology. *Preq.: FS (MB) 405 or equivalent. 3(1-6) S. Alt. yrs.* The interactions of microorganisms in foods and their roles in food spoilage and bioprocessing. Cellular and molecular relationships in bacterial injury, repair and aging resulting from environmental stresses. Bacterial sporulation, germination and physiological properties of bacterial spores. Graduate Staff

FS 511 Food Research and Development. *Preqs.: FS 331, FS 402, FS (MB) 405. 3(2-3) S.* A study of the scientific principles underlying the development of new and improved food products and processes. The study of specific food industry problems by the case method. Special emphasis on the application of research and development principles to meat, poultry and fisheries industries. Lanier

FS (NTR) 530 Human Nutrition. *Preqs.: FS 400 or NTR 415 or 419; BCH 451. 3(3-0) S. Alt. yrs.* Biochemical and physiological bases of nutrition. Human nutrient requirements, assessment of nutritional status, clinical and subclinical disorders resulting from nutrient deficiencies or inadequacies. Catignani

FS (HS) 562 Post-Harvest Physiology. *3(3-0) S.* (See horticultural science.)

FS 580 Food Kinetics. *Preqs.: FS 212, FS 402, FS 405, MA 212 or CI. 3(3-0) S. Alt. yrs.* Basic and applied kinetic principles, development and use of kinetic data of food components, food processing system design, system modeling, system evaluation and storage stability considerations. Swartzel

FS (BAE) 585 Food Rheology. *Preqs.: FS 331 or MAE 314. 3(2-3) F.* Principles and methods for measuring rheological properties. Theories of elastic, viscous, viscoelastic and viscoplastic behavior and relationships to food texture and commodity damage during harvest, handling and processing. Influence of time, composition and processing. Influence of time, composition and processing on rheological properties. Hamann

FS 591 Special Problems in Food Science. *Preq.: Grad. or sr. standing. Maximum 6. F,S,Sum.* Analysis of scientific, engineering and economic problems of current interest in foods. The problems are designed to provide training and experience in research. Graduate Staff

FOR GRADUATES ONLY

FS 601 Physical Measurements of Biopolymers. *Preqs.: CH 231 or CH 431, FS 504 or BCH 551. 3(2-3) Alt. S.* The theory of methods commonly used to physically characterize biopolymers will be discussed. Interpretation and limitations of measured values of various physical parameters will be stressed. Particular emphasis will be given to the experimental design and interpretation of the data obtained which will yield the maximum amount of information. Swaisgood

FS (NTR) 606 Vitamin Metabolism. *2(2-0) F.* (See nutrition.)

FS 690 Seminar in Food Science. *1(1-0) F,S.* Preparation and presentation of scientific papers, progress reports and research and special topics of interest in foods.
Graduate Staff

FS 691 Special Research Problems in Food Science. *Credits Arranged. F,S,Sum.* Directed research in a specialized phase of food science designed to provide experience in research methodology and philosophy. Graduate Staff

FS 699 Research in Food Science. *Credits Arranged. F,S,Sum.* Original research preparatory to the thesis for the Master of Science or Doctor of Philosophy degree.
Graduate Staff

Foreign Languages and Literatures

GRADUATE FACULTY

Professor J. H. Stewart, *Head*

Professors: G. F. Gonzalez, J. R. Kelly, M. Paschal, G. G. Smith, E. M. Stack; *Professors Emeriti:* A. A. Gonzalez, G. W. Poland; *Associate Professors:* D. A. Cortes, A. C. Malinowski, E. W. Rollins Jr., M. A. F. Witt; *Associate Professor Emeritus:* H. Tucker Jr.; *Assistant Professor:* L. Mykyta

The Department of Foreign Languages and Literatures offers courses to assist graduate students in preparing to use modern foreign languages in research and advanced study. These courses are not open to undergraduates.

With special permission of the Graduate School, certification may be obtained in languages not normally taught by the department.

***FLF 401 French for Graduate Students.** *3(3-0) F.* Basic French grammar, with special attention to characteristics of formal expository style, and illustrative readings. Study of extracts from scholarly publications in the students' areas of research. Graduate language certification granted on satisfactory completion of the course.

***FLG 401 German for Graduate Students.** *3(3-0) F.* Basic German grammar, with special attention to characteristics of formal expository style, and illustrative readings. Study of extracts from scholarly publications in the students' areas of research. Graduate language certification granted on satisfactory completion of the course.

***FLS 401 Spanish for Graduate Students.** *3(3-0) F.* Basic Spanish grammar, with special attention to characteristics of formal expository style, and illustrative readings. Study of extracts from scholarly publications in the students' areas of research. Graduate language certification granted on satisfactory completion of the course.

*These courses are designed to be audited and credits do not apply toward advanced degrees.

Forestry

GRADUATE FACULTY

Professor A. W. Cooper, *Head*

Professor D. L. Holley Jr., *Graduate Administrator*

Professors: D. A. Adams, E. B. Cowling, C. B. Davey, H. A. Devine, P. D. Doerr, M. H. Farrier, E. C. Franklin, D. J. Frederick, L. F. Grand, W. L. Hafley, F. P. Hain, A. E. Hassan, R. C. Kellison, S. Khorram, L. A. Nelson, R. L. Noble, T. O. Perry, L. C. Saylor, R. R. Sederoff, A. L. Sullivan, R. R. Wilkinson, A. G. Wollum II; *Professor (USDA):* D. E. Moreland; *Professors (USFS):* F. E. Bridgwater Jr., G. Namkoong; *Adjunct Professors:* G. F. Dutrow, J. D. Hair, A. Krochmal, C. G. Wells; *Professors Emeriti:* J. W. Duffield, J. O. Lammi, W. D. Miller, R. J. Preston, B. J. Zobel; *Associate Professors:* H. L. Allen Jr., H. V. Amerson, R. I. Bruck, J. D. Gregory, L. E. Hinesley, J. B. Jett Jr., J. G. Laarman, R. A. Lancia, R. Lea, R. R. Perdue, R. A. Powell, D. H. J. Steensen, R. J. Weir, J. N. Woodman; *Adjunct Associate Professors:* G. L. DeBarr, J. R. Jorgensen, R. W. Stonecypher; *Assistant Professors:* R. R. Braham, L. J. Frampton Jr., S. E. McKeand, J. P. Roise, R. L. Sanford Jr., A.-M. Stomp; *Assistant Professor (USFS):* J. E. de Steiguer; *Adjunct Assistant Professors:* D. L. Bramlett, R. G. Campbell, W. E. Ladrach, R. B. McCullough, H. D. Smith; *Research Associate:* W. S. Dvorak

The Department of Forestry offers graduate work leading to the degrees of Master of Forestry, Master of Science and Doctor of Philosophy. Because of the diversity of disciplines and the wide range of opportunities in forestry, each of these degrees allows considerable flexibility in developing programs of graduate study tailored to the student's objectives. In addition, graduate students in the Department of Forestry may pursue three interdisciplinary graduate degrees: Master of Wildlife Biology, Master of Science in wildlife biology and Master of Science in ecology.

The Master of Forestry is a professional degree designed to broaden and extend knowledge in the scholarly disciplines of forestry. The program emphasizes course work and application of principles. A thesis is not required. Two options are available: one requires 36 hours of course work and the other requires 30 hours plus a special project.

The Master of Science degree emphasizes training and experience in research. This degree typically leads to specialization in one of the disciplines of forestry. Requirements include 30 hours of course work and a thesis.

The Doctor of Philosophy degree is available to students who demonstrate outstanding intellectual capacity and the ability to conduct original research and scholarly work at the highest levels. There is no foreign language requirement and no specific credit hour requirement; however, the student's advisory committee will insist on a rigorous and appropriate program of study and research.

All applicants for graduate study in forestry must take the Graduate Record Examination and submit scores as part of their application. Students not holding an undergraduate degree in forestry may be admitted for graduate study, but they must lengthen their programs to obtain appropriate background courses in forestry.

The department offers graduate instruction in all of the major areas of forestry. The faculty has professional expertise and on-going research in the following areas: biometrics, biotechnology and pine tissue culture, botany, computer applications, ecology, economics, engineering, entomology, environmental impact assessment, forest management, genetics and tree breeding, hydrology and watershed management, international development, landscape architecture, operations research, plant pathology, remote sensing and computer mapping, resource planning and administration, silviculture, soils and fertilization, wildlife biology, and wildlife management. Strong supporting departments on campus increase opportunities for broad and thorough training. Relationships with these departments are strengthened by many joint and associate faculty appointments. In addition, an adjunct faculty of 12 distinguished scientists and practitioners working in industry and government are available to serve on student advisory committees.

Facilities for forest biological research include a phytotron, greenhouses and a small experimental nursery. The experimental and production forests of the School total more than 80,000 acres. The Hofmann Forest on the Coastal Plain, the Goodwin Forest in the Sandhills, and the Schenck, Hope Valley and Hill Forests in the Piedmont provide a variety of forest types and problems in the management of timber, water, wildlife and recreational resources.

The department has formal research ties with forest industry and public agencies through its four research and development cooperatives (Tree Improvement, Hardwood Research, Forest Nutrition and Central America and Mexico Coniferous Resources), the Small Woodlot Research and Development Program, and the College's Forest Biology Research Center (which administers major projects on tissue culture, site productivity, and gene transfer mechanisms in loblolly pine). Much of the department's research is conducted on forest industry lands in the Southeast.

Inquiries concerning graduate study should be directed to the Graduate Administrator, Department of Forestry, Box 8002, North Carolina State University, Raleigh, NC 27695-8002.

SELECTED ADVANCED UNDERGRADUATE COURSES

FOR 401 Forest Hydrology and Watershed Management. *Preq.: SSC 200. 4(3-3) F.*

FOR (FW) 404 Forest Wildlife Management. *Preqs.: BS 100 or equivalent plus 8 hours of biological sciences; advanced undergrad. or grad. student. 3(3-0) S.*

FOR 405 Forest Management. *Preqs.. FOR 319, 374; Coreq.: FOR 434. 4(2-4) F.*

FOR 406 Forest Inventory, Analysis and Planning. *Preqs.: FOR 273, 353, 405, ST 312. 4(0-16) S.*

FOR 411 Forest Tree Improvement. *Preq.: Jr. or sr. standing in FOR. 3(3-0) S.*

FOR 412 Forest Types of the Southeast. *Preq.: FOR 212. 2(1-3) S.*

FOR 422 Consulting Forestry. *Preq.: Sr. standing in forestry. 3(3-0) F.*

FOR (WPS) 423 Forest Machinery and Systems. *Preq.: Jr. standing in FOR, WST or BAE. 3(2-3) F.*

FOR (WPS) 434 Decision Making in Forestry and Wood Products. *Preqs.: FOR (WPS) 273, MA 113 and 114. 3(3-0) F.*

FOR 472 Renewable Resource Policy and Management. *Preq.: Jr. standing. 4(3-2) S.*

FOR 491 Senior Problems in Forestry. *Preq.: Consent of department. 1-6.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

FOR 510 Quantitative Forest Genetics Methods. *Preqs.: GN 506, ST 512. 3(3-0) F. Alt. yrs.* Fundamental principles and procedures for part.tioning experimental variance, estimating parameters of interest from different mating schemes and experimental designs and their uses in making tree breeding decisions. Bridgwater

FOR 511 Tree Improvement Research Techniques. *Preq.: FOR 411 or GN 411. 3(1-4) S. Alt. yrs.* Research methods involved in forest tree breeding and genetics programs. Emphasis is placed on laboratory, greenhouse and field research techniques. Summary and presentation of research results are also stressed. Jett, Zobel

FOR 512 Forest Economics. *Preq.: Basic course in economics. 3(3-0) S.* Economics applied to problems in forest management, including timber demand and supply models, optimal rotation length, benefit-cost analysis of forestry projects, impacts of forest taxation and consideration of non-market forest goods and services. Laarman

FOR (PP) 518 Advanced Forest Pathology. *3(3-0) Alt. F.* (See plant pathology.)

FOR 534 Advanced Forest Management Planning. *Preq.: FOR 405 or FOR 434 or OR 501; Coreq.: FOR 572A. 3(3-0) S. Alt. yrs.* History, principles, structures and use of modern forest management planning and decision-making techniques. Emphasis on optimization procedures and public forest management. Roise

FOR (ENT) 565 Advanced Forest Entomology. *3(2-2) S.* (See entomology.)

FOR 571 Advanced Topics in Growth and Yield. *Preqs.: FOR 272, ST 312. 3(3-0) S.* Development and application of site index, volume and forest yield models. Primary emphasis is on underlying biological and mensurational assumptions and their impact on application. Hafley

FOR 572A,B Forest Management Policies on the Public Lands. *2(2-0) S. Alt. yrs.* History, development and current status of policies relating to forest management on the public lands. FOR 572A deals with history and policies through passage of the National Forest Management Act. FOR 572B deals with current issues. Students may enroll in either FOR 572A or FOR 572A and FOR 572B but not FOR 572B alone. Cooper

FOR 580 Soil-Machine Interactions in Forestry Operations. *Preq.: FOR 423. 3(3-0) F. Alt. yrs.* Mechanics of interactions between forestry soils and tillage and traction devices; determination of relevant physical properties of soil; analyses of stresses and strains in soil due to machine-applied loads; experimental and analytical methods for synthesizing characteristics of overall systems. Hassan

FOR (UNI) 584 The Practice of Environmental Impact Assessment. *4(0-8) F. Alt. yrs.* Students (in teams) inventory natural resources in a large watershed, predict development at year 2000, analyze impact upon the natural resource base and compile results as an environmental impact assessment. Techniques include map and aerial photo interpretation, timber and wildlife habitat inventory, erosion estimation, curve fitting, technical writing, computer modeling and project organization and management. Adams

FOR (FW) 585 Advanced Wildlife Habitat Management. *Preqs.: ZO (FW) 553 and ZO (FW) 554. 3(2-3) S. Alt. yrs.* Assessing and modeling habitat capability for wildlife species

are discussed and evaluated. Students will develop models of habitat requirements for wildlife species and will integrate the models into wildlife management plans. Laboratory exercises include manipulation of habitat management computer packages and development of a wildlife management plan using computer cartographic techniques. Lancia

FOR 592 Special Topics in Forestry. *Credits Arranged. F,S,Sum.* Individual students or groups of students, under the direction of a faculty member, may explore topics of special interest not covered by existing courses. Format may consist of readings and independent study, problems or research not related to thesis. Also used to develop and test new 500-level courses. Graduate Staff

FOR 593 Colloquium on Tropical Forestry. *1(1-0) S.* Overview of tropical forest resources emphasizing biological, economic and social issues. Concepts and case studies covering ecological, silvicultural, cultural and socio-economic principles. Graduate Staff

FOR (FW) 594 Seminar in Wildlife Management. *1(1-0) S. Alt. yrs.* Current topics and issues in wildlife biology and management will be discussed. Students will select and research topics, give seminars and lead group Lancia

FOR GRADUATES ONLY

FOR 601 Advanced Hydrology. *Preqs.: FOR 401, ST 512. 3(3-0) S. Alt. yrs.* The physical concepts of water movement through the hydrologic cycle and interactions with ecosystem components are discussed. Mathematical approaches to characterizing and quantifying hydrologic processes are derived and applied to problem solutions. Experimental design and statistics needed for collecting and analyzing hydrologic data are discussed and utilized. Development and use of simulation models are considered. Gregory

FOR (GN) 611 Forest Genetics. *Preq.: GN 411 or CI. 3(3-0) S.* Application of genetic principles to silviculture, management and wood utilization. Emphasis is on variation in wild populations, the bases for selection of desirable qualities and fundamentals of controlled breeding. McKeand, Zobel

FOR (GN) 612 Advanced Topics in Quantitative Genetics. *Preqs.: GN (FOR) 611, GN (ST) 626 or GN (ANS) 603 or CI. 3(3-0) F. Alt. yrs.* Advanced topics in statistics and population genetics pertinent to current research problems in genetics with special applications to forestry. Basic statistical and genetic theory is reviewed as bases for intensive study of selection theory and experimental and mating design evaluation. The genetics of natural populations are studied for evolutionary interest as well as for their implications to breeding theory. Namkoong

FOR 613 Special Topics in Silviculture. *Preq.: FOR 304. 3(3-0) F.* Critical examination of selected silvicultural topics, with special emphasis on concepts and phenomena which distinguish forests from other biotic communities and silviculture from other fields of applied biology. Emphasis is on intensive silviculture in the United States and selected international locations. A written research proposal is a course requirement. Frederick

FOR 614 Advanced Topics in Administration of Forest Resources. *Preq.: FOR 613. 3(3-0) S.* State-of-the-art practices for administering commercial forest lands are explicitly detailed for advanced forestry graduate students. The economics of intensive and extensive management, the effect of management policies on timber yields and the financial stability of the forest industry are set forth using governmental and industrial perspectives. Kellison, Lea

FOR 672 Current Issues in Natural Resource Policy. *2(2-0) S. Alt. yrs.* Discussion of the current and historical dimensions of major natural resource policy issues, including water and air pollution control, land use planning, public works development projects, wilderness, hazardous waste disposal and land preservation. Adams, Cooper, Devine

FOR (SSC) 673 Forest Productivity: Edaphic Relationships. *Preqs.: BO (ZO) 560, SSC 532. 3(2-3) S. Alt. yrs.* An advanced consideration of forest productivity; edaphic and other environmental factors influencing productivity; and the influence of forest management practices on forest soil properties and processes. Allen

FOR 689 Seminar in Forest Research. *Preq.: Grad. standing. 1(1-0) F.* Philosophy and objectives of scientific research and the steps in the research process. Basic and applied research, inductive and deductive reasoning and the need for hypothesis development and testing as a basis for scientific research. Special emphasis on the preparation of study plans, graduate theses, published articles and technical presentations. Franklin

FOR 691 Graduate Seminar. *1(1-0) F,S,Sum.* Weekly seminar in which students registered for the course present the results of research and special projects. All graduate students and faculty in the department are invited to attend and join the discussion. Graduate Staff

FOR 692 Advanced Topics in Forestry. *Credits Arranged. F,S,Sum.* Individual students or groups of students, under the direction of a faculty member, may explore topics of special interest not covered by existing courses. Format may consist of readings and independent study, problems or research not related to dissertation. Also used to develop and test new 600-level courses. Graduate Staff

FOR 699 Research in Forestry. *Credits Arranged. F,S,Sum.* Individual research, under faculty supervision, that will furnish material for a thesis or dissertation. Graduate Staff

Genetics

GRADUATE FACULTY

Professor W. R. Atchley, *Head*

Professors: G. C. Bewley, W. D. Hanson, W. E. Kloos, C. S. Levings III, D. F. Matzinger, W. H. McKenzie, R. H. Moll, J. G. Scandalios, A. C. Triantaphyllou; *Professor (USDA):* C. W. Stuber; *Professor (USFS):* G. Namkoong; *Adjunct Professor:* M. D. Chilton; *Professors Emeriti:* C. H. Bostian, D. S. Grosch, T. J. Mann, L. E. Mettler; *Associate Professors:* T. H. Emigh, S. L. Spiker; *Assistant Professors:* M. A. Conkling, S. E. Curtis

ASSOCIATE MEMBERS OF THE DEPARTMENT

Professors: J. L. Apple, F. B. Armstrong, C. C. Cockerham, E. J. Eisen, D. A. Emery, M. M. Goodman, C. L. Markert, B. T. McDaniel, T. O. Perry, J. O. Rawlings, O. W. Robison, L. C. Saylor, H. E. Schaffer, W. F. Thompson, D. H. Timothy, B. S. Weir, E. A. Wernsman; *Professors Emeriti:* J. F. Chaplin, E. W. Glazener, F. L. Haynes, J. E. Legates, L. L. Phillips

Graduate study under the direction of the genetics faculty may enable the student to qualify for the Master of Science or the Doctor of Philosophy degrees. A candidate for the master's degree must acquire a thorough understanding of genetics and its relation to other biological disciplines and must present a thesis

based upon one's own research. In addition to a comprehensive knowledge of his or her field, a candidate for the doctorate must demonstrate a capacity for independent investigation and scholarship in genetics.

At North Carolina State University there are no sharp divisions along departmental lines or between theoretical and applied aspects of genetics research. The members and associate members of the genetics faculty are located in six different departments of the Schools of Agriculture and Life Sciences, Forest Resources and Physical and Mathematical Sciences. They are studying a wide range of genetic problems and are utilizing not only the "classic" laboratory materials (maize, bacteria, *Drosophilia*, tobacco, mice), but also farm animals and agricultural and forest plants of the region. A student has, therefore, a wide choice of research problems in any of the following fields: cytology and cytogenetics, microbial and biochemical genetics, molecular and developmental genetics, evolution and speciation, quantitative and population genetics and the application of genetics to breeding methodology.

Departmental offices and laboratories are located in Gardner Hall with greenhouse facilities adjacent to the building. A genetics garden for use in intensive research with plants and teaching functions is located three miles from the offices. The departmental staff and the associate faculty members in animal science, biochemistry, crop science, horticultural science, plant pathology, statistics and the School of Forest Resources are fortunate in being able to draw upon the extensive facilities of the North Carolina Agricultural Research Service.

SELECTED ADVANCED UNDERGRADUATE COURSES

GN 411 The Principles of Genetics. *Preqs.: BS 100, jr. standing. 3(3-0) F,S.*

GN 412 Elementary Genetics Laboratory. *Preq. or coreq.: GN 411. 1(0-2) F,S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

GN 504 Human Genetics. *Preq.: GN 301 or 411 or equivalent. 3(3-0) F.* The basic principles needed for an understanding of the genetics of man. Current knowledge and important areas of research in human genetics. McKenzie

GN 505A,B,C,D Genetics I. *Preq.: GN 411. 1-4 F.* Principles presented as a series of five-week minicourses: GN 505A, molecular genetics; GN 505B, biochemical genetics; GN 505C, developmental genetics. The laboratory, GN 505D, involves experimental techniques in genetics and extends throughout the semester. Majors and minors must enroll for the entire course. Others may enroll for specific minicourses and attend the first lecture of semester for schedule. Graduate Staff

GN 506A,B,C Genetics II. *Preq.: GN 411; Coreq.: ST 511. 1-3 S.* Principles presented as a series of five-week minicourses: GN 506A, population genetics; GN 506B, quantitative genetics; GN 506C, cytogenetics. Majors and minors must enroll for the entire series. Others may enroll for specific minicourses and attend the first lecture of the semester for schedule. Graduate Staff

GN (ANS) 508 Genetics of Animal Improvement. *3(3-0) S.* (See animal science.)

GN (PO) 520 Poultry Breeding. *3(2-2) S.* (See poultry science.)

GN (ZO) 540 Evolution. *Preq.: Nine credits in biological sciences. 3(3-0) S.* The nature of organic evolution is explored by examining the types of evidence that allow reconstruction of the history of life on earth as well as experimental and descriptive evidence regarding the mechanisms of genetic change in populations. Graduate Staff

GN (CS, HS) 542 Plant Breeding Field Procedures. *2(0-4) Sum.* (See crop science.)

GN (CS) 545 Origin and Evolution of Cultivated Plants. *2(2-0) S.* (See crop science.)

GN (BO, CS, HS) 547 Cell and Tissue Techniques in Plant Breeding. *3(1-4) F. Alt. yrs.* (See crop science.)

GN 555 Population Genetics. *Preqs.: GN 506A, MA 102. 3(3-0) S. Alt. yrs.* Theoretical population genetics and its relationship to natural and experimental populations. Topics include: single locus and multilocus systems, history of a gene in a population, diffusion approximations, suitability of models to natural and experimental populations. Emigh

GN 560 Molecular Genetics. *Preqs.: GN 411; BCH 451. 3(3-0) F.* A discussion of the structure and function of the genetic material at a molecular level. Both prokaryotic and eukaryotic systems will be considered. The aim will be to describe genetics in terms of chemical principles. Spiker

GN (BCH) 561 Biochemical and Microbial Genetics. *Preqs.: BCH 451 or 551, GN 411 or 505, MB 401 or equivalent. 3(3-0) S.* A study of the development of the fields of biochemical and microbial genetics, emphasizing both techniques and concepts currently used in molecular research. Includes lectures and discussions of current research publications. Armstrong

GN 567 Molecular Cytogenetics. *Preq.: GN 505 or equivalent. 3(3-0) F. Alt. yrs.* A molecular-genetic analysis of the structure function and evolution of eukaryotic genomes. Current methodology and approaches will be discussed, including DNA sequence analysis, chromosomal proteins, specific repeated genes, transposable elements in eukaryotic systems, structure and evolution of organelle genomes and use of recombinant DNA techniques in studies of chromosome structure. Graduate Staff

FOR GRADUATES ONLY

GN (ANS) 603 Population Genetics in Animal Improvement. *3(3-0) F.* (See animal science.)

GN (FOR) 611 Forest Genetics. *3(3-0) S.* (See forestry.)

GN (FOR) 612 Advanced Topics in Quantitative Genetics. *3(3-0) F.* (See forestry.)

GN (CS, HS) 615 Quantitative Genetics in Plant Breeding. *1(1-0) S. Alt. yrs.* (See crop science.)

GN (CS, HS) 616 Breeding Methods. *2(2-0) S. Alt. yrs.* (See crop science.)

GN (CS, HS) 617 Nonconventional Plant Breeding. *1(1-0) F. Alt. yrs.* (See crop science.)

GN (CS, HS, PP) 618 Breeding for Pest Resistance. *2(2-0) F. Alt. yrs.* (See crop science.)

GN (ST) 626 Statistical Concepts in Genetics. *3(3-0) S.* (See statistics.)

GN 641 Colloquium in Genetics. *Preqs.: Grad. standing; CI. 2(2-0) F,S.* Informal group discussion of prepared topics assigned by the instructor. Graduate Staff

GN 650 Developmental Genetics. *Preq.: GN 505. 3(3-0) S. Alt. yrs.* The action and regulation of genes and gene-products in development and differentiation. Examples will be taken from microorganisms, plants and animals. Emphasis will be placed on molecular and biochemical aspects of mechanisms controlling gene expression in eukaryotic cell differentiation. Curtis

GN 651 Somatic Cell Genetics. *Preqs.: GN 505; BCH 451. 3(3-0) S. Alt. yrs.* Discussion of the use of non-germ line cells for the genetic analysis of eukaryotic organisms. Plant, animal and fungal systems will be considered. Topics include: mutagenesis, selection, cell fusion, parasexual cycles, cloning, genetic engineering and regeneration of whole organisms. Spiker

GN (BCH) 658 Nucleic Acids: Structure and Function. *3(3-0) F. Alt. yrs.* (See biochemistry.)

GN (MB) 660 Experimental Microbial Genetics. *4(2-6) F.* (See microbiology.)

GN 666 Laboratory in Molecular Genetics. *Preqs.: GN 505 or equivalent and CI. 4(2-6) S. Alt. yrs.* A laboratory course in modern techniques of molecular genetics for advanced students. Techniques will include *in situ* hybridization, recombinant DNA methodology, and DNA sequencing. Enrollment is limited to 12 students. Applications for a place in the course may be obtained from the department. Conkling

GN 691 Seminar. *Preq.: Grad. standing. 1(1-0) F,S.* Graduate Staff

GN 694 Selected Topics in Cytogenetics. *Preqs.: GN 506 or CI. 2(2-0) F,S.* Readings and discussions of original cytogenetic literature. Chromosome replication, DNA redundancy, heterochromatin, models of crossing over and somatic cell genetics are some of the areas included. Topics of special interest to class members will also be covered. Graduate Staff

GN 695 Special Problems in Genetics. *Preqs.: Advanced grad. standing, CI. 1-3 F,S.* Special topics designed for additional experience and research training. Graduate Staff

GN 699 Research. *Preqs.: Grad. standing, permission of adviser. Credits Arranged.* Original research related to the student's thesis problem. A maximum of six credits for the master's degree; by arrangement for the doctorate. Graduate Staff

Graduate School Registrations (GR)

For information regarding these registrations, see Special Registration and Fees.

History

GRADUATE FACULTY

Professor A. J. DeGrand, *Head*

Associate Professor J. R. Banker, *Assistant Head*

Professor W. C. Harris, *Graduate Administrator*

Professors: B. F. Beers, W. H. Beezley, C. H. Carlton, M. S. Downs, J. P. Hobbs, D. E. King, A. J. LaVopa, L. O. McMurry, J. M. Riddle, R. H. Sack, E. D. Sylla, B. W. Wishy; *Professors Emeriti:* M. L. Brown Jr., R. W. Greenlaw, M. E. Wheeler; *Associate Professors:* J. A. Mulholland, G. D. Newby, G. W. O'Brien, J. K. Ocko, S. T. Parker, R. W. Slatta, J. D. Smith, K. P. Vickery, K. S. Vincent; *Associate Professor Emeritus:* R. N. Elliott; *Assistant Professors:* J. E. Crisp, D. P. Gilmartin, S. A. Glenn, W. A. Jackson III, W. C. Kimler, S. L. Spencer, G. D. Surh; *Adjunct Assistant Professors:* W. S. Price Jr., H. K. Steen

ASSOCIATE MEMBER OF THE DEPARTMENT

Assistant Professor: J. C. Bonham

The history department offers programs leading to the Master of Arts degree in history and Master of Arts degree in archival management. Although no specific courses are stipulated for admission to the programs, preference will be given to those students with at least 18 hours in history and a total of 30 hours in the social sciences. Candidates are expected to have taken the aptitude portion of the Graduate Record Examination, or if admitted provisionally, must do so before the end of their first semester. Candidates are requested to include brief statements of their objectives in entering the programs along with their applications.

Normally a degree candidate for a Master of Arts in history will concentrate work in either European or American history with the required total of 30 hours being made up of nine to twelve hours of course work at the 500 level or above; six hours of research seminar (600 level); up to six hours of research and preparation of thesis (600 level); and six to nine hours of course work in a field related to the candidate's area of concentration (500 or 600 level). Under special circumstances a candidate may be permitted to include a 400-level course (see undergraduate catalog for descriptions) in his or her program if it has particular relevance to one's program objectives. Social studies teachers may be awarded G certification through completion of a degree with a major in history and a minor in education.

The Master of Arts in archival management requires thirty-six hours of courses, including two three-hour practicums in lieu of the thesis. Half of the course hours fall in historical studies, the rest in archival management. One practicum places the student under the direct supervision of the State Archivist of North Carolina. Students may select the other areas of interest—college archives, history sites administration, museology, historical preservation or others.

One fellowship, one graduate scholarship and three teaching assistantships are now offered. Inquiry should be addressed to the graduate administrator.

North Carolina State University is a member of the Folger Institute of Renaissance and Eighteenth-Century Studies, a unique collaborative enterprise sponsored by the Folger Shakespeare Library in Washington, D.C., and twenty universities in the Middle Atlantic region. Each year the Institute offers an interdisciplinary program in the humanities—seminars, workshops, symposia, colloquia and lectures. Admission is open to faculty and students of North Carolina State University, and a limited number of fellowships are available through the Campus Folger Institute Committee.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

NOTE: Prerequisite: (500 level) Six hours of advanced history or equivalent.

HI 509 The High Middle Ages. *Credit in both HI 409 and HI 509 is not allowed. 3(3-0).* An analysis of various aspects of medieval culture for the period 936-1250. Selected topics will be examined using source readings in such subjects as the revival of the Roman Empire, monastic and papal reform, the rise of uni&$.ver&$.si&$.ties, the evolution of representative bodies, the Gothic style, troubadour and goliardic poetry, scholasticism and the revival of Roman law. Riddle

HI 515 Revolutionary Europe. *Credit in both HI 415 and HI 515 is not allowed. 3(3-0).* A broadly based analysis of Europe's first revolutionary era. Topics covered are the Enlightenment and its impact, the causes and character of the Revolution in France and the impact of these events in France and Europe. Luria

HI 516 European Society and Culture in the Eighteenth Century. *Credit in both HI 419 and HI 519 is not allowed. 3(3-0).* Study of social traditions and change in Western Europe in the 18th century. Population growth and its effects, changes in lower and middle class family life, evolution of experience and perception of poverty, types of popular protest. LaVopa

HI 518 Fascism in Germany and Italy, 1919-45. *Credit in both HI 418 and HI 518 is not allowed. 3(3-0).* Hitler and Mussolini: two aspects of European fascism. DeGrand

HI 519 Modern European Imperialism. *Credit in both HI 419 and HI 519 is not allowed. 3(3-0).* Historical background of European Colonialism. Its influence on modern independence movements and major power foreign policy. Third World concept in international relations. Gilmartin

HI 520 European Diplomatic History. *Preq.: Three hours of HI. Credit in both HI 420 and HI 520 is not allowed. 3(3-0).* Survey of major issues and events in European international relations; Congress of Vienna, 1815, to defeat of Axis powers and origins of Cold War in 1945. DeGrand

HI 528 England in the Age of the American Revolution. *3(3-0).* An intensive study of English political, religious, economic, social and imperial ideas and institutions between 1763 and 1783 with special emphasis on how these affected and were affected by the War of the American Revolution. Downs

HI 539 History of the Soviet Union. *Credit in both HI 439 and HI 539 is not allowed. 3(3-0).* History of the Soviet Union from the revolutions of 1917 to the present, emphasizing political, economic and cultural developments that have molded the Soviet state and society. Attention is also given to foreign policy with emphasis on the position of the Soviet Union in the world since 1945. Surh

HI 542 The United States: Revolution to Constitution. *Credit in both HI 442 and HI 542 is not allowed. 3(3-0).* The conflict with Great Britain after 1763 leading to the declaring of independence; the war for American independence; the political, social and ideological problems in establishing the government of the new nation. Graduate Staff

HI 546 Civil War and Reconstruction. *Credit in both HI 446 and HI 546 is not allowed. 3(3-0).* A study of the period of sectional strife, war and reconstruction, including a close examination of the sectional polarization of the 1850s, the impact of the war on both northern and southern societies and the trauma of reconstructing the Union. Harris

HI 554 History of U. S. Foreign Relations, 1900-Present. *Credit in both HI 454 and HI 554 is not allowed. 3(3-0).* American diplomatic history since 1900; the expansion of American economic and cultural relations; the evolution of the American foreign policy bureaucracy; and the historical forces and personalities that shaped American relations with other nations. Beers

HI 557 U. S. Social History Methods. *Credit in both HI 457 and HI 557 is not allowed. 3(3-0).* Introduction to U. S. social history. Survey of methodologies, quantification, social science theory, comparative analysis, with application to in-depth investigation of selected themes, including demography, class, ethnicity, labor, race and sex. O'Brien

HI 561 Civilization of the Old South. *Credit in both HI 461 and HI 561 is not allowed. 3(3-0).* The distinctive features of the Old South as part of the regional development of the United States. Colonial factors in the making of the South, development of the plantation system and slavery, Southern social order, intellectual and cultural life, economic development and rise of Southern nationalism. Crisp, Smith

HI 565 The History of Urban Life in the U.S., 1607-1865. *Credit in both HI 465 and HI 565 is not allowed. 3(3-0).* The historical background of today's urban problems. King

HI 566 The History of Urban Life in the U.S., 1865-Present. *Credit in both HI 466 and HI 566 is not allowed. 3(3-0).* The historical background of today's urban problems. King

HI 569 Latin American Revolutions in the Twentieth Century. *Credit in both HI 469 and HI 569 is not allowed. 3(3-0).* The varieties of revolutionary changes in twentieth-century Latin American revolutions: Argentina, Bolivia, Peru, Cuba and Chile. Beezley, Slatta

HI 576 Leadership in Modern Africa. *Credit in both HI 476 and HI 576 is not allowed. 3(3-0).* The conditions under which 20th century African leaders have obtained and exercised power. Case studies of prominent leaders, both radicals, reactionaries, democrats and tyrants, such as Nkrumah, Kenyatta, Nyerere, Amin, Cabral, Vorster and Senghor. Vickery

HI 580 Scientific Revolution: 1300-1700. *Credit in both HI 480 and HI 580 is not allowed. 3(3-0).* Factors behind dramatic scientific changes of the seventeenth century. Role of mathematics and experiment. Interaction of the new science with trends in philosophy, religion, alchemy, magic, medicine and with institutional educational, political, economic and technological factors. Sylla

HI 581 History of Life Sciences. *Credit in both HI 481 and HI 581 is not allowed. 3(3-0).* Surveys the major ideas, methods, institutions and individuals that have contributed to the biological sciences from antiquity to modern times and examines the connections between the life sciences and other aspects of culture, including the physical sciences, religious belief, medical practice and agriculture. Students in the History of Life Sciences will read original sources and historical monographs concerning those topics. Kimler

HI 585 Principles and Practice of Applied History. *Preqs.: Grad. standing; 6 hours of history or equivalent. Credit in both HI 485 and HI 585 is not allowed. 3(3-0).* An introduction to applications of history to public life and to the conservation and presentation of historical materials, with particular attention to conservation problems generated by modern technology. Topics include archives, records management, historical editing, museology, historical preservation, special forms of presentation like historic sites and audiovisual techniques and computer applications. Smith

HI 586 History and Principles of the Administration of Archives and Manuscripts. *Credit in both HI 486 and HI 586 is not allowed. 3(3-0).* Nature, importance and use of original manuscript resources; the history and evolution of written records and the institutions administering them; the principles and practices of archives administration. Olson

HI 587 Application of Principles of Administration of Archives and Manuscripts. *Preqs.: Six hours of advanced history and HI 586. Credit in both HI 487 and HI 587 is not allowed. 3(3-0).* Internship training in the application of the principles and practices of archival management as developed in HI 586. Olson

FOR GRADUATES ONLY

NOTE: Prerequisite: (600 level) Six hours of advanced history or equivalent.

HI 601 Historiography and Historical Method. *3(3-0).* A study of the major steps in the development of historical investigation; analysis of elements of historical research; discussion of methodology and archival materials used by the contemporary scholarly historian. Graduate Staff

HI 602 Historical Writing. *Preq.: Grad. standing or PBS status. 3(3-0).* Critical studies in the methods and practice of contemporary historical writing. Graduate Staff

HI 685 Independent Study. *Preq.: Grad. standing or PBS status. 1-6.* Individualized study conducted under supervision of graduate faculty. Letter grades (ABCD/NC). Course of study, assigned readings, course projects or papers, and methods of evaluating work to be detailed in writing and approved by department head. Graduate Staff

HI 688 Iconographic and Other Archival Materials. *Preq.: HI 485/585. 3(2-2).* Introduction to archival materials. Examination of and practice in the storage and care of paper and books, prints, engravings and maps. Films, transparencies, negatives, magnetic tapes and phonorecords. Emphasis on preventive conservation. Mulholland, Smith

HI 689 Documentary Editing. *Preq.: HI 485/585. 3(3-0).* An introduction to the field of documentary editing. Development of historical editing and the rules of literal, expanded and modern editorial method. Special documentary/papers projects. Crow, Smith

HI 691 Practicum in Applied History. *Preq.: HI 601, 602, 685. 1-6.* Supervised internship experience in an archival management and/or applied history. Graduate Staff

HI 699 Research in History. *Credits Arranged. 1-6.* Individual research under graduate thesis supervisor. Graduate Staff

Horticultural Science

GRADUATE FACULTY

Professor A. A. De Hertogh, *Head and Graduate Coordinator*

Professors: F. A. Blazich, W. W. Collins, T. R. Konsler, R. A. Larson, J. W. Love, C. M. Mainland, C. H. Miller, T. J. Monaco, P. V. Nelson, D. M. Pharr, J. C. Raulston Jr., D. C. Sanders, W. A. Skroch, C. R. Unrath, L. G. Wilson; *Adjunct Professor:* R. L. Sawyer; *Professors Emeriti:* W. E. Ballinger, F. D. Cochran, F. L. Haynes, J. M. Jenkins, D. T. Pope; *Associate Professors:* J. R. Ballington, T. E. Bilderback, P. R. Fantz, W. C. Fonteno III, R. G. Gardner, W. R. Henderson, L. E. Hinesley, W. E. Hooker, M. M. Peet, K. B. Perry, E. B. Poling, T. C. Wehner, D. J. Werner, E. Young; *Associate Professors Emeriti:* T. F. Cannon, D. C. Zeiger; *Assistant Professors:* S. M. Blankenship, A. R. Bonanno, R. G. Goldy, S. L. Warren, K. M. Williams; *Lecturer:* M. E. E. Traer

ASSOCIATE MEMBERS OF THE DEPARTMENT

Professors: D. E. Carroll Jr., R. J. Downs, R. H. Moll, R. L. Mott; *Professor Emeritus:* R. Aycock

Graduate study under the direction of the horticultural science faculty may lead to the Master of Science and the Doctor of Philosophy degrees. Areas of study include plant physiology, plant breeding and genetics, post-harvest physiology, agricultural meteorology, plant nutrition, tissue culture, growth regulators and weed science. The Master of Agriculture, a professional degree, can be earned by substituting additional course work for research requirements of graduate study.

Facilities for graduate studies on the Raleigh campus include a 30,000 square-foot greenhouse (21 sections, each with separately controlled light and temperature); the University Phytotron (available for controlled environmental studies on horticultural crops); 19 well-equipped laboratories (chromatography, seed handling and storage, cytological/anatomical, radioisotope, tissue culture, post-harvest and nutritional studies). There are 14 controlled temperature storage rooms; an extensive collection of plant materials, both living (NCSU Arboretum) and preserved; and a variety of climates and soils from coast to mountains in North Carolina on 15 outlying research stations.

Opportunities for employment after graduate study include: teaching and research faculty positions in state and private universities; research and regulatory positions with the Departments of Agriculture, both foreign and domestic; extension specialists and county agents; research, production and promotional work with agri-business concerned with production of horticultural crops or services to horticultural industries.

Graduate teaching and research assistantships (commercial, Agricultural Foundation or N.C. Agricultural Research Service) for promising and qualified students are available. Students are encouraged to apply for assistantships at least six months prior to the anticipated enrollment date.

SELECTED ADVANCED UNDERGRADUATE COURSES

HS 400 Residential Landscaping. *Preqs.: DF 234; HS 211, 212, 342; HS 416 or DN 433; SSC 200, DN 257, 430. Seniors in the landscape area of concentration given priority. 6(0-9) F,S.*

HS 411 Nursery Management. *Preqs.: BS 100, SSC 200, jr. standing. 3(2-3) F.*

HS 416 Principles of Ornamental Planting Design. *Preqs.: HS 211, HS 212, HS 342, SSC 200, DN 234. 3(2-4) F,S.*

HS 421 Tree Fruit Production. *Preqs.: BS 100 or BO 200, SSC 200, HS 201. 3(2-3) F.*

HS 422 Small Fruit Production. *Preqs.: BS 100 or BO 200, SSC 200, HS 201. 3(2-3) S. Alt. yrs.*

HS 431 Vegetable Production I. *Preqs.: BS 100, SSC 200. 4(3-3) F.*

HS 440 Greenhouse Management. *Preqs.: BS 100, SSC 200. 3(2-3) F.*

HS 441 Floriculture I. *Preqs.: BS 100, SSC 200. 3(2-3) F.*

HS 442 Floriculture II. *Preqs.: BS 100, SSC 200. 3(2-3) S.*

HS 471 Tree and Grounds Maintenance. *Preqs.: BS 100 or BO 200; PP 315; SSC 200. 4(3-3) S.*

HS 491 Horticultural Science Seminar. *Preq.: Jr. standing in horticultural science. 1(1-0) F.*

HS 495 Special Topics in Horticultural Science. *1-6 F,S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

HS (CS) 514 Principles and Methods in Weed Science. *Preq.: CS 414 or equivalent. 3(2-2) S.* Studies on the losses caused by weeds, the ecology of weeds, biological control, basic concepts of weed management, herbicide-crop relationships and herbicide development. Introduction to greenhouse and bioassay techniques used in herbicide work and to field research techniques supplemented by laboratory and field exercises. Monaco

HS 531 Physiology of Landscape Plants. *Preq.: BO 421 or CI. 3(2-3) S.* A course designed to cover relationships of plants to landscape environments. Study of plant function, basic climatology and plant physiological principles involved in the selection, utilization and maintenance of physical landscape environments in exterior and interior ornamental landscape plantings. Raulston

HS 532 Vegetable Crop Physiology. *Preqs.: BO 421, HS 431, SSC 341. 2(2-0) F. Alt. yrs.* Physiological aspects of field and greenhouse vegetable production: germination, photoperiod, nutrition, growth regulations, fruit quality, physiological disorders, source-sink interactions, environmental physiology and physiological aspects of plant protection. Emphasis on current areas of research and the physiological implications of new production techniques. Peet

HS 534 Vegetable Crops Practicum. *Preq.: HS 431. 3(1-6) S. Alt. yrs.* Field techniques for research on vegetable production problems. Eleven all-day field trips (two overnight) are required during the period May-August. Peet

HS (CS, GN) 541 Plant Breeding Methods. *3(3-0) F.* (See crop science.)

HS (BO, CS, GN) 547 Cell and Tissue Techniques in Plant Breeding. *3(1-4) F. Alt. yrs.* (See crop science.)

HS (FS) 562 Postharvest Physiology. *Preq.: BO 421. 3(3-0) S.* A study of chemical and physiological changes that occur during handling, transportation and storage which affect the quality of horticultural crops. Consideration will be given to preharvest and postharvest conditions which influence these changes. Blankenship

HS 595 Special Topics in Horticultural Science. *Preq.: CI. 1-6 F,S,Sum.* Investigation of special theoretical problems at the 500 level in horticultural science not related to a thesis problem; new 500-level courses during the developmental phase. Graduate Staff

HS 599 Research Principles. *Preq.: CI. Credits Arranged, Maximum 6.* Investigation of a problem in horticulture under the direction of the instructor. The students obtain practice in experimental techniques and procedures, critical review of literature and scientific writing. The problem may last one or two semesters. Credits will be determined by the nature of the problem, not to exceed a total of three hours for any one problem. A written report and final oral exam required for completion of course. Graduate Staff

FOR GRADUATES ONLY

HS (CS, SSC) 614 Herbicide Behavior in Plants and Soils. *3(3-0) F.* (See crop science.)

HS (CS, GN) 615 Quantitative Genetics in Plant Breeding. *1(1-0) S. Alt. yrs.* (See crop science.)

HS (CS, GN) 616 Breeding Methods. *2(2-0) S. Alt. yrs.* (See crop science.)

HS (CS, GN) 617 Nonconventional Plant Breeding. *1(1-0) F. Alt. yrs.* (See crop science.)

HS (CS, GN, PP) 618 Breeding for Pest Resistance. *2(2-0) F. Alt. yrs.* (See crop science.)

HS 621 Methods and Evaluation of Horticultural Research. *Preq.: Grad. standing. 3(3-0) F.* Study of necessary elements for a career in horticultural research including: background and philosophy of scientific research; survey of horticultural research history and current status; research design and evaluation; photographic techniques; technical writing including project proposals, administrative reports and publications; office and personnel management. Raulston

HS 622 Mineral Nutrition in Plants. *Preqs.: BO 551, 552. 3(2-3) S. Alt. yrs.* A comprehensive study of the functional roles of nutrients essential to plant growth, their interrelationships and their mode of influence on quality indices of crops. Consideration of the complexity of mineral nutrition experimentation and evaluation of results. A detailed look at the establishment and application of foliar analysis, foliar fertilization and slow-release fertilizers. A general view of the nutrient uptake process in plants. (Offered 1986-87 and alt. years.) Nelson

HS 691 Seminar. *Preq.: Grad. standing. 1(1-0) F,S.* Required of all graduate students with a minor in horticultural science. Optional for all horticultural science graduate students. Presentation of scientific articles and special lectures. Students will be required to present one or more papers. Graduate Staff

HS 695 Graduate Topics in Horticultural Science. *Preq.: CI. 1-6 F,S,Sum.* Investigation of theoretical problems at the 600 level in horticultural science not related to a thesis problem; new 600-level courses during the development phase. Graduate Staff

HS 699 Research. *Preqs.: Grad. standing in HS, consent of advisory committee chairman. Credits Arranged.* A maximum of six credits is allowed toward the Master of Science degree; no limitation on credits in doctoral program. Original research on specific problems in fruit, vegetable and ornamental crops. Graduate Staff

Industrial and Technical Education

For a listing of graduate faculty and program information, see industrial and technical education in the education section.

Industrial Arts Education

For a listing of graduate faculty and program information, see industrial arts education in the education section.

Industrial Engineering

GRADUATE FACULTY

Professor T. J. Hodgson, *Head*

Professor R. G. Pearson, *Graduate Administrator*

Professors: R. E. Alvarez, M. A. Ayoub, R. H. Bernhard, J. R. Canada, S. E. Elmaghraby, H. L. W. Nuttle, A. L. Prak, W. A. Smith Jr.; *Professors Emeriti:* C. A. Anderson, R. W. Llewellyn; *Associate Professors:* M. G. Joost, P. J. O'Grady; *Adjunct Associate Professor:* D. C. Antonelli; *Associate Professor Emeritus:* J. J. Harder; *Assistant Professors:* J. F. Antin, M. M. Bengtson, C. T. Culbreth Jr., Y. Fathi, E. L. Fisher, R. E. King, C. B. Oldham, E. T. Sanii; *Visiting Assistant Professors:* J. E. Richards, J. Trevino; *Adjunct Assistant Professor:* J. Taheri

ASSOCIATE MEMBERS OF THE DEPARTMENT

Associate Professors: W. J. Rasdorf, R. D. Rodman

Industrial engineering is concerned with solutions to problems relating to design and control of organizational systems, such as industrial and commercial corporations, government agencies, and other institutions which provide goods or services for public consumption. Interests include the management of operations, planning and scheduling, manufacturing engineering, allocation of resources, dynamic system design, man-machine relationships, and occupational safety and health.

The department offers the degrees of Master of Science and Doctor of Philosophy. Principal areas of specialization include manufacturing systems, production systems, information systems, economic decision analysis, and ergonomics. Typical minors are taken in statistics, economics and business, computer science, artificial intelligence, psychology, operations research, and other engineering disciplines.

The M.S. degree may be taken either with or without a thesis. The thesis work for the M.S. degree may account for as many as six semester hours. For the non-thesis option a formal written report, based upon scholarly project work, is required. A departmental brochure which details the orientation and requirements for all degrees is available. No foreign language is required at the master's level, and a foreign language is optional with the student's advisory committee at the doctoral level.

The University provides access to an outstanding mainframe computer facility at the Triangle Universities Computing Center (TUCC) through conveniently located computer terminals. In addition, the department supports a VAX 11/750 and a MICROVAX II, both of which are networked campus and nationwide. Other resources include a wide range of microcomputer systems, among which are several INTEL 310 supermicrocomputers and Tektronics graphic terminals.

The manufacturing laboratory has a representative sample of basic machine tools and numerical control equipment. A number of robots exist for part handling and assembly work research. Modern material handling equipment, such as computer-controlled carousels and conveyors, and a broad range of programmable controllers are part of the manufacturing cells for research in decision support systems for flexible assembly operations and robotics issues. Facilities for ergonomics research are also excellent for the study of environmental factors, biomechanics, work physiology and human performance assessment. Finally, a laboratory for voice input-output research contains state-of-the-art equipment for research in this contemporary area of interest.

SELECTED ADVANCED UNDERGRADUATE COURSES

IE 401 Stochastic Models in Industrial Engineering. *Preq.: An introductory course in probability and/or math statistics. 3(3-0) F,S.*

IE (CSC) 441 Introduction to Simulation. *Preqs.: MA 202, ST 372, proficiency in a programming language 3(3-0) F,S.*

IE 443 Quality Control. *Preq.: ST 361. 3(2-2) F,S,Sum.*

IE 452 Ergonomics. *Coreq.: IE 352. 3(2-2) F,S.*

IE 453 Facilities Design. *Preqs.: IE 351, 352. 3(2-2) F.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

IE (MA, OR) 505 Linear Programming. *Preq.: MA 405. 3(3-0) F,S.* A study of mathematical methods applied to problems of planning. Linear programming will be covered in detail. This course is intended for those who desire to study this subject in depth and detail. It provides a rigorous and complete development of the theoretical and computational aspects of this technique as well as a discussion of a number of applications.

Fathi, Peterson

IE (OR) 509 Dynamic Programming. *Preqs.: MA 405, ST 421. 3(3-0) S.* An introduction to the theory and computational aspects of dynamic programming and its application to sequential decision problems. Elmaghraby, Stidham

IE 511 Capital Investment Economic Analysis. *Preqs.: IE 311, ST 371. 3(3-0) F.* Analysis of economic merits of alternatives including interest and income tax considerations. Risk and sensitivity exploration techniques. Introduction to analytical techniques for multiple objectives or criteria. Use of mathematical programming and computers for capital budgeting. Bernhard, Canada

IE 512 Bayesian Decision Analysis for Engineers and Managers. *Preq.: ST 371 or ST 421. 3(3-0) F.* The Bayesian approach to decision making, with numerous applications in engineering and business. Expected value maximization, decision trees, Bayes' theorem, value of information, sequential procedures and optimal strategies. Axiomatic utility theory and controversies, utility of money, theoretical and empirical determination of utility functions and relationship to mean-variance analysis. Brief introduction to multiattribute problems, time streams and group decisions. Bernhard, Canada

IE 515 Advanced Manufacturing Processes. *Preqs.: IE 351 and ECE 331 or equivalent. 3(3-0) F.* The course examines manufacturing processes which involve chemical, electrochemical, electrical, thermo-electric and non-conventional mechanical energy modes. Each process is investigated as to its underlying theory, state-of-the-art technology, interaction with the workpiece material, geometric capability and economics.

O'Grady, Sanii

IE 516 CAM I: A Systemic Approach to Computer-Aided Manufacturing. *Preq.: IE 351. 3(3-0) F.* General principles of CAD/CAM integration. Elements of computer graphics. Engineering data base. Computer Process Control. Group Technology concepts and applications. Flexible manufacturing systems. Culbreth, O'Grady, Sanii

IE 517 CAM II: Software Applications in Computer-Aided Manufacturing. *Preqs.: IE 516. 3(3-0) S.* Computer techniques for controlling machine tool motions. Extensive application of Numerical Control Programming using the APT language. Computer Aided Process Planning through the CAPP system. Theory and applications of Programmable Controllers for Process Control. Various application software for manufacturing use. O'Grady, Sanii

IE 518 Manufacturing Operations Management. *Preqs.: MA 202 or MA 212; ST (EB) 350 or ST 372. 3(3-0) F. Not for IE majors.* Concepts, problems and procedures for the management of manufacturing operations. Emphasis will be on forecasting, capacity planning, material requirements planning, scheduling, inventory control and related computer-based control systems. Hodgson, King, Nuttle

IE (MAE) 520 Industrial Robotics. *Preqs.: IE 351; MA 301 or MA 303. 3(3-0) F.* Development, structure, specifications and capabilities of industrial robots. Robot control fundamentals. Kinematics of manipulators. Applications, selection, economics and implementation of robotic systems. Safety considerations, end-of-arm tooling and design of robotic workplace. Acutators, sensors including vision and tactile sensory systems for robots. Sanii

IE 521 Management Decision and Control Systems. *Preqs.: IE 421, CSC 421 or equivalent. 3(3-0) S.* Planning and development of comprehensive computer-based information systems to support management decisions. Formal systems concepts; management information requirements. Management science and organizational behavior influences. Data bases and advanced system techniques and concepts. System evaluation and cost effectiveness. Smith

IE 523 Production Planning, Scheduling and Inventory Control. *Preqs.: OR 501 and ST 515 or equivalents. 3(3-0) S.* An analysis of Production-Inventory systems. Discussion of commonly used planning and scheduling techniques. Introduction to the use of math modeling for solution of planning and scheduling problems. Interface with quality control and information systems. Hodgson, King, Nuttle

IE 525 Organizational Planning and Control. *Preq.: Three credit hours in operations management (such as EB 325, IE 308). 3(3-0) F.* Organization theory and systems approaches to administrative functions. Human and social influences of management systems for planning and control of activity. Policy, structure and procedure related to industrial engineering activities. Effects of automation. Oldham, Smith

IE (PSY) 540 Human Factors in Systems Design. *Preq.: IE 452 or PSY 340; Coreq.: ST 507 or 515. 3(3-0) F.* Introduction to the systems development cycle, Man-machine function allocation, design standards, display and control systems, workspace layout, the personnel sub-system concept, anthropometry and maintainability design. Antin, Pearson

IE 541 Systems Safety Engineering. *Preqs.: IE 452, ST 371. 3(3-0) S.* Problems in occupational safety and health; OSHA standards; preventive aspects involving product and work design and personnel selection. Consideration of the methods used in accident-injury study, including field investigation, experimental engineering and biomedical research, and statistical and epidemiological studies. Managerial aspects of safety accountability. Product liability and forensics. Pearson

IE 542 Physiological Criteria in Work Measurement. *Preq.: Grad. status. 3(3-0) F. Alt. yrs.* Emphasis is placed on basic endocrine and autonomic nervous system anatomy and physiology; measures reflecting sympathetic nervous system activity; concepts applicable

to work measurement studies including a discussion of arousal theory and the concept of autonomic balance; and survey of current literature on equipment design and use.
Ayoub

IE 544 Occupational Biomechanics. *Preq.: Grad. standing in engineering. 3(2-2) F. Alt. yrs.* General concepts and techniques of understanding the anatomical and physiological bases of human motion. Characteristics and limitations of human motor capabilities, body mechanics and use of biomedical instrumentation for monitoring and quantifying human performance. Applications of biomechanics in work, industry, rehabilitation, sports, space research and safety are also considered. Ayoub

IE 547 Reliability and Quality Assurance. *Preq.: One of the following: IE 308, IE 371, ST 421 or ST 515. 3(3-0) S.* An introduction to basic concepts of reliability and quality assurance. Application of probability and statistics to estimation and control of quality and reliability of industrial processes. Control charts and acceptance sampling. Reliability estimation, life testing. Failure distributions and rates. Reliability of systems: series, parallel and monotone systems. Maintenance of systems. Redundancy optimization. Quality management in industrial systems. Fathi, King, Prak, Richards

IE 553 Material Handling Systems. *Preq.: IE 453. 3(3-0) S.* Analysis, design, evaluation and implementation of material handling systems. Principles, functions, equipment concepts and traditional approaches of material handling. Impact of facilities design on material handling and application of quantitative techniques to material handling systems design. Description of factors and approaches to material handling management and the criticality of properly designed and operated material flow systems. Trevino

IE 556 Industrial Logistics. *Preq.: IE 453. 3(3-0) F.* Materials management, materials flow and physical distribution. Management of activities required to move raw materials, parts and finished inventory from vendors, within an enterprise and to customers. This course will cover the design and operation of effective industrial logistics systems.
Trevino

IE (OR) 561 Queues and Stochastic Service Systems. *Preq.: MA 421. 3(3-0) F.* General concepts of stochastic processes are introduced. Poisson processes, Markov processes and renewal theory are presented. These are then used in the analysis of queues, starting with a completely memoryless queue to one with general parameters. Applications to many engineering problems will be considered. King, Perros, Stewart

IE (CSC, CSE, ECE, OR) 562 Computer Simulation Techniques. *3(3-0) F.* (See computer studies.)

IE (CSC, CSE, ECE) 575 Voice Input/Output Communication Systems. *Preqs.: MA 202 and IE 307 or CSC 312. 3(3-0) F.* Introduction to the physical, linguistic and computational principles that underlie speech synthesis and speech recognition. Human factors of speech I/O. Advantages and disadvantages of implementing voice applications. Hands-on use of voice I/O equipment through class projects. Case studies of current applications of speech I/O technology. Joost, Rodman

IE (MA, OR) 586 Network Flows. *Preq.: IE (OR, MA) 505 or equivalent. 3(2-2) S. Alt. yrs.* This course will study problems of flows in networks. These problems will include the determination of the shortest chain, maximal flow and minimal cost flow in networks. The relationship between network flows and linear programming will be developed as well as problems with nonlinear cost functions, multicommodity flows and the problem of network synthesis. Elmaghraby, Fathi

IE 589 Special Topics in Industrial Engineering. *Preqs.: Grad. or sr. standing and CI. 1-4.* Exploration of emerging topics of interest to faculty and students. Generally used for the first offering of a new course, using conventional lecture format. Sometimes used for directed readings, problem sets and reports as required. Graduate Staff

IE 591 Project Work. *Preq.: Grad. standing. 1-6 F,S,Sum.* Investigation and report on assigned problems requiring application of industrial engineering techniques.
Graduate Staff

IE (PSY) 593 Area Seminar in Ergonomics. *1(0-2) F.* (See psychology.)

FOR GRADUATES ONLY

IE 611 The Design of Production Systems. *Preqs.: IE (MA, OR) 505, OR 501. 3(3-0) F. Alt. yrs.* The study of production systems: the model, the criterion, decision making and optimization, levels of decision. The graphic representation of systems: signal flow graphs, activity analysis, networks of flow models. The machine assignment problem, scheduling and sequencing, line balancing location-allocation of new facilities. The use of computers in the design of production systems. Elmaghraby

IE 616 Computer Integration of Manufacturing Systems. *Preqs.: IE 516, IE 517. 3(3-0) F.* In-depth study of computer integration of manufacturing systems. CIM elements (CAD, CAPP, CNC, industrial robotics), manufacturing control, communication and networking, interfacing, database design, material handling and computer hardware requirements in automated manufacturing systems. Emphasis on the integration of the components involved in computerized manufacturing environments.
Culbreth, O'Grady, Sanii

IE 621 Advanced Problems in Management Systems Engineering. *Preq.: CI. 1-4 S.* Coverage of advanced techniques, current research and contemporary problems in analysis, design and operation of management systems. Varied topics will cover aspects of economic decision analysis, cost effectiveness, information flow, system performance evaluation and modern organization concepts. Bernhard, Canada, Smith

IE 622 Inventory Control Methods II. *Preq.: IE 523. 3(3-0) F.* A continuation of IE 523; stochastic inventory systems of lot sized-reorder type; periodic review and single period models. Application of dynamic programming theory to deterministic and stochastic cases.
Hodgson, King, Nuttle

IE 631 Multi-attribute Decision Analysis. *Preqs.: IE 511 or IE 512; OR 501 or OR 505. 3(3-0) S.* Specification of attributes/criteria/objectives for complex decisions. Determination of alternatives, attribute weights and decision-making process. Graphical and weighted evaluation techniques. Multi-attribute utility, multi-objective/goal programming and analytic hierarchy process methodologies. Computer applications and case studies.
Canada

IE (PSY) 640 Skilled Operator Performance. *Preqs.: PSY 545, ST 507, or ST 515. 3(3-0) S. Alt. yrs.* Theories of the human operators are considered with regard to the classical problems of monitoring, vigilance and tracking. Factors such as biological rhythm, sleep loss, sensory restriction, environmental stress and time-sharing are considered as they interact with and determine overall systems efficiency. Antin, Pearson

IE 641 Environmental Factors and Human Performance. *Preqs.: IE (PSY) 540 and IE 542 or other equivalent. 3(3-0) S. Alt. yrs.* Study of major problem areas, methodology, theory and experimental work in biotechnology; interaction among engineering, biological and behavioral factors in design for safety and survival; physiology and biomechanics of acceleration, deceleration and pressure altitude; consideration of operator effectiveness in submarine, extra-terrestrial, arctic and desert environments; techniques in evaluation of crash dynamics and pathology; closed-ecological systems. Pearson

IE 651 Special Studies in Industrial Engineering. *Preq.: Grad. standing. Credits Arranged.* The purpose of this course is to allow individual students or small groups of students to undertake studies of special areas in industrial engineering which fit into their particular program and which may not be covered by an existing industrial engineering

graduate level course. Problems may require individual research and initiative in the application of industrial engineering training to new areas or fields. Graduate Staff

IE (CSE,OR) 662 Stochastic Simulation Design and Analysis. *Preqs.: CSE (CSC, ECE, IE, OR) 562 and ST 516. 3(3-0) S.* Advanced topics in stochastic system simulation are covered, including random variate generation, output estimation for stationary and nonstationary models, performance optimization techniques, variance reduction approaches. Students apply these techniques to actual simulations. A paper written on a current research topic is required. Bengston, Perros, Richards

IE (CSC, CSE, ECE) 675 Advanced in Voice Input/Output Communications Systems. *Preq.: IE (CSC, CSE, ECE) 575. 3(2-3) S.* Selected topics from the current literature in voice input/output research, technology and applications. Each student must carry out a significant experiment or project. Joost, Rodman

IE (OR, MA) 692 Special Topics in Mathematical Programming. *Preq.: IE (MA, OR) 505. 3(3-0) F,S,Sum.* The study of special advanced topics in the area of mathematical programming. New techniques and current research in this area will be discussed. The faculty responsible for this course will select the areas to be covered during the semester according to their preference and interest. This course will not necessarily be taught by an individual faculty member but can, on occasion, be a joint effort of several faculty members from this university as well as visiting faculty from other institutions. To date, a course of Theory of Networks and another on Integer Programming have been offered under the umbrella of this course. It is anticipated that these two topics will be repeated in the future together with other topics. Graduate Staff

IE 693 Seminar in Applied Ergonomics. *Preqs.: IE (PSY) 540, ST 515. 1(0-2) S.* Discussion of contemporary issues involving the systems approach to accident prevention and injury control. History of safety research; federal health, industrial and military activities in safety, current centers of safety research and their activity. Ayoub, Pearson

IE 694 Advanced Problems in Ergonomics. *Preqs.: IE (PSY) 540, ST 515. 3(3-0) F.* Exploration in depth of a problem area of contemporary interest involving the man-machine-environment interface. Class discussion and analysis of research and theory, with special focus on the human factors aspects of systems design and operation. Antin, Ayoub, Pearson

IE 695 Seminar. *1(1-0) S.* Seminar discussion of industrial engineering problems for graduate students. Case analyses and reports. Graduate Staff

IE 699 Industrial Engineering Research. *Preq.: Grad. standing. Credits Arranged. F,S,Sum.* Graduate research in industrial engineering for thesis credit. Graduate Staff

Integrated Manufacturing Systems Engineering

Professor C. F. Zorowski, *Director*

A list of the graduate faculty participating in the program is available from the IMSE Institute Office.

The Integrated Manufacturing Systems Engineering program was established in 1984 to provide an interdisciplinary course of study in manufacturing systems at the graduate level. The program is administered through the Integrated Manufacturing Systems Engineering Institute, a multifaceted educational, research and technology transfer organization within the School of Engineering. The objective of the academic program is education in the theory and practice of advanced design and manufacturing methods. Central to all aspects of the Institute's operation is the integration of computer-aided techniques in the

design of both product and process and in the control of manufacturing facilities. The development and application of this technology requires specially structured academic and research programs to produce graduates capable of bringing about the productivity and quality gains desired by industry.

The academic focus of the Institute is a multidisciplinary master's degree program consisting of courses offered by the Departments of Electrical and Computer Engineering, Industrial Engineering, Mechanical and Aerospace Engineering, Computer Science, and Economics and Business. The degree program provides flexibility to meet the changing needs of industry and students. An interdisciplinary minor is also available for students who wish to pursue an M.S. or Ph.D. program in a specific department. In either instance, the goal is to provide an academic background essential to the understanding and implementation of computer integrated manufacturing systems.

The IMSE degree program does not include specified major and minor areas of study as normally found in classical master's degree programs. By its very nature, the manufacturing function is multidisciplinary, cutting across traditional engineering disciplines as well as others including economics, business and computer science. The development and use of computer technology in modern manufacturing systems for planning, design, control and information access requires a multidisciplinary approach.

A typical program of study extends over sixteen months for a student supported on a half-time assistantship. However, it is possible to complete the academic program in as few as twelve months. The curriculum includes a minimum of 27 credit hours of graduate course work in addition to participation in the research activities of the Institute for an additional six hours of credit. Additional course work may be required, dependent upon the background of the student. This may be in the form of intensive immigration modules, or undergraduate courses, for which no graduate credit is received. At least six credit hours must be at the advanced graduate level. The IMSE degree does not require a thesis; however, a comprehensive technical report must be prepared by each student on the required six-credit-hour research project.

The general plan of study for the IMSE degree consists of three components: core courses, concentration electives and a research project.

Program Requirements	*Credit Hours*
Core Courses (5)	15
Concentration Electives (4)	12
Research Project	6
Total Hours	33

Five core courses, required of all students, present an interdisciplinary overview of subject material basic to manufacturing systems. Subject matter specialization is provided in the student's plan of work through the selection of a minimum of four electives in a specified area of concentration. The five following concentrations are offered by the Institute:

1) Manufacturing Automation
2) Manufacturing Operations Management
3) Mechanical Design Automation
4) Sensors, Controls and Robotics
5) Artificial Intelligence and Information Handling

Over thirty courses are available in the concentration areas. A list of these offerings can be obtained from the Institute. The six credit hours of required individual or team research project complement and reinforce the area of concentration.

Core Courses:	*Credit Hours*
IE 516 CAM I: A Systemic Approach to Computer-aided Manufacturing	3
IE 518 Manufacturing Operations Management	
or	
IE 523 Production Planning, Scheduling and Inventory Control	3
IE 511 Capital Investment Economic Analysis	3
CSE 501 Design of Systems Programs	
or	
IE 589 Special Topics in Industrial Engineering	3
MAE 589 Special Topics in Mechanical Engineering	3
Total Credit	**15**

The academic program of each student is tailored to meet specific goals and interests. Suggested plans of study in each of several concentration areas can be obtained by contacting the Program Director in the IMSE Institute Office.

The student's advisory committee is made up of three or more members of the graduate faculty who associate with and participate in the activities of the Institute. The chairman is normally chosen from the area of concentration the student has selected. Other members of the committee come from the supporting areas of the program.

Each student is required to pass a final oral examination as a degree requirement. This examination consists principally of a formal presentation and defense of the student's participation and accomplishments in the research project activity before a jury of review. This jury will consist of the student's advisory committee and industry representatives associated with the project. Only the advisory committee has the authority to pass the student in the examination as authorized by the Graduate School. There may be instances in which simultaneous examinations are desirable depending on the nature, breadth and complexity of a specific project. The work of individual students may complement each other's activities such that a total team presentation may be beneficial. In such instances a jury will be present for each student and each advisory committee will exercise its own perogatives and authority. One committee chairman will be selected out of the entire group by all chairmen to moderate the presentation and defense activity.

FOR GRADUATES ONLY

IMS 698 Manufacturing Systems Engineering Project. *Preqs.: Grad. standing in IMSE; CI. 1-3 F,S.* Individual or team project work in integrated manufacturing systems engineering resulting in an engineering report. Required of all degree candidates in IMSE master's program. Forms the basis for IMSE student's final oral examination.

International Development

Professor J. L. Apple, *Coordinator*

The degree of Master of Technology for International Development (MTID) gives an international orientation to the master's degree which is sought in any of

the scientific, social and professional fields represented at this university. At a time when the world is moving inexorably toward greater interchange of people and increased commerce among nations, the MTID program provides specialized training for students who are interested in utilizing their skills in international activities, whether technical, consultative or administrative in nature.

The program of work requires the following:

1) A total of 36 semester credits, at least half of which must be in the relevant professional area. The remainder of the course work provides special orientation, sensitivity and understanding for work in a foreign culture. Among these "internationalizing" courses, 12 semester credits may be drawn from courses at the 300 or 400 levels with no more than six credits being taken from the 300 level.

2) A work experience of a minimum of 12 weeks in a foreign country and a substantial report on that field experience.

3) Conversational facility in one foreign language as determined by an oral examination.

4) A comprehensive written examination, which may be required at the discretion of the advisory committee.

5) Passage of a comprehensive oral examination conducted by the advisory committee.

The program of study is tailored to the student's individual needs rather than following a prescribed course; therefore, the student is expected to be able to demonstrate maturity and assume initiative in planning his/her own course of study. The relevant department assists in choosing a set of courses which provide grounding in the professional area, and the Office of International programs assists in identifying appropriate "internationalizing" courses which satisfy the student's particular needs and interests.

The following exemplify MTID plans of study:

Example 1—Core Area: Animal Science

Courses in Animal Science

ANS 502	**Reproductive Physiology of Vertebrates**	3
ANS 508	**Genetics of Animal Improvement**	3
ANS 510	**Advanced Livestock Management**	3
ANS 520	**Tropical Livestock Production**	3
ANS 540	**Ruminant Physiology and Metabolism**	3
PO 524	**Comparative Endocrinology**	4
		19

"Internationalizing" Courses

EB 401	**Economics Analysis for Nonmajors**	3
HI 476	**Leadership in Modern Africa**	3
HI 498	**Independent Study in History**	3
PA 533	**Global Problems and Policy**	3
PS 431	**International Law and Organization**	3
SOC 652	**Comparative Societies**	3
		18
Total semester hours		37

Example 2—Core Area: Public Administration

Courses in Public Administration

PA 511	Public Administration	3
PA 516	Public Policy Analysis	3
PA 612	The Budgetary Process	3
PA 614	Management Systems	3
PA 617	Seminar in Organization Theory	3
PA 621	Collective Negotiations in the Public Service	3
		18

"Internationalizing" Courses

EB 448	International Economics	3
HI 415	Revolutionary Europe	3
HI 554	History of U.S. Foreign Relations, 1900-Present	3
PS 641	Seminar in Comparative Politics	3
SOC 503	Contemporary Sociology	3
SOC 514	Developing Societies	3
		18

Total semester hours 36

Recognition that the interdependence of nations and the free exchange of ideas and technology is vital to global survival is now commanding greater attention than at any other time in history. The MTID program is a sophisticated response that equips graduates with the social, philosophical and technical skills necessary for employment with national and international organizations (profit and non-profit), business firms and government agencies.

General requirements for admission to the MTID program include a Bachelor's degree from an accredited college or university, a grade point average of 3.0 ("B") in one's undergraduate major and satisfactory performance on the Graduate Record Exam.

Landscape Architecture

GRADUATE FACULTY

Associate Professor D. W. Dalton, *Program Director*

Professors: C. E. McKinney, T. O. Perry, J. C. Raulston Jr., R. E. Stipe, A. L. Sullivan, R. R. Wilkinson; *Professor Emeritus:* E. G. Thurlow; *Associate Professors:* A. R. Abbate, R. C. Moore, D. Wood; *Assistant Professor:* F. H. Magallanes; *Lecturers:* R. S. Altman, R. M. Leary

The Master of Landscape Architecture degree at NCSU is fully accredited by the Landscape Architecture Accreditation Board to prepare students from many academic backgrounds for careers in landscape architecture. Advanced standing is available for students offering undergraduate work in landscape architecture or closely allied subjects. Students without advanced standing should expect to spend the equivalent of three academic years completing the program.

The MLA degree is both a first professional degree as recognized by state registration boards and the professional society (American Society of Landscape Architects) as well as a Master's degree in a designated field as described by the Graduate School of NCSU.

For students without preparation in landscape architecture, the beginning phase of the program introduces the means by which the landscape is creatively altered. Impacts of alteration to the rock, soil, water, flora and fauna are considered and evaluated against the social and economic benefits of the proposed use, and a well-designed accommodation is sought within the traditions of the profession's practical arts and techniques.

Prior to beginning the second or scholarship and research phase of the program, a graduate advisory committee is nominated by the student, approved by the department head, and formally appointed by the Dean of the Graduate School. The student and this committee of three faculty advisers constructs a list of courses and a final project proposal, constituting a Plan of Graduate Work which is submitted for approval to the Graduate School. When approved, the Plan serves as a contract for the degree. It may be altered by petition but gives the student a clear idea of the path ahead. The Plan of Graduate Work focuses the student's program in one of three concentrations: site planning and construction, community design, or environmental management, described below. A minor field of study is also specified, for example, horticulture, architecture, computer science, forestry, psychology, etc.

The beginning phase of the program is structured and developmental. Students acquire the skills and traditions of professional practice in both the private and public sectors. Site planning, construction, planting, graphics, history and design policy are taught in three-credit courses. Design is taught in six-credit studios. One studio and two courses per semester constitute a normal graduate load. Our academic year is divided into fall and spring semesters and two six-week summer sessions.

SELECTED ADVANCED UNDERGRADUATE COURSE

LAR 400 Landscape Architecture Studio. *Preqs.: School of Design majors: DF 102; Horticultural Science-Landscape Technology option majors: LAR 234. 6(0-9) F,S.*

LR 430 Site Planning. *Preqs.: MEA 101/110 or MEA 120/110 or SSC 200. 3(2-3) F,S.*

LAR 433 Native Plants in Environmental Design. *Preqs.: DN 221 or DN 232, HS 211. 3(2-2) S.*

LAR 444 History of Landscape Architecture. *3(3-0) F.*

LAR 457 Landscape Construction Materials, Methods and Documentation. *Preq.: LAR 430. 3(2-3) S.*

LAR 494 Internship in Landscape Architecture. *Preqs.: Jr. standing in LAR and 3.0 GPA or better and approval of department head. 3-6 F.2.*

LAR 495 Independent Study in Landscape Architecture. *Preqs.: jr. standing in LAR and 3.0 GPA or better and approval of department head. 3-6. F,S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

LAR 510 Graphics for Landscape Architects. *Preq.: Grad. standing or CI; Coreq.: LAR 600 or CI. 3(3-0) F.* A series of demonstrations and exercises organized to give students exposure to and experience with conventional techniques of graphic representation and presentation.

LAR 511 Community Design Policy. *Preq.: Grad. standing or CI. 3(3-0) S.* The course explores the theory and practices of the social policy impact on the designed environment and users of that environment. The public community development process is studied as it relates to the built environment.

LAR 512 Landscape Resource Management. *Preq.: CI. 3(1-4) S.* Laboratory techniques course in the methodology of analysis and management of natural resources as it relates to landscape architecture. Case study approach to managed resource systems using spatial mapping and analysis techniques.

LAR 521 Values, Theory and Methods of Landscape Architecture. *Preq.: Grad. standing. 3(3-0) F.* The profession of landscape architecture has undergone radical change in the past decade. Regional analysis, landscape assessment, land development, urban planning, recreation planning, etc., are new and emerging roles for the landscape architect. This course will develop the core values and theories from which each have emerged and survey the techniques and methods of their development.

LAR 530 Advanced Site Planning. *Preqs.: LAR 430. 3(2-2) S.* An expansion of fundamental site planning techniques applied to development of design proposals including grading, utilities, layout plans, hydrologic calculations, details and specifications.

LAR 531 Project Planning and Design. *Preq.: Grad. standing or CI; Coreq.: LAR 600. 3(3-0) S.* Procedures and issues in project planning, activity programming and site development are discussed in conjunction with three assigned projects.

LAR 533 Plants and Design. *3(2-2) F.* The course examines three landscape types: natural landscapes, landscapes altered by man and designed landscapes. Investigation of relevant plant materials and planting design processes is utilized to reveal natural principles as the basis for a design theory and methodology. Course assignments range from an analysis of actual plant materials and landscapes to the preparation of contract documents.

LAR 551 Ethics of Professional Practice in Landscape Architecture. *3(3-0) S.* An examination of the place of the professional in society, the contents and philosophies of various professional codes of ethics, the relationship of the practitioner with clients, peers and the public interest. It will include preparation of proposals, conduct as an expert witness, office organization and contracts.

LAR (RRA) 562 Computer Cartography. *3(3-0) S.* (See recreation resources administration.)

LAR 564 Management and Marketing Techniques in Community Design. *3(3-0) S. Alt. yrs.* Methods for effective management of community design processes. Emphasis on personal management skills, group process techniques, publicity materials, public relations and marketing strategies. A technical assistantship with a local agency/organization is required.

LAR 573 Historic Preservation. *Preqs.: Grad. standing and CI. 3(3-0) F.* Seminar covering the legal, administrative, fiscal and political aspects of preserving and conserving buildings, sites, districts, objects and landscapes of architectural, historical and design significance as related to community design and planning considerations. Subjects to be treated include federal, state and local statutes and ordinances; federal and state court decisions and administrative processes.

LAR 574 Landscape and Townscape Conservation. *Preqs.: LAR 511. 3(3-0) S.* Examination of local, state and federal law, affecting the visual quality of large-unit natural and built environments such as landscapes and townscapes, as expressed in local ordinances, state statutes, executive orders, administrative regulations and court decisions. Emphasis is placed on the legal, administrative, fiscal and governmental tools and processes for maintaining and enhancing visual environmental quality.

LAR 575 Development Planning. *Preq.: Grad. standing or CI. 3(3-0) F,S.* The seminar presents the concepts, processes and principles used in the design and development of communities. The discussions will focus on a general development process, the development team and the role of the designer in the context of the team. A wide range of project types will be discussed. The seminar presents the relationships of public regulatory policies and programs to the community design and development process.

LAR 591 Special Seminar. *Preq.: Grad. standing. 1-3 F,S.* Seminars on subjects of current interest in design which are presented by persons not part of the regular faculty.

LAR 592 Special Topics. *Preq.: Grad. standing. 2-3 F,S.* Topics of current interest to the programs in the School of Design offered by faculty in the School. Subjects offered under this number are normally used to test and develop new courses.

LAR 595 Independent Study. *Preq.: Grad. standing. Max. 6. F,S,Sum.* Special problems in various aspects of design developed under the direction of a faculty member on a tutorial basis.

FOR GRADUATES ONLY

LAR 600 Landscape Design Studio. *Preq.: Grad. standing. 6(0-12) F,S.* The application of information and skills developed in course work to environmental design problems. A process of site selection, activity programming, site planning, and program evaluation is followed which employs the creation of interactive communication systems between the designer, clients and users. Goals include the design of satisfying new landscapes as well as conservation and design strategies for existing culturally important landscapes and townscapes.

LAR 611 Advanced Community Design and Development Control. *Preq.: LAR 511. 3(1-3) S.* Advanced work in design and application of governmental planning and development control techniques to built environments, and impact of such controls on design solutions at varying scales. Emphasis is on design implications of complex control systems: development rights transfer, land use intensity rating systems, planned unit development regulations and other zoning and non-zoning site planning regulations.

LAR 612 Social Factors Analysis in Site Planning. *Preq.: LAR 511 or CI. 3(2-1) S.* The course explores social factors techniques and research applications to the design of the landscape. Interaction, neighborhood theory and user preference analysis techniques will be presented through discussion and development of research and case studies.

LAR 691 Degree Seminar. *Preqs.: 3 LAR 600 studios. 0.* Each student in his or her terminal semester not registered in any other courses and in conjunction with the terminal case study will prepare and submit to his or her committee a presentation on the relevance of one's minor to the design process with particular reference to the individual's case study.

LAR 698 Advanced Research Projects. *Preqs.: 2 LAR 600 studios or CI. 2-6 F,S.* Graduate students sufficiently prepared may undertake selected research investigations. A proposal for such investigations must be submitted prior to consent for enrollment.

Management

Professor S. E. Margolis, *Coordinator*

Graduate Advisor and Program Assistant B. L. Puryear

PROGRAM COMMITTEE

G. A. Berkstresser, *Textiles*; R. H. Bernhard, *Industrial Engineering*; W. Chou, *Computer Studies*; S. E. Elmaghraby, *Operations Research*; D. W. Johnston, *Civil Engineering*; C. P. Jones, *Economics and Business*; T. W. Reiland, *Statistics*

GRADUATE FACULTY

Professors: S. G. Allen, F. B. Armstrong, J. R. Canada, G. A. Carlson, R. L. Clark, D. A. Dickey, E. W. Erickson, D. Fisher, A. R. Gallant, T. J. Grennes, D. M. Holthausen, L. A. Ihnen, P. R. Johnson, T. Johnson, R. A. King, C. R. Knoeber, J. J. Seater, V. K. Smith, W. A. Smith, D. A. Sumner, K. C. Tai; *Associate Professors:* E. W. Davis Jr., J. C. Dutton Jr., D. J. Flath, J. D. Hess, T. L. Honeycutt, J. S. Lapp, S. J. Liebowitz, M. B. McElroy, R. B. Palmquist, J. W. Rockness, R. J. Rossana, G. J. Zuckerman; *Assistant Professors:* E. F. Gehringer, P. H. Kupiec, E. A. McDermed, K. Mitchell, C. M. Newmark, C. B. Oldham, R. R. Rucker, W. N. Thurman

The Master of Science in Management (MSM) program provides management education in the land-grant tradition. Drawing on the historical strength of North Carolina State University in applied economics, statistics and technology, the MSM program prepares students for careers that will extend well into the twenty-first century. Successful management requires not only an awareness of current business practices, but also the theoretical background necessary to understand when and why these practices work and when they must be modified. The MSM program has strong emphasis on theory and quantitative skills to meet these requirements.

The MSM degree is offered jointly by seven academic departments: Economics and Business, Civil Engineering, Computer Studies, Industrial Engineering, Operations Research, Statistics, and Textile Management and Technology. The range of faculty expertise and courses available through these departments distinguishes the MSM from other graduate management programs and provides the MSM student with flexibility in selecting a set of courses that will complement their background and career interests.

The MSM program requires 36 semester hours of graduate course work consisting of seven core courses required of all students and five courses to be chosen in a technical option.

Included in the core are graduate-level and micro- and macroeconomics courses (EB 501 and EB 502) which consider the theory of business decisions and the determinants of the economic environment in which business operates. Statistical methods (usually satisfied by completing ST 508, 512 or 514) and Intro-

duction to Operations Research (OR 501) provide useful analytical tools. The remainder of the core includes corporation finance (EB 520), marketing (EB 513), and an elective to be selected from one of the following: advanced managerial accounting (ACC 520), personnel management (EB 526), or long-range planning (EB 625).

Suggested technical options have been prepared by each of the participating departments and examples are provided below. Complete course offerings are listed by department throughout this bulletin. Courses from one or more departments may be combined to develop an option that complements the academic and career interests of the individual student. Under consultation with faculty advisors, students have constructed options such as Biotechnology and Management Information Systems.

Economics and Business

EB 512 Law and Economics
EB 522 Portfolio and Capital Market Theory
EB 525 Mangerial Economics
EB 606 Industrial Organization and Control
EB 650 Economics Decision Theory

Civil Engineering

CE 464 Legal Aspects of Contracting
CE 561 Construction Planning and Scheduling
CE 562 Construction Productivity
CE 566 Building Construction Systems
CE 665 Construction Equipment Systems

Computer Studies

CSE (CSC, ECE) 501 Design of Systems Programs
CSE 505 Design and Analysis of Algorithms
CSE (CSC, ECE) 510 Software Engineering
CSE (CSC, ECE) 542 Database Management
CSE (CSC, ECE) 671 Advanced Computer Performance Modelling

Industrial Engineering

IE 511 Capital Investment Economic Analysis
IE 512 Bayesian Decision Analysis for Engineers and Managers
IE 521 Management Decision and Control Systems
IE 525 Organizational Planning and Control
IE 621 Advanced Problems in Management Systems Engineering

Operations Research

OR (IE, MA) 505 Linear Programming
OR (IE) 509 Dynamic Programming
OR (IE, MA) 586 Network Flows
OR (MA, ST) 606 Nonlinear Programming
OR (MA) 614 Integer Programming

Statistics

ST 421 Introduction to Mathematical Statistics I
ST 422 Introduction to Mathematical Statistics II
ST 517 Applied Least Squares
ST 518 Applied Time Series Analysis
ST (EB) 651 Econometrics

Textiles

TMT (TES) 530 Textile Quality Control
TMT (EB) 585 Market Research in Textiles
TMT 680 Special Projects in Textile Management
TMT 686 Advanced Textile Labor Management Seminar
TMT 687 Competitive Strategy and Planning for the Textile Firm

A project paper and a final oral examination are required of each student. The project paper is usually written in conjunction with one of the 600-level courses and often involves an analysis of a problem faced by a local business firm. Defense of the paper constitutes the basis for the final oral examination that is conducted by the student's graduate advisory committee.

Prerequistes for the MSM program include two semesters of calculus and one semester each of intermediate microeconomics and macroeconomics. Generally a student should complete these courses before applying for admission. Domestic students may complete this course work by registering through the Division for Lifelong Education in a special part-time preparatory program, Post-baccalaureate Studies (PBS). Submission of the Graduate Management Admission Test (GMAT) or the Graduate Record Exam (GRE) is highly recommended but not required.

In addition to the prerequisite calculus and economics course work, the MSM program requires that students have an undergraduate-level foundation in financial and managerial accounting, introductory computer science (including some programming) and statistical methods (including regression and analysis of variance). Students who have not completed these foundation courses in recent undergraduate work should take them early in their graduate programs.

The MSM program is available to students interested in part-time and full-time studies. Approximately two-thirds of the current student enrollment is part-time. All core courses and many of the electives are offered in the evening on a rotating basis for individuals interested in part-time evening studies. Students should consult the program advisers for further information on evening study.

A wide range of employers have found the analytical nature of the MSM program to be very attractive. Recent graduates have been employed by many firms, governmental agencies and nonprofit institutions in North Carolina and other states. The services of the University's Career Planning and Placement Center are available to all students. In addition, the Department of Economics and Business employs a placement counselor to serve its current students and recent graduates.

For additional information, contact B. L. Puryear, Graduate Advisor, Department of Economics and Business, Box 8109, North Carolina State University, Raleigh, NC 27695-8109, phone (919) 737-7157, or any member of the Graduate Faculty.

Marine, Earth and Atmospheric Sciences

GRADUATE FACULTY

Professor H. S. Brown, *Head*

Professor G. S. Janowitz, *Graduate Administrator*

Professors: C. E. Anderson, S. P. S. Arya, G. Briggs, V. V. Cavaroc Jr., J. M. Davis, K. Kamykowski, L. J. Pietrafesa, S. Raman, C. W. Welby, T. G. Wolcott, I. J. Won; *Professors Emeriti:* L. J. Langfelder, C. J. Leith, J. M. Parker III, W. J. Saucier; *Associate Professors:* D. J. DeMaster, R. V. Fodor, M. M. Kimberley, C. E. Knowles, J. M. Morrison, A. J. Riordan, V. K. Saxena, E. F. Stoddard, G. F. Watson; *Visiting Associate Professors:* V. P. Aneja, D. L. Wolcott; *Adjunct Associate Professors:* J. K. Ching, R. E. Eskridge, V. R. Lamb, R. H. Weisberg; *Assistant Professors:* M. G. Bevis, N. E. Blair, S. Businger, L. A. Levin, W. J. Showers; *Visiting Assistant Professors:* D. M. Checkley Jr., A. P. S. Reymer, J. W. Rottman; *Adjunct Assistant Professors:* T. B. Curtin, M. DeMaria

ASSOCIATE MEMBERS OF THE DEPARTMENT

Professors: M. Amein, B. J. Copeland, F. Y. Sorrell Jr., C. C. Tung; *Associate Professor:* J. M. Miller

The Department of Marine, Earth and Atmospheric Sciences offers graduate programs leading to the M.S. and Ph.D. degrees.

The Atmospheric Science areas of specialization include atmospheric dispersion, boundary layer flows and air quality; synoptic weather systems and weather forecasting; climatology and agricultural meteorology; and cloud and aerosol physics.

Areas of specialization in Earth Science include mineralogy, igneous and metamorphic petrology, sedimentology and sedimentary petrology, sedimentary geochemistry, economic geology, global and exploration geophysics, structural geology, hydrogeology and geomorphology. As geology and geophysics are considered distinct areas of study, students can major in one area and minor in the other.

In Marine Science, areas of specialization are biological, chemical, geological and physical oceanography, geophysical fluid dynamics and marine meteorology.

Admission with a specialization in Atmospheric Science requires a bachelor's degree in meteorology or other technical areas which include a background in chemistry, physics and mathematics. Candidates in Earth Science should hold a bachelor's degree in geology or a satisfactory equivalent, preferably with a strong background in physics, chemistry and mathematics. Graduate students in Marine Science are normally admitted after having received a baccalaureate degree in biology, chemistry, engineering, geology, mathematics, physics or meteorology.

In each discipline the master's program includes a minimum of 30 semester credit hours. Doctoral programs normally contain at least 50 semester credit hours beyond the B.S. degree, although course requirements are determined by the student's advisory committee. Graduate work includes major and minor fields and a research thesis. An M.S., non-thesis option is also available. Marine Science students are expected to be familiar with areas of marine studies other than their own and are required to complete two (three) courses from other Marine Science core areas in the M.S. (Ph.D.) program.

Sponsored research is being conducted in various areas of geology and geophysics, in air pollution and boundary layer meteorology, cloud and aerosol physics, and in Marine Science, in continental shelf, Gulf Stream and equatorial dynamics, geophysical fluid dynamics, sediment transport and water column and benthic biology. Graduate students are actively involved in the conduct of the research which often forms the basis of their theses. Research projects range from theoretical studies to international field experiments. Regional studies are being performed within the North Carolina Blue Ridge, Piedmont and Coastal Plain as well as in estuaries, on the continental shelf and slope and in equatorial regions.

Research facilities are available for analytical work in most areas of geology, geophysics and atmospheric sciences. Biological, chemical, geological and physical oceanography laboratories and shop facilities for electronic and mechanical equipment repair and fabrication are available for student use. Students also have on-campus access to the TUCC IBM System 370/165 and Amdahl computers and to several smaller computing facilities operated by the department. Remote sensing capabilities are utilized in both research and classroom instruction. Collections of pertinent literature are available in the University library and elsewhere in the Research Triangle area. Consultation with scientists of the federal and state agencies in Raleigh as well as with the staffs of the neighboring universities is possible and encouraged.

The State of North Carolina operates three Marine Resources Centers on our coast where research space is available. Our students have also made use of facilities at Duke University's Marine Laboratory and the National Marine Fisheries Laboratory, both on Pivers Island, North Carolina. The department has a small boat and is a member of the Duke/UNC consortium that operates the new 131 ft. R/V Cape Hatteras.

Financial aid is available through both teaching assistantships (9 month) and research assistantships (9 or 12 month). Government agencies and industry occasionally provide part-time employment and small grants from the State are sometimes available to assist with thesis expenses.

Atmospheric Science

SELECTED ADVANCED UNDERGRADUATE COURSES

MEA 412 Atmospheric Physics. *Preqs.: MA 202, PY 208 or equiv. 3(3-0) S.*

MEA 421 Air Processes and Motions I. *Preqs.: MA 202, PY 208, MEA 311, 312, 313, 314. 4(3-2) F.*

MEA 422 Air Processes and Motions II. *Preq.: MEA 421. 4(3-2) S.*

MEA 443 Weather Analysis and Forecasting I. *Preq.: MEA 421. 3(1-6) F.*

MEA 444 Weather Forecasting Principles. *Preq.: MEA 443. 3(2-3) F.*

MEA 455 Micrometeorology. *Preq.: MEA 422 or MAE 402. 3(3-0) F.*

MEA 493 Special Topics in Meteorology. Preq.: Consent of department. 1-3 F,S,Sum.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

MEA 512 Satellite Meteorology. *Preq.: MA 202; Coreq.: MEA 443. 3(3-0) S. Alt. yrs.* Basic background in satellite orbits, coordinate systems and image navigation; description of sensors and techniques for quantitative measurement of atmospheric variables. Applications of satellite data in analysis of weather systems; evolution of convective systems, tropical disturbances and mid-latitude cyclones as revealed by visible and infrared imagery; current research in satellite applications. Riordan

MEA 514 Advanced Physical Meteorology. *Preqs.: MEA 412, 421. 3(3-0) F.* The fundamental laws and concepts of thermodynamics and electromagnetic radiative transfer are considered in an atmospheric context. These principles are then applied to a number of meteorological problems, including those of radiative climate models, the global energy balance, atmospheric aerosols, lidar/radar backscatter and remotely sensed temperature fields.

MEA 521 The Upper Atmosphere. *Preq.: MEA 311 or CI. 3(3-0) S,Sum.* Meteorological conditions in the upper atmosphere from the stratosphere to the ionosphere. Compositions, mean distributions and variability, circulation and transport properties in the region. Physical theories. Graduate Staff

MEA 524 Dynamic Meteorology. *Preq.: MEA 422 or equivalent. 3(3-0) F.* A brief review of the classical and physical hydrodynamics; scale analysis of dynamic equations; atmospheric instabilities; dynamics of tropical convections; perturbation theory and approximations for atmospheric wave motions. Graduate Staff

MEA 525 Numerical Weather Prediction. *Preqs.: MEA 524, CSC (MA) 427 or equivalent and some FORTRAN programming experience. 3(3-0) F,S. Alt. yrs.* Physical and mathematical basis of numerical weather prediction with computer experiments to demonstrate principles and techniques. Topics include derivation of sets of prediction equations consistent with scale analysis and dynamical constraints; atmospheric waves and filtered equations; numerical methods and computational instabilities; filtered and primitive equation models; NWS operational models. Watson

MEA 526 Air-Sea Interaction. *Preq.: MEA 422 or MEA 560 or CI. 3(3-0) S. Alt. yrs.* Review of basic equations and concepts of turbulent transfer in geophysical flows, air-sea interaction processes and their importance to man's activities, theory and observation of wind-generated ocean surface waves, turbulent transfers in the planetary boundary layer of the marine atmosphere, oceanic mixed layer, development of thermocline and inversion. Raman

MEA 527 Planetary Boundary Layer. *Preq.: MEA 455 or MEA 526 or CI. 3(3-0) F,S. Alt. yrs.* Review of the basic equations and concepts of planetary boundary layers. Study of the closure problem and semi-empirical theories of turbulence, buoyancy effects on mean flow and turbulence, instrumentation and observational platforms for PBL experiments, observed characteristics of atmospheric boundary layers, numerical and physical modeling of PBL and its parameterization in large-scale atmospheric circulation models. Arya

MEA 555 Meteorology of the Biosphere. *Preqs.: PY 205 or 211; CH 103 or 107; MA 102 or 112. 3(3-0) F.* A course designed for graduate students in the life sciences, presenting the physical principles governing the states and processes of the atmosphere in contact with earth's surface of land, water and life. Exchanges of heat, mass and momentum are analyzed for various conditions of the atmosphere and surface and as a function of season, time and geographic location. Davis

MEA 556 Air Pollution Meteorology. *Preqs.: MA 201 or 212, PY 208 or 212, CH 103 or 105 or 107 or equivalent. 3(3-0) F.* Wind structure in the atmospheric surface layer and planetary boundary layer; temperature structure and stability; mixed layer and inversions; turbulence intensity and scale; meteorological factors affecting the dispersion of pollutants; diffusion theories and models; diffusion and transport experiments; plume rise, fumigation and trapping; removal processes; effects of buildings and hills; effects of local winds. Arya

MEA 557 Advanced Cloud and Precipitation Physics. *Preq.: MEA 421 or MEA 412. 3(3-0) F. Alt. yrs.* An analysis of the microstructure of warm and cold clouds and precipitation, cloud microphysics-dynamics interactions, formation of cloud droplets, growth of cloud droplets by condensation, initiation of rain in nonfreezing clouds, formation and growth of ice crystals, precipitation theories, planned and inadvertent weather modification and the problem of acid rain. Saxena

MEA 558 Atmospheric Aerosols. *Preqs.: CH 103 or 107 and PY 205 or 211; Coreq.: MEA 412. 3(3-0) S. Alt. yrs.* An understanding of aerosols as primary air pollutants, indoor versus outdoor pollution, transformation processes, prediction of atmospheric concentrations, scavenging of aerosols, transport of air pollutants on a regional scale, discussion of national experiments to characterize and study the impact of urban-industrial pollution, tropospheric aerosol and weather, stratospheric aerosol, effect of aerosols on atmospheric warming and cooling and air-quality models. Saxena

MEA 593 Special Topics. *Preq.: CI. 1-6 F,S,Sum.* Special topics in meteorology, provided to groups or to individuals. Graduate Staff

FOR GRADUATES ONLY

MEA 614 Atmospheric Radiative Transfer. *Preq.: MEA 412. 3(3-0) S.* The study of solar and terrestrial radiation. Methods of actinometric measurements, radiation absorption in the atmosphere, scattering of radiation, the solar spectrum, infrared radiative transfer and methods of determining net radiation. Satellite measurement of radiation and determination of atmospheric properties from satellite measurements. Saxena

MEA 627 Atmospheric Turbulence and Diffusion. *Preq.: MEA 422. 3(3-0) F.* Mechanics of turbulence in the atmosphere, spectra and scales of atmospheric turbulence and magnitudes of turbulent fluctuations. Theories of diffusion in the atmosphere. Diffusion and transport experiments. Processes other than natural turbulence affecting concentration of effluents. Arya

MEA 635 Dynamical Analysis of the Atmosphere. *Preqs.: MEA 441, 443. 3(2-3) F.* Theory and analysis of circulation and weather systems based on dynamical concepts; structure, movement and development of systems; evaluation of theoretical concepts in prognosis and forecasting. Graduate Staff

MEA 695 Seminar. *Preq.: Grad. standing. 1(1-0) F,S.* Presentation of scientific articles and special lectures. Each student is required to present or critically review one or more papers. Graduate Staff

MEA 699 Research. *Preqs.: Grad. standing and consent of advisory committee. Credits Arranged. F,S.* Graduate research in fulfillment of requirements for a graduate degree. Graduate Staff

Earth Science

SELECTED ADVANCED UNDERGRADUATE COURSES

MEA 415 Geology of Metalliferous Deposits. *Preqs.: MEA 440, MEA 452. 3(2-3) S.*

MEA 423 Invertebrate Paleontology and Biostratigraphy. *Preqs.: MEA 201/210 or ZO 202. 4(3-3) F.*

MEA 440 Igneous and Metamorphic Petrology. *Preq.: MEA 331. 4(3-3) F.*

MEA 452 Sedimentary Petrology and Stratigraphy. *Coreq.: MEA 331. 4(3-3) S.*

MEA 461 Engineering Geology. *Preq.: MEA 101 or 120. 3(3-0) F.*

MEA 465 Geologic Field Camp I. *Preqs.: MEA 351, 440, 452. First part of 6 weeks out-of-state summer field camp. Both MEA 465 and 466 must be taken in the same summer. 3 Sum.*

MEA 466 Geologic Field Camp II. *Preq.: MEA 465. Second part of 6 weeks out-of-state summer field camp. Both MEA 465 and 466 must be taken in the same summer. 3 Sum.*

MEA 470 Principles of Geophysics. *Preqs.: PY 208 or 212; MEA 120 or equivalent recommended. 3(3-0) F.*

MEA 471 Exploration and Engineering Geophysics. *Preq.: MEA 470 or PY 208. Credit may not be received for both MEA 471 and MEA 570. 3(3-0) F.*

MEA 475 Geophysical Field Methods. *Preq.: MEA 471. Credit is not allowed for both MEA 475 and MEA 575. 2 cr. Sum. field camp.*

MEA 476 Seismic Exploration for Oil. *Preqs.: PY 208, knowledge of FORTRAN. Credit is not allowed for both MEA 476 and MEA 576. 3(3-0) S.*

MEA 481 Principles of Geomorphology. *Preq.: MEA 201 or equivalent. 3(2-2) F.*

MEA 491 Seminar on Selected Geologic Topics. *1-3 F.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

MEA 500 Regional Geology of North America. *Preqs.: MEA 101 or 120, sr. standing. 1-6 F,S.* Field study of classic geologic localities and geomorphic processes not indigenous to North Carolina. Typical areas are New England and adjacent Canada, northern Mexico and southwestern United States and the Pacific Northwest. Representative subjects include the Canadian Shield, Precambrian mineral deposits, the San Andreas fault, desert geomorphology, Grand Canyon stratigraphy, modern and ancient reefs and glaciated volcanoes. Mineral, rock and fossil collecting. Student reports required. Graduate Staff

MEA 510 Geological Oceanography. *Preq.: MEA 452 or equivalent. 3(3-0) F.* A comprehensive overview of the geological aspects of oceanography. Topics include: a) marine geophysics and the evolution of ocean basins, b) sedimentological processes and the formation of marine deposits, c) marine geochemistry and authigenic sedimentation, d) paleoceanography and the interpretation of marine stratigraphy. Graduate Staff

MEA 515 Topics in Southern Appalachian Geology. *Preqs.: MEA 351 and MEA 440 or equivalent. 3(3-0) F. Alt. yrs.* Examination of the geology of North Carolina and surrounding areas. Lectures, discussions, reading of and review of current literature and consideration of ideas concerning the geological evolution of the area. A term project on a selected topic is required. Required field trips. Stoddard

MEA 522 Petroleum Geology. *Preq.: MEA 452. 3(3-0) S. Alt. yrs.* Properties, origin and modes of occurrence of petroleum and natural gas. Geologic and economic features of the principal oil and gas fields, mainly in the United States. Graduate Staff

MEA 523 Introduction to Subsurface Well Evaluation. *Preqs.: CH 103, PY 212, MEA 120. 3(2-3) F. Alt. yrs.* Principles, uses and interpretation of commonly used wireline technique for structural, lithologic and fluid evaluation of wells. Oriented towards petroleum reserve/evaluations. Cavaroc

MEA 532 Ore Microscopy. *Preq.: MEA 331. 3(0-6) F. Alt. yrs.* The theory and technique of microscopic investigation of opaque ore minerals, ores and mill products produced by beneficiation of ores. Studies of compositions and textures of materials in polished surfaces are based on observations of optical and physical properties, etch reactions and microchemical tests. (Offered F 1985 and alt. years.) Brown

MEA 542 Intermediate Petrographic Analysis. *Preq.: MEA 440 or equivalent. 2(0-5) F.* Systematic study of rocks in thin section by means of the petrographic microscope. Mineralogy, mineral and rock compositions and rock textures applied to an interpretation of the origin and crystallization or depositional history of specimens studied. Suites representative of each of the three major rock groups will be studied during the first half of the semester; during the remainder of the semester, the student will concentrate on suites representative of his/her area of specialization. Cavaroc, Stoddard

MEA 545 Advanced Igneous Petrology. *Preq.: MEA 440. 3(2-2) S. Alt. yrs.* Physicochemical principles related to igneous petrogenesis. General principles and specific problems including the origin, differentiation and emplacement of magmas and the possible relationships of igneous processes to global tectonics. Fodor

MEA 546 Advanced Metamorphic Petrology. *Preq.: MEA 440. 3(2-2) S. Alt. yrs.* The petrogenesis of metamorphic rocks including conditions of metamorphism, metamorphic facies and facies series, the petrogenetic grid, contact and regional metamorphism, metamorphism and plate tectonics. Heterogeneous chemical equilibrium and application of Gibbs Phase Rule to metamorphic rocks. Thermodynamically valid algebraic and graphical analysis of equilibrium mineral assemblages. Chemical zoning. Petrographic studies of selected metamorphic suites. Stoddard

MEA 551 Advanced Structural Geology. *Preq.: MEA 351. 3(2-3) F. Alt. yrs.* Principles of rock mechanics and their application in solving geologic problems; finite strain analysis of deformed rocks; advanced techniques of structural analysis; petrofabrics; development of various geologic structures. Course is designed to emphasize the application of principles and techniques in the field. Graduate Staff

MEA 562 Applied Sedimentary Analysis. *Preqs.: MEA 452, ST 361. 3(2-2) F. Alt. yrs.* Extension of MEA 452, with emphasis on coarser grained clastic sedimentary rocks. Sampling of sedimentary population, critical study of assumptions underlying standard measurement techniques; treatment, testing and evaluation of sedimentary data; application to problems in sedimentology. Cavaroc

MEA 564 Depositional Environments and Lithostratigraphy. *Preq.: MEA 452 or grad. standing. 3(2-3) S.* Fabric of large sedimentary basins in terms of the spatial distribution of component major rock facies; current litho-genetic models based upon comparison with recent equivalents; field trips. Cavaroc

MEA 565 Hydrogeology. *Preq.: MEA 452. 3(3-0) S. Alt. yrs.* Occurrence and sources of surface and subsurface water. Relationships of surface water to subsurface water. Rock properties affecting infiltration, movement, lateral and vertical distribution and quality of ground water. Determination of permeability, capacity, specific yield and other hydraulic characteristics of aquifers. Principles of well design, legal aspects of water supplies. Welby

MEA 566 Hydrogeology of Groundwater Pollution and Protection. *Preq.: MEA 565 or CE 543 or equivalent. 3(3-0) S. Alt. yrs.* Hydrogeologic factors associated with protection of groundwater; use of geologic principles and materials to protect groundwater quality; geologic evaluation and monitoring of waste disposal sites, including appropriate models.
Welby

MEA 567 Geochemistry. *Preq.: CH 331 or 433. 3(3-0) F. Alt. yrs.* The quantitative distribution of elements in the earth's crust, the hydrosphere and the atmosphere. Application of the laws of chemical equilibrium and resultant chemical reactions to natural earth systems. Geochemical application of Eh-pH diagrams. Geochemical cycles. Isotope geochemistry.
Kimberley

MEA 570 Exploration and Engineering Geophysics. *Preq.: MEA 470 or PY 208. Credit in both MEA 470 and MEA 570 is not allowed. 3(3-0) S.* Geophysical methods as applied to exploring the earth's mineral and energy resources and to investigating subsurface geological structure and physical properties. Principles, measurements, analyses, and interpretations of gravity, magnetic, electric, electromagnetic, seismic methods. Research paper required.
Won

MEA 572 Laboratory and Field Methods for Investigation of the Seabed. *Preqs.: MEA 510 or CH 107 or MEA 571. 3(2-3) S. Alt. yrs.* An initial lecture and laboratory phase acquaints the student with the use of advanced techniques and instrumentation for chemical and geological oceanographic investigations. A field project in the the coastal waters of North Carolina and then allows application of these tools to a specific marine problem.
DeMaster

MEA 575 Geophysical Field Methods. *Preq.: MEA 570. Credit in both MEA 475 and MEA 575 is not allowed. 2(2-week summer camp) Sum. Alt. yrs.* Two-week summer field course. Practical geophysical field measurements using instruments for gravity, magnetic, electric, electromagnetic and radioactivity methods. Data interpretation in terms of subsurface geological structures and their physical properties, locations, sizes and shapes. Students are required to register for the course in the second summer session. Location: within the state of North Carolina. Estimated expense: $150.00. Research paper required.
Won

MEA 576 Seismic Explortion for Oil. *Preqs.: PY 208 and knowledge of FORTRAN language. Credit in both MEA 476 and MEA 576 is not allowed. 3(3-0) S.* A comprehensive introduction to the reflection seismic method as applied to exploring oil and gas resources. Seismic instrumentation, field data acquisition, common-depth-point method, deconvolution, digital filtering, migration and seismic stratigraphy of hydrocarbon depositional environments, along with computer-oriented exercises. Research paper required. Won

MEA 577 Sedimentary Geochemistry. *Preq.: CH 331 or CH 431 or MEA 567 or equivalent background. 3(3-0) S. Alt. yrs.* This course applies thermodynamic data to the calculation of reactions in natural waters at or near the earth's surface. Topics include weathering to form clay minerals, precipitation of economic minerals and carbonate sedimentology.
Kimberley

MEA 581 Advanced Geomorphology. *Preq.: MEA 481 or other equivalent background. 3(2-3) S. Alt. yrs.* The application of quantitative techniques to the study of the geologic processes responsible for the formation and modification of land forms. Analysis of processes and landforms related to drainage basins, and regions of karst, glacial and coastal geomorphology. Emphasis on geomorphic areas in North Carolina. Field trips.
Graduate Staff

MEA 582 Quaternary Geology. *Preqs.: MEA 101 or 120, sr. standing. 3(3-0) S. Alt. yrs.* Glaciology, glacial geology, Pleistocene stratigraphy, periglacial geomorphology; Quaternary volcanism, tectonism and sea-level fluctuations; late Cenozoic climate changes; field trips.
Graduate Staff

MEA 583 Photogeology and Remote Sensing. *Preqs.: MEA 101 or 120, MEA 481 or equivalent. 3(2-3) S.* Study and interpretation of aerial photographs and other remotely sensed data for geological information relating to mineral resource exploration and evaluation and geological controls on environmental problems. Graduate Staff

MEA 588 Regional Tectonics. *Preqs.: MEA 351, 440, 452. 3(3-0) S. Alt. yrs.* Methods of study of the tectonic history of major geologic regions in North America and other areas of the world through the application of stratigraphy, petrology and structural geology. Synthesizing regional tectonic patterns and events. Graduate Staff

MEA 593 Special Topics. *Preq.: CI. 1-6 F,S.* Special study of some advanced phases of geology. Graduate Staff

MEA 598 Advanced Topics in Geophysics. *Preq.: CI. 1-6 F,S,Sum.* Special study of some advanced phases. Graduate Staff

FOR GRADUATES ONLY

MEA 610 Marine Sedimentology. *Preq.: MEA 510. 3(3-0) S. Alt. yrs.* A quantitative examination of sedimentology with specific reference to the marine environment including an introduction to fluid mechanics, sediment transport theory, quantitative models of sedimentation and dynamic stratigraphy. Graduate Staff

MEA 611, 612 Advanced Economic Geology. *Preqs.: MEA 440, 452. 3(3-0) F,S.* Detailed study of the origin and economic occurrence of specific mineral deposits. Brown

MEA 630 Geotectonics. *Preqs.: MEA 351, 440, 452. 3(3-0) F. Alt. yrs.* In-depth examination of current ideas in plate tectonic theory. Plate tectonic controls on orogeny, orogenic belts, magmatism and metallogeny. Bevis, Reymer

MEA 670 Advanced Geophysics I. *Preqs.: MEA 570 and MA 401. 3(3-0) F. Alt. yrs.* Advanced geophysical theories and applications: topics chosen from the potential field theory of Laplace and Poisson, gravity, heatflow, magnetism, electric and electromagentic fields as means of investigating the earth's internal structure. Understanding geodynamic principles and applications to exploring for mineral and hydrocarbon resources. Bevis

MEA 671 Advanced Geophysics II. *Preqs.: MEA 570 and MA 401. 3(3-0) F. Alt. yrs.* Advanced geophysical theories and applications: topics chosen from scalar and vector wave propagation phenomena in geophysics, earthquake seismology, focal mechanisms, propagation of body and surface waves, plate tectonics, advanced reflection seismology for oil and gas exploration, electromagnetic waves as applied to mineral exploration. Won

MEA 695 Seminar. *Preq.: Grad. standing. 1(1-0) F,S.* Scientific articles, progress reports and special problems of interest to geologists and geological and mining engineers discussed. Graduate Staff

MEA 698 Geophysical Research. *Preq.: CI. Credits arranged. F,S,Sum.* Thesis research in geophysics. Graduate Staff

MEA 699 Research. *Preq.: CI. Credits Arranged. F,S,Sum.* Lectures reading assignments and reports; special work in geology to meet the needs and interests of the students. Thesis problem. Graduate Staff

Marine Science

FOR GRADUATES AND ADVANCED UNDERGRADUATES

MEA 501 Environmental Fluid Mechanics. *Preqs.: MA 202, PY 208. 3(3-1) F.* Basic concepts and the laws governing the motion of the atmosphere and oceans are developed

from first principles, including approximations valid for environmental flows, the kinematics, dynamics and thermodynamics of fluid flows as well as an introduction to environmental turbulence. Graduate Staff

MEA 510 Geological Oceanography. *Preq.: MEA 452 or equivalent. 3(3-0) F.* A comprehensive overview of the geological aspects of oceanography. Topics include: a) marine geophysics and the evolution of ocean basins, b) sedimentological processes and the formation of marine deposits, c) marine geochemistry and authigenic sedimentation, d) paleoceanography and the interpretation of marine stratigraphy. Graduate Staff

MEA (ZO) 520 Principles of Biological Oceanography. *Preqs.: BS 100 and either BO (ZO) 360 or grad standing. 3(3-0) S.* Biological productivity and trophic relationships in Plankton, Nekton and Benthos; community ecology of selected habitats (estuaries, intertidal zones, coral reefs, deep sea) and adaptation of organisms to the marine environment. Wolcott

MEA 526 Air-Sea Interaction. *Preq.: MEA 422 or MEA 560 or CI. 3(3-0) S. Alt. yrs.* Review of basic equations and concepts of turbulent transfer in geophysical flows, air-sea interaction processes and their importance to man's activities, theory and observation of wind-generated ocean surface waves, turbulent transfers in the planetary boundary layer of the marine atmosphere, oceanic mixed layer, development of thermocline and inversion. Raman

MEA (ZO) 534 Marine Benthic Ecology. *Preqs.: ZO 302, ZO 509 or ZO 517 or MEA (ZO) 520. 3(3-0) S. Alt. yrs.* Marine benthic systems in the deep sea and in shallow waters, focusing upon the abiotic and biotic processes which regulate density, diversity and taxonomic and functional composition. Discussions of benthic-pelagic coupling, predation, interspecific competition, biogeography, sampling problems, evolutionary trends, trophic structure and community organization. Levin

MEA (CE) 541 Gravity Wave Theory I. *Preq.: MAE 308 or PY 411. 3(3-0) S.* Classical gravity wave theory with emphasis on the basic mechanics of wave motions, mass transport induced by waves and various conservation laws with their applications in wave study. Knowles

MEA 560 Principles of Physical Oceanography. *Preqs.: MA 212 and PY 212 or equivalent. 3(3-0) S.* An introduction to the principles and practice of physical oceanography. Subjects to be covered include: the equation of state of seawater; energy transfer to the ocean by thermal, radiative and mechanical processes; the heat budget; oceanic boundary conditions; the geographical distribution of oceanic properties; observational methods; conservation equations; simple waves and tides; physical oceanography of the North Carolina coastal zone. Knowles

MEA 561 Introduction to Physical Oceanography. *Preqs.: MA 301, PY 208 or CI. 3(3-0) F.* An introduction to the descriptive and dynamical features of ocean circulation. Topics to be covered include the physical properties of seawater, oceanic heat budget, fluid mechanics, dynamics of ocean currents, descriptive oceanography, tides and other waves. Morrison

MEA (MAE) 563 Geophysical Fluid Mechanics. *Preq.: MAE 550 or equivalent. 3(3-0) F. Alt. yrs.* The principles of fluid mechanics are applied to geophysical systems. Special emphasis is placed on those features of these systems, such as almost rigid rotation and stable stratification, which produce unique and important effects. The effects of almost rigid rotations on homogeneous and stratified flows are examined in detail. Janowitz

MEA 568 Ocean Circulation. *Preq.: MAE 308 or PY 411. 3(3-0) F.* Basic study of the mechanics of ocean circulation with emphasis on various simple models of circulation systems. Pietrafesa

MEA 569 The Physical Dynamics of Estuaries. *Preqs.: MA 202 or 212; PY 208 or 212 or CI. 3(3-0) S. Alt. yrs.* A physical/dynamical description of estuaries and estuarine processes which occur as a function of tides, atmospheric forcing, river runoff and topography. Includes classification schemes; the development of salt, heat energy and momentum balances; a discussion of biological modeling and sediment transport processes as a function of the physical dynamics; conservative and non-conservative pollution dispersion prediction; and the theoretical, mathematical modeling of estuaries, including those in North Carolina. Pietrafesa

MEA 571 Principles of Chemical Oceanography. *Preq.: CH 107 or equivalent. 3(3-0) F.* Chemical processes which control the composition of the oceans, including discussions of chemical equilibria, biological cycling of nutrients and the use of chemical tracers in the marine environment; the origin and chemical history of the oceans are also considered. DeMaster

MEA 572 Laboratory and Field Methods for Investigation of the Seabed. *Preqs.: MEA 510 and CH 107 or MEA 571. 3(2-3) S. Alt. yrs.* An initial lecture and laboratory phase acquaints students with the use of advanced techniques and instrumentation for chemical and geological oceanographic investigations. A field project in the coastal waters of North Carolina then allows application of these tools to a specific marine problem. DeMaster

MEA 591, 592 Seminar. *1(1-0) S.* A seminar designed to give perspective in the field of marine science. Topics vary from semester to semester. In order to obtain credit a student must deliver a seminar. Graduate Staff

MEA 593 Special Topics. *Preq.: CI. 1-3 F,S.* This course provides the opportunity for advanced undergraduate and graduate students to study timely special problem areas in marine science and engineering. Graduate Staff

FOR GRADUATES ONLY

MEA 610 Marine Sedimentology. *Preq.: MEA 510. 3(3-0) S. Alt. yrs.* A quantitative examination of sedimentology with specific reference to the marine environment including an introduction to fluid mechanics, sediment transport theory, quantitative models of sedimentation and dynamic stratigraphy. Graduate Staff

MEA 613 Continental Margin Sedimentation. *Preq.: MEA 510. 3(3-0) S. Alt. yrs.* A detailed examination of the processes and sedimentation active along continental margins. The specific environments explored are the continental shelf, slope and rise. Graduate Staff

MEA 622 Marine Plankton Ecology. *Preqs.: BCH 451 and MA 212 and ZO 419 or equivalents. 3(3-0) F. Alt. yrs.* This course will examine the worldwide relationships between the physical-chemical environment and planktonic organisms. Topics include organism descriptions; the effects of light, temperature, salinity, density, water motion and chemical constituents on organisms; interactions among different organisms emphasizing competition and predation; community structure, distribution and succession; and mathematics models of distribution, production and interaction. Kamykowski

MEA (ZO) 623 Advances in Marine Community Ecology. *Preqs.: ZO 302 and ZO 517 or ZO 560 or MEA (ZO) 534. 3(3-0) S. Alt. yrs.* Current research and biological and physical processes structuring shallow and deep water benthic communities. Recent research on competition, predation, disturbance, succession, animal-sediment-flow interactions, life history tactics and experimental design in marine benthic biology. Student discussion of current issues and critique of recent papers. Levin

MEA (ZO) 624 Ecology of Fishes. *Preq.: BO (ZO) 360 or 560 or equivalent. 3(3-0) F.* Physiological ecology of fishes emphasizing energetics, production and adaptations to aquatic mediums. Ecological classification of fishes and theory of resource partitioning in freshwater, estuarine and marine realms. Miller

MEA (MAE) 663 Advanced Geophysical Fluid Mechanics. *Preq.: MAE 550 or equivalent. 3(3-0) S. Alt. yrs.* The principles of fluid mechanics are applied to geophysical systems. Special emphasis is placed on the role of stable stratification on the flows in these systems. The generation, interaction, propagation and dissipation of internal gravity waves are studied in detail. Other geophysically important flows are also studied. Janowitz

MEA (MAE) 664, 665 Perturbation Method in Fluid Mechanics I, II. *Preqs.: MA 401, MAE 308. 3(3-0) F,S.* Basic theory and application of perturbation methods in fluid mechanics including: regular and singular perturbations, matching principles, method of strained coordinate, two variable expansion and applications to partial differential equations. (Offered 1984-85 and alt. years.) Janowitz

MEA 674 Marine Geochemistry. *Preqs.: CH 331, MEA 571 or equivalent. 3(3-0) S. Alt. yrs.* A detailed examination of the chemical processes occurring in the marine environment. Topics discussed include: chemical evolution of the oceans, continental and submarine weathering, particle scavenging of reactive elements from the water, column, formation of biogenic and metalliferous deposits, sediment diagenesis and marine geochronology. DeMaster

MEA 693 Advanced Special Topics. *Preqs.: Grad. standing and CI. 1-3.* This course will provide the opportunity for advanced graduate students to study in special problem areas in marine sciences. Various areas in the program may use this course concurrently in their areas. Graduate Staff

MEA 699 Research. *Preqs.: Grad. standing and consent of advisory committee. Credits Arranged. F,S.* Graduate Staff

Materials Science and Engineering

GRADUATE FACULTY

Professor J. J. Hren, *Head*

Professor H. Palmour III, *Associate Department Head*

Professor, A. A. Fahmy, *Graduate Administrator*

Professors: K. J. Bachmann, J. R. Beeler Jr., R. B. Benson Jr., H. Conrad, R. F. Davis, C. C. Koch, K. L. Moazed, J. Narayan, G. A. Rozgonyi, R. O. Scattergood, H. H. Stadelmaier; *Adjunct Professors:* G. Mayer, J. L. Routbort; *Professors Emeriti:* W. W. Austin, J. K. Magor, R. F. Stoops; *Associate Professor:* P. E. Russell; *Associate Professor Emeritus:* J. V. Hamme; *Assistant Professors:* C. M. Balik, N. A. El-Masry, R. L. Porter

ASSOCIATE MEMBERS OF THE DEPARTMENT

Professors: J. A. Bailey, K. Havner, Y. Horie, G. Lucovsky; *Associate Professor:* R. J. Nemanich

The Department of Materials Science and Engineering offers graduate programs leading to the degrees of Master of Science, Master of Materials Science and Engineering and Doctor of Philosophy. Students with appropriate back-

grounds in engineering, chemistry or physics can be accommodated, although most students enter the program with degrees in a materials-related discipline. Financial aid is available on a competitive basis to qualified students.

Graduate students in materials engineering are involved with academic studies and research programs that focus on understanding the structure, structure modification and properties of materials. Included is the development of new or improved materials and advanced processing methods, which are critical links between the design and the realization of new systems. Materials and materials limitations pervade all of the engineering and high technology fields that are an integral part of our society. The challenges and opportunities for graduates in materials engineering are exceptional.

Research in the department comprises a wide range of programs that deal with physical, chemical and mechanical behavior involving both bulk and surface phenomena in metals, ceramics, polymers and composites. There are rapidly growing activities in the areas of microelectronic materials, advanced processing methods for metals and ceramics, non-equilibrium structures and surface modification processes. The research programs are supported by state-of-the-art facilities for preparation, processing and characterization of materials. An ion-beam microprobe, analytical scanning-transmission microscopy and VAX-based computer facility are among the recent acquisitions that support departmental research programs.

The faculty in materials science and engineering offers experience in all of the basic materials-related disciplines. Each student's program is designed to provide the appropriate balance of academic and research work consistent with that student's background and career objectives.

A brochure describing the department's graduate programs, research interests and faculty members is available upon request.

SELECTED ADVANCED UNDERGRADUATE COURSES

MAT 400 Metallic Materials in Engineering Design. *Preq.: MAT 200 or 201. 3(3-0) F,S.*

MAT 410 Computer Applications for Materials Engineering. *Preqs.: CSC 111; Coreq.: MAT 330. 3(3-0) S.*

MAT 411 Physical Principles in Materials Science I. *Preq.: MAT 321. 3(3-0) F.*

MAT 423 Materials Factors in Design. *Preq.: MAT 450. 3(2-3) S.*

MAT 431 Physical Metallurgy I. *Preqs.: MAT 321, 450. 4(4-0) F.*

MAT 432 Physical Metallurgy II. *Preq.: MAT 431. 3(3-0) S.*

MAT 435 Physical Ceramics I. *Preqs.: MAT 321, MAT 434. 3(3-0) F.*

MAT 436 Physical Ceramics II. *Preq.: MAT 435. 3(3-0) S.*

MAT 450 Mechanical Properties of Materials. *Preq.: MAT 325 and 330; MAE 314. 3(3-0) F.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

MAT 500 Modern Concepts in Materials Science. *Preq.: Grad. standing. 3(3-0) F.* Fundamentals of structure, structure modification and properties of materials with emphasis on structure-property relationships and the modern theory of solids.

MAT 501 Diffusion and Mass Transport Processes in Solids. *Preq.: CI. 3(3-0) F.* Interatomic forces and crystal structure, basic concepts in diffusion theory, diffusion and mass transport in metals and alloys, semiconductors, ionic crystals (ceramics) and amorphous materials. Diffusion along dislocations and grain boundaries, surface and interface diffusion, electromigration and thermomigration, concentration-enhanced diffusion, transient diffusion, stress-induced diffusion, mass and heat transport during rapid solidification, radiation damage and defect diffusion.

MAT 502 Defects in Solids. *Preq.: CI. 3(3-0) Sum.* Defect structure in ionic, covalent and metallic solids of either a crystalline or an amorphous nature. Effects of defects on the mechanical, electrical, magnetic, chemical and optical properties of solids. Computer software is provided for the exploration of defect interactions via computer simulation.

MAT 504 Electrical, Optical and Magnetic Properties of Materials. *Preqs.: MAT 500, 510. 3(3-0) S.* Electron theory of materials, band theory; electrical behavior of metals, semiconductors, dielectrics and noncrystalline materials; theory of optical behavior and applications; foundations of magnetic properties and applications of ferrites and permanent magnetic materials.

MAT 505 Mechanical Behavior of Engineering Materials. *Preqs.: MAT 450, MAT 502. 3(3-0) S.* Both fundamental and engineering aspects of mechanical behavior of materials are covered. Elasticity, plasticity and dislocation theory concepts are used to describe phenomenological behavior and micromechanical mechanisms. Topics covered include strengthening mechanisms in crystals, high-temperature deformation, fracture mechanics, fracture toughening mechanisms and cyclic deformation. Various aspects of deformation of noncrystalline solids will also be included.

MAT 506 Phase Transformations and Kinetics. *Preqs.: MAT 500, 510. 3(3-0) F.* Homogeneous and heterogeneous nucleation, spinodal decomposition, interface and diffusion-controlled growth, formal theory of transformation kinetics, growth of crystals from the vapor, precipitation, coarsening, order-disorder, and martensitic transformations.

MAT (CH) 507 Chemical Concepts in Materials Science and Engineering. *Preq.: CI. 3(3-0) F.* Structure, symmetry and chemical bonding; spectroscopic methods and their utilization in trace analysis and pollution control; phase equilibria, crystal growth and materials purification; vapor phase equilibria and the kinetics of chemical reactions and transport; electrochemical thermodynamics and kinetics with applications to batteries, solar cells, electrorefinement, plating and corrosion processes.

MAT 508 Thermodynamics of Materials. *Preq.: MAT 301 or equivalent. 3(3-0) F.* A review of the first and second laws of thermodynamics, equilibrium and irreversible processes, open and closed systems, partition functions and particle distribution functions. Applications will include extension of the thermodynamic potentials to situations where electrical, magnetic and stress fields are present, heat capacity of crystals, electron gas in metals, solution models, binary phase diagrams and rubber elasticity in polymers.

MAT 510 Elements of Crystallography and Diffraction. *Preq.: MAT 411. 3(3-0) F.* Crystal symmetry, lattices and space groups; elementary diffraction by crystalline matter; experimental methods of x-ray diffraction.

MAT 511 Stereology and Image Analysis. *Preq.: Grad. standing. 3(3-0) S. Alt. yrs.* Development of principles and their practical application to measurement of images from microscopy (primarily materials) to describe three-dimensional structure of specimens

viewed in transverse sections or projection. Includes basic statistics, manual and automatic (computerized) image analysis methods. Basic stereological parameters (volume fraction, surface density, curvature) plus object size and shape parameters, fractal and stereoscopic description of surfaces.

MAT 512 Scanning Electron Microscopy. *Preq.: Grad. standing. 3(3-0) F.* Electron optics, sources and detectors. Beam specimen interactions, secondary and backscattered electrons, EDS and WDS. Resolution limits, experimental conditions, related techniques, beam-induced damage and materials modification.

MAT 515 Fundamentals of Transmission Electron Microscopy. *Preq.: MAT 510 or equivalent. 3(2-3) S.* Electron optics, electron solid interactions, basic electronic diffraction, contrast from amorphous materials, diffraction contrast, defect characterization, introduction to analytical electron microscopy. Laboratory experiments illustrating these concepts.

MAT (NE) 525 Nuclear Materials. *3(3-0) F.* (See nuclear engineering.)

MAT 529 Properties of High Temperature Materials. *Preqs.: MAT 201 and MAT 301. 3(3-0) S.* Effects of temperature on the physical, mechanical and chemical properties of inorganic materials; relationships between microstructure and high temperature properties; applications of ceramics, metals and composites at elevated temperatures.

MAT (MAE) 531 Materials Processing by Deformation. *3(3-0) F.* (See mechanical and aerospace engineering.)

MAT (MAE) 532 Fundamentals of Metal Machining Theory. *3(3-0) S.* (See mechanical and aerospace engineering.)

MAT 533 Advanced Ceramic Engineering Design. *Preq.: MAT 417. 3(2-3) F.* Advanced studies in analysis and design of ceramic products, processes and systems leading to original solutions of current industrial problems and the development of new concepts of manufacturing.

MAT 540 Glass Technology. *Preq.: MAT 435. 3(3-0) F.* Fundamentals of glass manufacture including compositions, properties and application of the principal types of commercial glasses.

MAT 541 Principles of Corrosion. *Preqs.: MAT 201 and CH 431 or MAT 301. 3(2-3) F.* The fundamentals of metallic corrosion and passivity. The electro-chemical nature of corrosive attack, basic forms of corrosion, corrosion rate factors, methods of corrosion protection. Laboratory work included.

MAT 556 Composite Materials. *Preq.: MAT 450. 3(3-0) F.* Basic principles underlying the properties of composite materials as related to properties of the individual constituents and their interactions. Emphasis on the design of composite systems to yield desired combinations of properties.

MAT (NE) 573 Computer Experiments in Materials and Nuclear Engineering. *Preq.: Advanced undergrad. standing. 3(3-0) S.* Monte Carlo and dynamical computer experiments are covered from the standpoint of how to design and use them in materials and nuclear engineering work.

MAT 595 Advanced Materials Experiments. *Preq.: Sr. or grad. standing. 1-3.* Advanced engineering principles applied to a specific experimental project dealing with materials. A seminar period is provided and a written report is required.

FOR GRADUATES ONLY

MAT 610 Advanced Crystallography and Diffraction. *Preq.: MAT 510. 3(3-0) F.* Symmetry in crystals and space group determination. Kinematic and dynamical scattering theories. Experimental methods involving single crystals. Image formation in x-ray topography and electron microscopy. Disorder and defects. Methods of crystal structure analysis. Residual stresses and preferred orientation in polycrystals.

MAT 612 Advanced Scanning Electron Microscopy and Surface Analysis. *Preq.: MAT 512 or equivalent. 3(3-0) S. Alt. yrs.* Beam specimen interactions, voltage contrast, electron spectrometers, stroboscopy, EBIC, cathodoluminescence, channeling, backscattering, magnetic contrast, vacuum science, instrumentation, ion sputtering, Auger electron spectroscopy, SIMS, quantitative EDS, ESCA, FIM, STM.

MAT 621 Theory and Structure of Amorphous Materials. *Preq.: MAT 500. 3(3-0) S.* Bond types and structure of amorphous solids, relations of bond types and structure to flow mechanisms, electrical, optical and thermal properties.

MAT 622 Theory and Structure of Ceramic Materials. *Preq.: MAT 500. 3(3-0) F.* Electrical and optical properties of non-conducting materials, ferro-electric behavior and materials parameters, magnetic properties of non-metallics, semi-conducting materials.

MAT 623 Theory and Structure of Metallic Materials. *Preq.: MAT 500. 3(3-0) F.* The metallic state, its atomic and electronic structure. Electron theory of metals and alloys. Advanced methods of determining electronic structure in metallic materials. Solid solutions and intermediate phases, superconducting and magnetic alloys.

MAT 630 Phase Transformation in Materials II. *Preqs.: MAT 510, 530, 550. 3(3-0) F.* Formal theories of solid-solid transformations, transformation mechanisms, transformation morphologies.

MAT 631, 632 Advanced Physical Ceramics I, II. *Coreqs.: MAT 510, 610 or MAT 530, 630 or CE 511, 512 or PY 503, 552. 3(2-3) F,S.* Lattice structures and lattice energies in crystalline ceramics; relationships with elastic, optical and thermal properties. Effects of constitution and microstructure on lattice-sensitive properties. The defect crystalline state in ceramics; vacancies, color centers; dislocations, boundaries. Crystal growth. Plastic deformation processes, including creep and fatigue; the ductile-brittle transition. Structure-sensitive properties of crystalline, vitreous and composite ceramics; effects of constitution, microstructure and non-stoichiometry.

MAT 633 Advanced Mechanical Properties of Materials. *Preq.: MAT 630. 3(3-0) F.* The theories of yield strength, work hardening, creep, fracture and fatigue of crystalline materials will be developed in terms of dislocation theory.

MAT 691, 692 Advanced Topics in Materials Science and Engineering. *Preq.: Grad. standing. 1-3.* Special studies of advanced topics in materials engineering.

MAT 695 Materials Science and Engineering Seminar. *1(1-0) F,S.* Reports and discussion of special topics in materials engineering and allied fields.

MAT 699 Materials Science and Engineering Research. *Credits Arranged.* Independent investigation of an appropriate research problem. A report on this investigation is required as a graduate thesis.

Mathematics

GRADUATE FACULTY

Professor E. E. Burniston, *Head*

Associate Professor: J. E. Franke, *Graduate Administrator*

Professors: J. W. Bishir, S. L. Campbell, R. E. Chandler, J. M. A. Danby, J. C. Dunn, M. J. Evans, A. Fauntleroy, R. O. Fulp, R. E. Hartwig, K. Koh, J. Luh, J. A. Marlin, L. B. Martin Jr., R. H. Martin Jr., C. D. Meyer, P. A. Nickel, N. K. Nichols, C. V. Pao, E. L. Peterson, R. J. Plemmons, M. S. Putcha, N. J. Rose, H. Sagan, J. F. Selgrade, C. E. Siewert, M. F. Singer, E. L. Stitzinger, R. A. Struble; *Visiting Professor:* S. A. Jurovics; *Professors Emeriti:* R. C. Bullock, J. M. Clarkson, W. G. Dotson Jr., W. J. Harrington, J. Levine, H. M. Nahikian, H. V. Park, J. B. Wilson, L. S. Winton; *Associate Professors:* M. T. Chu, L. O. Chung, J. D. Cohen, G. D. Faulkner, C. T. Kelley, T. J. Lada, D. M. Latch, L. B. Page, R. T. Ramsay, J. Rodriguez, E. W. Sachs, S. Schecter, M. Shearer, R. Silber, J. W. Silverstein, D. F. Ullrich; *Associate Professor Emeritus:* J. W. Querry; *Assistant Professors:* R. Byers, H. J. Charlton, D. E. Garoutte, G. H. Guirguis, D. J. Hansen, K. C. Misra, L. K. Norris, S. O. Paur, J. L. Rulla, S. J. Wright

The Department of Mathematics offers programs leading to the degrees of Master of Science and Doctor of Philosophy with a major in either mathematics or applied mathematics.

Applicants for admission should have an undergraduate degree in mathematics or its equivalent. This should include a year of mathematical analysis (or advanced calculus) and a year of modern algebra, including linear algebra. All applicants are advised to take the Graduate Record Examination including the Advanced Test in Mathematics.

A number of teaching assistantships are available. A student carrying a half-time assistantship is allowed to carry a course load of nine semester hours.

The requirements for the Master of Science degree include 36 semester hours of approved credits and a comprehensive examination. A master's project for 3 hours credit is required. Foreign languages are not required for the master's degree.

There is no prescribed minimum number of courses for the degree of Doctor of Philosophy. Normally a student will take approximately 60 semester hours of course credits including certain core courses in algebra, analysis and applied mathematics. Independent reading and participation in seminars constitute an indispensable part of the doctoral program.

All doctoral students are required to have a reading knowledge of two modern foreign languages. Comprehensive examinations are also required. These consist of a written examination designed to test basic knowledge and oral and written examinations on material related to the field of proposed thesis work.

The heart of the doctoral program is the dissertation. It must be original research resulting in a significant contribution in some area of mathematics or its applications and should be worthy of publication in the current literature. The doctoral dissertation must be defended at the final oral examination.

A detailed statement of requirements for graduate degrees is available on request from the graduate administrator.

SELECTED ADVANCED UNDERGRADUATE COURSES

MA 401 Applied Differential Equations II. *Preq.: MA 301. Credit for both MA 401 and MA 501 will not be given. 3(3-0) F,S,Sum.*

MA (PHI) 402 Advanced Logic. *Preq.: PHI 335 or CI. 3(3-0) S.*

MA 403 Introduction to Modern Algebra. *Preq.: One year of calculus. 3(3-0) F,S,Sum.*

MA 403M Introduction to Modern Algebra for Mathematics Majors. *Preq.: One year of calculus (MA 225 is desirable). 3(3-0) F,S.*

MA 405 Introduction to Linear Algebra and Matrices. *Preq.: One year of calculus. 3(3-0) F,S,Sum.*

MA 408 Foundations of Euclidean Geometry. *Preq.: MA 403. 3(3-0) F.*

MA 410 Theory of Numbers. *Preq.: One year of calculus. 3(3-0) S.*

MA 414 Introduction to Differential Geometry. *Preqs.: MA 202 and 405. 3(3-0) S.*

MA (CSC) 416 Introduction to Combinatorics. *Preq.: MA 403 or CSC 322. 3(3-0) F.*

MA 421 Introduction to Probability. *Preq.: One year of calculus. 3(3-0) F,S,Sum.*

MA 425 Mathematical Analysis I. *Preq.: MA 202 (MA 403 desirable). 3(3-0) F,S.*

MA 426 Mathematical Analysis II. *Preqs.: MA 425 and MA 405. 3(3-0) S.*

MA (CSC) 427 Introduction to Numerical Analysis I. *Preqs.: MA 301 and a programming language proficiency. 3(3-0) F.*

MA (CSC) 428 Introduction to Numerical Analysis II. *Preqs.: MA 405 and programming language proficiency. 3(3-0) S.*

MA 430 Mathematical Models in the Physical Sciences. *Preqs.: MA 301 and MA 405. 3(3-0) F.*

MA 432 Mathematical Models in Life Sciences and Social Sciences. *Preqs.: MA 301, MA 405; Coreq.: MA 421 or ST 371. 3(3-0) S.*

MA 433 History of Mathematics. *Preq.: One year of calculus. 3(3-0) F,S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

MA 501 Advanced Mathematics for Engineers and Scientists I. *Preq.: MA 301 or equivalent. Credit for this course and MA 401 is not allowed. 3(3-0) F,S,Sum.* Survey of mathematical methods for engineers and scientists. Ordinary differential equations and Green's functions; partial differential equations and separation of variables; special func-

tions, Fourier series. Applications to engineering and science are stressed. This course cannot be taken for credit by mathematics majors.

MA 502 Advanced Mathematics for Engineers and Scientists II. *Preq.: MA 301 or equivalent. Any student receiving credit for MA 502 may receive credit for, at most, one of the following: MA 405, MA 512, MA 513. 3(3-0) F,S,Sum.* Determinants and matrices; line and surface integrals, integral theorems; complex integrals and residues; distribution functions of probability. This course cannot be taken for credit by mathematics majors.

MA (IE, OR) 505 Linear Programming. *3(3-0) F,S.* (See industrial engineering.)

MA 507 Analysis for Secondary Teachers. *Preq.: Grad. standing. 3(3-0) F,Sum. Alt. yrs.* A course designed to update and broaden the secondary teacher's capability and point-of-view with respect to topics in analysis. Emphasis is upon the historical development, logical refinement and applications of concepts such as limits, continuity, differentiation and integration. This course may be taken for graduate credit for certificate renewal by secondary school teachers. Credit towards a graduate degree may be allowed only for students in mathematics education.

MA 508 Geometry for Secondary Teachers. *Preq.: Grad. standing. 3(3-0) S,Sum. Alt. yrs.* A course designed to study topics in geometry of concern to secondary teachers in their work and to provide background and enrichment. Various approaches to the study of geometry are investigated, including vector geometry, transformational geometry and axiomatics. This course may be taken for graduate credit and for certificate renewal by secondary school teachers. Credit towards a graduate degree may be allowed only for students in mathematics education.

MA 509 Abstract Algebra for Secondary Teachers. *Preq.: Grad. standing. 3(3-0) F,Sum. Alt. yrs.* A course designed to investigate from an advanced viewpoint topics in algebra from the high school curriculum. Emphasis is upon the theory of equations, polynomial rings, rational functions and elementary number theory. This course may be taken for graduate credit for certificate renewal by secondary school teachers. Credit towards a graduate degree may be allowed only for students in mathematics education.

MA 510 Selected Topics in Mathematics for Secondary Teachers. *Preq.: Grad. standing. 3(3-0) S,Sum. Alt. yrs.* A course designed to cover various topics in mathematics of concern to secondary teachers. Topics will be selected from areas such as mathematics of finance, probability, statistics, linear programming and theory of games, intuitive topology, recreational math, computers and applications of mathematics. This course may be taken for graduate credit for certification renewal by secondary school teachers. Credit towards a graduate degree may be allowed only for students in mathematics education.

MA 511 Advanced Calculus I. *Preq.: MA 301. May not be taken for credit by undergrad. mathematics majors. 3(3-0) F,S,Sum.* Fundamental theorems on continuous functions; convergence theory of sequences, series and integrals; the Riemann integral.

MA 512 Advanced Calculus II. *Preq.: MA 301. 3(3-0) F,S,Sum.* General theorems of partial differentiation; implicit function theorems; vector calculus in 3-space; line and surface integrals; classical integral theorems.

MA 513 Introduction to Complex Variables. *Preq.: MA 202. 3(3-0) F,S,Sum.* Operations with complex numbers, derivatives, analytic functions, integrals, definitions and properties of elementary functions, multivalued functions, power series, residue theory and applications, conformal mapping.

MA 514 Methods of Applied Mathematics. *Preq.: MA 511 or 425. 3(3-0) S.* Introduction to integral equations, the calculus of variations and difference equations.

MA 515 Linear Functional Analysis I. *Preq.: MA 426. 3(3-0) F.* Metric spaces; Lebesgue measure and integration; L^p and l^p spaces; Riesz-Fischer and Riesz representation theorems; normed linear spaces and Hilbert spaces.

MA 516 Linear Functional Analysis II. *Preq.: MA 515. 3(3-0) S.* Basic theorems in Banach spaces, dual spaces, weak topologies; basic theorems in Hilbert spaces and detailed theory of linear operators on Hilbert spaces; spectral theorem for self-adjoint completely continuous linear operators.

MA 517 Introduction to Topology. *Preq.: MA 426. 3(3-0) F.* Sets and functions, metric spaces, topological spaces, compactness, separation, connectedness.

MA 518 Calculus on Manifolds. *Preq.: MA 426. 3(3-0) S.* Calculus of several variables from a modern viewpoint. Differential and integral calculus of several variables, vector functions, integration of manifolds, Stokes' and Green's theorems, vector analysis.

MA 520 Linear Algebra. *Preq.: MA 405. 3(3-0) F.* Vector spaces, linear mappings and matrices, determinants, inner product spaces, bilinear and quadratic forms, canonical forms, spectral theorem.

MA 521 Fundamentals of Modern Algebra. *Preqs.: MA 403 and 520. 3(3-0) S.* Groups, normal subgroups, quotient groups, Cayley's theorem, Sylow's theorem. Rings, ideals and quotient rings, polynomial rings. Fields, extension fields, elements of Galois theory.

MA 524 Mathematical Methods in the Physical Sciences I. *Preqs.: MA 405, 511 and either MA 401 or 501. 3(3-0) F.* Green's functions and two-point boundary value problems; elementary theory of distributions; generalized Green's functions. Finite and infinite dimensional inner product spaces; Hilbert spaces; completely continuous operators; integral equations; the Fredholm alternative; eigenfunction expansions; applications to potential theory. Nonsingular and singular Sturm-Liouville problems; Weil's theorem.

MA 525 Mathematical Methods in the Physical Sciences II. *Preq.: MA 524. 3(3-0) S.* Distribution theory in n-space; Fourier transforms; partial differential equations, generalized solutions, fundamental solutions, Cauchy problem, wave and heat equations, well-set problems. Laplace's equation, the Dirichlet and Neumann problems, integral equations of potential theory, Green's functions, eigenfunction expansions.

MA (CSE) 529, 530 Numerical Analysis I, II. *Preqs.: (529) MA 405, MA 511 or equivalents, knowledge of a high level computing language; (530) MA 529. 3(3-0) F,S.* A practical survey of numerical analysis for graduate students in the engineering, physical and mathematical sciences. Topics chosen from: iterative methods for nonlinear equations, approximation theory, numerical solution of ordinary and partial differential equations, numerical linear algebra. Computing assignments illustrate algorithm behavior and applicability.

MA (E, OR) 531 Dynamic Systems and Multivariable Control I. *3(3-0) F.* (See operations research.)

MA 532 Theory of Ordinary Differential Equations. *Preqs.: MA 301, 405, advanced calculus. 3(3-0) S.* Existence and uniqueness theorems, systems of linear equations, fundamental matrices, matrix exponential, series solutions, regular singular point; plane autonomous systems, stability theory.

MA 534 Introduction to Partial Differential Equations. *Preqs.: MA 425 or MA 511, MA 301. 3(3-0) F.* Theory of characteristics and classification of second order equations, existence, uniqueness and representation of solutions for the wave equation, Dirichlet and Neumann boundary-value problems for the Laplace equation, potential theory in two and higher dimensional domains, mean-value theorem and the maximum principle, Green's

identities, initial boundary-value problems of heat equation and wave equation. Maximum principle of parabolic equation, method of eigenfunction expansions, Fourier series and Fourier transforms.

MA (ST) 541 Theory of Probability I. *Preq.: MA 425 or 511. 3(3-0) F,Sum.* Axioms, combinatorial analysis, conditional probability, independence, random variables, expectation, special discrete and continuous distributions, probability and moment generating functions, central limit theorem, laws of large numbers, branching processes, recurrent events, random walk.

MA (ST) 542 Introduction to Stochastic Processes. *3(3-0) S.* (See statistics.)

MA 545 Set Theory and Foundations of Mathematics. *Preq.: MA 403. 3(3-0) S.* Logic and the axiomatic approach, the Zermelo-Fraenkel axioms and other systems, algebra of sets and order relations, equivalents of the Axiom of Choice, one-to-one correspondences, cardinal and ordinal numbers, the Continuum Hypothesis.

MA (PY) 555 Mathematical Introduction to Celestial Mechanics. *Preq.: MA 301. 3(3-0) F.* Central orbits, N-body problem, 3-body problem, Hamilton-Jacobi theory, perturbation theory, applications to motion of celestial bodies.

MA (PY) 556 Orbital Mechanics. *Preqs.: MA 301, 405, knowledge of elementary mechanics and computer programming. 3(3-0) S.* Keplerian motion, iterative solutions, numerical integration, differential corrections and space navigation, elements of probability, least squares, sequential estimation, Kalman filter.

MA (BMA, ST) 571 Biomathematics I. *3(3-0) F.* (See biomathematics.)

MA (BMA, ST) 572 Biomathematics II. *3(3-0) S.* (See biomathematics.)

MA 581 Special Topics. *Preq.: Consent of department. 1-6 F,S.*

MA (CSC) 582 Numerical Linear Algebra. *Preqs.: MA 405 or equivalent and a knowledge of computer programming. 3(3-0) F.* A mathematical and numerical investigation of direct, iterative and semi-iterative methods for the solution of linear systems. Methods for the calculation of eigenvalues and eigenvectors of matrices.

MA (CSC) 583 Numerical Solution of Ordinary Differential Equations. *Preq.: Knowledge to the level of CSC 427. 3(3-0) S.* Numerical methods for initial value problems including predictor-corrector, Runge-Kutta, hybrid and extrapolation methods; stiff systems; shooting methods for two-point boundary value problems; weak, absolute and relative stability results.

MA (CSC) 584 Numerical Solution of Partial Differential Equations—Finite Difference Methods. *Preqs.: MA 501; knowledge of a high level programming language. 3(3-0) F.* A survey of finite difference methods for partial differential equations including elliptic, parabolic and hyperbolic PDE's. Both linear and nonlinear problems are considered. Theoretical foundations are described; however, emphasis is placed on algorithm design and implementation.

MA (CSC, OR) 585 Graph Theory. *3(3-0) F.* (See computer science.)

MA (IE, OR) 586 Network Flows. *3(2-2) S.* (See industrial engineering.)

MA (CSC) 587 Numerical Solution of Partial Differential Equations—Finite Element Method. *Preqs.: MA 501; knowledge of a high level programming language. 3(3-0) S.* An introduction to the finite element method. Applications to both linear and nonlinear elliptic and parabolic partial differential equations. Theoretical foundations are described; however, emphasis is placed on agorithm design and implementation.

FOR GRADUATES ONLY

MA 600 Advanced Differential Equations I. *Preqs.: MA 513, 518, 520. 3(3-0) F. Alt. yrs.* Analytical theory of ordinary differential equations, stability theory, perturbations, asymptotic behavior, nonlinear oscillations.

MA 601 Advanced Differential Equations II. *Preq.: MA 600. 3(3-0) S. Alt. yrs.* Qualitative theory of ordinary differential equations, general properties of dynamical systems, limit sets, integral invariants, global theory.

MA 602 Partial Differential Equations I. *Preqs.: MA 426, 520, 532 or 600. 3(3-0) F. Alt. yrs.* First order equations, initial value problems; theory of characteristics; existence and uniqueness theorems; hyperbolic equations.

MA 603 Partial Differential Equations II. *Preq.: MA 602. 3(3-0) S. Alt. yrs.* Elliptic and parabolic equations; approximation methods; generalized solutions.

MA 604 Topology. *Preqs.: MA 515, 520. 3(3-0) S.* Topological spaces: separation axioms, compactness, connectedness, local topological properties; continuous mappings and convergence; product and quotient spaces; compactification; homotopy equivalence of mappings, fundamental groups, covering spaces, universal coverings, deck transformations.

MA (ST, OR) 606 Nonlinear Programming. *3(3-0) S.* (See statistics.)

MA (NE) 607 Exact and Approximate Solutions in Particle Transport Theory. *Preq.: MA 501 or MA 511. 3(3-0) S.* The method of elementary solutions is used to solve exactly basic problems in neutron-transport theory and related topics. In addition, the F_N method is developed and used to establish concise approximate solutions in the realm of particle transport theory.

MA 611 Analytic Function Theory I. *Preq.: MA 426. 3(3-0) F.* A rigorous introduction to the theory of functions of a complex variable. The complex plane, functions, Mobius transformations, the exponential and logarithmic functions, trigonometric functions, infinite series, integration in the complex plane, Cauchy's theorem and its consequences.

MA 612 Analytic Function Theory II. *Preq.: MA 611. 3(3-0) S.* A continuation of MA 611. Taylor and Laurent series. The residue theorem, the argument principle, harmonic functions and the Dirichlet problem, analytic continuation and the monodromy theorem, entire and meromorphic functions, the Weierstrass product representation and the Mittag-Leffler partial fraction representation, special functions, conformal mapping and the Picard theorem.

MA 613 Techniques of Complex Analysis. *Preq.: MA 513 or 611. 3(3-0) S.* A course dealing with the applications of complex analysis to mathematical problems in physical science in the setting of the potential equation and other partial differential equations: contour integrals, special functions of mathematical physics from the line integral point of view, solution of problems in potential theory, asymptotic methods including WKB and Wiener-Hopf techniques.

MA (OR) 614 Integer Programming. *3(3-0) S. Alt. yrs.* (See operations research.)

MA 615 Theory of Functions of a Real Variable. *Preq.: MA 516. 3(3-0) S.* Real functions, semicontinuity, upper and lower limits, sequences; Lebesgue measure and integration, absolute continuity and differentiation.

MA (ST) 617, 618 Measure Theory and Advanced Probability. *3(3-0) F,S.* (See statistics.)

MA (ST) 619 Topics in Advanced Probability. *3(3-0) F.* (See statistics.)

MA 620 Modern Algebra I. *Preq.: MA 521. 3(3-0) F. Alt. yrs.* A study of groups, rings and modules. Elements of homology. Polynomials, Noetherian rings, Algebraic extensions, Galois theory.

MA 621 Modern Algebra II. *Preq.: MA 620. 3(3-0) S. Alt. yrs.* A study of linear maps, bilinear forms, representations, multilinear products, semisimplicity and the representation of finite groups.

MA 622 Linear Transformations and Matrix Theory. *Preq.: MA 405. 3(3-0) F.* Vector spaces, linear transformations and matrices, minimal polynomials, elementary divisors, canonical forms, quadratic forms, functions of matrices.

MA 623 Theory of Matrices and Applications. *Preq.: MA 520 or 622. 3(3-0) S.* Generalized inverses, matrix equation, variational methods for eigenvalues, matrix norms, perturbation of linear systems, computational methods, applications to differential equations, Markov chains.

MA 626 Algebraic Topology. *Preq.: MA 605. 3(3-0) S. Alt. yrs.* Simplicial and singular homology and cohomology, the Eilenberg-Steenrod axioms, duality, cohomology operations; higher homotopy groups, Hurewicz homomorphisms.

MA (OR) 629 Vector Space Methods in System Optimization. *3(3-0) F.* (See operations research.)

MA (E, OR) 631 Dynamic Systems and Multivariable Control II. *3(3-0) S. Alt. yrs.* (See operations research.)

MA 632 Operational Mathematics I. *Preq.: MA 513 or 611. 3(3-0) F.* Laplace transforms with theory and application to ordinary and partial differential equations arising from problems in engineering and physics.

MA 633 Operational Mathematics II. *Preq.: MA 632. 3(3-0) S.* Extended development of the Laplace and Fourier transforms and their application to the solution of ordinary and partial differential equations, integral equations and difference equations; Z-transforms, other infinite and finite transforms and their applications.

MA 637 Differentiable Manifolds. *Preqs.: MA 405, 521; Coreq.: MA 604. 3(3-0) F. Alt. yrs.* An introduction to the topology and geometry of differentiable manifolds, multilinear algebra, exterior differential forms, differentiable manifolds, theory of connexions, Riemannian manifolds.

MA 647 Functional Analysis I. *Preq.: MA 516. 3(3-0) F. Alt. yrs.* Banach spaces; linear functionals; linear operators, uniform boundedness, open mapping and closed graph theorems; dual spaces; weak topologies.

MA 648 Functional Analysis II. *Preq.: MA 647. 3(3-0) S. Alt. yrs.* Advanced topics in functional analysis such as linear topological spaces; Banach algebra, spectral theory and abstract measure theory and integration.

MA 661 Differential Geometry and Tensor Analysis I. *Preq.: MA 426 or 512. 3(3-0) F. Alt. yrs.* Concepts of classical and modern differential geometry presented from the point of view of tensor analysis and differential forms. Topics to include: theory of curves, tensor analysis and differential forms, intrinsic geometry of surfaces, Riemannian geometry.

MA 662 Differential Geometry and Tensor Analysis II. *Preq.: MA 661. 3(3-0) S. Alt. yrs.* Continuation of MA 661.

MA 681 Special Topics in Real Analysis. *1-6.*

MA 682 Special Topics in Complex Analysis. *1-6.*

MA 683 Special Topics in Algebra. *1-6.*

MA 684 Special Topics in Combinatorial Analysis. *1-6.*

MA 685 Special Topics in Numerical Analysis. *1-6.*

MA 686 Special Topics in Topology. *1-6.*

MA 687 Special Topics in Geometry. *1-6.*

MA 688 Special Topics in Differential Equations. *1-6.*

MA 689 Special Topics in Applied Mathematics. *1-6.*

The subject matter in the special topics courses varies from year to year. The topics and instructors are announced well in advance by the department.

MA (IE, OR) 692 Special Topics in Mathematical Programming. *3(3-0) F,S,Sum.* (See industrial engineering.)

MA 697 Master's Project. *3(3-0) F,S,Sum.* Investigation of some topic in mathematics to a deeper and broader extent than is typically done in a classroom situation. For the applied mathematics student the topic will usually consist of a realistic application of mathematics to the student's minor area. A written and oral report on the project is required.

MA 699 Research. Credits Arranged. Individual research in mathematics.

Mathematics and Science Education

For a listing of graduate faculty and departmental information, see mathematics and science education under education.

Mechanical and Aerospace Engineering

GRADUATE FACULTY

Professor J. A. Bailey, *Head*

Professor J. N. Perkins, *Associate Department Head (Aerospace Engineering)*

Professor J. A. Edwards, *Associate Department Head (Mechanical Engineering)*

Professor J. C. Mulligan, *Graduate Administrator*

Professors: E. M. Afify, F. R. DeJarnette, T. A. Dow, J. A. Edwards, W. C. Griffith, F. J. Hale, F. D. Hart, H. A. Hassan, T. H. Hodgson, C. J. Maday, M. N. Ozisik, J. N. Perkins, L. H. Royster, F. O. Smetana, F. Y. Sorrell, C. F. Zorowski; *Visiting Professors:* M. M. Fikry, S. A. Jurovics; *Adjunct Professors:* R. L. Bradow, C. T. Crowe, D. L. Dwoyer, D. E. Klett, E. R. McClure; *Professors Emeriti:* R. A. Burton, M. H. Clayton, J. S. Doolittle, B. H. Garcia Jr., J. K. Whitfield, J. Woodburn; *Associate Professors:* M. A. Boles, M. D. Bryant, A. C. Eberhardt, H. M. Eckerlin, R. R. Johnson, R. F. Keltie, C. Kleinstreuer, J. W. Leach, D. S. McRae, R. T. Nagel, J. S. Strenkowski, S. Torquato; *Adjunct Associate Professors:* J. P. Archie Jr., R. W. Barnwell, J. F. Campbell, P. B. Corson, R. M. Hall, D. L. Margolis, D. W. Moon, D. M. Rao; *Assistant Professors:* J. W. David, J. W. Eischen, R. D. Gould, E. C. Klang, L. M. Silverberg, C. E. Spiekermann; *Adjunct Assistant Professors:* J. A. Daggerhart, P. A. Gnoffo, J. H. Hebrank, A. L. Patra

The Department of Mechanical and Aerospace Engineering offers graduate study leading to the Master of Mechanical Engineering, Master of Science and Doctor of Philosophy degrees. Entrance to the degree programs is based upon a pertinent, accredited baccalaureate degree.

Graduate study and research are available in the following areas:

(1) thermal sciences including classical and statistical thermodynamics, energy conservation and conversion, solar energy, alternative energy sources, heat and mass transfer; energy systems;

(2) sound and vibration technology including acoustic radiation, industrial and community noise control, transportation noise and hearing conservation, acoustic signal processing and computer vibration analysis;

(3) gas dynamics including subsonic, transonic, supersonic and hypersonic aerodynamics, lasers, plasmagasdynamics and combustion;

(4) computational fluid dynamics for inviscid flows, boundary layers and parabolized and complete Navier-Stokes equations for external and internal flows, grid generation;

(5) aerospace sciences including aeroelasticity, stability and control and aerospace propulsion; aerospace structures;

(6) mechanical sciences including machine vibrations, mechanical transients, materials processing, photoelasticity and experimental stress analysis, finite element analysis and transportation systems and vehicle safety; automatic control of active structures; design optimization;

(7) mechanical design, precision engineering and tribology;

(8) computer-aided design with dedicated graphics work stations, advanced interactive software and a dedicated VAX 11/785 computer.

Extensive laboratory facilities include subsonic and supersonic wind tunnels; extensive sound and vibration laboratories including anechoic chambers, a large reverberation room, a machinery noise laboratory with field test and analysis instrumentation, a signal processing laboratory, a computer graphics and vibration analysis laboratory using a Nicolet 6602 structural analysis system and a Tektronix 4114 terminal for finite-element analysis, a materials processing laboratory; an experimental stress analysis and photoelasticity laboratory; an aeroelasticity laboratory; automotive performance and emission control facility;

a solar energy house and laboratory; a heat transfer laboratory; a precision engineering laboratory; and an applied energy research laboratory.

Computational facilities include VAX 11/785 and IBM 3081 computers, micro and array processors, minicomputers and terminals connected to the computational facilities at NASA Langley Research Center.

The objective of the department is to provide graduate education both in rigorous experimental and theoretical research training and practitioner-oriented engineering design.

SELECTED ADVANCED UNDERGRADUATE COURSES

MAE 403 Air Conditioning. *Preq.: MAE 302. 3(3-0) F.*

MAE 404 Refrigeration. *Preq.: MAE 302. 3(3-0) S.*

MAE 405 Mechanical Engineering Laboratory III. *Preq.: MAE 306. 1(0-3) F,S.*

MAE 406 Energy Conservation in Industry. *Preqs.: MAE 301 or 307; jr. or sr. status in engineering. 3(2-3) F.*

MAE 407 Steam and Gas Turbines. *Preqs.: MAE 302, MAE 308, or MAE 355. 3(3-0) S.*

MAE 408 Internal Combustion Engine Fundamentals. *Preq.: MAE 302. 3(3-0) F.*

MAE 409 Particulate Control in Industrial Atmospheric Pollution. *Preq.: MAE 301 or equivalent. 3(3-0) F.*

MAE 410 Convective Heat Transfer and Fluid Flow. *Preqs.: MAE 301, MAE 308. 3(3-0) F.*

MAE 411 Machine Component Design. *Preqs.: MAE 315, 316. 3(3-0) F.*

MAE 412 Energy Systems. *Preqs.: MAE 302, MAE 410. 3(3-0) S.*

MAE 415 Mechanical Engineering Analysis. *Preqs.: MAE 302, 315, 316, EE 331. 3(3-0) F.*

MAE 416 Mechanical Engineering Design. *Preqs.: MAE 302, 315, 316, EE 331. 4(3-2) S.*

MAE 431 Thermodynamics of Compressible Fluid Flow. *Preqs.: MAE 301, MA 301, MAE 308. 3(3-0) S.*

MAE 435 Principles of Automatic Control. *Preq.: MA 301. 3(3-0) F,S.*

MAE 442 Automotive Engineering. *Preq.: Sr. in Engineering. 3(3-0) S.*

MAE 452 Aerodynamics of V/STOL Vehicles. *Preq.: MAE 355. 3(3-0) F.*

MAE 455 Boundary Layer Theory. *Preq.: MAE 355. 3(3-0) F.*

MAE 456 Computational Methods in Aerodynamics. *Preq.: CSC 302 and MAE 455. 3(3-0) S. Alt. yrs.*

MAE 462 Flight Vehicle Stability and Control. *Preqs.: MAE 261, 435. 3(3-0) F.*

MAE 465 Propulsion II. *Preq.: MAE 365. 4(3-3) F.*

MAE 466 Propulsion II Laboratory. *Preqs.: MAE 365; MAE 357; Coreq.: MAE 465. 1(0-3) F.*

MAE 472 Aerospace Vehicle Structures II.*2Preq.: MAE 371. 4(3-3) S.*

MAE 473 Aerospace Vehicle Structure II Laborabory. *Preq.: MAE 371; Coreq.: MAE 472. 1(0-3) S.*

MAE 478 Aerospace Vehicle Design I. *Preqs.: MAE 356, 472; Coreqs.: MAE 462, 465. 2(2-0). F.*

MAE 479 Aerospace Vehicle Design II. *Preq.: MAE 478. 3(1-6) S.*

MAE 495 Special Topics in Mechanical and Aerospace Engineering. *1-3 F,S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

MAE 501 Advanced Engineering Thermodynamics. *Preqs.: MAE 302; MA 401 or MA 511. 3(3-0) F.* Thermodynamics of a general reactive system; conservation of energy and the principles of increase of entropy; the fundamental relation of thermodynamics; Legendre transformations; equilibrium and stability criteria in different representation; general relations; chemical thermodynamics; multi-reaction system; ionization; irreversible thermodynamics; the Onsager relation; applications to thermoelectric, thermomagnetic and diffusional processes.

MAE 502 Advanced Energy Systems. *Preq.: MAE 412. 3(3-0) S.* An engineering examination of energy sources, both conventional and proposed. Review of existing energy conversion systems and a critical examination of advanced systems, such as magnetohydrodynamics, fuel cells, solar, geothermal, wind, tides, thermal gradients in oceans and the hydrogen economy.

MAE 503 Advanced Power Plants. *Preq.: MAE 412. 3(3-0) F.* A critical analysis of the energy balance of thermal power plants, thermodynamics and economic evaluation of alternate schemes of development; study of recent development in the production of power.

MAE 504 Fluid Dynamics of Combustion I. *Preqs.: MAE 301, MAE 355 or MAE 308. 3(3-0) F.* Gas-phase thermochemistry including chemical equilibrium and introductory chemical kinetics. Homogeneous reaction phenomena. Subsonic and supersonic combustion waves in premixed reactants (deflagration and detonation). Effects of turbulence. Introduction to diffusion flame theory.

MAE 505 Heat Transfer Theory and Applications. *Preq.: MAE 410 or equivalent. 3(3-0) F.* Development of basic equations for steady and transient heat and mass transfer processes. Emphasis is placed on the application of the basic equations to engineering problems in the areas of conduction, convection, mass transfer and thermal radiation.

MAE 506 Advanced Automotive Energy Systems. *Preq.: MAE 408. 3(3-0) S.* A critical study of the various cycles and energy systems for automotive transportation is carried out. The feasibility of automotive Rankine cycle power plants, Sterling engines, gas turbines and hydrogen-air fueled engines are discussed. Means of improving the efficiency and exhaust emissions of internal combustion engines and the use of alternative fuel sources are considered.

MAE 510 Effects of Noise and Vibration on Man. *Preqs.: Sr. standing in Engineering, MA 301. 3(3-0) F. Alt. yrs.* Study of the effects of noise and vibration on man. Topics covered include acoustic and vibration fundamentals, auditory and non-auditory response to noise, subjective response to noise, environment noise, body physical characteristics, effects of vibration and shock exposure.

MAE 513 Vibration of Mechanical and Structural Components. *Preq.: MAE 315 or 472. 3(3-0) F.* Modeling of mechanical and structural systems for vibration analysis and presentation of exact and approximate solution techniques. Techniques of vibration control are presented and experience on the digital computer is provided.

MAE 514 Industrial Noise Control. *Preq.: MAE 315. 3(2-3) S.* Provides definition of the industrial noise problem, development of analytical problem solving skills, introduction to instrumentation, involvement in design project, laboratory demonstrations.

MAE 517 Instrumentation in Sound and Vibration Engineering. *Preq.: ECE 331; Coreq.: MAE 513. 3(3-0) S.* This course is devoted to a presentation of measurement techniques and the theory and operation of transducers and amplifiers. An introduction to signal analysis techniques such as power spectral density and correlation is also provided.

MAE 518 Acoustic Radiation I. *Preqs.: MA 301 and MAE 308 or MAE 356. 3(3-0) F.* An introduction to the principles of acoustic radiation from vibrating bodies and their related fields. The radiation of simple sources, the propagation of sound waves in confined spaces and transmission through different media are considered.

MAE 519 Theory of Noise in Transportation Systems. *Preq.: MAE 550. 3(3-0) S.* A study of the basic noise generating mechanisms encountered in transportation systems. Coverage includes jet noise, propeller noise, helicopter noise, fan and compressor noise, aircraft induced community noise, surface vehicle noise models and efforts to control noise in transportation systems.

MAE (IE) 520 Industrial Robotics. *3(3-0) F.* (See industrial engineering.)

MAE 525 Advanced Flight Vehicle Stability and Control. *Preq.: MAE 462. 3(3-0) F.* Preliminary analysis and design of flight control systems to include autopilots and stability augmentation systems. Study of effects of inertial cross-coupling and nonrigid bodies on vehicle dynamics.

MAE 526 Inertial Navigation Analysis and Design. *Preq.: MAE 435 or 462. 3(3-0) S.* Performance analysis and engineering design of inertial navigation components, subsystems and systems. Development of transfer functions and application of linear system techniques to determine stability, transient response and errors of gyroscopes, accelerometers, stable platforms and inertial alignment systems. Error analysis and its significance. Preliminary analysis and design of typical inertial navigation systems for aircraft and marine vehicles.

MAE (MAT) 531 Materials Processing by Deformation. *Preq.: Six hours of solid mechanics and/or materials. 3(3-0) F.* The course involves a presentation of the mechanical and metallurgical fundamentals of materials processing by deformation. Topics to be discussed include: principles of metal working, friction, forging, rolling, extrusion, drawing, high energy rate forming, chipless forming techniques, manufacturing system concept in production.

MAE (MAT) 532 Fundamentals of Metal Machining Theory. *Preq.: Six hours of solid mechanics and/or materials. 3(3-0) S.* The course involves a presentation of the mechanical and metallurgical fundamentals of metal machining. Topics to be discussed include: mechanics of machining, temperatures generated, tool life and tool wear, lubrication, grinding process, electrical machining processes, surface integrity, economics, nomenclature of cutting tools.

MAE 533 Finite Element Analysis of Mechanical and Aeronautical Systems I. *Preq.: MAE 472; Coreq.: MAE 415. 3(3-0) F.* Concepts and applications of the finite element method for stress and deformation analysis. Explanation and application of a general purpose finite element program for stress and deformation analysis of simple structures and load-carrying components.

MAE 534 Finite Element Analysis of Mechanical and Aeronautical Systems II. *Preq.: MAE 533. 3(3-0) S.* This course extends the finite element study, initiated in MAE 533, for stress analysis to other fields of interest in mechanical and aerospace engineering. Topics considered include vibration and frequency analysis, heat transfer and potential flow. Two topics of advanced stress analysis, thin shells and the bending of plates, are also included.

MAE 535 Experimental Stress Analysis. *Preq.: MAE 316 or 371. 3(2-3) F.* Theoretical and experimental techniques of strain and stress analysis with emphasis on electrical strain gages and instrumentation, brittle coatings, grid methods and an introduction to photoelasticity. Laboratory includes an investigation and complete report of a problem chosen by the student under the guidance of the instructor.

MAE 536 Photoelasticity. *Preq.: MAE 316 or 371. 3(2-3) S. Alt. yrs.* Theory and experimental techniques of two- and three-dimensional photoelasticity including photoelastic coatings, photoplasticity and an application of photoelastic methods to the determination of stress-strain distributions in loaded members. Laboratory includes an investigation and complete report of a problem chosen by the student under the guidance of the instructor.

MAE 540 Advanced Air Conditioning Design. *Preqs.: MAE 403, 404. 3(3-0) S.* The design of heating and air-conditioning systems; the preparation of specifications and performance tests on heating and air-conditioning equipment.

MAE 541 Advanced Machine Design I. *Preq.: MAE 416. 3(3-0) F.* An advanced integrated treatment of stress analysis and materials engineering devoted to current rational methods of analysis and design applicable to mechanical components. Primary attention placed on the determination and prediction of strength, life and deformation characteristics of machine components as dictated by performance requirements.

MAE 542 Mechanical Design for Automated Assembly. *Preq.: Grad. standing or PBS status in engineering. 3(3-0) F.* Mechanical design principles important in high volume production using modern automated assembly technology. Production and component design for ease of assembly as dictated by part handling, feeding, orientation, insertion and fastening requirements. Existing product evaluation and redesign for improved assemblage.

MAE 550 Foundations of Fluid Dynamics. *Preqs.: MAE 301, MAE 355 or MAE 308. 3(3-0) F.* Review of basic thermodynamics pertinent to gas dynamics. Detailed development of the general equations governing fluid motion in both differential and integral forms. Simplification of the equations to those for specialized flow regimes. Similarity parameters. Applications to simple problems in various flow regimes.

MAE 551 Airfoil Theory. *Preq.: MAE 355. 3(3-0) S.* Development of fundamental aerodynamic theory. Emphasis upon mathematical analysis and derivation of equations of motion, airfoil theory and comparison with experimental results. Introduction to supersonic flow theory.

MAE 552 Transonic Aerodynamics. *Preq.: MAE 356. 3(3-0) S.* A detailed study of the latest theoretical and experimental findings in transonic aerodynamics, including two-dimensional and axisymmetric flows.

MAE 553 Compressible Fluids. *Preq.: MAE 356 or MAE 431 or MAE 550. 3(3-0) F. Alt. yrs.* Equations of motion in supersonic flow. Prandtl-Meyer turns, method of characteristics, hodograph plane, supersonic wind tunnels, supersonic airfoil theory and boundary layer shock interaction.

MAE 554 Hypersonic Aerodynamics. *Preq.: MAE 356. 3(3-0) F.* A detailed study of the latest theoretical and experimental findings in hypersonic aerodynamics.

MAE 555 Aerodynamic Heating. *Preq.: MAE 356. 3(3-0) F.* A detailed study of the latest theoretical and experimental findings of the compressible laminar and turbulent boundary layers with special attention to the aerodynamic heating problem. Application of theory in the analysis and design of aerospace hardware.

MAE 556 Mechanics of Ideal Fluids. *Preq.: MAE 355 or MAE 308. 3(3-0) S.* Fundamental principles of fluid dynamics. Mathematical methods of analysis are emphasized. Potential flow theory development with introduction to the effects of viscosity and compressibility. Two-dimensional and three-dimensional phenomena are considered.

MAE 557 Dynamics of Internal Fluid Flow. *Preq.: MAE 356 or MAE 308. 3(3-0) F.* A general development of the governing equations of fluid motion with subsequent restriction to incompressible flow. Exact and approximate solutions of the Navier-Stokes equations for internal laminar flow and elementary boundary layer theory. Applications include: hydrodynamic lubrication, converging-diverging channel flows, entrance flows and turbulent internal flow.

MAE 558 Plasmagasdynamics I. *Preqs.: MAE 356, PY 414. 3(3-0) F.* Study of basic laws governing plasma motion for dense and rarefied plasmas, hydromagnetic shocks, plasma waves and instabilities, simple engineering applications.

MAE 559 Molecular Gas Dynamics I. *Preq.: MAE 550. 3(3-0) F.* Statistical mechanics as applied to the derivation of the equations of gas dynamics from the microscopic viewpoint. Collision processes, treatments of viscosity, heat conduction and electrical conductivity.

MAE 560 Computational Fluid Mechanics and Heat Transfer. *Preqs.: MA 501 or MA 512, MAE 550 or MAE 557, 3(3-0) S.* Introduction to the integration of the governing partial differential equations of fluid flow and heat transfer by numerical finite difference means. Methods are developed for parabolic, hyperbolic and elliptical equations and applied to model equations. Error analysis and physical considerations are emphasized.

MAE 561 Wing Theory. *Preq.: MAE 551. 3(3-0) S. Alt. yrs.* Inviscid flow fields over wings in subsonic flow are discussed. Vortex lattice methods, lifting surface theories and panel methods are developed for wings with attached flow and leading-edge separation. Aerodynamic characteristics are calculated and the effects of planform and airfoil shapes are determined.

MAE (MEA) 563 Geophysical Fluid Mechanics. *3(3-0) F. Alt. yrs.* (See marine, earth and atmospheric sciences.)

MAE (ECE) 565 Gas Lasers. *Preqs.: MAE 356 or equivalent, PY 407. 3(3-0) F.* Study of the principles, design and potential application of ion, molecular, chemical and atomic gas lasers.

MAE 570 Theory of Particulate Collection in Air Pollution Control. *Preq.: MAE 409 or grad. standing. 3(3-0) S.* Particulate matter is classified and its properties are described. The motion of particles as applied to particulate collection is carefully analyzed. The elements of aerodynamic capture of particles are developed and applications in filtration and liquid scrubbing are considered. Fundamentals of acoustical, electrostatic and thermal precipitation are introduced. Sampling techniques and instrumentation are also considered.

MAE 586 Project Work in Mechanical Engineering. *1-6 F,S.* Individual or small group investigation of a problem stemming from a mutual student-faculty interest. Emphasis is placed on providing a situation for exploiting student curiosity.

MAE 589 Special Topics in Mechanical Engineering. *Preq.: Advanced undergrad. or grad. standing. 3(3-0) F,S.* Faculty and student discussions of special topics in mechanical engineering.

FOR GRADUATES ONLY

MAE 601 Statistical Thermodynamics. *Preq.: MAE 501. 3(3-0) S.* The conclusions of classical thermodynamics are analyzed and established from the microscopic viewpoint. Relationship of thermodynamics and transport properties of a substance of microscopic structure. Topics include: perfect and imperfect gases, dense fluids, critical-point theory, kinetic theory and properties of disordered composite media.

MAE 603 Advanced Direct Energy Conversion. *Preq.: MAE 501. 3(3-0) F.* An engineering study of the modern developments in the field of conversion of heat to power in order to meet new technology demands. Thermoelectric, thermomagnetic, thermionic, photovoltaic and magneto-hydrodynamic effects and their utilization for energy conversion purposes, static and dynamic response, limitations imposed by the first and second laws of thermodynamics. Energy and entropy balances, irreversible sources, inherent losses, cascading, design procedures, experimental studies to determine the response and efficiency of various systems.

MAE 604 Fluid Dynamics of Combustion II. *Preq.: MAE 504. 3(3-0) S.* Advanced theory of detonation and deflagration. Ignition criteria. Direct initiation of detonation including blast-wave theory. Transition from deflagration to detonation. Combustion wave structure and stability. Liquid droplet and solid particle combustion.

MAE 608 Advanced Conductive Heat Transfer. *Preq.: MAE 505. 3(3-0) S.* A generalized treatment of the solution of transient and steady heat conduction in finite and infinite regions. Approximate and exact methods of solution of problems involving phase change, variable thermal properties and non-linear boundary conditions. Heat conduction in composite media and in anisotropic solids.

MAE 609 Advanced Convective Heat Transfer. *Preq.: MAE 557. 3(3-0) S.* Advanced topics in steady and transient, natural and forced convective heat transfer for laminar and turbulent flow through conduits and over surfaces. Mass transfer in laminar and turbulent flow is also covered. Topics on compressible flow with heat and mass transfer are included.

MAE 610 Advanced Radiative Heat Transfer. *Preq.: MAE 505. 3(3-0) F.* A comprehensive and unified treatment of basic theories; exact and approximate methods of solution of radiative heat transfer and the interaction of radiation with conductive and convective modes of heat transfer in participating and non-participating media.

MAE 612 Dynamics of Space Structures. *Preq.: MAE 513 or equivalent. 3(3-0) F.* Provides fundamental background in the area of dynamics of complex space structures such as large antennas and rotating spacecraft and platforms. Vibration of discrete structures, computational methods for the eigensolution, vibration of distributed structures, discretization methods including finite element method and substructure synthesis.

MAE 614 Mechanical Transients and Machine Vibrations. *Preq.: MAE 513. 3(3-0) S.* Forces and motions produced in mechanical systems by periodic transient inputs including shock and impact loading. Application to lumped mass and continuous systems including plates and shells.

MAE 615 Nonlinear Vibrations. *Preq.: MAE 513. 3(3-0) S. Alt. yrs.* A study of free and forced vibrations of non-linear systems with non-linear restoring forces and self-sustained oscillations. Various analytical and phase plane methods are developed and used in obtaining actual solutions. Emphasis is placed on understanding properties unique to non-linear systems.

MAE 618 Acoustic Radiation II. *Preq.: MAE 518. 3(3-0) S.* Advanced treatment of the theory of sound generation and transmission. Topics include: techniques for solution of the wave equation, radiation from spheres, cylinders and plates, sound propagation in ducts, scattering.

MAE 619 Random Vibration. *Preq.: MAE 513. 3(3-0) F. Alt. yrs.* Mathematical description of stochastic processes. The stationary and ergodic assumptions and response analysis of mechanical systems to random excitation. Simulation of and failure due to random environments.

MAE 623 Mechanics of Machinery. *Preqs.: MAE 315, MA 512. 3(3-0) S. Alt. yrs.* Advanced applications of dynamics to the design and response analysis of dynamic behavior of machines and mechanical devices. Emphasis on developing competence in transforming real problems in dynamics into appropriate mathematical models whose analysis permits performance predictions of engineering value.

MAE 640 Advanced Machine Design II. *Preqs.: MAE 541 and CI. 3(3-0) S.* A continuation, at the advanced level, of MAE 541, Advanced Machine Design I.

MAE 642 Mechanical Design Analysis. *Preq.: Nine hours of graduate credit in MAE. 3(3-0) F.* Lecture and project activity devoted to development of the ability to apply knowledge and experience in performing comprehensive design analysis of complete mechanical systems. Areas of interest to include critical problem recognition, system modeling, performance determination and optimization and reliability evaluation.

MAE 643 Mechanical Design Synthesis. *Preq.: MAE 642. 3(2-2) S.* Application of the basic philosophy and methodology of the complete design process to advanced mechanical system design. Individual and group experience in the conception, synthesis, analysis, optimization and implementation phases of feasibility, preliminary and final design studies; provided by means of comprehensive system design projects.

MAE 654 Dynamics of Real Fluids I. *Preq.: MAE 550 or 557. 3(3-0) S.* Exact solutions to the Navier-Stokes equations. Approximate solutions for low Reynolds numbers. Approximate solutions for high Reynolds numbers—incompressible boundary layer theory. Laminar and turbulent boundary layers in theory and experiment. Flow separation.

MAE 655 Dynamics of Real Fluids II. *Preq.: MAE 654. 3(3-0) F.* A continuation of MAE 654. Compressible laminar and turbulent boundary layers. Laminar and turbulent jets. The stability of laminar boundary layers with respect to small disturbances, transition from laminar to turbulent flow.

MAE 656 Turbulence. *Preq.: MAE 550. 3(3-0) S.* A development of the basic concepts and governing equations for turbulence and turbulent field motion. Formulations of the various correlation tensors and energy spectra for isotropic and nonisotropic turbulence. An introduction to turbulent transport processes, "free" turbulence, and "wall" turbulence.

MAE 658 Plasmagasdynamics II. *Preq.: MAE 558. 3(3-0) S.* Quantum statistics and ionization phenomena. Charged particle interactions. Transport properties in the presence of electric and magnetic fields and nonequilibrium ionization.

MAE 659 Molecular Gas Dynamics II. *Preqs.: MAE 559, 601. 3(3-0) S.* A continuation of MAE 559. Approximate methods of solution to the Boltzmann equation. Modeling of the Boltzmann equation. Results obtained by the various methods of analysis.

MAE 660 Computational Fluid Dynamics. *Preq.: MAE 560. 3(3-0) F.* Advanced computational methods for integrating by use of finite differences the non-linear governing equations of fluid flow; the Euler equations, the boundary layer equations and the Navier-Stokes equations. Topics from the current literature are covered.

MAE 661 Introduction to Rocket Propulsion. *Preq.: MAE 501. 3(3-0) F.* Review of the exterior ballistics and performance of rocket-propelled vehicles. Thermodynamics of real gases at high temperatures. Nonequilibrium flow in rocket nozzles.

MAE 662 Chemical Propulsion. *Preq.: MAE 661. 3(3-0) S. This course will cover solid or liquid propellant rockets, and deal* Depending upon student interest, with combustion of propellants, combustion instabilities and the design and performance of solid or liquid propellant engines.

MAE (MEA) 663 Advanced Geophysical Fluid Mechanics. *3(3-0) S. Alt. yrs.* (See marine, earth and atmospheric sciences.)

MAE (MEA) 664, 665 Perturbation Method in Fluid Mechanics I, II. *3(3-0) F,S.* (See marine, earth and atmospheric sciences.)

MAE 686 Advanced Topics in Mechanical Engineering. *Preq.: Grad. standing. 1-3 F,S.* Faculty and graduate student discussions of advanced topics in contemporary mechanical engineering.

MAE 695 Mechanical Engineering Seminar. *1(1-0) F,S.* Faculty and graduate student discussions centered around current research problems and advanced engineering theories.

MAE 699 Mechanical Engineering Research. *Preqs.: Grad. standing in mechanical engineering, consent of adviser. Credits Arranged.* Individual research in the field of mechanical engineering.

Microbiology

GRADUATE FACULTY

Professor L. W. Parks, *Head*

Associate Professor T. Melton, *Graduate Administrator*

Professors: W. J. Dobrogosz, G. H. Elkan, J. J. Perry; *Adjunct Professor:* R. E. Kanich; *Professor Emeritus:* J. B. Evans; *Associate Professors:* R. E. Johnston, G. H. Luginbuhl, J. M. Mackenzie Jr.; *Associate Professor (USDA):* P. E. Bishop; *Adjunct Associate Professor:* K. T. Kleeman; *Adjunct Assistant Professor:* W. S. Dallas

ASSOCIATE MEMBERS OF THE DEPARTMENT

Professors: P. B. Hamilton, W. E. Kloos, J. G. Lecce; *Associate Professors:* E. V. De Buysscher, H. M. Hassan, T. R. Klaenhammer; *Assistant Professors:* P. M. Foegeding, F. J. Fuller, P. E. Orndorff

The Department of Microbiology offers programs leading to the Master of Science and Doctor of Philosophy degrees. These are research oriented programs that require a dissertation based on personal research. For students wishing a more general education without the thesis requirement, the Master of Life Sciences degree is offered with an emphasis in microbiology.

Applicants should have a bachelor's degree in one of the biological or physical sciences including at least one course in microbiology and courses in organic chemistry and calculus. Deficiencies may be made up while in graduate school but will not be counted as credit toward a graduate degree.

There are no specific departmental requirements regarding courses of study. There is a core of basic courses in microbiology that will be in the programs of most graduate students who have not had equivalent courses previously. As many as half of the courses in most programs will be basic courses in related areas such as biochemistry, chemistry, genetics or toxicology.

At least one semester of half-time teaching experience is required of all Ph.D. candidates. All graduate students are expected to attend and participate in the seminar program every semester they are in residence. As a general rule the M.S. program requires two full years (including summers) beyond the B.S. level and the Ph.D. program requires two or three full years beyond the M.S. level.

SELECTED ADVANCED UNDERGRADUATE COURSES

MB 401 General Microbiology. *Preqs.: BS 100; CH 223 or CH 220. 4(3-3) F,S.*

MB (FS) 405 Food Microbiology. *Preq.: MB 401. 3(2-3) F.*

MB 411 Medical Microbiology. *Preq.: MB 401. 4(3-3) S.*

MB 490 Special Topics in Microbiology. *Preqs.: Three courses in MB and CI. 1-3 F,S,Sum.*

MB 491 Seminar in Microbiology. *Preq.: Jr. standing. 1(1-0) F.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

MB 501 A,B,C Advanced Microbiology I (A-Metabolism; B-Physiology; C-Immunology). *Preq.: MB 401. 1-3 F.* Basic concepts and principles of three major areas of microbiology presented as a series of five-week minicourses: MB 501A, metabolism; MB 501B, physiology; MB 501C, immunology. Graduate students majoring in microbiology must take all sections or have equivalent knowledge. Others may enroll for specific minicourses.
Hassan, Lecce, Parks

MB 502A,B,C Advanced Microbiology II (A-Systematics; B-Virology; C-Pathogenesis). *Preq.: MB 401. 1-3 S.* Basic concepts and principles of three major areas of microbiology presented as a series of five-week minicourses: MB 502A, systematics; MB 502B, virology; MB 502C, pathogenesis. Graduate students majoring in microbiology must take all sections or have equivalent knowledge. Others may enroll for specific minicourses.
Elkan, Johnston, Luginbuhl

MB 503 Microbial Ecology. *Preq.: MB 401. 3(2-3) F.* An integrated treatment of all aspects of biological changes in habitats brought about by microorganisms. The physiological and biochemical approach will be stressed. Elkan

MB (FS) 506 Advanced Food Microbiology. *3(1-6) S.* (See food science.)

MB 511 Industrial Microbiology. *Preqs.: BCH 451 and MB 401. 1(1-0) S.* Concepts, principles and procedures involved in the industrial production of useful chemicals by microbial fermentation. Screening methods for selection and evaluation of inoculum cultures, the potential role of genetic engineering and practical considerations in implementing a profitable fermentation process will be discussed, with examples from currently operational fermentations. Perry

MB 514 Microbial Metabolic Regulation. *Preqs.: MB 401, BCH 451 or BCH 551. 3(3-0) S.* An integrative perspective on bacterial physiology and metabolism through an analysis of metabolic regulatory functions. Dobrogosz

MB (SSC) 532 Soil Microbiology. *4(3-3) S.* (See soil science.)

MB 551 Immunology. *Preq.: MB 501C or equivalent. 3(3-0) S.* Principles of the immune mechanism of man and animals; interactions between cells of the immune system and their genetic basis; the molecular basis of the generation of diversity and selective processes in the immune system. Graduate Staff

MB (ZO) 555 Protozoology. *4(2-6) S.* (See zoology.)

MB (BAE, CE) 570 Sanitary Microbiology. *3(2-3) S.* (See civil engineering.)

MB 571 Molecular Virology of Animal Viruses. *Preqs.: BCH 551, MB 401. 3(3-0) F.* Animal virus replication. Selected examples from each virus group illustrate the principles underlying lytic, persistent and tumor-inducing viral infection. Johnston

MB (BO) 574 Phycology. *3(1-4) S.* (See botany.)

MB (BO, PP) 575 The Fungi. *3(3-0) F.* (See botany.)

MB (BO, PP) 576 The Fungi—Lab. *1(0-3) F.* (See botany.)

MB 590 Topical Problems. *Preqs.: Grad. standing, CI. Credits Arranged. F,S.* Graduate Staff

FOR GRADUATES ONLY

MB (SSC) 632 Ecology and Functions of Soil Microorganisms. *3(3-0) S.* (See soil science.)

MB (GN) 660 Experimental Microbial Genetics. *Preqs.: BCH 561, GN 411, MB 401. 4(2-6) F.* Laboratory-oriented presentation of current methodologies and concepts in molecular microbial genetics and their application to strain construction, plasmid and phage manipulations, mutagenesis, cloning and genetic engineering of microorganisms. Melton

MB 671 Molecular Virology of Animal Viruses. *Preqs.: BCH 551, MB 502B. 3(3-0) F.* Animal virus replication. Selected examples from each virus group illustrate the principles underlying lytic, persistent and tumor-inducing viral infection. Johnston

MB 690 Microbiology Seminar. *1(1-0) F,S.* Graduate Staff

MB 692 Special Problems in Microbiology. *Credits Arranged. F,S,Sum.* Graduate Staff

MB 699 Microbiology Research. *Credits Arranged. F,S,Sum.* Graduate Staff

Nuclear Engineering

GRADUATE FACULTY

Professor P. J. Turinsky, *Head*

Associate Professor J. G. Gilligan, *Graduate Administrator*

Professors: T. S. Elleman, R. P. Gardner, K. L. Murty, R. F. Saxe, C. E. Siewert, K. Verghese, B. W. Wehring; *Professors Emeriti:* R. L. Murray, E. Stam, L. R. Zumwalt; *Associate Professor:* O. H. Auciello; *Assistant Professors:* J. M. Doster, O. E. Hankins

The discipline of nuclear engineering is concerned with the development of nuclear processes for energy production and with the applications of radiation for the benefit of society. The Department of Nuclear Engineering offers graduate study via courses and research leading to the Master of Nuclear Engineering, Master of Science and Doctor of Philosophy degrees.

Representative topics of investigation include nuclear, analytic, computational and experimental research in the neutronics, materials and thermal-hydraulics of aspects of fission reactors; radiation detection and measurement of basic physics parameters; applications of radioisotopes and radiation in industry, medicine and science; and plasma, plasma-material surface interactions and design cycles aspects of fusion reactors.

The department's one-megawatt PULSTAR reactor, which became operational in 1973, is similar in design, type of fuel and performance to modern power reactors. It is used for teaching, research and service in behalf of the University. Also available for student use in research are radiation detection laboratories, NAA laboratory, nuclear materials laboratory, plasma and plasma-surface interaction laboratory, prompt gamma facility, neutron radiography unit, NMR facility, noise analysis equipment, IBM Model 3081 computer, VAX/750 minicomputer, many microcomputers, access to super computers and several other well-equipped laboratories.

Bachelor's degree graduates in any of the fields of engineering or physical sciences may be qualified for successful advanced study in nuclear engineering. Prior experience or course work in nuclear physics, differential equations and basic reactor analysis is helpful but may be gained during the first semester of graduate study.

Teaching assistantships, research assistantships and fellowships are available for qualified applicants. Opportunities are also available for graduate traineeships with utility companies and reactor manufacturers, providing a valuable combination of financial support and learning in the classroom, the research laboratory and on the job.

Thirty semester hours are required for the Master of Nuclear Engineering and M.S. degrees. Students may also work directly toward a Ph.D. degree. Interdisciplinary programs with other departments in the School of Engineering and the School of Physical and Mathematical Sciences are available.

The advent of competitive nuclear power and the ever-increasing need for reliable clean energy has created a strong demand for nuclear engineers to participate in all phases of the nuclear power field—environmental studies, siting, design, construction, testing, operation, licensing and evaluation. Graduates of the department find positions in industry, government and educational institutions, working with reactors in the several categories—thermal, fast breeder and fusion.

SELECTED ADVANCED UNDERGRADUATE COURSES

NE 401 Reactor Analysis and Design. *Preq.: C or better in NE 301. 4(3-2) S.*

NE 402 Reactor Engineering. *Preqs.: NE 302, MA 401. 4(3-2) F.*

NE 403 Nuclear Engineering Design Projects. *Preqs.: NE 401, NE 402. 3(2-3) S.*

NE 404 Radiological, Reactor, and Environmental Safety. *Preq.: NE 302 or NE 419. 3(3-0) S.*

NE 405 Reactor Systems. *Coreq.: NE 402. 3(3-0) F.*

NE (MAT) 409 Nuclear Materials. *Preq.: MAT 201. 2(2-0) S.*

NE 412 Nuclear Fuel Cycles. *Preq.: NE 302. 3(3-0) S.*

NE 414 Nuclear Power Plant Instrumentation. *Preqs.: NE students—ECE 331, 332; ECE students—NE 419. 3(3-0) S.*

NE 419 Introduction to Nuclear Engineering. *Preq.: PY 202 or PY 208. 3(3-0) F.*

NE 491 Special Topics in Nuclear Engineering. *Preq.: CI. 1-4 F,S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

NE 508 Radiation Safety. *Preq.: NE 401 or NE 520. 3(2-3) S.* Presents the basic concepts of health physics, biological effects of radiation and calculation of radiation exposure. Topics include: radiation units, regulatory agencies and allowable limits of radiation, sources of radiation, dose calculations—external and internal, radiation dosimetry, reactor radiation sources and dose reduction with particular emphasis on shielding. Mani

NE (PY) 511 Nuclear Physics for Engineers. *3(3-0) F.* (See physics.)

NE 520 Radiation and Reactor Fundamentals. *Preqs.: MA 401 and NE 401 or equivalent. 2(2-0) F.* An introduction to radiation physics and reactor physics. Topics include atomic and nuclear decay processes, nuclear reactions, neutron slowing down and diffusion, criticality for bare and reflected reactors and reactor kinetics. Wehring

NE 521 Nuclear Laboratory Fundamentals. *Preqs.: MA 401 and NE 401 or equivalent. 2(1-3) F.* Introduction to nuclear instrumentation and experimental techniques used in nuclear engineering research. Topics include radiation detection and spectroscopy, neutron instrumentation, statistical analysis, use of microcomputers and nuclear reactor operations. Wehring

NE 522 Reactor Dynamics and Control. *Preq.: NE 401 or NE 520. 3(3-0) F.* Introduces the students to methods of describing and analyzing dynamic behavior of systems. These methods are applied to reactor systems and the effects of feedbacks studies. Methods of measuring the behavior of reactor systems are described and logic systems for control and safety are developed. Saxe

NE 523 Reactor Analysis. *Preq.: NE 401 or NE 520. 3(3-0) F.* Basic models of neutron motion and methods of calculating neutron flux distributions in nuclear reactors. Emphasis on multigroup diffusion theory. Criticality search, neutron slowing down models, resonance absorption, thermalization and heterogeneous cell calculations. Objective is to enable students to read literature and perform relevant analysis in reactor physics. Verghese

NE 524 Reactor Heat Transfer. *Preq.: NE 401 or NE 520. 3(3-0) S.* Considers heat generation and transfer in nuclear power reactors. Topics include reactor heat generation, steady-state and transient heat conduction in reactor fuel elements, boiling heat transfer and single and two-phase flow. Doster

NE (MAT) 525 Nuclear Materials. *Preqs.: NE 409 or MAT 201, CI. 3(3-0) F.* Introduces students to properties and selection of materials for nuclear steam systems and to radiation effects on materials. Implications of radiation damage to reactor materials and material problems in nuclear engineering are discussed. Topics include an overview of nuclear steam systems, crystal structure and defects, dislocation theory, mechanical properties, radiation damage, hardening and embrittlement due to radiation exposure and problems concerned with fission and fusion materials. Auciello, Murty

NE 526 Radioisotopes Measurement Applications. *Preq.: NE 401 or NE 520. 3(3-0) S.* Introduces the student to measurement applications using radioisotopes. All the major tracing and gauging principles are discussed and several specific applications are treated in detail. Objective is to familiarize student with design and analysis of industrial measurement systems which use radioisotopes. Gardner, Verghese

NE 527 Nuclear Engineering Analysis. *Preq.: NE 401 or NE 520. 3(3-0) S.* Provides a unified view of the basic equations and techniques of radiation transport calculations. The course introduces the common analytical and numerical solution techniques used in nuclear engineering and develops solutions for typical problems in the nuclear field. The course is intended to provide the background in analysis needed for more advanced studies in nuclear engineering. Gardner

NE 528 Principles of Fusion Reactors. *Preq.: NE 401 or NE 520. 3(3-0) S.* Provides an introduction to plasma concepts and fusion reactor design. Topics included: basics of thermonuclear reactions, charged particle collisions and radiation, plasma confinement, plasmas as fluids, formation and heating of plasmas and reactor concepts and design. Gilligan, Hankins

NE 550 Laboratory Projects in Nuclear Engineering. *Preq.: NE 521. 3(1-6) F.* Enhancement of laboratory skills that are pertinent to nuclear engineering research is sought through projects that require the student to design the experiment. assemble equipment, carry out the measurements and analyze and interpret data. Students work in groups of two and perform to completion two laboratory projects. Graduate Staff

NE (MAT) 562 Materials Problems in Nuclear Engineering. *3(3-0) F.* (See materials engineering.)

NE (MAT) 573 Computer Experiments in Materials and Nuclear Engineering. *3(3-0) S.* (See materials engineering.)

NE 580 Plasma Generation and Diagnostics Laboratory. *Preq.: NE 528 or PY 508 or PY 509. 3(2-3) F. Alt. yrs.* Provides an introduction to experimental plasma generation and plasma diagnostic techniques. Lecture topics include high vacuum techniques, perturbing and non-perturbing probe techniques, and laser and emission spectroscopy. Laboratories utilize various methods of measuring plasma parameters discussed in lectures. Auciello, Hankins

NE 581 Fusion Energy Engineering. *Preq.: NE 528. 3(3-0) F. Alt. yrs.* Describes and analyzes the technologies of devices necessary to produce fusion energy including vacuum technology, plasma heating and fueling, magnetics, special energy conversion, neutronics, materials, environment and safety. Design integration and the ensuing technological constraints are stressed. Auciello, Gilligan

NE 591, 592 Special Topics in Nuclear Engineering I, II. *Preq.: CI. 3(3-0) F,S.*
Graduate Staff

FOR GRADUATES ONLY

NE 601 Reactor Theory and Analysis. *Preqs.: NE 523, 527. 3(3-0) F.* Theoretical aspects of neutron diffusion and transport related to the design computation and performance analysis of nuclear reactors. Principal topics are a unified view of the neutron cycle including slowing, resonance capture and thermalization; reactor dynamics and control; fuel cycle studies; and neutron transport methods. Background is provided for research in power and test reactor analysis. Turinsky

NE (MA) 607 Exact and Approximate Solutions in Particle Transport Theory. *Preq.: MA 501 or MA 511. 3(3-0) S.* The method of elementary solutions is used to solve exactly basic problems in neutron-transport theory and related topics. In addition, the F_N method is developed and used to establish concise approximate solutions in the realm of particle transport theory. Siewert

NE 610 Nuclear Reactor Design Calculations. *Preq.: NE 523. 3(3-0) S. Alt. yrs.* Application of the digital computer to problems in reactor core nuclear design. Available reactor core physics computer modules are studied and exercised. Systems and programs used by industry for power reactor core design and core follow are described. A review of relevant analytic and numerical methods facilitates computer program development by the students. Turinsky

NE 611 Radiation Detection. *Preq.: NE 526. 3(2-2) F.* Covers the advanced aspects of radiation detection such as computer methods applied to gamma-ray spectroscopy, absolute detector efficiencies by experimental and Monte Carlo techniques, the use and theory of solid state detectors, time-of-flight detection experiments and Mossbauer and other resonance phenomena. Gardner, Verghese, Wehring

NE 612 Thermal Hydraulic Design Calculations. *Preq.: NE 524. 3(3-0) F. Alt. yrs.* An advanced presentation of thermal-hydraulic analysis of nuclear power systems. Topics include development of single phase and two-phase fluid flow evaluations, subchannel analysis, models of nonnuclear components, interphase phenomena and numerical solution methods relevant to design and safety analysis codes. Doster

NE 620 Nuclear Radiation Attenuation. *Preqs.: NE 527. 3(3-0) F.* The physical theory and mathematical analysis of the penetration of neutrons, gamma-rays and charged particles. Analytical techniques include point kernels, transport theory, Monte Carlo and numerical methods. Digital computers are employed in the solution of practical problems. Doster

NE 621 Radiation Effects on Materials. *Preq.: NE 525. 3(3-0) F.* Interactions of radiation with matter, with emphasis on the physical effects. Current theories and experimental techniques are discussed. Annealing of defects, radiation induced changes in physical properties and effects in reactor materials are discussed. Murty

NE 631 Reactor Kinetics and Control. *Preq.: NE 522. 3(3-0) S.* A study of the control of nuclear reactor systems. Basic control theory is developed including the use of Bode, Nyquist and S-plane diagrams and state-variable methods. Reactor and reactor systems are analyzed by these methods and control methods and optimum-control methods are developed. Models for reactors and reactor-associated units, such as heat exchangers, are discussed. The effects of non-linearities are presented. Saxe

NE 641 Radioisotopes Applications. *Preq.: NE 526. 3(3-0) F.* Principles and techniques of radioisotope applications are presented. Topics include radiotracer principles, radio-

tracer applications to engineering processes, radioisotope gauging principles and charged particle, gamma ray and neutron radioisotope gauges. Gardner, Verghese

NE 653 Power Plant Engineering and Safety Analysis. *Preqs.: NE 522, 524. 3(3-0) F.* Detailed discussion of project engineering, safety analysis licensing and regulations that pertain to the procurement and operation of nuclear power systems. Turinsky

NE 691, 692 Advanced Topics in Nuclear Engineering I, II. *Preq.: CI. 3(3-0) F,S.* A study of recent development in nuclear engineering theory and practice. Graduate Staff

NE 695 Seminar in Nuclear Engineering. *1(1-0) F,S.* Discussion of selected topics in nuclear engineering. Graduate Staff

NE 699 Research in Nuclear Engineering. *Preq.: Grad. standing. Credits Arranged.* Individual research in the field of nuclear engineering. Graduate Staff

Nutrition

GRADUATE FACULTY

Professor J. D. Garlich, *Coordinator*

Professors: L. W. Aurand, A. J. Clawson, W. E. Donaldson, R. W. Harvey, C. H. Hill, H. N. Jacobson, W. L. Johnson, E. E. Jones, C. A. Lassiter, J. G. Lecce; D. R. Lineback, J. E. Marion, R. D. Mochrie, A. H. Rakes, H. A. Ramsey, H. E. Swaisgood, S. B. Tove; *Professors Emeriti:* E. R. Barrick, E. S. Cofer, F. H. Smith, G. H. Wise; *Associate Professors:* G. L. Catignani, W. J. Croom, W. H. Hagler, J. F. Ort, J. C. H. Shih, J. W. Spears; *Assistant Professors:* M. T. Coffey, K. R. Pond

Graduate study leading to either a Master of Science or a Doctor of Philosophy degree in nutrition may be taken in the interdepartmental nutrition program. Participating departments include animal science, biochemistry, food science and poultry science. Students reside and conduct research in one of these departments under the direction of an appropriate advisor. Co-majors involving a participating department or related discipline are permitted. Minors may be biochemistry, biotechnology, microbiology, physiology, statistics or other approved graduate field.

Research in the nutrition program is conducted with a variety of species and at levels ranging from the molecular to the whole animal. The approach, therefore, is frequently both fundamental and comparative. Research facilities in each department are extensive and the problems under investigation are many and varied. Additional information about the program may be obtained by writing to Dr. J. D. Garlich, Coordinator, Nutrition Program, P.O. Box 7608, North Carolina State University, Raleigh, North Carolina 27695-7608.

SELECTED ADVANCED UNDERGRADUATE COURSES

NTR (ANS, PO) 415 Comparative Nutrition. *Preq.: CH 220 or both 221 and 223. 3(3-0) F.*

NTR (ANS) 419 Human Nutrition in Health and Disease. *Preqs.: BCH 451, NTR (ANS,PO) 415 or FS 400. 3(3-0) S.*

Associated courses related to nutrition are:

FS 400 Foods and Nutrition. *Preq. : CH 220. 3(3-0) F.*

FS 402 Food Chemistry. *Preq.: CH 220 or CH 221. 3(2-3) F.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

NTR (ANS) 516 Quantitative Nutrition. *Preq.: BCH 451 or NTR (ANS) 415 or NTR (ANS) 419 or FS 400. 3(1-6) S.* The quantitative evaluation of dietary ingredients and the determination of nutrient utilization. Exploration of the quantitative principles of nutrition through the use of laboratory animals and microorganisms. Johnson

NTR (FS) 530 Human Nutrition. *3(3-0) S. Alt. yrs.* (See food science.)

NTR (ANS) 540 Ruminant Physiology and Metabolism. *3(3-0) F. Even yrs.* (See animal science.)

NTR 590 Topical Problems in Nutrition. *Preq.: Grad. or sr. standing. 1-6 F,S.* Analysis of current problems in nutrition. Also entails the scientific appraisal and solution of a selected problem designed to provide training and experience in research.Graduate Staff

FOR GRADUATES ONLY

NTR 601 Protein and Amino Acid Metabolism. *Preqs.: BCH 551, ZO 421, a 400-level nutrition course. 3(3-0) S.* Protein and amino acid metabolism, regulation, dietary requirements and techniques for their investigation in human and other animals are studied. Garlich

NTR (ANS, PO) 605 Mineral Metabolism. *Preqs.: ANS (NTR, PO) 415 or BCH 551, BCH 451 and ZO 421. 3(3-0) F.* Requirements, function, distribution, absorption, excretion and toxicity of minerals in humans and domestic animals. Interactions between minerals and other factors affecting mineral metabolism or availability. Emphasis on mechanisms associated with mineral functions and the metabolic bases for the development of signs of deficiency. Spears

NTR (FS) 606 Vitamin Metabolism. *Preqs.: ANS (NTR, PO) 415 and BCH 551. 2(2-0) F. Even yrs.* Structures, chemical and physical properties, functions, deficiency symptoms, distribution, absorption, transport, metabolism, storage, excretion and toxicity of the vitamins in humans and domestic animals. Nutritional significance of the essential fatty acids and the metabolism of prostaglandins, prostacyclins and leucotrienes. Catignani, Garlich, Jones, Shih, Tove

NTR 608 Energy Metabolism. *Preqs.: BCH 551 and an introductory NTR course. 3(3-0) F.* This course relates biochemical and physiological events within the cell, tissue, organ and system with the nutrient needs as sources of energy for productive animal life. Digestion, absorption and metabolism of energy sources will be discussed. Processes of energy transformations within living structures will be presented in relation to energetics, biological oxidations, coupled reactions, anabolic and catabolic systems, metabolic control, partitioning and efficiency. Spears

NTR 690 Advanced Special Problems in Nutrition. *Preq.: Grad. standing. 1-6 F,S.* Di&$.rected research in a specialized phase of nutrition designed to provide experience in research methodology and philosophy. Graduate Staff

NTR 699 Research in Nutrition. *Preq.: Grad. standing. Credits Arranged. F,S.* Original research preparatory to the thesis for the Master of Science or Doctor of Philosophy degree. Graduate Staff

Occupational Education

For a listing of graduate faculty and departmental information, see occupational education under education.

Operations Research

GRADUATE FACULTY

Professor S. E. Elmaghraby, *Chairman and Program Director*

Professors: B. B. Bhattacharyya, J. W. Bishir, H. A. Devine, J. C. Dunn, W. S. Galler, H. J. Gold, T. J. Hodgson, C. J. Maday, D. F. McAllister, A. A. Nilsson, E. L. Peterson, N. J. Rose, W. J. Stewart; *Professor Emeritus:* B. M. Olsen; *Associate Professors:* H. J. Perros, T. W. Reiland, C. D. Savage; *Assistant Professors:* N. M. Bengtson, Y. Fathi, M. F. M. Stallmann; *Visiting Assistant Professor:* J. E. Richards

Operations research is a graduate program of a interdisciplinary nature, governed by an administrative board and the program committee, and administered through the office of the program director.

The program offers the degrees of Master of Science and Doctor of Philosophy. Both are research degrees requiring a thesis. A foreign language is not required at the master's level and is optional with the student's advisory committee at the doctoral level. A brochure is available which describes in more detail the requirements for both degrees.

An advanced program of study in operations research implies intensive study in at least two of the following areas: mathematical optimization, dynamical systems and control theory, stochastic systems, econometrics and economic decision theory and information and cybernetics.

For students who wish to combine their study in OR with studies in another field, the program offers a joint program at the Ph.D. level in computer studies and another joint program at the M.S. level with management. Furthermore, the OR program encourages co-majoring with mathematics, statistics or any field of science and engineering. Please consult the OR brochure for more details.

CENTRAL COURSES
FOR GRADUATES AND ADVANCED UNDERGRADUATES

OR 501 Introduction to Operations Research. *Preqs.: MA 421 or ST 421 or ST 371 and ST 372. 3(3-0) F,S.* OR Approach: modeling, constraints, objective and criterion. The problem of Multiple criteria. Optimization, Model validation. The team approach. Systems

Design. Examples, OR Methodology: mathematical programming; optimum seeking; simulation, gaming; heuristic programming. Examples. OR Applications; theory of inventory; economic ordering under deterministic and stochastic demand. The production smoothing problem; linear and quadratic cost functions. Waiting line problems: single and multiple servers with Poisson input and output. The theory of games for two-person competitive situations. Project management through PERT-CPM. Graduate Staff

OR (IE, MA) 505 Linear Programming. *Preq.: MA 405. 3(3-0) F,S.* An introduction including: applications to economics and engineering; the simplex method and its main variants; parametric programming and post-optimality analysis; duality matrix games, linear systems solvability theory and linear systems duality theory; polyhedral sets and cones, including their convexity and separation properties and dual representations; equilibrium prices, Lagrange multipliers, subgradients and sensitivity analysis.
Fathi, Peterson

OR 506 Algorithmic Methods in Nonlinear Programming. *Preqs.: MA 301, MA 405, knowledge of computer language, such as FORTRAN or PL1. 3(3-0) S.* Introduction to methods for obtaining approximate solutions to unconstrained and constrained minimization problems of moderate size. Emphasis on geometrical interpretation and actual coordinate descent, steepest descent, Newton and quasi-Newton methods, conjugate gradient search, gradient projection and penalty function methods for constrained problems. Specialized problems and algorithms will be treated as time permits. Fathi, Reiland

OR (IE) 509 Dynamic Programming. *Preqs.: MA 405, ST 421. 3(3-0) S.* An introduction to the theory and computational aspects of dynamic programming and its application to sequential decision problems. Elmaghraby

OR 520 Theory of Activity Networks. *Preqs.: OR 501, OR (IE, MA) 505. 3(3-0) S. Alt. yrs.* Introduction to graph theory and network theory. A discussion in depth of the theory underlying (1) deterministic activity networks (CPM): optimal time-cost trade offs; the problem of scarce resources; (2) probabilistic activity networks (PERT): critical evaluation of the underlying assumptions; (3) generalized activity networks (GERT, GAN): applications of signal flow graphs and semi-Markov process to probabilistic branching; relation to the theory of scheduling. Elmaghraby

OR (CHE) 527 Optimization of Engineering Processes. *Preqs.: CHE 451 or OR 501, FORTRAN programming. 3(3-0) F.* The formulation and solution of process optimization problems, with emphasis on nonlinear programming techniques. Computer implementation of optimization algorithms and structuring of process models to increase computational efficiency. Felder

OR (E, MA) 531 Dynamic Systems and Multivariable Control I. *Preqs.: MA 301, MA 405. 3(3-0) F.* Introduction to the modeling, analysis and control of linear discrete-time and continuous-time dynamical systems. State space representations and transfer methods. Controllability and observability. Realization. Applications to biological, chemical, economic, electrical, mechanical and sociological systems. Dunn, Rose

OR (IE) 561 Queues and Stochastic Service Systems. *Preq.: MA 421. 3(3-0) F.* General concepts of stochastic processes are introduced. Poisson processes, Markov processes, and renewal theory are presented. These are then used in the analysis of queues, starting with a completely memoryless queue to one with general parameters. Applications to many engineering problems will be considered. Bengtson, Stewart

OR (CSC, CSE, ECE, IE) 562 Computer Simulation Techniques. *3(3-0) F.* (See computer studies.)

OR (CSC, MA) 585 Graph Theory. *Preq.: MA 231 or 405. 3(3-0) F.* Basic concepts of graph theory. Trees and forests. Vector spaces associated with a graph. Representation of graphs by binary matrices and list structures. Traversability. Connectivity. Matchings and assignment problems. Planar graphs. Colorability. Directed graphs. Applications of graph theory with emphasis on organizing problems in a form suitable for computer solution.
Savage

OR (IE, MA) 586 Network Flows. *Preq.: OR (IE, MA) 505 or equivalent. 3(2-2) S. Alt. yrs.* This course will study problems of flows in networks. These problems will include the determination of the shortest chain, maximal flow and minimal cost flow in networks. The relationship between network flows and linear programming will be developed as well as problems with nonlinear cost functions, multi-commodity flows and the problem of network synthesis.
Nuttle, Stallmann

OR 591 Special Topics in Operations Research. *Preq.: CI. 1-3 F,S,Sum.* Individual or small group studies of special areas of OR which fit into the students' programs of study and which may not be covered by other OR courses. Furthermore, the course serves as a vehicle for introducing new or specialized topics at the introductory graduate level.
Graduate Staff

FOR GRADUATES ONLY

OR (CSC) 605 Large Scale Linear Programming Systems. *Preqs.: OR 505 and FORTRAN programming experience. 3(3-0) Alt. S.* A study of the specialized algorithms for the efficient solution of large scale LP problems. Includes: parametric programming, bounded variable algorithms, generalized upper bounding, decomposition, separable programming and mixed integer programming. Emphasis is on gaining firsthand practical experience with current computer codes and computational procedures.
Fathi, Haas

OR (MA, ST) 606 Nonlinear Programming. *Preq.: OR (IE, MA) 505. 3(3-0) S.* This course provides an advanced mathematical treatment of the analytical and algorithmic aspects of finite dimensional nonlinear programming. It includes an examination of the structure and effectiveness of computational methods for unconstrained and constrained minimization. Special attention will be directed toward current research and recent developments in the field.
Peterson, Reiland

OR 609 Advanced Dynamic Programming. *Preqs.: OR 509, MA 541. 3(3-0) F. Alt. yrs.* Introduction to measure theoretic concepts, review of finite state Markov processes, theory of Markovian programming, discrete decision processes, continuous time dynamic program&$.ming, relation to calculus of variation and the Maximum Principle. Emphasis throughout is on recent theoretical development in the field. (Offered in alt. years.)
Elmaghraby

OR (BMA) 611 System Modeling Theory. *3(3-0).* (See biomathematics.)

OR (MA) 614 Integer Programming. *Preqs.: MA 405, OR (MA, IE) 505; Coreq.: Some familiarity with computers (e.g., CSC 111). 3(3-0) S. Alt. yrs.* Study of general integer programming problems and principal methods of solving them. Emphasis on intuitive presentation of ideas underlying various algorithms rather than detailed description of computer codes. The students will have some "hands on" computing experience that should enable them to adapt the ideas presented in the course to integer programming problems they may encounter.
Stallmann

OR (MA) 629 Vector Space Methods in System Optimization. *Preqs.: MA 405, 511 or equivalent. 3(3-0) F.* Introduction to algebraic and function-analytic concepts used in system modeling and optimization: vector space, linear mappings, spectral decomposition, adjoints, orthogonal projection, quality, fixed points and differentials. Emphasis on geometric insight. Topics include least square optimization of linear systems, minimum norm problems in Banach space, linearization in Hilbert space, iterative solution of system

equations and optimization problems. Broad range of applications in operations research and system engineering including control theory, mathematical programming, econometrics, statistical estimation, circuit theory and numerical analysis. Dunn, Sagan

OR (E, MA) 631 Dynamic Systems and Multivariable Control II. *Preq.: OR (E, MA) 531. 3(3-0) S. Alt. yrs.* Stability of equilibrium points for nonlinear systems. Liapunov functions. Unconstrained and constrained optimal control problems. Pontryagin's maximum principle and dynamic programming. Computation with gradient methods and Newton methods. Multidisciplinary applications. Dunn, Rose

OR (E) 650 Algorithmic Methods in Optimal Control. *Preq.: OR 629 or equivalent; Coreq.: Knowledge of higher level language (e.g., FORTRAN or PL1). 3(3-0) S. Alt. yrs.* Study of computational methods for optimal control of dynamical systems. Emphasis on extensions of nonlinear programming to control problems described by differential and difference equations. Topics include linear systems with quadratic objective, gradient and dynamic programming algorithms for nonlinear control problems, methods for treating control and state constraints, and an introduction to optimization of delay and distributed parameter systems. The course will include computational exercises based on applications from OR and engineering. Dunn

OR (CSE, IE) 662 Stochastic Simulation Design and Analysis. *3(3-0) S.* (See computer studies.)

OR 691 Special Topics in Operations Research. *Preqs.: OR 501, OR (IE, MA) 505. 3(3-0) F,S,Sum.* The purpose of this course is to allow individual students or small groups of students to take on studies of special areas in OR which fit into their particular program and which may not be covered by other OR courses. The work will be directed by a qualified faculty member and in some instances by visiting professors. The subject matter in any year is dependent on the students and the faculty members. Graduate Staff

OR (IE, MA) 692 Special Topics in Mathematical Programming. *Preqs.: OR (IE, MA) 505. 3(3-0) F,S,Sum.* The study of special advanced topics in the area of mathematical programming. New techniques and current research in this area will be discussed. The faculty responsible for this course will select according to their preference and interest the areas to be covered during the semester. This course will not necessarily be taught by an individual faculty but can, on occasion, be a joint effort of several faculty members from this University as well as visiting faculty from other institutions. To date, courses on Theory of Networks, Optimal Control Algorithms and Integer Programming have been offered under the umbrella of this course. It is anticipated that these topics will be repeated in the future, together with other topics. Graduate Staff

OR 695 Seminar in Operations Research. *Preq.: Enrollment in OR as a major or minor. 1(1-0) F,S.* and reports. Graduate students with minors or majors in operations research are expected to attend throughout the period of their residence. Elmaghraby

OR 699 Project in Operations Research. *Preq.: Variable. 1-3 F,S,Sum.* Individual research by graduate students minoring and majoring in operations research. Research may be done under the operations research faculty member meeting the interest need of the student. Graduate Staff

SUGGESTED COGNATE COURSES

Cognate courses in the operations research program are courses often included in programs of study but which carry other departmental designations. They cover subject matter closely related to operations research and provide additional insight into the basis or application of operations research techniques. Students should not assume they will be able to include any of the cognate courses

in their own program of study unless they have made previous arrangements with their faculty advisor.

Biomathematics

BMA (MA, ST) 571, 572 Biomathematics I & II

Chemical Engineering

CHE 525 Chemical Process Control

Civil Engineering

CE 575 Civil Engineering Systems

Computer Science

CSE (MA) 529, 530 Numerical Analysis I, II
CSC (MA) 582 Numerical Linear Algebra
CSC (MA) 583 Numerical Solution of Ordinary Differential Equations
CSC (MA) 584 Numerical Solution of Partial Differential Equations—Finite Difference Methods
CSE (CSC,ECE) 671 Advanced Computer Performance Modelling

Economics and Business

EB 650 Economic Decision Theory
EB (ST) 651 Econometrics
EB (ST) 652 Topics in Econometrics

Electrical and Computer Engineering

ECE 516 System Control Engineering
ECE (CSE) 521 Digital Computer Technology and Design
ECE 691 Special Studies in Electrical Engineering

Industrial Engineering

IE 523 Production Planning, Scheduling and Inventory Control
IE 547 Reliability and Quality Assurance
IE 553 Materials Handling Systems
IE 611 The Design of Production Systems
IE 622 Inventory Control Methods II

Mathematics

MA (ST) 541 Theory of Probability I
MA (ST) 542 Introduction to Stochastic Processes
MA (ST) 617, 618 Measure Theory and Advanced Probability
MA (ST) 619 Topics in Advanced Probability
MA 622 Linear Transformations and Matrix Theory
MA 623 Theory of Matrices and Applications
MA 647 Functional Analysis I
MA 685 Special Topics in Numerical Analysis

Statistics

ST 583 Introduction to Statistical Decision Theory
ST 613 Time Series Analysis: Time Domain
ST 614 Time Series Analysis: Frequency Domain

Pest Management

GRADUATE FACULTY

Associate Professor Blanche C. Haning, *Program Coordinator*

Professors: J. T. Ambrose, C. S. Apperson, C. W. Averre III, R. C. Axtell, J. S. Bacheler, M. K. Beute, J. R. Bradley Jr., W. M. Brooks, G. A. Carlson, H. D. Coble, F. T. Corbin, J. M. Davis, E. J. Dunphy, H. J. Gold, F. P. Hain, G. G. Kennedy, W. M. Lewis, T. J. Monaco, G. C. Rock, T. J. Sheets, W. A. Skroch, R. E. Stinner, T. B. Sutton, J. W. Van Duyn, A. D. Worsham; *Professor (USDA):* R. A. Reinert; *Adjunct Professor:* L. Thompson Jr.; *Associate Professors:* J. J. Arends, J. E. Bailey, R. I. Bruck, F. Gould, L. D. King, H. M. Linker, J. R. Meyer, M. M. Peet, G. J. San Julian, D. P. Schmitt, P. S. Southern; *Assistant Professors:* A. R. Bonnano, R. L. Brandenburg, D. Hoag

The concept of integrated pest management (IPM) combines the theoretical and practical aspects of cultural, biological and chemical control into effective systems that maintain pest populations at levels that minimize economic and environmental damage. This approach and its implementation are opening new career opportunities for broadly informed individuals who understand the basic biology and ecology of pests and the systems with which they are associated.

Graduate study in integrated pest management draws upon faculty from several departments, especially plant pathology, entomology, crop science and horticultural science. The Integrated Pest Management Teaching Subcommittee establishes the general requirements. Each student's advisory committee must include a member of the IPM graduate faculty. All programs must have the approval of the chairman of the IPM Teaching Subcommittee.

A graduate minor in pest management emphasizing agricultural crops is available for the Master of Science degree. This minor provides students with an understanding of the theory, purpose and practice of integrated pest management. Required courses or their equivalents are PM 415, Principles of Pest Management; PM 490, Pest Management Seminar or PM 595, Topical Problems in Integrated Pest Management, and at least one graduate level course each in plant pathology, entomology and weed science. A course in ecology also is recommended. This plan can also be accommodated in the Master of Agriculture degree program.

Additionally, a concentration in pest management is available within the Master of Agriculture degree and is identified by "Pest Management" on the transcript. This concentration involves a minimum of 36 credit hours and allows interdisciplinary programs of study tailored to students' needs. It includes graduate course work from at least four closely related disciplines and a minimum 3-month internship in the field. Opportunities for teaching and observing or

cooperating in research are available. In the crop production and protection area the following courses or their equivalents are required: PP 515, Epidemiology and Plant Disease Control; ENT 562, Insect Pest Management in Agricultural Crops; CS(HS) 514, Principles and Methods in Weed Science; SSC 541, Soil Fertility. Deficiencies in basic course work in the crop and pest disciplines including integrated pest management will be taken in addition to these minimum requirements. Graduate students enrolled in this program are located in the department of their major professor and participate in departmental activities, including seminar.

Additional information may be obtained by contacting a member of the Graduate Faculty or the IPM Program Coordinator, 2705 Bostian Hall, Box 7611, North Carolina State University, Raleigh, North Carolina 27695-7611.

SELECTED ADVANCED UNDERGRADUATE COURSES

PM 415 Principles of Pest Management. *Preqs.: ENT 312, PP 315, BO (ZO) 360: Coreq.: CS 414. 4(3-3) F.*

PM 490 Pest Management Seminar. *Preq.: PM 415. 2(1-1) S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

PM (BO, CS, ENT, PP) 525 Biological Control. *Preqs.: ENT 312 or 425 and CS 414 or PP 315. 4(3-3) F. Odd yrs.* An interdisciplinary examination of the taxonomic and biological relationships of parasites, predators and pathogens of insects, weeds and plant pathogens, including their regulatory roles resulting from their occurrence either naturally in the environment or through human intervention. Brooks, Stinner, Van Dyke

PM 590 Advanced Topics in Integrated Pest Management. *Preq.: PM 405 or PM 415. 1-6 F,S,Sum.* Directed studies in Integrated Pest Management. Provides opportunity for advanced students to increase their understanding of current IPM philosophy, literature, research and technology through instruction or work experience in the field.
Graduate Staff

PM 595 Topical Problems in Integrated Pest Management. *Preq.: PM 415. 2(1-2) S.* One weekly lecture followed by discussions and projects relating to current topics in integrated pest management (IPM) under the guidance of interdisciplinary faculty teams; improves understanding of the depth and complexities of IPM and opportunities and limitations for its implementation. Haning

Students are advised to review course listings in such relevant departments as animal science, crop science, economics and business, entomology, horticultural science, plant pathology, soil science, the biomathematics program and the College of Forest Resources.

Physics

GRADUATE FACULTY

Professor R. R. Patty, *Head*

Professor G. E. Mitchell, *Associate Head and Graduate Administrator*

Professors: K. T. Chung, S. R. Cotanch, W. R. Davis, W. O. Doggett, R. E. Fornes, C. R. Gould, D. G. Haase, G. L. Hall, A. W. Jenkins Jr., C. E. Johnson, G. H. Katzin, F. Lado Jr., G. Lucovsky, J. D. Memory, J. Y. Park, J. S. Risley, D. E. Sayers, J. F. Schetzina, L. W. Seagondollar, D. R. Tilley; *Professors Emeriti:* J. T. Lynn, E. R. Manring, A. C. Menius Jr., A. W. Waltner; *Associate Professors:* J. Bernholc, G. C. Cobb Jr., J. W. Cook Jr., K. L. Johnston, M. A. Klenin, R. J. Nemanich, G. W. Parker III, M. A. Paesler; *Assistant Professors:* S. P. Reynolds, W. B. Westerveld

ASSOCIATE MEMBERS OF THE DEPARTMENT

Professors: J. M. A. Danby, J. Narayan, D. L. Ridgeway

Study in physics is available leading to the degrees of Master of Science and Doctor of Philosophy. In addition to the departmental VAX 11/750 computer, the facilities (including the IBM 3081D computer) of the nearby Triangle Universities Computation Center, which is jointly operated by Duke University, the University of North Carolina at Chapel Hill and North Carolina State University, are also available. These three universities also jointly staff the Triangle Universities Nuclear Laboratory located on the Duke campus. The major facilities are a 15 MeV model FN Tandem Van de Graaff accelerator with a 15 MeV cyclotron injector and on-line computer facilities.

Experimental and theoretical research is being performed in atomic and molecular physics, nuclear physics, plasma physics and solid state physics. Theoretical work is in progress in relativity and general field theory, statistical theory and astrophysics.

Programs of study leading to the Master of Science degree require a minimum of 30 semester hours; a thesis is required.

The Doctor of Philosophy degree is granted on successful completion of examinations, independent research and the submission of an acceptable dissertation. A minor area of study is required.

A large number of teaching and research assistantships is available. An out-of-state student holding such an assistantship may be eligible for reduced tuition charges.

SELECTED ADVANCED UNDERGRADUATE COURSES

PY 401, 402 Quantum Physics I, II. *Preq.: PY 411. 3(3-0) F,S.*

PY 407 Introduction to Modern Physics. *Preqs.: PY 208, MA 202. 3(3-0) F,S.*

PY 410 Introductory Nuclear Physics. *Preq.: PY 202 or 208. 4(3-2) S.*

PY 411, 412 Mechanics I, II. *Preqs.: PY 203 or 208, MA 301. 3(3-0) F,S.*

PY 413 Thermal Physics. *Preq.: PY 202 or 208; Coreq.: MA 301. 3(3-0) S.*

PY 414, 415 Electromagnetism I, II. *Preqs.: PY 203 or 208 and MA 301. 3(3-0) F,S.*

PY 441 Spacetime Physics. *Preq.: PY 203 or 407. 3(3-0) S.*

PY 451 Electronics for Physicists. *Preq.: PY 414; Coreq.: PY 415. 3(1-4) F.*

PY 452 Advanced Physics Laboratory. *Preqs.: Sr. standing and CI. 1(0-3) F,S.*

PY 499 Special Problems in Physics. *Preq.: Consent of department. 1-6 F,S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

PY 506 Nuclear and Subatomic Physics. *Preqs.: PY 203 or 407; PY 412. 3(3-0) F.* An introduction to nuclear and subatomic phenomena: properties of nuclear radiations and detectors, accelerators, nuclear forces and nuclear structure, elementary particles, fundamental symmetries and conservation laws. Gould

PY 508 Ion and Electron Physics. *Preq.: PY 414. 3(3-0) F.* Topics covered: charged particle dynamics, introduction to plasma physics, processes in ionized gases, electron emission and the physics of electron beams. Doggett

PY 509 Plasma Physics. *Preq.: PY 414. 3(3-0) F.* The individual and collective motion of charged particles in electric and magnetic fields and through ionized gases. Doggett

PY 510 Nuclear Physics II. *Preq.: PY 410. 4(3-2) S.* The properties of the atomic nucleus as revealed by radioactivity, nuclear reactions and scattering experiments with emphasis on the experimental approach. The laboratory stresses independent research and offers project work in nuclear spectroscopy and in neutron physics. Graduate Staff

PY (NE) 511 Nuclear Physics for Engineers. *Preq.: PY 410. 3(3-0) F.* The properties of atomic nuclei, of nuclear radiations and of the interaction of nuclear radiation with matter. Emphasis on the principles of modern equipment and techniques of nuclear measurement and their application to practical problems. Graduate Staff

PY 516 Physical Optics. *Preq.: PY 415. 3(3-0) F.* Physical optics with the major emphasis on the wave properties of light. Boundary conditions, interference and diffraction, optics of thin films, fiber optics and applications to absorption, scattering and laser operation. A background in Maxwell's equations and vector analysis is required. Johnson

PY 517 Atomic and Molecular Physics. *Preqs.: PY 401, 412. 3(3-0) S.* The quantum mechanical treatment of structure and spectra for atoms and molecules. Topics include the hydrogen atom, helium atom, multielectron atoms, selection rules, diatomic and simple polyatomic molecules and nuclear magnetic resonance spectroscopy. Mowat

PY 521 Statistical Physics I. *Preqs.: PY 401, PY 413. 3(3-0) S.* The basic elements of kinetic theory and equilibrium statistical mechanics, both classical and quantum; applications of the techniques developed to various ideal models of noninteracting particles. Jenkins

PY 531 Advanced Placement Physics for Secondary School Teachers. *Preq.: Teaching certificate. 6(6-0) Sum.* A preparation for teaching advanced placement physics to high school students. A review of the physics content on the AP curriculum and discussion of teaching techniques, demonstrations and laboratories for use in such a program. Graduate Staff

PY 543 Astrophysics. *Preqs.: PY 203 or 407; PY 411. 3(3-0) S.* The basic physics necessary to investigate, from observational data, the internal conditions and evolution of stars. Topics include the formation and structure of spectral lines, methods of energy generation and transport, stellar structure, degeneracy, white dwarfs and neutron stars. Reynolds

PY (ECE) 552 Introduction to the Structure of Solids. *Preq.: PY 401. 3(3-0) S.* Basic considerations of crystalline solids, metals, conductors and semiconductors. Bernholc

PY 553 Introduction to the Structure of Solids II. *Preq.: PY 552 or equivalent. 3(3-0) F.* A study of the properties of semiconductors, superconductors, magnets, ferroelectrics and crystalline defects and dislocations. Paesler

PY (MA) 555 Mathematical Introduction to Celestial Mechanics. *3(3-0) F.* (See mathematics.)

PY (MA) 556 Orbital Mechanics. *3(3-0) S.* (See mathematics.)

PY 561 Electronics for Physicists. *Preq.: Grad. standing. 3(1-4) S.* Analog and digital electronics laboratory course serving as an introduction to the use of modern instrumentation required for experimental research in physics. Bipolar and field effect transistors, operational amplifiers, oscillators, power supplies, analog-digital and digital-analog conversion and digital logic circuits. Cobb

PY 581, 582 Quantum Mechanics I, II. *Preqs.: MA 512; PY 411 or 414; grad. standing or permission of the graduate administrator. 3(3-0) F,S.* Fundamental concepts and formulations, including interpretation and techniques, and the application of theory to simple physical systems, such as the free particle, the harmonic oscillator, the particle in a potential well and central force problems. Other topics include approximation methods, identical particles and spin, transformation theory, symmetries and invariance, and an introduction to quantum theory of scattering and angular momentum. Johnson

PY 583 Advanced Classical Mechanics I. *Preqs.: MA 512, PY 412, PY 414; grad. standing or permission of the graduate administrator. 3(3-0) F.* An introduction to theoretical physics in preparation for advanced study. Emphasis is on classical mechanics, special relativity and the motion of charged particles. Topics include variational principles, Hamiltonian dynamics and the canonical transformation theory, structure of the Lorentz group and elementary dynamics of unquantized fields. Chung

PY 584 Advanced Classical Mechanics II. *Preqs.: PY 583; grad. standing or permission of the graduate administrator. 3(3-0) S.* Advanced classical mechanics, including continuum mechanics, fields, the group theoretical approach to dynamics and other selected topics. Katzin

PY 585, 586 Advanced Electricity and Magnetism I, II. *Preqs.: PY 415; grad. standing or permission of the graduate administrator. 3(3-0) F,S.* Topics include: techniques for the solution of potential problems, development of Maxwell's equations; wave equations, energy, force and momentum relations of an electromagnetic field; covariant formulation of electrodynamics; radiation from accelerated charges. Parker

PY 590 Special Topics in Physics. *Preq.: Consent of department. Credits arranged. F,S.* Investigations in physics under staff guidance. May consist of literature reviews, experimental or theoretical projects or special topics lectures. Graduate Staff

FOR GRADUATES ONLY

PY 601, 602 Theoretical Physics I, II. *Preqs.: PY 583, 586; Coreq.: MA 661. 3(3-0) F,S.* The mathematical and theoretical approach to the relationships between various branches of physics is treated. The restricted theory of relativity, electro-dynamics, classical field theory and the general theory of relativity and geometro-dynamics are considered. Davis

PY 611 Advanced Quantum Mechanics I. *Preqs.: MA 512, PY 582. 3(3-0) F.* An introduction to the relativistic quantum theory of Dirac particles and the positron. Other topics include second quantization technique and its application to many-body problems, radiation theory and the quantization of the electromagnetic field. Cotanch

PY 612 Advanced Quantum Mechanics II. *Preqs.: PY 601, 611. 3(3-0) S.* A general propagator treatment of Dirac particles, photons, and scalar and vector mesons. Applications of Feynman graphs and rules will be given illustrating basic techniques employed in the treatment of electromagnetic, weak and strong interactions. Renormalization theory, the effects of radiative corrections and aspects of the general Lorentz covariant theory of quantized fields will also be considered. Cotanch

PY 622 Statistical Physics II. *Preq.: PY 521. 3(3-0) F.* A continuation of PY 521, with emphasis on the static and dynamic properties of real (interacting) systems. Topics will include the equilibrium theory of fluids and the linear response theory of time-dependent phenomena. Lado

PY (ECE) 627 Semiconductor Thin Films Technology. *3(3-0) S. Alt. yrs.* (See electrical and computer engineering.)

PY 630 Nuclear Structure Physics I. *Preqs.: PY 582; PY 506 or 510. 3(3-0) S.* Advanced description of nuclear models and nuclear reactions. Topics include: internucleon forces, compound-nucleus processes, shell model, optical model, R-matrix theory, direct reactions, collective model, electromagnetic transitions, isobaric analog states. Mitchell

PY 653 The Quantum Theory of Solids. *Preqs.: PY 521, PY 552, 582. 3(3-0) S. Alt. yrs* A survey of advanced topics in the description of condensed matter. The course is intended to provide an introduction to current theoretical research tools. Klenin

The following five courses offer opportunities for advanced study in special areas of physics under staff members working in these areas.

PY 690 Special Topics in Molecular Physics. *Preq.: CI. 1-6 F,S.*

PY 691 Special Topics in Nuclear Physics. *Preq.: CI. 1-6 F,S.*

PY 692 Special Topics in Plasma Physics. *Preq.: CI. 1-6 F,S.*

PY 693 Special Topics in Solid State Physics. *Preq.: CI. 1-6 F,S.*

PY 694 Special Topics in Theoretical Physics. *Preq.: CI. 1-6 F,S.*

PY 695 Seminar. *1(1-0) F,S.* Reports on topics of current interest in physics. Several sections are offered so that students with common research interests may be grouped together. Graduate Staff

PY 699 Research. *Credits Arranged.* Graduate students sufficiently prepared may undertake research in some selected field of physics. Graduate Staff

Physiology

GRADUATE FACULTY

Professor J. H. Britt, *Coordinator*

Professors: R. A. Argenzio, E. V. Caruolo, F. W. Edens, C. H. Hill, E. Hodgson, B. H. Johnson, T. E. LeVere, I. S. Longmuir, W. D. Oxender, J. F. Roberts, M. C. Roberts, D. E. Smith, C. E. Stevens, C.-S. Teng, H. A. Underwood Jr.; *Adjunct Professor:* J. P. Thaxton; *Professors Emeriti:* L. Goode, L. C. Ulberg; *Associate Professors:* B. L. Black, J. T. Brake, V. L. Christensen, K. L. Esbenshade, R. M.

Grossfeld, N. C. Olson, R. M. Petters, T. D. Siopes; *Adjunct Associate Professor:* M. S. Hand; *Assistant Professors:* J. D. Armstrong, J. E. Gadsby, R. M. Roe, R. M. Shuman

Graduate study under the direction of the physiology faculty may lead to the Master of Science, Master of Life Sciences and the Doctor of Philosophy degrees. The physiology faculty is an interdepartmental group drawn from the departments participating in the program. They are animal science, biochemistry, entomology, food animal and equine medicine, poultry science, psychology, (veterinary) anatomy, physiological sciences and radiology and zoology. The program emphasizes the comparative approach implicit in this type of organization.

Experimental facilities of the above departments are available for physiological research, as are such special facilities as the Electron Microscope Center and the Wrightsville Marine Biomedical Laboratory. Experimental animals available cover a wide range, from insects and other invertebrates to large mammals.

In addition to courses in physiology, majors in the program are expected to take selected courses in biochemistry and cell biology. Minors are usually chosen from such fields as biochemistry, entomology, genetics, immunology, pharmacology, statistics, toxicology and zoology. A strong basic knowledge in one of these areas is essential.

Graduate students enrolled as physiology majors are located in the department of their major professor and may participate in departmental activities.

Prerequisites for admission include a year of physics and organic chemistry, one course in biochemistry and physiology. The Aptitude Test of the Graduate Record Examination is required and the Advanced Tests in biology and chemistry are desirable.

Financial assistance for qualified students in the form of research assistantships, fellowships and traineeships is available through participating departments. Prospective students may obtain further information by writing to any one of the graduate faculty listed above or to the Coordinator, Physiology Program, Box 7621, N. C. State University, Raleigh, North Carolina 27695-7621.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

PHY (ANS) 502 Reproductive Physiology of Vertebrates. *3(3-0) S.* (See animal science.)

PHY (ZO) 503 General Physiology I. *Preq.: Sr. or grad. standing; the following courses are recommended: ZO 421 or equivalent, BCH 451 or equivalent, a year of physics. 3(3-0) F.* The general principles of homeostasis will be discussed, emphasizing the importance of integrative action. The following systems will be studied: muscular, cardiovascular and nervous systems. Grossfeld

PHY (ZO) 504 General Physiology II. *Preq.: PHY (ZO) 503. 3(3-0) S.* The general principles of homeostasis will be discussed, emphasizing the importance of integrative action. The following will be studied: alimentary, renal, respiratory and endocrine systems. Grossfeld

PHY (ZO) 513 Comparative Physiology. *3(3-0) S.* (See zoology.)

PHY (BCH) 553 Physiological Biochemistry. *3(3-0) S.* (See biochemistry.)

PHY (ANS) 580 Mammalian Endocrine Physiology. *3(3-0) F.* (See animal science.)

PHY 590 Special Problems in Physiology. *Preqs.: Grad. standing, CI. Credits Arranged. F,S.* Graduate Staff

FOR GRADUATES ONLY

PHY (ANS) 604 Experimental Animal Physiology. *4(2-4) F.* (See animal science.)

PHY 690 Physiology Seminar. *Preq.: Grad. standing. 1(1-0) S.* Graduate Staff

PHY 695 Selected Topics in Physiology. *Preq.: Grad. standing. 1-4.* Graduate Staff

PHY 699 Physiological Research. *Preqs.: Grad. standing, CI. Credits Arranged. F,S.* Graduate Staff

COURSES FROM ASSOCIATED DEPARTMENTS

BCH 551 General Biochemistry I.

PO (ZO) 524 Comparative Endocrinology.

PSY 502 Physiological Psychology.

ZO 614 Advanced Cell Biology.

OTHER SUPPORTING COURSES AVAILABLE

GN (ZO) 532 Biological Effects of Radiations.
PSY 503 Comparative Psychology.
ZO 510 Animal Behavior Research Techniques.

Certain courses on the interface between physiology and engineering may be taken after consultation with adviser and the instructors concerned.

Plant Pathology

GRADUATE FACULTY

Professor W. L. Klarman, *Head*

Professor D. M. Benson, *Graduate Studies Coordinator*

Professors: J. L. Apple, C. W. Averre III, K. R. Barker, D. F. Bateman, M. K. Beute, E. B. Cowling, C. B. Davey, H. E. Duncan, E. Echandi, G. V. Gooding Jr., L. F. Grand, J. S. Huang, R. K. Jones, M. P. Levi, L. T. Lucas, C. E. Main, R. D. Milholland, J. W. Moyer, N. T. Powell, P. B. Shoemaker, T. B. Sutton, H. H. Triantaphyllou, N. N. Winstead; *Professors (USDA):* A. S. Heagle, K. J. Leonard, R. A. Reinert, H. W. Spurr Jr.; *Professors Emeriti:* R. Aycock, C. N. Clayton, D. E. Ellis, T. T. Hebert, L. W. Nielsen, J. P. Ross, J. N. Sasser, D. L. Strider, F. L. Wellman, J. C. Wells; *Associate Professors:* J. E. Bailey, R. I. Bruck, C. L. Campbell, W. M. Hagler Jr., B. C. Haning, G. A. Payne, D. F.

Ritchie, H. D. Shew, D. P. Schmitt, C. G. Van Dyke; *Assistant Professors:* M. E. Daub, C. H. Opperman; *Assistant Professors (USDA):* S. Leath, S. M. Schneider, S. R. Shafer, R. G. Upchurch

Plant pathology has major research programs in disease management, epidemiology, mycology, molecular biology, nematology, virology, biology of soil-borne pathogens, physiology of pathogenesis and general plant pathology. Programs leading to the Master of Agriculture, Master of Life Sciences (both non-thesis), Master of Science and Doctor of Philosophy degrees are offered. Requirements for these three degrees follow University policies: 30 credit hours and thesis for the M.S. degree; 36 for the Master of Agriculture and Master of Life Sciences degrees. The latter afford students an opportunity for general education with a major emphasis in plant pathology course work and subject matter.

Courses and number of hours taken by Ph.D. candidates are determined by the student's interest and background in consultation with an advisory committee. Strong foundation courses in botanical science as well as mathematics, biochemistry, chemistry and soil science are prerequisite, however, for admission to the Ph.D. degree. Students who enroll in any graduate program should have achieved a "B" average in the undergraduate major. A diagnostic examination is utilized in placing incoming Ph.D. students in appropriate graduate courses.

Opportunities for employment include research, extension and teaching appointments at Land-Grant colleges or universities and with the U. S. Department of Agriculture. Agribusiness and biotechnology industries also employs plant pathologists in research, promotion and service. Plant pathologists often participate in overseas assignments in developing countries through international and federal organizations, as well as in commercial enterprises.

Separate laboratories fully equipped and staffed for research in molecular biology, nematology, virology, soil-borne pathogens, physiology of pathogenesis and biochemical problems are available. Microcomputers, library, mycological herbarium, photography laboratory, and an interdepartmental electron microscope center are additional features available in the department. A faculty comprised of more than 50 scientists with varied interests provide for in-depth training in all of these areas.

The department has greenhouse facilities and access to controlled environmental growth chambers in the phytotron. Student participation in the Plant Disease Clinic provides experience in the diagnosis of all types of plant diseases.

North Carolina exhibits a wide range of soil types and climatic areas. Large acreages are planted to a variety of field, vegetable and ornamental crops, as well as forest trees. Special facilities for experimental work on diseases of these crops are found at 16 permanent research stations located throughout the state.

Graduate assistantships are funded by the Agricultural Research Service, the Agricultural Foundation and other agencies. Levels of stipends are adjusted to the previous training and experience of the recipients and are competitive with those offered by other Land-Grant universities. Special supplements to stipends and fellowships are available on a competitive basis for outstanding students.

SELECTED ADVANCED UNDERGRADUATE COURSE

PP 415 Plant Disease Control. *Preq.: PP 315. 3(2-3) S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

PP 501 Phytopathology I. *Preq.: PP 315 or equivalent. 5(3-6) F.* Basic concepts and principles of fungal and bacterial plant diseases. Emphasis on history, classification, etiology, pathogenesis, pathogen biology and genetics of host-parasite interaction. Laboratory emphasis on basis methodology of fungal and bacterial plant pathogens and development of an independent research project. Shew

PP 502A, B, C Phytopathology II. *Preq.: PP 315 or equivalent. 6(3-6) S.* Lectures and laboratory techniques in plant pathology presented as a series of five-week minicourses: PP 502A, nematode diseases; PP 502B, virus diseases; PP 502C, epidemiology. Students may enroll for one or all of the series. Each minicourse consists of lectures on principles and laboratories involving experimental techniques fundamental to the study of nematodes and viruses as plant pathogens and analyses of plant disease epidemics.
Barker, Campbell, Moyer

PP 503 Plant Disease Diagnoses. *Preqs.: PP 501 and 502A,B,C or equivalent. 4(2-6) Sum. Alt. yrs.* Diagnoses of plant diseases in the field and laboratory, and operational aspects of a plant disease clinic will be stressed. Frequent field trips to experiment stations and private farms will provide opportunities for field observation of plant disease, plant disease research and diagnosis. Laboratory studies will emphasize identification and major sources of descriptive information of plant pathogens and abiotic agents. Grand, Jones

PP 505 Histopathology. *Preq.: PP 501 or equivalent. 2(1-3) F.* Anatomical changes that occur in diseased plant tissues will be studied. The appropriate procedures of microtechnique necessary for interpretation of pathological changes in plant tissues will be considered. Laboratory assignments will involve projects on specific diseases including photography and scientific writing. Milholland

PP 515 Epidemiology and Plant Disease Control. *Preq.: PP 315 or PP 318. 3(3-0) S.* Consideration of fundamental concepts and principles of epidemiology as they apply to modern strategies of plant disease control. Special consideration is given to evaluation of current techniques for control of fungal, bacterial, viral and nematode pathogens in an integrated crop protection system. A term paper will be required to integrate concepts and principles of disease management for a specific crop. Sutton

PP (FOR) 518 Advanced Forest Pathology. *Preq.: PP 318 or equivalent. 3(3-0) F. Alt. yrs.* An in-depth study of the epidemiology and control of forest tree diseases. The nature of pathogenesis and host genetics will be related to concepts of functional diversity and disease resistance in natural ecosystems. Environmental and quantitative epidemiology, silvicultural, biological and chemical amelioration of forest tree diseases will be considered.
Bruck

PP (BO, CS, ENT, PM) 525 Biological Control. *4(3-3) F. Alt. yrs.* (See pest management.)

PP (MB, BO) 575 The Fungi. *3(3-0) F.* (See botany.)

PP (MB, BO) 576 The Fungi—Lab. *1(0-3) F.* (See botany.)

PP 595 Special Problems in Plant Pathology. *Preq.: CI. Credits Arranged, Maximum 6.* Investigation of special problems in plant pathology not related to a thesis problem. The investigations may consist of original research and/or literature survey. Graduate Staff

FOR GRADUATES ONLY

PP 604 Morphology and Taxonomy of Nematodes. *Preqs.: PP 502A, CI. 3(1-6) S. Alt. yrs.* A study of the morphology, anatomy and taxonomy of nematodes with emphasis on the identification of important plant-parasitic genera. Exercises include preparation of semipermanent and permanent nematode mounts. Triantaphyllou

PP 605 Molecular Biology of Plant Viruses. *Preqs.: PP 502B, BCH 451 or 551. 4(2-6) S. Alt. yrs.* An in-depth study of plant viruses with emphasis on the relationship between viral structure and function. Areas covered include infection, replication, genomic expression, encapsidation and transmission. Laboratory introduces students to contemporary molecular techniques. Graduate Staff

PP 608 History of Phytopathology. *Preqs.: PP 315, CI. 1(1-0) F. Alt. yrs.* Development of the science of phytopathology from its early beginnings to the early part of the 20th century. Campbell

PP 611 Advanced Plant Nematology. *Preqs.: PP 604. 4(3-3) F. Alt. yrs.* Nematode biology, genetics, physiology, molecular biology, ecology, embryogenesis, post-embryonic development, gametogenesis, cytology, reproduction, sexuality, evolution, behavior, host-parasite relationships, mechanisms of pathogenesis and resistance, interactions with other pathogens and impacts on crop performance. Laboratory exercises, research projects and techniques. Barker, Opperman, Triantaphyllou

PP 612 Plant Pathogenesis. *Preqs.: PP 501, BCH 551, BO 551, CI. 3(2-3) F. Alt. yrs.* Infection processes, alterations in photosynthesis, respiration, nitrogen metabolism, vascular function and growth regulator function are considered. The biochemical nature of the weapons utilized by pathogens in pathogenic attack and the defensive mechanisms employed by the hosts in resisting attack and the resultant dynamic interactions are studied. Huang

PP 615 Botanical Epidemiology. *Preqs.: PP 501, 502 or CI; Coreq.: ST 511. 4(2-6) S. Alt. yrs.* Advanced study of the dynamics of plant disease epidemics in relation to agricultural crop production and forestry systems. Emphasis will be placed upon epidemiological concepts and principles, pathogen and host dynamics, disease forecasting, geographic distribution of pathogens, crop-loss assessment and the development of theoretical and practical disease-management strategies. Bruck, Campbell, Main

PP (CS, GN, HS) 618 Breeding for Pest Resistance. *2(2-0) F. Alt. yrs.* (See crop science.)

PP (BO) 625 Advanced Mycology. *Preq.: PP 575 or CI. 4(2-6) F. Alt. yrs.* An in-depth treatment of major groups of fungi. Aspects of taxonomy, nomenclature, developmental morphology, genetics, host-parasite relations, physiology and ecology will be presented. Cardinal characteristics of selected fungi representing the major groups are determined. Field observations and collecting are also required. Grand

PP 628 Soilborne Plant Pathogens. *Preq.: PP 501. 3(2-3) S. Alt. yrs.* An in-depth study of the ecology of soilborne fungal and bacterial pathogens that induce root and wilt diseases in plants. Concepts and principles including but not limited to the rhizosphere, inoculum potential, soil fungistasis, survival, root disease models and biological control. Benson

PP 650 Colloquium in Plant Pathology. *Preq.: PP 502 or CI. 1(1-0) S.* Group discussions and individual presentations explore institutional operations in universities, research laboratories, international centers and industry. Sources of funding through appropriations, research grants and industry cooperators are examined. Criteria for evaluating the performance of professional employees, the role of scientific journals and professional societies, as well as public responsibilities are considered. Klarman, Graduate Staff

PP 690 Seminar in Plant Pathology. *Preq.: Consent of seminar chairman. 1(1-0) F,S.*
Discussion of assigned phytopathological topics. Echandi

PP 699 Research in Plant Pathology. *Preqs.: Grad. standing, CI. Credits Arranged.*
Original research in plant pathology. Graduate Staff

Political Science and Public Administration

GRADUATE FACULTY

Professor M. S. Soroos, *Head*

Associate Professor H. G. Kebschull, *Graduate Administrator for Political Science*

Associate Professor J. E. Swiss, *Graduate Administrator for Public Affairs Program*

Professors: G. D. Garson, A. Holtzman, E. R. Rubin, D. W. Stewart, J. O. Williams; *Professors Emeriti:* W. J. Block, J. T. Caldwell; *Associate Professors:* B. A. Cigler, R. H. Dorff, E. S. Fairchild, J. H. Gilbert, S. H. Kessler, J. P. Mastro, J. M. McClain, E. O'Sullivan, K. S. Petersen, M. L. Vasu; *Visiting Associate Professor:* D. W. McClintock; *Assistant Professors:* C. K. Coe, T. V. Reid, J. B. Rosch; *Visiting Assistant Professor:* B. A. Braddy

The Department of Political Science and Public Administration offers programs leading to the Master of Public Affairs degree and the Master of Arts degree.

A candidate for admission to either program must have demonstrated an aptitude for graduate study as indicated by the Graduate Record Examination; the student may also be required to take certain undergraduate courses to make up any deficiencies that may exist in the undergraduate record.

The Master of Public Affairs degree requires completion of a 40-semester-hour professional program for persons who are now or hope to be employed by government or by a government-related private enterprise or association. An internship in a government agency is required for persons with no previous public sector experience.

The program requires 31 hours to be selected from courses offered by the Department of Political Science and Public Administration, including 16 hours of core courses. Students may specialize in financial management, human resource management, data management, association/non-profit management, urban management, environmental resources management or administration of justice. The remaining hours may be taken in another discipline, such as economics and business, education, industrial engineering, psychology, recreation, sociology and statistics, or as an interdisciplinary sequence of courses.

Students who enroll in the program should have completed twelve hours in the social sciences as undergraduates and have achieved a B average in the last two years of school. PA 571, a core course, has a statistics prerequisite.

The Master of Arts degree requires each candidate to complete 30 hours of graduate work including three hours in Research Methods and Analysis (PS

571). The candidate must concentrate (18-21 hours, including thesis) in two major fields of political science. Major fields are to be selected from the following: political theory, American politics, comparative politics, international relations and public administration. A disciplinary minor of 9 to 12 hours outside the Department of Political Science and Public Administration is required. A student's work in a minor field must constitute a unified pattern and must contribute to one or both of the student's major fields.

In either program the student selects a graduate committee chairperson for the preparation of a program of study which shall be subject to the approval of two other committee members, including one from outside the Department of Political Science and Public Administration.

Comprehensive written and oral examinations are required of every candidate for both degrees. In addition, a candidate for the Master of Arts degree must demonstrate reading proficiency in one modern language (normally German, French, Spanish or Russian) or a research skill and must write a thesis in one of his or her major areas.

SELECTED ADVANCED UNDERGRADUATE COURSES

PS 401 American Parties and Interest Groups. *3(3-0) F.*

PS 402 Campaigns and Elections in the American Political System. *Preq.: PS 201. 3(3-0) F,S.*

PS 406 Politics and Policies of American State Governments. *3(3-0) F,S,Sum.*

PS 408 Urban Politics. *3(3-0) F,S.*

PS 411 Public Opinion and the Media. *Preq.: Six hours of social science. 3(3-0) S.*

PS 431 International Law and Organization. *3(3-0) F.*

PS 437 National Security Policy. *Preq.: PS 331. 3(3-0) S,Sum.*

PS 446 Comparative Communist Systems. *Preq.: PS 344 or 332. 3(3-0) F,S.*

PS 447 Political Development. *Preq.: Six hours of PS. 3(3-0) F. Alt. yrs.*

PS 462 Seminar in Political Theory. *Preq.: PS 361. 3(3-0) S.*

PS 498 Special Topics in Political Science. *Preq.: Six hours of PS. 3-6 F,S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

PA 505 Administrative Law. *Preq.: Grad. standing or PBS status. 3(3-0) S.* Case law of the exercise of administrative power, judicial and legislative control of administrative action, legal rights of public employers and legal procedures of administrative tribunals.
McClain

PA 508 Urban Politics. *Preq.: Advanced underyrad. standing including 12 hours of political science, grad. standing or PBS status. 3(3-0) S.* A comparative study of political conditions in cities and localities. Topics will include the formal structures and rules of city and metropolitan governments, and the relationships to the informal norms and distribution of power; patterns of local decision making; elite recruitment and citizen participation; variations of local autonomy and the scope of local politics; approaches to urban policy issues.
Cigler

PA 511 Public Administration. *Preq.: Advanced undergrad. standing including 12 hours in political science, grad. standing or PBS status. 3(3-0) F,S,Sum.* A general survey of the field of public administration, examining formal and informal organizations, processes of administration, the political environment of administration and administrative responsibility and accountability. Graduate Staff

PA 513 Financial Management in the Public Sector. *Preq.: Grad. standing or PBS status. 3(3-0) F.* This course surveys financial practices and concepts in the public sector. Topics covered include: public sector accounting, financial information systems, revenue projections, cash management and debt management. Case-based applications are emphasized. Coe

PA 515 Administration of Criminal Justice. *Preq.: Advanced undergrad. standing including 12 hours of political science, grad. standing or PBS status. Credit for both PS 415 and PA 515 is not allowed. 3(3-0) F.* A study of politics and administration in the American criminal justice system. The interrelationships between ideology, organization and policy outputs are emphasized in the analysis of major problems confronting the system today. Topics included are: intergovernmental relations, discretionary justice, impact of judicial decisions on criminal justice administration and management trends in criminal justice bureaucracies. Fairchild

PA 516 Public Policy Analysis. *Preq.: Advanced undergrad. standing including 12 hours of political science, grad. standing or PBS status. 3(3-0) F,S,Sum.* Course covers methods and techniques of analyzing, developing and evaluating public policies and programs. Emphasis is given to benefit-cost and cost-effectiveness analysis and concepts of economic efficiency, equity and distribution. Methods include problem solving, decision making and case studies. Examples are used in human resource, environmental and regulatory policy. Swiss, Williams

PA 518 Organization Design. *Preq.: Advanced undergrad. standing including 12 hours of political science, grad. standing or PBS status. 3(3-0) S.* An examination of contemporary approaches to organization design, including organization development, sociotechnical systems analysis and various forms of organizational participation ranging from human relations to self-management models. Issues in personnel administration are emphasized in relation to public management and government structure. Graduate Staff

PA 520 Environmental Policy. *Preq.: Advanced undergrad. standing including 12 hours of political science, grad. standing or PBS status. 3(3-0) F.* This course focuses on the formation and impact of environmental policy in the United States. Decision-making processes at all levels of government are examined. Comparisons are made between political, economic, social and technological policy alternatives. Emphasis is given to the application of policy analysis in environmental assessment, and theoretical perspectives on the nature of the environmental crisis are considered. Cigler

PA 570 Research Methods Computing Lab. *Preqs.: Advanced undergrad. standing including 12 hours of PS, grad. standing or PBS status and an introductory course in ST. 1(0-2) F,S.* A one-hour computing lab that complements the public administration curriculum. Introduction to computing on both mainframe and microcomputer. Includes TSO/QED statistical packages, SPSS data structures and microcomputing software. Graduate Staff

PA 571 Research Methods and Analysis. *Preqs.: Advanced undergrad. standing including 12 hours of political science, grad. standing or PBS status and an introductory course in statistics. 3(3-0) F,S.* A focus on the behavioral approach to the study of political and administrative behavior. Topics include the philosophy of social science; experimental, quasi and non-experimental research design; data collection techniques; basic statistical analysis with computer applications. O'Sullivan, Vasu

PA 573 Computer Applications in Public Affairs. *Preqs.: ST 507; CSC 462 or PS 371 or PA 571. 3(1-6) S,Sum.* The methodology, data analysis techniques and computer-based

skills necessary to conduct and manage applied research. The course focuses on the analysis and processing of data through the medium of conventional computer software frequently used in the field, *i.e.*, SPSS, SAS. Graduate Staff

PA 574 Data Management in Public Administration. *Preqs.: PS 374 or PA 573 and previous coursework or experience in public administration. 3(3-0) S.* An introduction to managerial applications of data management in public budgeting, public personnel and public policy analysis. Microcomputers are used to construct data bases and analytic models in these areas. Garson

PA 580 Independent Study. *Preq.: Grad. standing or PBS. 1-6. F,S,Sum.* Independent research or readings by graduate students under the direct supervision of individual faculty members. Students' work is evaluated, based on reports, papers and exams, with letter grading (A, B, C, D, NC) employed. Graduate Staff

PA 590 Readings and Research. *Preq.: Grad. standing. 1-3 F,S,Sum.* To enable graduate students to pursue a subject of particular interest to them by doing extensive readings or research in that subject under direct, individual faculty supervision. Graduate Staff

PA 598 Special Topics in Public Administration. *Preq.: Advanced undergrad. standing including 12 hours in political science, grad. standing or PBS status. 1-6 F,S,Sum.* Detailed investigation of contemporary topics in the fields of public administration. Topic and mode of study determined by program faculty. Graduate Staff

PS 502 The Legislative Process. *Preq.: Advanced undergrad. standing including 12 hours of political science, grad. standing or PBS status. 3(3-0) S.* A study of the formulation of public policy from the institutional and behavioral viewpoints. Important current legislative problems at the congressional and state legislative levels will be selected and will serve as a basis for analyzing the legislative process. Holtzman

PS 506 American Constitutional Theory. *Preq.: Advanced undergrad. standing including 12 hours of political science, grad. standing or PBS status. 3(3-0) F.* Basic constitutional doctrines, including fundamental law, judicial review, individual rights and political privileges and national and state power. Special attention is given to the application of these doctrines to the regulation of business, agriculture and labor and to the rights safeguarded by the First, Fifth and Fourteenth Amendments to the Constitution. Rubin

PS 507 Constitutional Theory II. *Preq.: Advanced undergrad. standing including 12 hours of political science, grad. standing or PBS status. 3(3-0) F,S.* A continuation of PS 506, but may be elected separately. An examination of leading constitutional cases, especially in the fields of civil liberties and individual rights and the writings of leading commentators. Reid, Rubin

PS 514 Public Finance. *Preq.: EB 205. 3(3-0) F.* A survey of the theories and practices of governmental taxing, spending and borrowing, including intergovernmental relationships and administrative practices and problems. Graduate Staff

PS (SOC) 517 The Police Bureaucracy in a Democratic Society. *Preq.: Advanced undergrad. standing including 12 hours of political science, grad. standing or PBS status. 3(3-0) S.* This is a political science seminar which focuses on the proposition that police departments are bureaucratic organizations which can be studied as such. Emphasis is placed on understanding the process by which police policy is made. Internal and external, psychological and structural variables are identified in tracing decisions on specific issues. Thus, attitudes of policemen, the nature of their work and the resources and power of various constituencies are factors seen as determining police behavior. Fairchild, Rosch

PS 531 International Law. *Preq.: Grad. or advanced undergrad. standing. 3(3-0) Every yr.* Sources and subjects of international law, domestic and international jurisdictions, judicial settlement, legal and illegal uses of force and the substance of law in selected policy ares. Graduate Staff

PS 533 Global Problems and Policy. *Preq.: Advanced undergrad. standing including 12 hours of political science, grad. standing or PBS status. Credit for both PS 433 and PS 533 is not allowed. 3(3-0) F.* International policy processes and policy responses to problems of global scope including the role of international law. Consideration given to economic development, human rights and other policy problems selected for specific semesters. Independent research on a global policy problem of student's choice. Soroos

PS 541 Military Coups and Regimes in the Third World. *Preqs.: Advanced undergrad. standing, grad. standing or PBS status. 3(3-0) F.* The seizure and exercise of political power by military forces in Asia, Africa and Latin America. Causes and techniques of military coups, with emphasis on the social, economic and political policies of military regimes. Case studies within the context of theories about the political role of the militar Graduate Staff

PS 542 Western European Politics. *Preq.: Nine hrs. of political science, grad. standing or PBS status. Credit in both PS 442 and PS 542 is not allowed. 3(3-0) F.* Analysis of political institutions and processes in selected Western Europen states and the European community and of major social, economic and political issues confronting European societies. Graduate Staff

PS 545 Comparative Systems of Law and Justice. *Preq.: grad. standing. Credit in both PS 445 and PS 545 is not allowed. 3(3-0) F,S.* A study of legal culture and administration of justice in Western European, Third World and Communist political systems, with a view to comparison with the American system of law and justice. Emphasis on the impact of legal ideology on such topics as the nature of crime, political justice, police administration, corrections and judicial processes. Graduate Staff

PS 562 Modern Political Theory. *Preq.: Advanced undergrad. standing including 12 hours of political science, grad. standing or PBS status. 3(3-0) S.* A study of selected classics in the tradition of modern political theory. Authors to be read include Machiavelli, Hobbes, Locke, Montesquieu, Rosseau, Marks and Nietzsche. Kessler

PS 571 Research Methods and Analysis. *Preqs.: Advanced undergrad. standing including 12 hrs. of PS, grad. standing or PBS status. 3(3-0) F,S.* A survey of methods used in behavioral research as applied to the field of political science: elements of empirical theory, research design, measurement of variables, sampling procedures, data courses, techniques of data collection, statistical analysis, qualitative methodologies and the presentation of research findings. Soroos, Vasu

PS 590 Readings and Research. *Preq.: Grad. standing or PBS status. 1-3 F,S,Sum.* Graduate students pursue a subject of particular interest to them by doing extensive readings or research in that subject under direct, individual faculty supervision. Graduate Staff

PS 598 Special Topics in Political Science. *Preq.: 6 hours of political science. 1-6 F,S.* Detailed investigation of a topic. Topic and mode of study determined by the student and a faculty member. Graduate Staff

FOR GRADUATES ONLY

PA 608 Seminar in Urban Management. *Preqs.: Grad. standing or Management Development Certificate Program and six semester hours of 500-level course work. 3(3-0) F.* A seminar focusing on the analytical techniques and managerial principles required for policy formation and implementation in a complex urban governmental environment. Specific topics include: urban planning and community development, housing, intergovernmental relations, organizational roles and decision making, budgeting and selected urban services (for example: police, transportation). Cigler

PA 611 Seminar in Public Personnel Management. *Preqs.: Grad. standing or Management Development Certificate Program and six semester hours of 500-level course work.*

3(3-0) F,S. Examines the major issues in public sector personnel management. Among topics considered are: staffing, position classification, compensation, affirmative action, performance review and appraisal, patronage, training, career development, employee assistance, unionization and rights of public employees. Graduate Staff

PA 612 The Budgetary Process. *Preqs.: Grad. standing or Management Development Certificate Program and six semester hours of 500-level course work. 3(3-0) F,S,Sum.* This course examines generalized budgetary process used at all levels of government in the United States. Understanding of the process is based upon comprehension of the institutions involved, the roles of politicians and professionals and the objectives of budgetary systems. The course also focuses upon budgetary reforms and on Planning-Programming-Budgetary and Zero-Based Budgeting as management tools. Coe, McClain

PA 613 Government and Planning. *Preqs.: Grad. standing or Management Development Certificate Program and six semester hours of 500-level course work. 3(3-0) F,Sum.* A study of the planning function at all levels of government in the United States, with particular attention to the problems posed for planning by the rapid growth of metropolitan areas. An overview of community development, urban spatial structure, housing economics and land use planning. Vasu

PA 614 Management Systems. *Preqs.: Grad. standing or Management Development Certificate Program and six semester hours of 500-level course work. 3(3-0) S,Sum.* An examination, through case studies and applied methodology, of various management systems and management techniques. Among the topics considered are: differences between market and nonmarket organizations, financial management systems, quantitative decision-making approaches, planning techniques such as CPM and PERT, MBO and productivity systems. O'Sullivan, Swiss

PA 615 Seminar in Administrative Problems. *Preqs.: Grad. standing or Management Development Certificate Program and six semester hour of 500-level course work. 2-4. S,Sum.* An advanced course in administrative principles and methods. Students will perform individual or group research under supervision in specific administrative topics within the context of those public agencies which function in their respective fields of technology. McClain

PA 616 Seminar in Program Evaluation. *Preqs.: Grad. standing or Management Development Certificate Program and a grad. course in research methods. 3(3-0) F,S.* The course combines seminar and field research techniques to study the evaluation of public programs. Focus on political and administrative problems associated with program evaluation. The availability and appropriateness of various quantitative methodologies are also examined. Seminar concepts are applied through evaluative projects conducted for public agencies. O'Sullivan

PA 617 Seminar in Organization Theory. *Preqs.: Grad. standing or Management Development Certificate Program and six semester hours of 500-level course work. 3(3-0) F,S.* The seminar examines major conceptual frameworks developed to understand organizational behavior. Topics stressed include motivation, leadership, group dynamics, communication, socio-technical systems, work design and organizational learning. The emphasis is on applying theories and concepts to public sector organizations. Stewart, Vasu

PA 619 Intergovernmental Relations in the United States. *Preqs.: Grad. standing or Management Development Certificate Program and six semester hours of 500-level course work. 3(3-0) S.* The course examines distinctive features of intergovernmental relations in the United States. Topics stressed include historical adaptations of federalism, the emerging role of the administrator, contemporary trends in intergovernmental relations and assessment of contemporary trends from federal, state and local perspectives. Coe

PA 620 Environmental Administration. *Preqs.: Grad. standing or Management Development Certificate Program and six semester hours of 500-level course work. 3(3-0) S.* A

review and investigation of the major environmental management systems utilized to plan, develop and implement environmental programs. Graduate Staff

PA 621 Collective Negotiations in the Public Service. *Preqs.: Grad. standing or Management Development Certificate Program and six semester hours of 500-level course work. 3(3-0) Sum.* This course includes intensive consideration of the background of the collective negotiations movement; analysis of key policy issues, such as bargaining rights and the use of strike weapons; framework for collective negotiations; scope and conduct of negotiations; impasse resolution; grievance procedure. Graduate Staff

PA 691 Internship in Public Affairs. *Preq.: Minimum 9 hrs. graduate work. 1-6 F,S,Sum.* This course exposes the student to the environment and value systems of the public organization through a supervised work experience. It involves the application of substantive knowledge and analytical skills to organizational problems. Credit will vary with the nature of the work experience. Graduate Staff

PS 631 Seminar in International Relations. *Preq.: Six semester hours of 500-level course work. 3(3-0) F,S,Sum. May be taken for up to six hours credit.* An in-depth examination of a topic within the larger field of international politics to be selected by the instructor for each semester from subjects pertaining to interstate relations, international law and organization, regional politics, foreign and security policy or global issues. Students will undertake a substantial independent research project. Graduate Staff

PS 641 Seminar in Comparative Politics. *Preqs.: One course in comparative politics and one course in political science methodology or CI. 3(3-0) F,S.* This seminar will open with a survey of the problems and methods of comparative political analysis, after which students will be assigned a specific, limited subject to be examined within the framework of a systematic, analytical scheme appropriate to the topic. Specific topics will be drawn from the subjects of political ideologies, political groups, political elites and decision-making institutions and processes. Graduate Staff

PS 691 Internship in Political Science. *Preq.: Grad. standing. 1-6 F,S,Sum.* This course exposes the student to the environmental and value systems of public organizations through a supervised work experience. Graduate Staff

PS 696 Seminar in Politics. *Preq.: Advanced grad. standing. 2-4 F,S.* An independent advanced research course in selected problems of government and politics. The problems will be chosen in accordance with the needs and desires of the students registered for the course. Graduate Staff

PS 699 Research in Politics. *Preqs.: Grad. standing and approval of adviser. Credits Arranged. F,S.* Research for writing the master's thesis. Graduate Staff

Poultry Science

GRADUATE FACULTY

Professor J. E. Marion, *Head*

Professors: T. A. Carter, R. E. Cook, W. E. Donaldson, F. W. Edens, J. D. Garlich, P. B. Hamilton, C. H. Hill, C. R. Parkhurst; *Adjunct Professors:* D. I. McRee, J. P. Thaxton; *Professors Emeriti:* E. W. Glazener, J. R. Harris; *Associate Professors:* J. T. Brake, V. L. Christensen, W. M. Hagler Jr., F. T. Jones, J. F. Ort, J. C. H. Shih, T. D. Siopes; *Assistant Professors:* J. B. Carey, M. A. Qureshi, S. E. Scheideler, R. M. Shuman; *Adjunct Assistant Professor:* R. P. Gildersleeve

ASSOCIATE MEMBERS OF THE DEPARTMENT

Professors; H. R. Ball Jr., D. G. Simmons; *Assistant Professor:* B. W. Sheldon

The Department of Poultry Science offers the Master of Science degree. Doctoral programs are offered in the disciplines of microbiology, physiology, genetics and nutrition.

The department occupies Scott Hall, containing well-equipped laboratories, animal rooms and offices. Additional research facilities are located on the University farms and the Piedmont Research Station.

The Dearstyne Avian Research Center, a three-building complex, is used in connection with special research projects related to disease resistance and treatment of various pathological conditions. The complex is made up of animal isolation rooms, biochemical laboratories and related facilities.

The research program is comprehensive and includes fundamental studies in genetics, microbiology, nutrition, pathology, immunology, molecular biology, toxicology and physiology. In addition, investigation of problems of more practical urgency is undertaken when appropriate.

The demand for men and women with advanced training in poultry science is far greater than the supply. Opportunities exist for graduates in research and teaching in universities, in government and in private industry.

SELECTED ADVANCED UNDERGRADUATE COURSES

PO 405 Avian Physiology. *Preq.: CH 220. 4(3-3) F.*

PO 410 Production and Management of Game Birds in Confinement. *Preq.: PO 201. 3(2-3) S.*

PO (ANS, NTR) 415 Comparative Nutrition. *Preqs.: CH 220 or both 221 and 223. 3(3-0) F.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

PO 505 Physiological Aspects of Poultry Management. *Preqs.: PO 201, PO 405 or grad. standing. 3(3-0) S.* Application of physiological principles to modern poultry management. Poultry physiology related to management topics including nutrition, housing, ventilation, disease, heat stress and lighting programs. Graduate Staff

PO (GN) 520 Poultry Breeding. *Preq.: GN 411. 3(2-2) S.* Application of genetic principles to poultry breeding, considering physical traits and physiological characteristics. Graduate Staff

PO (ZO) 524 Comparative Endocrinology. *Preq.: ZO 421 or equivalent. 4(3-3) S.* Basic concepts of endocrinology, including functions of major endocrine glands involved in processes of growth, metabolism and reproduction. Siopes

PO 590 Graduate Seminar in Poultry Science. *1(1-0) F.* Preparation for research, research perspectives, rising concerns in poultry production, orientation for graduate studies in poultry science. Required of all graduate students in the Department of Poultry Science. Graduate Staff

FOR GRADUATES ONLY

PO (ANS, NTR) 605 Mineral Metabolism. *3(3-0) F.* (See animal science.)

PO 698 Special Problems in Poultry Science. *Preq.: Grad. standing. Maximum 6 F,S.* Specific problems of study are assigned in various phases of poultry science.
Graduate Staff

PO 699 Poultry Research. *Preq.: Grad. standing. Credits Arranged. A maximum of six credits is allowed towards a master's degree. F,S.* Appraisal of present research; critical study of some particular problem involving original investigation. Problems in poultry breeding, disease, endocrinology, hematology, microbiology, nutrition or physiology.
Graduate Staff

Product/Visual Design

GRADUATE FACULTY

Professor H. Khachatoorian, *Program Director*

Professors: V. M. Foote, A. S. Lowrey, C. E McKinney; *Professors Emeriti:* G. L. Bireline Jr., J. H. Cox; *Associate Professors:* A. V. Cooke, R. A. Donaldson, C. E. Joyner, P. L. Middleton, J. M. Wittkamp; *Assistant Professors:* S. K. Ater, K. R. Finkel, M. S. Lange, S. D. Wilchins

The Department of Product/Visual Design offers courses of study leading to a Master of Product Design degree with three distinct concentrations: Product Design, Visual Design and Textile Design.

Product design deals with all aspects of machine-made products and their relationship to people and the environment. The discipline therefore involves three major research and design activities: human behavior, the human/product relationship and the product itself. In the School of Design's Product Design curriculum, the emphasis is on the designer's responsibility in enhancing the quality of human life. Students learn to consider the effects of a product from conception through production and eventually its use.

The graduate curriculum prepares students for professional careers in product research, development and design. Core and elective courses focus on problem identification, problem-solving methods, communication skills and the nature of materials and production processes.

In the studio, students use this knowledge to solve real-world design problems requiring research, creativity and the application of newly acquired technical skills. Working on these projects helps students consider essential design factors such as form, safety, physiology, manufacturing processes, color, texture, cost and maintenance.

Graduates of the Product/Visual Design Department are working in a variety of fields, including furniture, housewares, appliances, transportation, machine tools, medical and electrical instruments and microelectronics. In addition, the department offers many opportunities for 'co-op' educational programs, which combine academic coursework with valuable on-the-job experiences.

Students in the Visual Design curriculum learn to graphically communicate information, concepts and feelings through various media, especially print. Classes in graphic design history, typography, photography, illustration, printing processes and materials are synthesized with theory and methodology in the studio.

The graduate curriculum prepares students to apply creativity and technical expertise in either professional or non-applied academic research. Professional situations include study of signs and symbols, posters, book and magazine design, packaging, exhibits, advertising and computer graphics. The academic orientation of study involves investigations of communication theory, problem-solving methodologies, form generating strategies, visual perception and design evaluation.

Textile design is the conception and creation, by hand or machine, of fiber and fiber objects. While fabric yardage immediately comes to mind, textile designers also create clothing and accessories, home furnishings, wall hangings and other textiles for specific architectural or environmental purposes.

In all these areas, the textile designer must combine creative ability and technical skills to conceive a product that is aesthetically pleasing, functionally sound and appropriate for production. This requires a thorough understanding of the production process, including product research, development and design; basic management principles and structures; and marketing, manufacturing and merchandising. Students pursue study in specific areas of textile design, including printing, weaving, knitting, design and production processes. Whether the interest is in industrial mass production or individual craftsmanship in traditional methods of fabric construction, the same emphasis is placed on high quality textile design and how it shapes, alters and enhances the human environment.

In the graduate program, students earn the professional Master of Product Design, with a Textile Design concentration.

The student's program of selected course work and terminal project are under the direction of his/her graduate advisory committee. The terminal project shall constitute the final test of the candidate's mastery of his/her design studies. The project shall be developed in the design studio or special projects framework in the final year and shall consist of an in-depth investigation of an approved problem, which relates product design studies to the student's minor field. All students with a five-year undergraduate degree, equivalent or professional experience shall be required to complete a minimum of 30 hours of course work of which approximately 70 percent will be in the major field and the remainder elected from various specialized knowledge areas.

For students holding four-year undergraduate degrees in design, the program requires a minimum of 48 credit hours of course offerings in the normal two-year master's work.

Applications for this program may come from the following sources: graduates of approved schools of product design, graduates of approved programs of industrial design, graduates of approved schools of graphic design, graduates of accredited schools of architecture or landscape architecture, graduates of approved schools of art and design, graduates of accredited schools of engineering and, under special circumstances, students with degrees in fields other than

design. In those latter instances an advisory committee will evaluate the applicant's preparation with regard to design capabilities and professional competence. In addition, course offerings are available to any graduate student who can demonstrate reasonable competence or equivalent qualifications for prerequisites in the requested courses. All applicants in addition to meeting the qualifications of the Graduate School must meet the special requirements of the Product Design program with regard to design capabilities and professional competence.

SELECTED ADVANCED UNDERGRADUATE COURSES

PD 400 Product Design Studio. *Preq.: DF 102 or written approval of dept. head. 6(0-9) F,S.*

PD (TX) 471 Textile Design Studio. *Preqs.: A grade of C or better in PD (TMT) 272, 371 and 372. 6(0-9) F,S.*

VD 400 Visual Design Studio. *Preq.: DF 102 or written approval of dept. head and dean; Coreq.: DN 456, DN 242. 6(0-9) F,S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

PD 510 Product Design Project Preparation. *Preq.: Grad. standing. 3(3-0) S.* A seminar course designed to assist students in preparing the groundwork for the final project to be conducted in the design studio.

PD 511 Product Design Materials and Processes I. *Preq.: Grad. standing. 3(3-0) F.* An analysis of paper, wood, metal and manufacturing processes utilized in the production of mass-produced products. Advanced studies in mass production processes and their influence on design and development of products. Emphasis is placed on material search and process selection in relation to product safety, cost, function, human factors, form, finishes and joining methods.

PD 512 Product Design Materials and Processes II. *Preq.: Grad. standing. 3(3-0) S.* An analysis of plastics and rubber and the related manufacturing processes utilized in the production of mass-produced products. Advanced studies in mass production processes and their influence on design and development of products. Emphasis is placed on material search and process selection in relation to cost, product safety, function, human factors, form, finishes and joining methods.

PD 541, 542 Advanced Visual Design I, II. *Preqs.: ARC 400, LAR 400, PD 400 or VD 400; waiver of prerequisite is at the discretion of the instructor. 6(3-9) F,S.* Application of previous studies in design and visual communications to a wide variety of visual problems presented by our physical environment.

PD 591 Special Seminar in Product Design. *Preq.: Grad. standing. 1-3 F,S.* Seminars on subjects of current interest in product design which are presented by persons not part of the regular faculty.

PD 592 Special Topics in Product Design. *Preq.: Grad. standing. 2-3 F,S.* Topics of current interest to the program/option offered by faculty in the School. Subjects offered under this number are normally used to test and develop new courses.

PD 595 Independent Study in Product Design. *Preq.: Grad. standing. Max. 6. F,S,Sum.* Special problems in various aspects of product design developed under the direction of a faculty member on a tutorial basis.

VD 510 Visual Design Project Preparation. *Preq.: BEDVD degree or equivalent. 3(3-0) S.* A seminar course designed to assist students in preparing the foundation for the final project to be conducted in the design studio.

VD 517 Advanced Typographic Systems. *Preqs.: DN 217 and DN 317. 3(2-2) F.* Systematic approaches to structuring typographic form according to information hierarchies, user needs and visual expression. Application to the organization of tables, charts, books, magazines, corporate identities and signage.

VD 518 Advanced Typographic Expression. *Preqs.: DN 217 and DN 317 or equivalent. 3(2-2) S.* This course will focus on experimentation in typography for the purpose of subjective expression. Analysis of historical precedent, contemporary usage and the semiotics of shaped writing will provide a basis for the advanced student to study and use typography as image, metaphor and symbol.

VD 591 Special Seminar in Visual Design. *Preq.: Grad. standing. 1-3 F, S.* Seminar on subjects of current interest in graphic design, which are presented by persons not part of the regular faculty.

VD 592 Special Topics in Visual Design. *Preq. Grad. standing. 2-3 F, S.* Topics of current interest to the program/option offered by faculty in the School. Subjects offered under this number are normally used to test and develop new courses.

VD 595 Independent Study in Visual Design. *1-3 F,S,Sum.* Special problems in various aspects of graphic design developed under the direction of a faculty member on a tutorial basis.

FOR GRADUATES ONLY

PD 600 Advanced Product Design (Series). *Preq.: Portfolio review. 6(0-12) F,S.* Advanced studies in product design. Special emphasis is given to problem identification, program formulation and application of advanced design methods. All problems will be of an individual nature leading to a synthesis of previous design experience.

PD 631, 632 Advanced Concepts in Product Engineering. *Preqs.: PD 600, grad. standing. 3(3-0) F,S.* Group investigation of advanced concepts in product design with emphasis on engineering. Engineering principles play an important role in the design of useful products. The scope of this course will include mass movement of persons as well as the designs of consumer products. The field of transportation and consumer products are fast-changing to satisfy the needs of present and future generations. The product designer is to be made aware of these needs by special investigations into future technologies and material developments.

PD 670 Advanced Product Design-Textiles (Series). *Preq.: Portfolio review. 6(0-12) F,S,Sum.* Advanced studies in textile styling. Special emphasis is given to problem identification, program formulation and application of advanced design methods. All problems will be of an individual nature.

PD 691 Special Topics in Product Design. *Preq.: Grad. standing. 1-6 S.* An investigation of special topics in product design of a particular interest to advanced students under the direction of the chair of the graduate committee on a tutorial basis. Credit and content will vary with each student.

PD 698 Final Project Studio in Product Design. *Preq.: 18 hours of PD 600. 6(0-12).* Final project for graduate students supervised by members of their graduate advisory committees.

VD 600 Advanced Visual Design (Series). *Preq.: Portfolio review. 6(0-12) F,S,Sum.* Advanced studies in graphic design. Special emphasis is given to problem identification, problem formulation and application of advanced design methods. All problems will be of an individual nature leading to a synthesis of previous design experiences.

VD 691 Special Topics in Visual Design. *Preq.: Permission of grad. advisor. 1-6 F,S,Sum.* An investigation of special topics in graphic design of a particular interest to advanced students under the direction of the chair of the graduate committee on a tutorial basis; credit and content will vary with each student.

VD 698 Final Project Studio in Visual Design. *Preq.: 18 hrs. of VD 600. 6(0-12) F,S.* Final project for graduate students supervised by members of their graduate advisory committees.

Psychology

GRADUATE FACULTY

Professor P. W. Thayer, *Head*

Professors: J. W. Cunningham, D. W. Drewes, T. E. LeVere, S. E. Newman, B. W. Westbrook; *Professors Emeriti:* K. L. Barkley, H. M. Corter, J. C. Johnson, H. G. Miller; *Associate Professors:* J. L. Cole, D. O. Gray, T. M. Hess, J. W. Kalat, K. W. Klein, J. E. R. Luginbuhl, D. H. Mershon, S. B. Pond III, F. J. Smith, S. S. Snyder, N. W. Walker; *Adjunct Associate Professors:* B. F. Corder, J. L. Howard; *Associate Professors Emeriti:* M. H. Pitts, R. F. Rawls; *Assistant Professors:* L. E. Baker-Ward, W. P. Erchul, P. E. Horan; *Adjunct Assistant Professors:* A. D. Hall, C. L. Kronberg

ASSOCIATE MEMBERS OF THE DEPARTMENT

Professors: R. G. Pearson, J. L. Wasik; *Associate Professor:* C. D. Korte

The Department of Psychology offers courses of study leading to the Master of Science and Doctor of Philosophy degrees. Specialization in applied developmental psychology, experimental psychology, ergonomics, industrial-organizational and vocational psychology, school psychology, social psychology and human resource development is available.

A minimum of 30 semester hours of graduate credit is required for the master's degree. Though no minimum number of additional hours is required for the doctoral degree, the student may expect to take 30 or more additional semester hours of graduate credit. The actual graduate program for each master's and doctoral student is tailored to the needs, interests and accomplishments of the individual. Admission requirements for the beginning graduate student in psychology are satisfactory grades in all undergraduate work and at least a "B" average in undergraduate psychology courses and in the undergraduate major, satisfactory scores on the Graduate Record Examination including the Advanced

Test in psychology and the Miller Analogies Test and three satisfactory letters of recommendation in regard to quality of work and character. It is possible to enter the program without undergraduate coursework in psychology but some preparation in experimental psychology, statistics and mathematics is desirable.

Admission requirements for students already possessing the master's degree who wish to obtain the doctorate in psychology are a minimum of a "B" average in their graduate work and a substantial background in psychology or related fields, satisfactory grades in undergraduate studies, satisfactory scores on the Miller Analogies Test and the Graduate Record Examination including the Advanced Test in psychology (if the applicant's master's degree is in a field other than psychology, the Advanced Test score in that field should also be submitted) and three satisfactory letters of recommendation in regard to quality of work and character. Beginning and advanced students must be sponsored by a faculty member of this department to be admitted.

A limited number of research and teaching assistantships and fellowships are available to qualified graduate students.

SELECTED ADVANCED UNDERGRADUATE COURSES

PSY 476 Psychology of Adolescent Development. *Preq.: Jr. standing. 3(3-0) F,S.*

PSY 491 Special Topics in Psychology. *Preq.: PSY 200. 3(3-0) F,S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

PSY 500 Visual Perception. *Preq.: Grad. standing or CI. 3(2-2) F.* Detailed consideration of anatomy and physiology of the visual system (both peripheral and central components). Modern quantitative approaches to psychophysical problems of detection, discrimination scaling. Examination of chief determinants determiners of visual perception, including both stimulus variables and such organismic variables as learning, motivation and attention. Discussion of perceptual theory and processes emphasizes several topics in twoand three-dimensional spatial perception. Mershon

PSY 501 Introduction to Graduate Study in Psychology. *Preq.: Grad. standing in PSY. 1(1-0) F.* Orientation to graduate study in psychology. Library and computer systems. Faculty research and teaching interests. Special research facilities and populations. Standards for research with human and infrahuman subjects. Ethical principles of American Psychological Association. Generic and specialty guidelines for providers of psychological services. North Carolina Licensing Law and supporting rules. Psychology as science, discipline and profession. Newman

PSY 502 Physiological Psychology. *Preq.: Twelve hours of PSY including PSY 200, 300, 310. 3(3-0) F.* First of two-semester sequence concerned with the physiological foundations of behavior. The emphasis in this first course is basic vertebrate neuroanatomy and neurophysiology. LeVere

PSY 503 Comparative Psychology. *Preq.: 9 hours in PSY or animal behavior or CI. 3(3-0) S.* A study of animal behavior, species differences in behavior and biological determinants of behavior. An emphasis on the careers and research styles of some eminent comparative psychologists, for example, Richter, Tinbergen, Harlow, Stein and Rensch. Kalat

PSY 504 Advanced Educational Psychology. *Preq.: Six hours of PSY. 3(3-0) F.* A critical appraisal of current psychological findings that are relevant to educational practice and theory. Baker-Ward

PSY 505 History and Systems of Psychology. *Preqs.: PSY 200, 300, 310, 320 or CI or grad. status. 3(3-0) S.* The aim of this course is to acquaint students with the history of psychology and psychological systems and to give students some practice in taking different approaches to a particular problem area. Cole

PSY 510 Learning and Motivation. *Preq.: Grad. standing or PBS status. 3(3-0) S.* A systematic analysis of some of the major classes of variables determining behavioral change. Learning variables are analyzed within their primary experimental setting, and emphasis is upon the diversity of the functions governing behavior change rather than upon the development of some comprehensive theory. Both learning and motivational variables are examined as they contribute to changes in performance within the experimental setting. Cole

PSY 511 Advanced Social Psychology. *Preq.: Grad. standing or PBS status. 3(3-0) F.* A survey of theory and research in social psychology through reading and discussion of primary source materials. In addition, the course will deal with issues of methodology, ethical questions in social psychological research and application of research findings to the world at large. Klein, Luginbuhl, Smith

PSY 512 Action Research in Psychology. *Preq.: ST 507 or equivalent; Coreq.: ST 508 or equivalent. 3(3-0) S.* Action research models in psychology and their relationships to research methods. Research in field settings and implications for ethics and social responsibility, internal and external validity, experimenter and volunteer effects and problems of measurement. Gray

PSY 513 Psychology and Law. *Preq.: Grad. standing. 3(3-0) S. Alt. yrs.* Interaction between psychology and law, including pretrial surveys, jury selection, eyewitness identification, jury decision making, competence to stand trial, insanity, expert testimoney, sexual assault and the death penalty. Luginbuhl

PSY 514 Foundations of Behavioral Research. *Preqs.: Grad. standing, ST 507 and PSY 535 or equivalent. 3(3-0) F.* A course in scientific behavioral research, basically psychological in nature, designed to help students understand the fundamental nature of the scientific approach to problem solution. Technical and methodological problems are considered. The course emphasizes the controlled and objective study of the relations among phenomena, the scientific approach and the relations between a research problem and the design and methodology of its solution. Westbrook

PSY 520 Cognitive Processes. *Preq.: Grad. standing or PBS status. 3(2-2) F.* This course will emphasize the results from research on a number of complex processes (*e.g.*, remembering, concept learning, problem solving, acquisition and use of language) and the theories that have been proposed to explain these results. Newman

PSY 530 Advanced Abnormal Psychology. *Preqs.: PSY 200, 370. 3(3-0) S.* The causes, symptomatic behavior and treatment of the major personality disturbances. Emphasis on theory, experimental psychopathology and preventive measures. Graduate Staff

PSY 533 Biological Factors in Abnormal Behavior. *Preqs.: 6 hours of PSY and 6 hours of biology. 3(3-0) Sum. Alt. yrs.* Biological influences and predispositions in abnormal human behavior, including brain damage and disconnection syndromes, psychosomatic illnesses, anxiety and neurosis, manic-depressive disorder, schizophrenia and disorders of memory, eating, movement, sexual behavior and others. Assumes only a moderate biology background. Kalat

PSY 535 Tests and Measurements. *Preq.: Six hours of PSY. 3(3-0) F,S.* A study of the principles of psychological testing including norms and units of measurement, elementary statistical concepts, reliability and validity. In addition, some attention is devoted to the major types of available tests such as general intellectual development, tests of separate abilities, achievement tests, measures of personality and interest inventories. Westbrook

PSY (IE) 540 Human Factors in Systems Design. *Preq.: IE 452 or PSY 340; Coreq.: ST 507 or 515. 3(3-0) F.* Introduction to problems of the systems development cycle, including man-machine function allocation, military specifications, display-control compatibility, the personnel sub-system concept and maintainability design. Detailed treatment is given to man as an information processing mechanism. Pearson

PSY 545 Fundamentals of Skill. *Preq.: Grad. standing or PBS status. 3(3-0) F. Alt. yrs.* Fundamentals of human perceptual, cognitive and sensory-motor abilities that are basic to skilled performance. Treatment of such topics as channel capacity, short-term memory, stress, fatigue, arousal theory, task taxonomy, skill acquisition, proficiency decrement, information feedback and performance analysis. Problems of attention, search, monitoring, tracking, complex tasks and skill maintenance. Graduate Staff

PSY 560 Personnel Selection Research. *Preqs.: Six hrs. of grad. statistics, PSY 535. 3(3-0) F. Alt. yrs.* A survey of theoretical, methodological and research literature on personnel selection. Topics include organization, task and person analyses, validation strategies, utility and equal opportunity issues and selection strategies. Emphasis is on research. Thayer

PSY 561 Training Research. *Preqs.: Six hours of grad. PSY and six hours of grad. ST. 3(3-0) F. Alt. yrs.* A survey of conceptual and research literature on training. Topics include needs assessments, learning, transfer, maintenance, criterial and evaluation issues, as well as a review of research on specific training techniques. Emphasis is on research methods and findings, not skill development in specific training techniques. Thayer

PSY 565 Organizational Psychology. *Preq.: Nine hours of PSY. 3(3-0) F.* A study of the application of behavioral science, particularly psychology and social psychology, to organizational and management problems. Pond

PSY 566 Organization Development and Change. *Preq.: PSY 565. 3(3-0) S.* A survey of theory and research in organization development. Attention will be directed to: (1) methods of diagnosing the need for organizational change, (2) techniques currently used to implement and evaluate organizational change, (3) professional ethics and other issues dealing with the client-consultant relationship. Emphasis will be on developmental approaches originating from psychology and allied fields. Pond

PSY 570 Theories of Personality. *Preq.: Grad. standing. 3(3-0) F.* A review of theories of personality, with emphasis on research, application in psychotherapy and measurement, principles involved in similarities and differences among them and development of a personal model. Horan

PSY 571 Individual Intelligence Measurement. *Preq.: PSY 535 and consent of school psychology coordinator. 3(3-0) S.* A practicum in individual intelligence testing with emphasis on the Wechsler Bellevue, Stanford-Binet, report writing and case studies. Walker

PSY 572 Psychological Survey Operations. *Preq.: ST 507 or equivalent; Coreq.: ST 508 or equivalent. 3(3-0) S.* Emphasis is on application of survey operational methods to problems of interest to psychologists in governmental, institutional and industrial settings. Course is designed to provide competency in questionnaire construction, data collection, design and analysis procedures and report writing. The class will design, conduct and analyze a survey on topic of their own selection in the area of psychology. Klein

PSY 573 Theories of Intelligence. *Preq.: Grad. standing. 3(3-0) S. Alt. yrs.* Critical analysis of the psychological construct of intelligence. Traditional theories, as well as cognitive developmental, information-processing, comparative psychology, artificial intelligence, cross-cultural and epistemological approaches to intelligence explored. Horan

PSY 576 Developmental Psychology. *Preq.: Nine hours of PSY, including PSY 376, PSY 475 or PSY 476. 3(3-0) F.* A survey of the role of growth and development in human behavior, particularly during the child and adolescent periods. This course will pay particular attention to basic principles and theories in the area of developmental psychology.
Snyder

PSY 577 Adolescent Development. *Preq.: 6 hours in PSY or CI. 3(3-0) S,Sum. Alt. yrs.* Current theories and research on development during adolescence. Topics include: physical growth, cognitive changes, relationships with peers, parents and teachers, quest for identity and independence, morality andsexuality. Snyder

PSY 578 Individual Differences. *Preq.: Six hours of PSY. 3(3-0) S. Alt. yrs.* The objective and quantitative investigation of individual differences in behavior. The course deals with the following questions: What is the nature and extent of individual differences? What can be discovered about their causes? How are the differences affected by training, growth and physical conditions? In what manner are the differences in various traits related to one another or organized? Westbrook

PSY 579 Adult Development and Aging. *Preq.: PSY 576 or equivalent. 3(3-0) S. Alt. yrs.* Critical examination of theory and research associated with the study of normal adult development and aging. Topics include: methodological issues; cognitive and intellectual development; changes in learning and memory; personality and emotional development; socialization processes; psychophysiological and biological factors. Hess

PSY 580 Psychological Consultation. *Preq.: Nine hrs. grad. PSY or ED. 3(2-2) S.* Introduction to psychological consultation with emphasis on school setting. Presentation of various consultation models and theoretical bases. Development of skills in practice of consultation. Erchul

PSY 591 Special Topics in Psychology. *Preq.: 6 hours of PSY; Coreq.: 3 hours of ST. 1-3 F,S.* Course will provide opportunity for exploration in depth of advanced areas and topics of current interest. Graduate Staff

PSY 592 Area Seminar in Experimental Psychology. *Preq.: Grad. standing or PBS status. 1-3, Max. 6. F,S.* The following topics will be dealt with: (1) the development of experimental psychology as an area of inquiry, (2) methods of inquiry, (3) contemporary issues, (4) ethical questions, (5) relationship to other areas within psychology.
Graduate Staff

PSY (IE) 593 Area Seminar in Ergonomics. *Preq.: Grad. standing or PBS status. 1(0-2); Max. 3. F.* Introduction to ergonomics as an area of study; historical aspects; contemporary issues; ethical questions; overview of campus research, facilities and courses in the area; consideration of information sources, financial support for research proposals and employment opportunities. Graduate Staff

PSY 594 Area Seminar in Human Resources Development. *Preq.: CI. 1-3, Max. 6. F,S.* The following topics will be dealt with: (1) human resources development as an area of inquiry, (2) methods of inquiry, (3) contemporary issues, (4) ethical questions, (5) relationship to other areas within psychology. Drewes

PSY 595 Area Seminar in School Psychology. *Preq.: Grad. standing or PBS status. 1-3, Max. 6. F,S.* The following topics will be dealt with: (1) the development of school psychology as a professional area, (2) methods of inquiry, (3) scientific and theoretical bases, (4) contemporary issues, (5) ethical questions, (6) relationship to other areas within psychology.
Graduate Staff

PSY 596 Area Seminar in Social Psychology. *Preq.: Grad. standing. 1-3, Max. 6. F,S.* This course will deal with the following topics: (1) a survey of areas within social psychology, (2) methods of inquiry, (3) contemporary issues, (4) ethical questions, (5) the relation of social psychology to other branches of psychology, to other disciplines and to society and its problems. Graduate Staff

PSY 599 Research Problems in Psychology. *Preq.: CI. Credits Arranged. F,S.* Research project for graduate students supervised by members of the graduate faculty. Research to be elected on basis of interest of student and is not to be part of thesis or dissertation research. Graduate Staff

FOR GRADUATES ONLY

PSY 600 Advanced Problems in Perception. *Preq.: PSY 500. 3(2-2) S. Alt. yrs.* An exploration of advanced topics in the field of perception. Specific coverage varies from year to year but may include examination of sensory/perceptual processes in audition and other non-visual systems, attentional and organizational factors in perception, information processing approaches to perception, theories of perception and/or perceptual/motor skills. Mershon

PSY 602 Physiological Psychology. *Preq.: PSY 502 and/or CI. 3(3-0) S.* PSY 602 is the sequel to PSY 502 and will concentrate on relating the neuroanatomy and neurophysiology studied in PSY 502 to overt observable behaviors such as sleep-waking, motivation-emotion and reflexive and learned behaviors. LeVere

PSY 611 Social Psychology: Small Groups Research. *Preq.: PSY 511. 3(3-0) S.* Surveys the literature and research pertaining to social psychological processes in and between groups. Course content includes basic principles of group formation, role differentiation, communication, influence, norms, social exchange, equity, cooperation/conflict, decision making and pro-social behavior. Environmental factors affecting group behavior are also considered. In conjunction with each substantive topic, the suitable methodologies for research are considered. Graduate Staff

PSY 612 Attitudes. *Preq.: Six hours grad. PSY or CI. 3(3-0) F.* Theory and research in attitude formation and change; analysis of various persuasion paradigms employed in mass communication and group influence processes; study of individual attitudinal structures, resistance to persuasion, behavior as a precursor to attitude change; attitude behavior discrepancy, attitude measurement techniques and methodological considerations. Klein

PSY 613 Attribution. *Preq.: PSY 511. 3(3-0) S. Alt. yrs.* The determinants and consequences of assigning causes for the behavior of others and ourselves. Topics include attributional models, emotional states, success and failure, responsibility assignments, self-handicapping, self-fulfilling prophecy, motivational biases and applications to therapy. Luginbuhl

PSY 620 Advanced Problems in Cognition. *Preq.: PSY 520 or CI. 3(3-0) S.* This seminar will provide the opportunity for exploring in depth problems and issues in memory, concept learning, problem solving, psycholinguistics and other areas in cognition. Newman

PSY 635 Psychological Measurement. *Preqs.: ST 507, 511 or equivalent, 12 hours of PSY. 3(3-0) F.* Theory of psychological measurement. Statistical problems and techniques in test construction. Cunningham

PSY (IE) 640 Skilled Operator Performance. *Preqs.: PSY 545, ST 507 or ST 515. 3(3-0) F. Alt. yrs.* Theories of the human operator are considered with regard to the classical problems of monitoring, vigilance and tracking. Factors such as biological rhythm, sleep loss, sensory restriction, environmental stress and timesharing are considered as they interact with and determine overall systems efficiency. Pearson

PSY 650 Vocational Psychology. *Preqs.: ST 507, PSY 514, 635 or equivalent. 3(3-0) F. Alt. yrs.* The study of the individual's vocational behavior and development through the years of choice and adjustment. An up-to-date review and synthesis of research and theory in the field of vocational psychology. Empirical studies and theoretical statements in the field are appraised and evaluated to determine what behavioral laws apply to vocational phenomena. Westbrook

PSY 665 Work Motivation. *Preq.: PSY 565. 3(3-0) S. Alt. yrs.* Theory and research in work motivation. An in-depth examination of motivation theory as it pertains to the study of individual behavior in work settings. Pond

PSY 672 Personality Measurement. *Preqs.: PSY 570, 571. 3(2-3) S.* Theory and practicum in individual personality testing of child and adults with emphasis on projective techniques, other personality measures, report writing and case studies. Walker

PSY 674 Psychological Intervention I. *Preqs.: PSY 672, 530 and CI. 3(2-2) F.* This course is designed to examine theories, research, techniques, ethics and professional responsibilities related to approaches to psychological intervention. Types of psychological intervention to be studied will include behavior modification, milieu approaches, crisis intervention techniques and group process methods, in addition to more intensive relationship approaches. A close integration of experiences, content and supervision will be emphasized in a variety of professional settings with a wide range of personal problems and age groups. Graduate Staff

PSY 675 Psychological Intervention II. *Preq.: PSY 674. 3(2-2) S.* The primary purpose of this course is to provide students opportunities to acquire information, conceptual frameworks, interpersonal skills and a sense of ethical responsibility, all of which are basic to their further development as practicing psychologists. A major effort in the course is made to help the student increase his interpersonal skills as a means of promoting the psychological growth and effectiveness of others. Graduate Staff

PSY 676 Cognitive Development. *Preq.: PSY 576. 3(3-0) S. Alt. yrs.* Examination of research and theory in cognitive development. The primary focus is on childhood, but implications for the entire life span will be addressed. Application of cognitive developmental principles in creating interventions and educational programs will also be discussed. Graduate Staff

PSY 677 Social Development. *Preq.: PSY 576. 3(3-0) Alt. yrs.* Survey of current theory and research on the development of social behavior systems, including attachment, aggression, gender-role behavior, prosocial behavior. Attention to the role of social class, race and culture, and to contemporary phenomena such as day care, single-parent and dual-career families, child abuse. Graduate Staff

PSY 680 Systems Theory and Applications in Human Resource Development. *Preq.: PSY 594 or equivalent. 3(3-0) F.* An introduction to the systems approach and general systems theory. (1) Concepts and terminology of general systems theory, (2) techniques currently used to access system requirements and (3) methods of analyzing system performance. Emphasis will be on application of systems techniques to the design and implementation of human resource development programs. Drewes

PSY 681 Quasi-experimental Evaluation Design. *Preq.: ST 507 or equivalent. 3(3-0) S.* An introduction to quasi-experimental design as applied to HRD program evaluation. (1) Methods of assessing informational needs, (2) recognition of internal and external validity threats, (3) design of quasi-experiments to minimize threats and (4) use of results by program decision makers. Drewes

PSY 690 Seminar in Industrial Psychology. *3(3-0) S.* Scientific articles, analysis of experimental designs in industrial psychology and study of special problems of interest to graduate students in industrial psychology. Graduate Staff

PSY 691 Special Topics in Psychology. *Preqs.: Grad. standing, CI. 1-3 F,S.* Course will provide opportunity for exploration in depth of advanced topical areas which, because of their degree of specialization, are not generally involved in other courses; for example, multivariate methodology in psychology, computer simulation, mathematical model building. Some new 600-level courses will first be offered under this title during the developmental phase and as such may involve lectures and/or laboratories. Graduate Staff

PSY 693 Psychological Clinic Practicum. *Preqs.: Twelve hours in grad. PSY, which must include clinical skill courses PSY 571 and PSY 672 and/or CI. Max. 12 F,S.* Clinical participation in interviewing, counseling, psychotherapy and administration of psychological tests. Practicum to be concerned with adults and children. Erchul, Horan, Walker

PSY 697 Advanced Seminar in Research Design. *Preqs.: Nine hours of statistical methods and research or CI, advanced grad. status. 3(3-0) F.* This course will be designed as a seminar-type course, with topics selected each semester in accordance with the interests and needs of the students. Attention will be given to the research strategies that underlie educational and psychological research, to the development of theoretical constructs, to a critical review of research related to problems in which the students are interested, and to a systematic analysis and critique of research problems in which the students are engaged. Graduate Staff

PSY 698 Internship in Psychology. *Preqs.: Master's degree in PSY and approval of advisory committee. 1-12 F,S.* Supervised work experience in an appropriate setting with professional supervision in the field from a doctoral level psychologist with credentials and/or experience in the appropriate specialty in psychology. Experience will consist of full time for one semester or half time for an academic year or equivalent time. Erchul, Horan, Walker

PSY 699 Thesis and Dissertation Research. *Preqs.: Grad. standing, CI. Credits arranged. F,S.* Individual research on a thesis or dissertation problem; a maximum of six credits is allowed toward the master's degree, but any number toward the Ph.D. degree. Graduate Staff

Recreation Resources Administration

GRADUATE FACULTY

Associate Professor P. S. Rea, *Acting Head*

Associate Professor R. R. Perdue, *Graduate Administrator*

Professors: H. A. Devine, C. D. Siderelis, R. E. Sternloff, M. R. Warren; *Professors Emeriti:* T. I. Hines, W. E. Smith; *Associate Professor:* S. L. Kirsch; *Adjunct Associate Professor:* H. K. Cordell; *Associate Professors Emeriti:* G. A. Hammon, L. L. Miller; *Assistant Professors:* C. S. Love, B. E. Wilson

The Department of Recreation Resources Administration offers programs of study leading to the Master of Science and Master of Recreation Resources degrees. The programs are based on an interdisciplinary approach and are designed to meet the problems and opportunities posed by changing social forces which affect the recreation profession. Students pursuing these degrees will have an opportunity to develop an understanding of the relationship between recreation and disciplines such as forestry, wildlife management, horticulture, landscape design, conservation, economics and business, politics, sociology and anthropology.

The Master of Science degree is designed for students who are interested in the advanced applications of research to the management and operations of recreation and park agencies. A student will be required to complete a minimum of 30 hours of graduate work. The program will consist of a major and minor field of study. The minor may be concentrated wholly in a different discipline or may consist of courses selected from the offerings of two departments.

Each candidate for the Master of Science degree will be required to complete a thesis representing an original investigation as a part of the minimum requirements for the degree.

The Master of Recreation Resources degree is designed for students who are interested in the more advanced applications of management and organization principles in the operation of recreation and park agencies. Requirements for the Master of Recreation Resources degree include a minimum of 36 hours of course work. In lieu of a thesis the student will be required to complete additional departmental course work and an independent master's project.

SELECTED ADVANCED UNDERGRADUATE COURSES

RRA 420 Resort Management and Operations. *Preq.: RRA 152. 3(3-0) S.*

RRA 438 Recreation for Special Populations. *Preq.: RRA 358. 3(3-0) F.*

RRA 442 Recreation and Park Interpretive Services. *Preq.: Jr. standing. 3(2-3) F,S.*

RRA 443 Applied Recreation and Park Interpretive Services. *Preqs.: RRA 442, jr. standing. 3(1-6) S.*

RRA 451 Principles of Recreation Planning and Facilities Development. *Preq.: RRA 358. 3(2-3) F,S.*

RRA 453 Administrative Policies and Procedures. *Preq.: RRA 359. 3(3-0) F.*

RRA 454 Recreation and Park Finance. *Preqs.: Six hours of RRA courses and sr. standing. 3(3-0) S.*

RRA 480 Recreation Analysis and Evaluation. *Preqs.: RRA 359, ST 311. 3(2-2) S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

RRA 500 Theories of Leisure and Recreation. *3(3-0) F.* Analysis of leisure and recreation and a study of their origin and development as revealed by man's behavioral patterns. Interpretation of the influence and social significance of leisure and recreation concepts on contemporary American culture and their implications on future recreation thought and action. Culkin, Warren

RRA 501 Research Methods in Recreation. *Preqs.: ST 311. 3(3-0) F.* Examination and understanding of advanced scientific investigative methods in their application toward explaining recreation and leisure behavioral phenomena and for the resolution of recreation management problems. Perdue

RRA (EB) 503 Economics of Recreation. *Preq.: EB 301 or 401. 3(3-0) F.* The principal emphasis will be on identity and importance of economic information for planning. The market mechanism and government will be examined as they affect and interact to affect allocation of resources to recreation, distribution of recreation services and behavior of recreationists. Other topics include demand analysis, economics of planning, cost/benefit

analysis, secondary economic impacts, public decision making, externalities, public finance and supply considerations in urban and rural recreation situations. Devine

RRA 504 Recreation and Park Data Systems. *Preqs.: CSC 200, ST 311. 3(3-0) S.* This course includes the analysis of such topics as the identification of maintenance, operation and service delivery work areas in recreation and park agencies for system applications; development of reporting structures; recreation and maintenance activity scheduling; system monitoring; system implementation evaluation. Siderelis

RRA 505 Quantitative Techniques for Recreation and Natural Resource Management. *Preqs.: CSC 200, ST 311. 3(3-0) S.* A review of the application of specific management science techniques to recreation and natural resource management. Gravity, optimization, simulation and other modeling procedures will be discussed through a case study approach. The primary emphasis of the course is exposure to techniques and problem formulation rather than development of theoretical bases or computational methodologies. Devine

RRA 510 Theories of Sport and Fitness Program Management. *Preq.: RRA 358. 3(3-0) F.* The development of a theoretical basis for sport and physical fitness program management. The sociological, psychological, political and economic considerations of sport and fitness are studied. Values and motivation of sport and fitness are stressed. Graduate Staff

RRA 511 Foundations for Sport, Exercise and Fitness Program Management. *Preq.: RRA 358. 3(3-0) Every third sem.* The development of a scientific basis for sport, exercise and fitness program development. Characteristics of human growth, development and aging are studied as they relate to participation in physical activity. Emphasis on physical fitness evaluation and program development. Graduate Staff

RRA 512 Recreational Sports Management. *Preq.: RRA 358. 3(3-0) Every third sem.* An overview and analysis of key managerial concerns of the sports enterprise. Problems and issues unique to the sports-oriented service or business are stressed. Emphasis on recreational sports settings. Graduate Staff

RRA 520 Concepts of Travel and Tourism. *Preq.: Grad. standing. 3(3-0) S.* Theory and research in travel and tourism, including conceptual foundations, research problems and methods and the application of research results to strategic tourism development and marketing. Perdue

RRA (LAR) 562 Computer Cartography. *Preq.: Grad. standing or CI. 3(3-0) S.* An introduction to the application of computers and associated analytic technology to problems in natural resource planning and management. The course will emphasize the use of automated mapping and display procedures in land use decision making and will involve the student in first-hand experiences with a number of different procedures and computer hardware configurations. This is not a general course in computer graphics and will deal exclusively with natural resource management applications. Devine

RRA 580 Current Issues in Recreation Resources. *Preqs.: Grad. standing, CI. 1-3 S.* An examination of current issues in recreation resources. Course content varies as changing conditions require new approaches to emerging problems. Graduate Staff

RRA 591 Recreation Resources Problems. *Preq.: Advanced undergrad. or grad. status. 1-4 F,S.* Assigned or selected problems in the field of recreation administration, planning, supervision, maintenance, operations, financing or program. Special research problems selected on basis of interest of students and supervised by members of the graduate faculty. Graduate Staff

RRA 595 Special Topics in Recreation Resources. *Preqs.: Grad. standing, CI. 1-3 F,S.* Special topics in various aspects of recreation resources are developed under direction of a graduate faculty member on a tutorial basis. Subjects offered under this course listing are also used to test and develop new courses. Graduate Staff

FOR GRADUATES ONLY

RRA 675 Field Studies in Recreation. *Preq.: Minimum of nine hrs. of grad. credit. 1-4 F,S,Sum.* Experience in applying analytical methods to administrative, managerial and planning problems in providing recreation and park opportunities. Completion of an evaluation project or analytical study for the practicum agency is required.
Graduate Staff

RRA 690 Recreation Management Seminar I. *Preqs.: RRA 500, 501. 2(0-4) S.* Research and theories of (1) marketing, (2) case law and liability and (3) personnel practices as they relate to the management of recreation resources. Graduate Staff

RRA 691 Recreation Management Seminar II. *Preqs.: RRA 500, RRA 501. 2(0-4) F.* Research and theories of (1) planning and development, (2) financing and (3) maintenance management of recreation resources. Graduate Staff

RRA 692 Advanced Problems in Recreation. *Preq.: Twelve hours of RRA courses. Credits Arranged. F,S.* Directed research in a specialized phase of recreation other than a thesis problem. Graduate Staff

RRA 696 Seminar in Recreation Research. *Preq. or coreq.: RRA 501. 1(2-0) S.* Research studies, scientific articles and progress reports on research effects presented and critically evaluated. Each student pursuing a graduate degree is expected to take this offering twice for one hour of credit each time. Graduate Staff

RRA 699 Research in Recreation. *Preq.: Twelve hours of RRA courses. Credits Arranged. F,S.* Original research preliminary to writing a master's thesis.
Graduate Staff

Sociology and Anthropology

GRADUATE FACULTY

Professor L. B. Otto, *Head*

Associate Professor M. P. Atkinson, *Associate Head, HASS Programs*

Professor W. B. Clifford II, *Associate Head, ALS Programs*

Professor E. M. Suval, *Graduate Administrator*

Professors: L. R. Della Fave, V. A. Hiday, C. P. Marsh, R. L. Moxley, P. N. Reid, M. M. Sawhney, O. Uzzell, R. C. Wimberley; *Professors Emeriti:* L. A. Drabick, H. D. Rawls, J. N. Young; *Associate Professors:* R. C. Brisson, A. C. Davis, S. K. Garber, G. D. Hill, J. C. Leiter, S. C. Lilley, G. S. Nickerson, W. C. Peebles-Wilkins, I. Rovner, M. D. Schulman, R. J. Thomson, K. M. Troost, M. L. Walek, J. M. Wallace, E. M. Woodrum, M. T. Zingraff; *Associate Professor Emeritus:* J. G. Peck; *Assistant Professors:* R. S. Ellovich, T. M. Hyman, B. J. Risman, D. Tomaskovic-Devey

ASSOCIATE MEMBERS OF THE DEPARTMENT

Professors: V. E. Hamilton, T. N. Hobgood Jr., R. D. Mustian, M. M. Sawhney

The Department of Sociology and Anthropology offers programs of study in sociology leading to the advanced degrees of Master of Sociology, Master of Science and Doctor of Philosophy. The core program includes sociological theory, research methods and quantitative analysis. Other major areas of concentration include social organization, family, crime and deviance, social psychology, social change and development, demography, comparative sociology, community, agriculture and rural sociology.

The Master of Science and Doctor of Philosophy degrees are oriented toward the basic and applied science of sociology. Special attention is given to sociological skills for analyzing social factors and policies affecting informal groups, formal organizations, families, communities, regions, nations and international development. The Master of Sociology is designed for applied sociology careers in local, state and federal agencies; management and administration; human service delivery; program development and evaluation; and the teaching of sociology in secondary schools. The program focuses on the application of sociological theory, methods and research to social issues and problems. A practicum gives the student experience in an agency/organization.

The department also offers a minor in cultural anthropology at the Master's level. Graduate courses are designed to give a broad background in major concepts of cultural anthropology with emphasis on theory. These offerings may be supplemented with courses at the 400 level.

Computer facilities are available to graduate students and faculty in the department as described under "Computing Facilities." Graduate students on assistantships and fellowships are normally provided office facilities. Research opportunities reflect the wide range of interests of the graduate faculty and the imagination of the students themselves. The department also has a statewide extension focus in applied sociology.

SELECTED ADVANCED UNDERGRADUATE COURSES

ANT 416 Research Methods in Cultural Anthropology. *Preq.: Six hours ANT. 3(3-0).*

ANT 420 Biological Bases for Human Social Behavior. *Preq.: ANT 251, or BS 100 or 105, GN 301, or equivalent. 3(3-0).*

ANT 498 Special Topics in Anthropology. *Preq.: Six hours of SOC/ANT. 1-6.*

SOC 400 Theories of Social Structure. *Preq.: 3 credits of SOC, 200 level. 3(3-0).*

SOC 401 Theories of Social Interaction. *Preq.: 3 credits of SOC, 200 level. 3(3-0).*

SOC 402 Urban Sociology. *Preq.: SOC 202. 3(3-0).*

SOC 410 Sociology of Organizations. *Preq.: SOC 202. 3(3-0).*

SOC 414 Social Class. *Preq.: SOC 202. 3(3-0).*

SOC 418 Sociology of Education. *Preq.: SOC 202. 3(3-0).*

SOC 420 Sociology of Corrections. *Preqs.: SOC 306 and PS 311. 3(3-0).*

SOC 425 Juvenile Delinquency. *Preq.: SOC 202, SOC 301 desirable. 3(3-0).*

SOC 426 The Juvenile Justice System. *Preq.: SOC 202. 3(3-0).*

SOC 440 Social Change. *Preq.: SOC 202. 3(3-0).*

SOC 490 Senior Seminar in Sociology. *Preqs.: Sr. standing and consent of department. 3(3-0).*

SOC 498 Special Topics in Sociology. *Preq.: Six hours SOC above 200 level. 1-6.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ANT 501 Advanced Survey of Cultural Anthropology. *Preq.: Grad. standing or PBS status. 3(3-0).* An intensive examination of the field of cultural anthropology. As a foundation course for subsequent graduate work in anthropology, emphasis will be placed on main currents in anthropological thinking and research Graduate Staff

ANT 505 Comparative Social Organization. *Preq.: ANT 501 or 6 hours in Cultural Anthropology. 3(3-0).* This course will focus on an analysis of forms of social organization in both technologically simple and complex societies from several analytical perspectives. Discussion of kinship theory: the relationship of social organization to systems such as the economic, political and religious; and an examination of modern development in social organization research will be stressed. Graduate Staff

ANT 508 Culture and Personality. *Preq.: ANT 501 or 6 hours in Cultural Anthropology. 3(3-0).* The course focuses on the interplay between cultural norms and the enculturation process. From a cross-cultural perspective, it examines the process by which cultural norms are transmitted and learned, as well as the effect of culture change on the individual. The historical development of the field as well as contemporary trends are also discussed in both theoretical and applied contexts. Graduate Staff

ANT 511 Anthropological Theory. *Preqs.: ANT 501 or 6 hours in Cultural Anthropology. 3(3-0).* Approaches theory from both an historical and contemporary point of view. Emphasizes the key anthropological concept of culture and its significance for understanding man and his works. Graduate Staff

ANT 512 Applied Anthropology. *Preq.: ANT 252 or CI. 3(3-0).* Includes a review of the historical development of applied anthropology and a study of anthropology as applied in government, industry, community development, education and medicine. The processes of cultural change are analyzed in terms of the application of anthropological techniques to programs of developmental change. Graduate Staff

ANT 591 Special Topics in Anthropology. *Preq.: ANT 501 or equivalent. 1-6.* This course is designed to provide the opportunity for students to investigate in depth some particular topic in anthropology. Course content and mode of study will vary, reflecting current student needs and interests. Topics will be determined by the faculty member(s) and student. Graduate Staff

SOC 501 Leadership. *Preq.: SOC 202 or equivalent. 3(3-0).* Leadership in various fields of American life; analysis of factors associated with it; techniques of leadership. Stresses recreational, scientific and executive leadership procedures. Graduate Staff

SOC 502 Society, Culture and Personality. *Preq.: SOC 202 or equivalent. 3(3-0).* Studies human personality from its origins in primary groups through its development in secondary contacts and its ultimate integration with social norms. Explores comparative anthropological materials but places emphasis on the normal personality and individual adjustment to our society and culture. Dynamics of personality and character structure analyzed in terms of society's general culture patterns and social institutions.
Graduate Staff

SOC 503 Contemporary Sociology. *Preq.: Grad. standing or PBS status. 3(3-0).* An overview of the current status of sociological theory and research. Introduction to contemporary sociological thinking and research. Graduate Staff

SOC 504 Education in Modern Society. *Preqs.: SOC 202, 301 or equivalent. 3(3-0).* Places varying emphasis on the historical development of education in the United States, cross-cultural comparisons of educational structure and function, professionalization of educators, investigation of the ecological factors affecting education, effects of group processes upon learning and the effects of social processes and changes upon the educational institution. Graduate Staff

SOC 505 Medical Sociology. *Preq.: Six credits in SOC or grad. standing or PBS status. 3(3-0).* Advanced sociological analysis of health care organizations and their systemic linkage to other community institutions. Measurement of health and illness and their social significance. Applications of sociological and social-psychological theories to practitioner-client relationships and interaction. Implications of alternative models of health care provision. Graduate Staff

SOC 506 The Sociology of Rehabilitation. *Preq.: Grad. standing or PBS status. 3(3-0).* Students engage in individual research projects on a specific handicap, a rehabilitation process or a rehabilitative agency or subagency. Lectures and discussions furnish perspective concerning rehabilitation work in process while student pursues a specialized interest. Emphasizes sociological methods and techniques applicable to above aspects of social behavior. Graduate Staff

SOC 507 Social Movements. *Preq.: SOC 503 or 6 hours of SOC or social psychology. 3(3-0).* Major topics include: the nature and variety of social movements; conditions affecting the emergence of social movements; the structure of social movements; and the relationship between social movements, social conflict and social change. While the primary emphasis will be conceptual and theoretical, a number of social movements both past and contemporary will be examined within this framework. Similarly, research issues relative to social movements will be examined. Graduate Staff

SOC 509 Population Problems. *Preq.: SOC 202 or equivalent. 3(3-0).* Examines population growth, rates of change and distribution. Emphasizes functional roles of population, *i.e.*, age, sex, race, residence, occupation, marital status and education. Population dynamics are stressed: fertility, mortality and migration. Population policy is analyzed in relation to national and international goals stressing a world view. Graduate Staff

SOC 510 Industrial Sociology. *Preq.: SOC 202 or equivalent. 3(3-0).* Industrial relations are analyzed as group behavior with a complex and dynamic network of rights, obligations, sentiments and rules. This social system is viewed as an interdependent part of total community life. The background and functioning of industrialism are studied as social and cultural phenomena and its social problems are analyzed. Graduate Staff

SOC 511 Sociological Theory. *Preqs.: Six hours SOC and grad. standing or PBS status. 3(3-0).* The interdependence of theory and method; the major theoretical and methodological systems. Examines selected cases of research in which theory and method are classically combined. Graduate Staff

SOC 512 Survey of Family Sociology. *Preq.: SOC 202. 3(3-0).* Examines structural and demographic continuities and changes for American families in general and within major subgroups (*e.g.*, race, ethnicity, social class). Historical and cross-cultural comparisons considered. Assesses the impact of families upon their members and the dynamics of marital and family relationships. Graduate Staff

SOC 513 Community Organization and Development. *Preq.: SOC 202 or equivalent. 3(3-0).* Community organization is viewed as a process of bringing about desirable changes in community life. Community needs and resources are studied. Democratic processes in

community action and principles of organization are stressed, along with techniques and procedures. Roles of lay and professional workers are analyzed. Graduate Staff

SOC 514 Developing Societies. *Preq.: Six hours SOC or ANT or grad. standing or PBS status. 3(3-0).* Defines major problems posed for development sociology and explores the social barriers and theoretical solutions for development set forth with regard to the newly-developing countries. Significant past strategies reviewed and main themes in current development schemes presented. Untested strategies for the future proposed and discussed. These problems are examined in their national and international contexts.
Graduate Staff

SOC 515 Deviant Behavior. *Preq.: Six hours SOC or ANT or grad. standing or PBS status. 3(3-0).* Topics include: the inevitability of deviance and its social utility; cross-cultural variations in appearance and behavioral cues for labeling the deviant; descriptive and explanatory approaches to kinds and amounts of deviance in contemporary American society; social change, anomie and social disorganization theories; the process of stigmatization; formal and informal societal responses to deviance and the deviant; social action implications. Graduate Staff

SOC 516 Social Control. *Preq.: Six hours SOC above 200 level or grad. standing or PBS status. 3(3-0).* The need, functions, utilization and effects of both informal and formal social control mechanisms are examined. Theoretical perspectives on social control and the empirical support for these positions are emphasized and critically evaluated.
Graduate Staff

SOC (PS) 517 The Police Bureaucracy in a Democratic Society. *3(3-0).* (See political science and public administration.)

SOC 520 Sociology of Religion. *Preq.: SOC 202 or equivalent or grad. standing or PBS status. 3(3-0).* Alternative theoretical analyses are presented for religious beliefs, practices and organizations and the relationships between these and other social phenomena. The utility and deficiencies of each conceptual framework are assessed through general applications and case studies. Major research findings in this classical field of sociology are reviewed. Contemporary trends and issues concerning religion in society are addressed.
Graduate Staff

SOC 523 Sociological Analysis of Agricultural Development. *Preq.: Six hours SOC or grad. standing. 3(3-0).* Systematic sociological analysis of agricultural development and change, emphasizing less-developed countries. Review of classical and contemporary theoretical perspectives. Specific topics: land tenure and agricultural development; peasants and peasant societies; peasant revolt and revolution; women and development.
Graduate Staff

SOC 533 Theory of Human Communication Behavior. *Preqs.: Six hours SOC or social psychology and grad. standing or PBS status. 3(3-0).* The behavioral science approach to understanding human communication which is treated as a basic social psychological process in which communication events are analyzed in terms of their effects on individual, interpersonal and group behavior. Surveys theory, research methods and empirical findings. Communication behavior as a mediating mechanism in social interactions.
Graduate Staff

SOC 534 Sociology of U.S. Agriculture. *Preqs.: Six hours of SOC or grad. standing. 3(3-0).* Analysis of the structural transformation of U. S. agriculture in the 19th and 20th centuries, particularly in terms of the role of the state in agricultural development. Review of theoretical perspectives and research in rural sociology and the sociology of agriculture.
Graduate Staff

SOC 541 Social Systems and Planned Change. *Preq.: Three hours SOC. 3(3-0).* An examination of social systems within the framework of both functional theory and conflict theory, with particular emphasis upon system change and the planning of social change.
Graduate Staff

SOC 555 Social Stratification. *Preq.: Six hours SOC. 3(3-0).* The theoretical background, methodological approaches and analysis of the consequences of systems of stratification. Emphasizes the static and dynamic qualities of stratification systems on relations within and between societies. Attention to the integrative and divisive quality of stratification as it is expressed in life styles, world views, etc. Graduate Staff

SOC 560 Racial and Cultural Contacts. *Preq.: Six hours SOC or CI. 3(3-0).* 1) Examines intergroup relations as a legitimate concern of the social sciences, 2) Appraises cross-cultural data drawn from a variety of situations wherein race and ethnicity figure in a significant manner, 3) Attempts to interpret data by delineating observable patterns, trends and relationships. Graduate Staff

SOC 565 Sociology and General Systems Theory. *Preqs.: Six hours SOC, one ST course. 3(3-0).* Examines the basis of general systems theory and its application in the sociological fields. Emphasizes the philosophical nature of systems theory and its potential as an alternative conceptualization to mechanistic and organismic models. Scrutinizes the underlying basis of systems theory; cybernetics as models of change and control; learning and equilibrium; information theory as models of choice and selection; decision theory and game theory. Graduate Staff

SOC 570 Commitment. *Preq.: Six hours SOC. 3(3-0).* The process of commitment and its strength is covered for several theoretical views as applicable to collective behavior, social movements, the sociology of religion, political sociology, deviance, attitudes, decision making, dissonance, structural effects and other topics. An aim is to construct propositions and testable models of the commitment process. Graduate Staff

SOC (EB) 574 The Economics of Population. *3(3-0).* (See economics and business.)

SOC 590 Applied Research. *Preq.: SOC 202 or equivalent. 3(3-0).* Studies research process with emphasis upon its application to action problems. The development of research design to meet action research needs is stressed. Graduate Staff

SOC 591 Special Topics in Sociology. *Preq.: CI. 1-6.* An examination of current problems organized on a lecture-discussion basis. Course content varies as changing conditions require new approaches to emerging problems. Graduate Staff

SOC 592 Demographic Structure and Processes. *Preq.: SOC 509 or equivalent. 3(3-0).* Explores in depth the major demographic variables (size, composition and distribution) and basic demographic processes (fertility, mortality and migration). Attention to theoretical and methodological considerations as well as to current substantive knowledge. Specific course content varies depending upon student needs and interests. Graduate Staff

SOC 595 Practicum in Sociology. *Preqs.: Grad. standing in the Master of Sociology program and 9 hours of SOC at the 500-600 level. 3-6.* Opportunity for student under the supervision of graduate advisory committee chairman and organization/agency supervisor to develop and demonstrate competency in the area of graduate specialization through application of sociological knowledge to practical problems facing the organization/-agency. Graduate Staff

FOR GRADUATES ONLY

SOC 601 Urban Ecology. *Preq. SOC 509. 3(3-0).* The course involves an historical approach to the development of the field as well as an analysis of the present state of the field. Because of the range of subject matter subsumed under the topic of ecology, the linkages between sociology and other disciplines concerning themselves with the subject will be delineated and examined. Graduate Staff

SOC 610 Formal Organizations. *Preq.: SOC 511 or equivalent or another course on organizations or CI. 3(3-0).* Sociological study of bureaucracies and other formal organizations, including theoretical roots, current theory and research, especially on organization-environment relations. Sociological assessment of psychological, economic and managerial theories of organizations. Graduate Staff

SOC 611 Research Methods in Sociology. *Preqs.: SOC 416, ST 311 or equivalent. 3(3-0).* Designed to give the student a mature insight into the nature of scientific research in sociology. Assesses the nature and purpose of research designs, the interrelationship of theory and research, the use of selected techniques and their relation to research designs and the use of modern tabulation equipment in research. Graduate Staff

SOC 612 Scaling and Indexing for Social and Behavioral Data. *Preqs.: ST 311, SOC 416 or equivalent. 3(3-0).* A basic introduction to the theory of measurement and scaling and to types of simple and composite measures used in the social and behavioral sciences. The development and utility of simple and composite indexes, paired comparison, equal appearing interval, summated rating cumulative, factor, latent structure and self-anchoring scales will be examined by means of problems and examples. Graduate Staff

SOC 613 Theory of Mass Communication. *Preq.: SOC 533 or equivalent. 3(3-0).* This course provides the advanced student in the social sciences with an opportunity to examine the emerging body of theory and research in the field of mass communications. Course content will treat: (1) the systems character of mass communication, (2) social communication at the individual and group level, (3) persuasive communication and social control, (4) communication and opinion change and (5) communication and societal development. In addition to the theoretical and methodological underpinnings drawn from the behavioral sciences, the course will examine contributions from the communication arts and applied communications. Graduate Staff

SOC 615 Research on Crime and Deviance. *Preq.: SOC 515 or equivalent. 3(3-0). S. Alt. yrs.* Major topics include: an examination of conceptual problems and research issues and methods in the study of crime and deviance; an assessment of current research on crime causation and deviance processes; an examination of research on social control processes and agencies; and an assessment of social action and evaluative research. A variety of substantive topics will be dealt with in the context of the above topical areas including: delinquency, drug usage, mental illness, obesity, stuttering, suicide, prostitution, homicide and rape. Graduate Staff

SOC 616 Crime and Collective Action. *Preq.: SOC 515 or equivalent. 3(3-0) S. Alt yrs.* Examines organized and spontaneous community responses to criminality, other normative violations and unpopular governments. Compares and critiques alternative theoretical explanations for the emergence of legal and extralegal punishment. Applies sociological interpretations to contemporary community and societal policy including economic, political and social consequences of crime. Graduate Staff

SOC 621 Social Psychology. *Preq.: Six hours SOC. 3(3-0).* The objective of this course is to present the major ideas of social psychology in the context of the theoretical orientations from which they have emerged. The nature and role of theory in social psychology are examined. The social psychologies of various theorists are then examined in terms of their particular approaches including the Gestalt, Field, Role, Psychoanalytic and Reinforcement orientations and combinations of these. Graduate Staff

SOC 628 Sociology of Gender. *Preq.: SOC 512 or CI. 3(3-0) Alt. yrs.* Reviews micro- and macro-level theories which explain the development and patterns of gendered behavior. Emphasis is on understanding gender as a variable in research. Focus is on both how gender roles have developed and how individuals come to exhibit gender-typed behavior.

SOC 631 Population Analysis. *Preq.: SOC 509 or equivalent. 3(3-0).* Methods of describing, analyzing and presenting data on human populations: distribution, characteristics, natural increase, migration and trends in relation to resources. Graduate Staff

SOC 632 Contemporary Family Theory and Research. *Preq.: Soc 512 or CI. 3(3-0).* Emphasis on contemporary research, theory and methodological techniques used by sociologists who study families. Critical examination of where the field is now and where it appears to be heading. Primarily for graduate students designing or doing research about families. Graduate Staff

SOC 633 The Community. *Preq.: Six hours SOC. 3(3-0).* The community is viewed in sociological perspective as a functioning entity. A method of analysis is presented and applied to eight "dimensions," with emphasis on the unique types of understanding to be derived from measuring each dimension. Finally, the effect of change on community integration and development is analyzed. Graduate Staff

SOC 641 Statistics in Sociology. *Preq.: ST 513 or equivalent. 3(3-0).* The application of statistical methods of sociological research. Emphasis on selecting appropriate models, instruments and techniques for the more frequently encountered problems and forms of data. Graduate Staff

SOC 645 Advanced Sociological Measurement. *Preqs.: SOC 611; ST 511 or 513. 3(3-0).* Various issues concerning the measurement of social variables are examined and techniques are described. These issues and techniques include operationalism and epistemic correlation, levels of measurement, transformations, social indicators, scaling, dimensionality, validity and reliability. Existing examples and potential applications in sociological research are considered. Graduate Staff

SOC 646 Advanced Sociological Analysis. *Preqs.: SOC 611; ST 511 or 513. 3(3-0).* Advanced analysis techniques adaptable to the needs of sociological research are examined. Special attention is given to causal analysis, the analysis of change, and aggregate *versus* individual level data analyses. Sociological examples are considered. Emerging issues and techniques are given attention. Graduate Staff

SOC 650 Contemporary Sociological Theory. *Preq.: SOC 511 or equivalent. 3(3-0).* Works by major figures who represent leading schools of sociological theory in the post-World War II period are studied as primary sources. Underlying assumptions are made explicit, the structure of the theory, including propositions, are examined critically, and relationships with other theoretical perspectives are discussed. Graduate Staff

SOC 652 Comparative Societies. *Preq.: Six hours SOC. 3(3-0).* Sociological analysis of societies around the world with particular reference to North and South America. Special emphasis is given to cultural and physical setting, population composition, levels of living, relationship of the people to the land, structure and function of the major institutions and forces making for change. Graduate Staff

SOC 653 Theory and Development of Sociology. *Preqs.: SOC 511, CI. 3(3-0).* Detailed analysis of methodological and substantive problems in utilizing sociological theories in varied areas, and an examination of events and trends in the development of sociology. Graduate Staff

SOC 655 Theory Construction. *Preq.: SOC 511 or equivalent. 3(3-0).* Provides students with a capability to develop theoretical frames of reference within which to devise and implement research activities. Acquaints students with the philosophical and disciplinary bases of theory, establishes the relationship between theory and research and enables objective evaluation of theoretical positions encountered in the literature. Graduate Staff

SOC 670 Theories of Population. *Preq.: SOC 509 and/or SOC 511 or CI. 3(3-0).* This course provides an overview of population theory utilizing a combined chronological and topical approach. Major topics include: sociological analysis of ancient and medieval views of population; mercantilism and population; economic, utopian, philosophical and biological theories of population in the 18th century; Malthusian theory; and post-Malthusian theory, including biological, anthropological, mathematical, economic, political, historical and especially social and social-psychological approaches. Graduate Staff

SOC 671 Social Demography. *Preq.: SOC 509 or 631 or equivalents. 3(3-0).* The basic purpose of this course is to develop on the part of the student an appreciation of the sociological variables capable of being used in demographic research and to provide an overview of the current substantive knowledge concerning social and demographic systems, social action systems and social aggregate systems. Graduate Staff

SOC 690 Seminar. *Credits Arranged.* Appraisal of current literature; presentation of research papers by students; progress reports on departmental research; review of developing research methods and plans; reports from scientific meetings and conferences; other professional matters. Graduate Staff

SOC 699 Research in Sociology. *Preq.: Consent of chairman of graduate study committee. Credits Arranged.* Planning and execution of research and preparation of manuscript under supervision of graduate committee. Graduate Staff

Soil Science

GRADUATE FACULTY

Professor R. H. Miller, *Head*

Professors: S. W. Buol, D. K. Cassel, M. G. Cook, F. R. Cox, G. A. Cummings, C. B. Davey, J. W. Gilliam, D. S. Israel, W. A. Jackson, E. J. Kamprath, C. B. McCants, G. S. Miner, J. A. Phillips, C. D. Raper Jr., P. A. Sanchez, E. D. Seneca, R. W. Skaggs, R. J. Volk, J. B. Weber, S. B. Weed, A. G. Wollum II; *Extension Professor:* J. V. Baird; *Visiting Professor:* M. D. Openshaw; *Professors Emeriti:* W. V. Bartholomew, R. W. Cummings, J. W. Fitts, W. G. Woltz, W. W. Woodhouse Jr.; *Associate Professors:* G. D. Hoyt, L. D. King, H. J. Kleiss, R. Lea, J. P. Lilly, J. E. Shelton, M. J. Vepraskas; *Extension Associate Professor:* G. C. Naderman; *Visiting Associate Professors:* D. E. Bandy, W. B. Couto, J. H. Villachica; *Adjunct Associate Professor:* D. W. Eaddy; *Associate Professor Emeritus:* R. E. McCollum; *Assistant Professors:* H. L. Allen Jr., A. Amoozegar, S. W. Broome, H. P. Denton, C. K. Martin, T. J. Smyth; *Visiting Assistant Professor:* J. C. Alegre; *Senior Researcher:* W. P. Robarge; *Visiting Lecturer:* R. B. Daniels

The Department of Soil Science offers graduate programs leading to the Master of Science and Doctor of Philosophy degrees. These are research-oriented degrees and require a thesis/dissertation based on individual research on some aspect of the science. In addition, the Master of Agriculture and Master of Life Sciences degrees (non-thesis) may be obtained through the department.

Each M.S. and Ph.D. student will participate in one of many active research projects supervised by personnel in the department. The research may be specialized in one of the traditional sub-disciplines, *e.g.*, soil chemistry or it may integrate subject matter from related disciplines to address current societal needs, *e.g.*, waste management. Several of the projects are interdepartmental in character and, thus, a student may develop a particularly strong supportive program in one of the cooperating departments.

The department provides opportunities for students to tailor their programs for careers in research, teaching, extension or international programs. A student interested in one of these areas is encouraged to add this special dimension to the

research emphasis required of all students. Arrangements for these opportunities are made on an individual basis with appropriate faculty.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

SSC 501 Tropical Soils: Characteristics and Management. *Preq.: Six credits in SSC. 3(3-0) S.* Characteristics of the tropical environment. Distribution and classification of tropical soils. Soil plant relationships in the tropics. Soil management systems emphasizing shifting cultivation, flooded rice production, subsistence farming and tropical pasture management. Sanchez

SSC 511 Soil Physics. *Preqs.: SSC 200, PY 212. 4(3-3) F.* The study of soil physical properties and theory of selected instrumentation to measure them. Topics include soil solids, soil water, air and heat. Transport processes and the energy concept of soil and water are emphasized. Cassel

SSC 520 Soil and Plant Analysis. *Preqs.: PY 212; CH 315; at least three soils courses including SSC 341 or CI. 3(2-3) S. Alt. yrs.* Theory and advanced principles of the utilization of chemical instruments to aid research on the heterogeneous systems of soils and plants. Gilliam

SSC 522 Soil Chemistry. *Preqs.: SSC 200, one year of general inorganic chemistry. 3(3-0) S.* A consideration of the chemical and colloidal properties of clay and soil systems, including ion exchange and retention, soil solution reactions, solvation of clays and electrokinetic properties of clay-water systems. Weed

SSC (MB) 532 Soil Microbiology. *Preqs.: MB 401; CH 220 or CI. 4(3-3) S.* Soil as a medium for microbial growth, the relation of microbes to important mineral transformations in soil, the importance of biological equilibrium and significance of soil microbes to environmental quality. Wollum

SSC 541 Soil Fertility. *Preq.: SSC 341. 3(3-0) F.* Soil conditions affecting plant growth and the chemistry of soil and fertilizer interrelationships. Factors affecting the availability of nutrients. Methods of measuring nutrient availability. Kamprath

SSC 551 Soil Morphology, Genesis and Classification. *Preqs.: MEA 120, SSC 200, SSC 341. 3(3-0) F.* Morphology: Chemical, physical and mineralogical parameters useful in characterizing soil. Genesis: Soil-forming factors and processes. Classification: Historical development and present concepts of soil taxonomy with particular reference to worldwide distribution of great soil groups as well as discussions of logical bases of soil classification. Buol

SSC 553 Soil Mineralogy. *Preqs.: SSC 200, SSC 341, MEA 330. 3(2-3) F. Alt. yrs.* Composition, structure, classification, identification, origin, occurrence and significance of soil minerals with emphasis on primary weatherable silicates, layer silicate clays and sesquioxides. Weed

SSC 560 Advanced Soil Management. *Preqs.: SSC 200, 341. 3(3-0) Sum. Alt. yrs.* Studies of soil characteristics in the coastal plain, piedmont and mountain areas of North Carolina. Discussion of management practices that should be associated with various soils for different types of enterprises. Two overnight field trips are required. Graduate Staff

SSC 590 Special Problems. *Preq.: SSC 200. Credits Arranged. F,S.* Special problems in various phases of soils. Emphasis will be placed on review of recent and current research. Graduate Staff

FOR GRADUATES ONLY

SSC (CS, HS) 614 Herbicide Behavior in Plants and Soils. *3(3-0) F.* (See crop science.)

SSC (MB) 632 Ecology and Functions of Soil Microorganisms. *Preqs.: MB 401, SSC (MB) 532 or equivalent. 3(3-0) S. Alt. yrs.* A comprehensive examination of theories and concepts relative to ecology and functions of soil microorganisms. Topics include relationships of microbes to their environments, adaptive mechanisms, microbial processes in soil organic matter formation and degradation, and function of organic matter in soil systems. Subject emphasis will be determined by class interests and by current literature.
Graduate Staff

SSC 651 Pedology. *Preqs.: SSC 522, 511; SSC 551 or equivalent. 3(3-0) S. Alt. yrs.* A critical study of current theories and concepts in soil genesis, morphology and classification.
Buol

SSC (BAE) 671 Theory of Drainage—Saturated Flow. *3(3-0) F. Alt. yrs.* (See biological and agricultural engineering.)

SSC 672 Soil Properties and Plant Development*Preqs.: BCH 551, SSC 522 or equivalent. 3(3-0) S. Alt. yrs.* An examination of the interrelationships of soil properties and plant characteristics which regulate inorganic ion accumulation and dry matter production in higher plants.
Jackson

SSC (FOR) 673 Forest Productivity: Edaphic Relationships. *3(2-3) F. Alt. yrs.* (See forestry.)

SSC (BAE) 674 Theory of Drainage—Unsaturated Flow. *3(3-0) S. Alt. yrs.* (See biological and agricultural engineering.)

SSC 690 Seminar. *Preq.: Grad. standing in SSC. 1(1-0) F,S.* A maximum of two semester hours is allowed toward the master's degree, but any number toward the doctorate. Scientific articles, progress reports in research and special problems of interest to soil scientists reviewed and discussed.
Graduate Staff

SSC 693 Colloquium in Soil Science. *Preq.: Grad. standing in SSC. Credits Arranged. F,S.* Seminar-type discussions and lectures on specialized and advanced topics in soil science.
Graduate Staff

SSC 699 Research. *Preq.: Grad. standing in SSC. Credits Arranged. F,S.* A maximum of six semester hours is allowed toward the master's degree but any number towards the doctorate.
Graduate Staff

Special Education

For information on this program, see special education under education.

Statistics

GRADUATE FACULTY

Professor D. L. Solomon, *Head*

Professor T. M. Gerig, *Graduate Administrator*

Professors: B. B. Bhattacharyya, P. Bloomfield, C. C. Cockerham, D. A. Dickey, A. R. Gallant, F. G. Giesbrecht, H. J. Gold, T. Johnson, A. R. Manson, L. A. Nelson, K. H. Pollock, C. H. Proctor, C. P. Quesenberry, J. O. Rawlings, D. L. Ridgeway, W. H. Swallow, H. R. van der Vaart, J. L. Wasik, B. S. Weir, O. Wesler; *Adjunct Professors:* M. W. Anderson, J. R. Chromy, A. L. Finkner, J. H. Goodnight; *Professors Emeriti:* A. H. E. Grandage, R. J. Hader, D. W. Hayne, D. D. Mason, F. E. McVay, R. J. Monroe, J. A. Rigney, R. G. D. Steel; *Associate Professors:* R. L. Berger, D. D. Boos, C. Brownie, E. J. Dietz, A. C. Linnerud, J. F. Monahan, T. W. Reiland; *Associate Professor (USDA):* K. P. Burnham; *Assistant Professors:* M. Davidian, S. P. Ellner, D. W. Nychka, S. G. Pantula, C. E. Smith, L. A. Stefanski

ASSOCIATE MEMBERS OF THE DEPARTMENT

Professors: W. R. Atchley, M. M. Goodman, W. L. Hafley; *Associate Professor:* T. H. Emigh; *Assistant Professor:* A. R. Hall

The Department of Statistics offers programs leading to the Master of Science and Doctor of Philosophy degrees in both statistics and biomathematics and to the Master of Statistics and Master of Biomathematics degrees. It also offers co-major and joint Ph.D. programs with other departments including economics and business, crop science, genetics, biomathematics, operations research, forestry and computer studies. Flexible minor programs in statistics are offered at the Master's and Ph.D. levels. With a graduate faculty of 36 representing virtually all major statistical specializations, the department is recognized as a world leader in graduate education and research in statistics. Its applied orientation sets it apart from most other departments in the country, offering training to those wishing to pursue careers as consulting statisticians in industry and government as well as to those seeking careers in research and teaching.

Areas of research specialization of the faculty and advanced graduate students include time series, biomathematics, econometrics, quantitative genetics and ecology, experimental design and analysis, multivariate analysis, sampling, life science applications, quality control, statistical computing, parametric modeling, robust and nonparametric inference, mathematical programming, Bayesian inference, decision theory and stochastic processes.

The department provides consulting services to many other departments. This function places the department in a unique position in the University community, offering opportunities for collaboration and providing students with hands-on consulting experiences.

In addition to its ongoing program, the department houses three special groups. The Biomathematics Graduate Program, which is described under biomathematics, offers its own degrees and supports a research program. The Quantitative Genetics Research Program is an internationally respected research group of faculty, post-doctoral fellows and graduate students. The Southeastern Cooperative Fish and Game Statistics Project provides statistical consulting services to wildlife agencies in the southeast. Training and research in wildlife statistics are supported through this project.

The well-prepared applicant to the department's Master's program has good grades in a three-semester calculus sequence, a two-semester advanced calculus sequence, a semester of linear algebra and a two-semester applied statistics sequence. Some of these courses can be taken as part of the program but this may result in lengthening the stay. Admission to our Ph.D. program is granted to students who have passed the departmental Basic Comprehensive Examination at the Ph.D. level. A suitably prepared student can complete the Master's degree in two years. The Ph.D. usually requires three years beyond the Master's.

Departmental assistantships and fellowships are awarded each year on a competitive basis. Fellowships are provided through the Department's Gertrude M. Cox Fellowship Fund. Approximately 25 teaching assistantships and 20 research assistantships are also available.

Extensive library facilities are available in the area including the University's D. H. Hill Library, the Statistics departmental library, and those at Duke University and the University of North Carolina at Chapel Hill.

The department provides extensive computing support for its students. The department computing laboratory houses terminals and IBM-PC and PC/AT microcomputers, as well as graphics terminals (Tektronix 4105 and Vectrix VX 384) and an 8-pen plotter (Tex 4662A). The department data switch provides access to remote and local computing facilities, as well as the D. H. Hill Library Bibliographic Information System (BIS). A powerful remote computer is the IBM 3081 (Model K) located at the Triangle Universities Computer Center; the NCSU Computer Center operates an IBM 4381 using CMS. The department DEC VAX 11/750 provides interactive computing and graphics in a VMX/EUNICE (UNIX emulator) environment. Software, languages and statistical packages available on the IBM systems include SAS, IMSL, SPSS, Fortran, APL and Pascal, among many others; on the VAX, Fortan, C, IMSL, S and the graphics system DI-3000 are available.

Currently, employment opportunities are excellent for statisticians trained at all levels. The department regularly receives notification of job openings from industry, government and academic institutions. The National Science Foundation predicts a shortage of statisticians in the coming years.

SELECTED ADVANCED UNDERGRADUATE COURSES

ST 401, 402 Basic Statistical Analysis. *Preq.: (401) ST 302 or 372; (402) ST 401. 3(3-0) F,S.*

ST 421, 422 Introduction to Mathematical Statistics. *Preq.: (421) MA 202 or MA 212; (422) ST 421. 3(3-0) F,S.*

ST 493 Special Topics in Statistics. *Preq.: CI. 1-3 F,S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ST 505 Applied Nonparametric Statistics. *Preq.: ST 372 or ST 511. 3(3-0) S.* Statistical methods that require relatively mild assumptions about the form of the population distribution. Hypothesis testing, point and interval estimation and multiple comparison procedures for a variety of statistical problems. Dietz

ST (ZO) 506 Sampling Animal Populations. *Preq.: ST 512. 3(3-0) F. Alt. yrs.* Statistical methods applicable to sampling of wildlife populations, including capture-recapture, re-

moval, change in ratio, quadrat and line transect sampling. Emphasis on model assumptions and study design. Pollock

ST 507 Statistics for the Behavioral Sciences I. *3(3-0) F.* A general introduction to the use of descriptive and inferential statistics in behavioral science research. Methods for describing and summarizing data are presented, followed by procedures for estimating population parameters and testing hypotheses concerning the summarized data.
Dietz, Gold, Swallow, Wasik

ST 508 Statistics for the Behavioral Sciences II. *Preq.: ST 507 or CI. 3(3-0) S.* The use of statistical design principles in behavioral science research is introduced. The use of a statistical model to represent the structure of data collected from a designed experiment or survey study is presented. Opportunities are provided for use of a computer to perform analyses of data, to evaluate the proposed statistical model and to assist in post-hoc analysis procedures. Least squares principles are used to integrate the topics of multiple linear regression analysis, the analysis of variance and analysis of covariance.
Swallow, Wasik

ST 511 Experimental Statistics for Biological Sciences I. *Preq.: ST 311 or grad. standing. 3(3-0) F,S.* Basic concepts of statistical models and use of samples; variation, statistical measures, distributions, tests of significance, analysis of variance and elementary experimental design, regression and correlation, chi-square. Graduate Staff

ST 512 Experimental Statistics for Biological Sciences II. *Preq.: ST 511 or equivalent. 3(3-0) F,S.* Covariance, multiple regression, curvilinear regression, concepts of experimental design, factorial experiments, confounded factorials, individual degrees of freedom and split-plot designs. Graduate Staff

ST 514 Experimental Statistics for Social Sciences II. *Preq.: ST 507 or equivalent. 3(3-0) S.* Extension of basic statistical concepts to computer handling of data from social surveys; sample designs using clustered, stratified, systematic and multi-stage selections; analysis of variance continued; multiple, multivariate regression. Proctor

ST 515, 516 Experimental Statistics for Engineers. *Preq.: (515) ST 361 or grad. standing; (516) ST 515. 3(3-0) F,S.* General statistical concepts and techniques useful to research workers in engineering, textiles, wood technology, etc. Probability distributions, measurement of precision, simple and multiple regression, tests of significance, analysis of variance, enumeration data and experimental designs. Manson, Quesenberry

ST 517 Applied Least Squares. *Preq.: ST 402 or equivalent. 3(3-0) F.* Least squares estimation and hypothesis testing procedures for linear models. Regression, analysis of variance and covariance is considered in a unified manner that requires no extensive mathematical background. Emphasis is on the use of the computer to apply these techniques to experimental (including unequal cell sizes) and survey situations. Rawlings

ST 518 Applied Time Series Analysis. *Preq.: ST 512. 3(3-0) F.* An introduction to the use of statistical methods for analyzing and forecasting data observed over time. Trigonometric regression, periodogram/spectral analysis. Smoothing. Autoregressive moving average models. Regression with autocorrelated errors. Linear filters and bivariate spectral analysis. Methods and applications stressed; software implementations described and used in assignments. Bloomfield, Dickey, Monahan, Pantula

ST 519 Applied Multivariate Statistical Analysis. *Preq.: ST 512 or equivalent. 3(3-0) S.* An introduction to the use of multivariate statistical methods in the analysis of data collected in experiments and surveys. Topics covered will include multivariate analysis of variance, discriminant analysis, canonical correlation analysis and principal components analysis. The use of a computer to perform the multivariate statistical analysis calculations will be emphasized. Gerig, Monahan

ST 521 Statistical Theory I. *Coreqs.: MA 425 or MA 511 and MA 405. 3(2-2) F.* Discussion of the use of statistics as illustrated by an example pointing out the need for a probabilistic framework. The probability tools for statistics: description of discrete and absolutely continuous distributions, expected values, moments, moment generating functions, transformation of random variables, marginal and conditional distributions, independence, order statistics, multivariate distributions, concept of random sample, derivation of many sampling distributions. Bhattacharyya

ST 522 Statistical Theory II. *Preq.: ST 521; Coreq.: MA 426 or MA 512. 3(2-2) S.* General framework for statistical inference. Point estimators: biased and unbiased, minimum variance unbiased, least mean square error, maximum likelihood and least squares, asymptotic properties. Interval estimators and tests of hypotheses: confidence intervals, power functions, Neyman-Pearson lemma, likelihood ratio tests, unbiasedness, efficiency and sufficiency. Bhattacharyya

ST 531 Design of Experiments. *Preq.: ST 402 or equivalent. 3(3-0) F.* Review of completely randomized, randomized complete block and Latin square designs and the basic concepts in the techniques of experimental design. Designs and analysis methods in factorial experiments, confounded factorials, response surface methodology, change-over design, split-plot experiments and incomplete block designs. Examples will be used to illustrate application and analysis of these designs. Giesbrecht, Manson

ST 532 Introduction to Survey Sampling. *Preq.: MA 214 or ST 311 or equivalent. 3(3-0) F.* Description of the principal steps in the planning and execution of sample surveys. Review of actual surveys in various fields. Basic concepts of sampling and sampling methods. Practice in evaluating and designing sample surveys. Proctor, Wasik

ST 535 Statistical Quality Control. *Preq.: ST 515. 3(3-0) F. Alt. yrs.* Modern quality control for students with a calculus-level prerequisite course in engineering statistics. Emphasis upon on-line QC methods including classic charting techniques and modern methods for automated control of processes. Off-line QC topics include methods for sampling inspection and topics from experimental design applied to parameter and allowance design. Quesenberry

ST (MA) 541 Theory of Probability I. *3(3-0) F,Sum.* (See mathematics.)

ST (MA) 542 Introduction to Stochastic Processes. *Preqs.: MA 405 and MA 541 or ST 521. 3(3-0) S.* Markov chains and Markov processes, Poisson process, birth and death processes, queuing theory, renewal theory, stationary processes, Brownian motion. Bhattacharyya, Wesler

ST 550 Intermediate Statistical Methods. *Preqs.: ST 512 and ST 522. 3(3-0) F.* Introduction to statistical models and methodologies for survival analysis (parametric and non-parametric), bioassay, logistic regression and categorical data analysis (log-linear model and weighted least squares approaches). Software implementations are described and used in assignments. Berger, Gerig

ST (EB) 561 Intermediate Econometrics. *3(3-0) S.* (See economics and business.)

ST (TOX) 563 Statistical Problems in Toxicology. *Preq.: ST 511 or equivalent. 2(2-0) S. Alt. yrs.* Introduction to statistical issues arising in toxicological research, including review of standard statistical techniques. Special topics include teratological and short-term mutagenicity studies, long-term cancer bioassays, epidemiology, risk assessment and the use of historical controls. Brownie

ST (BMA, MA) 571 Biomathematics I. *3(3-0) F.* (See biomathematics.)

ST (BMA, MA) 572 Biomathematics II. *3(3-0) S.* (See biomathematics.)

ST 581 Robust and Nonparametric Statistics. *Preq.: ST 522. 3(3-0) S. Alt. yrs.* Theory and methods for standard inference problems where the normal distribution may not correctly describe the error distribution. Topics include rank and order statistics, permutation methods, bootstrap, jackknife, Pitman efficiency, influence curve, breakdown point, M-estimation and minimum distance estimation. Boos

ST 583 Introduction to Statistical Decision Theory. *Preq.: ST 522. 3(3-0) F. Alt. yrs.* Zero sum two-person games and statistical inference. Bayesian methods and orthodox statistical estimation and testing; minimax decision rules; empirical Bayes procedures; Bayes sequential decision procedures. Berger, Bhattacharyya, Monahan

ST 591 Special Problems. *Preq.: CI. 1-3 F,S,Sum.* Development of techniques for specialized cases, particularly in connection with thesis and practical consulting problems. Graduate Staff

ST 595 Statistical Consulting. *Preqs.: ST 512 and ST 522. 1(1-1) F,S,Sum.* Participation in regularly scheduled supervised statistical consulting sessions with faculty member and client. Consultant's report written for each session. Regularly scheduled meetings with course instructor and other student consultants to present and discuss consulting experiences. Brownie

FOR GRADUATES ONLY

ST (MA, OR) 606 Nonlinear Programming. *Preqs.: OR (IE, MA) 505 and MA 425 or equivalent. 3(3-0) F.* This course provides an advanced mathematical treatment of the analytical and algorithmic aspects of finite dimensional nonlinear programming. It includes an examination of the structure and effectiveness of computational methods for unconstrained and constrained minimization. Special attention will be directed toward current research and recent developments in the field. Peterson, Reiland

ST 613 Time Series Analysis: Time Domain. *Preqs.: ST 512 and ST 522. 3(3-0) S. Alt. yrs.* Estimation inference for coefficients in autoregressive, moving average and mixed models and large sample. Distribution theory for autocovariances and their use in identification of time series models. Stationarity and seasonality. Extensions of theory and methods to multiple series including vector autoregressions, transfer function models, regression with time series errors, state space modeling. Dickey, Pantula

ST 614 Time Series Analysis: Frequency Domain. *Preqs.: ST 512 and ST 522. 3(3-0) S. Alt. yrs.* Theory and methods of time series analysis from the frequency point of view. Harmonic analysis, complex demodulation and spectrum estimation. Frequency domain structure of stationary time series and space-time processes. Sampling distributions of commonly used statistics. Bloomfield

ST (MA) 617, 618 Measure Theory and Advanced Probability. *Preqs.: (617) MA 426; ST 521 or MA 541 or equivalent; (618) ST 617. 3(3-0) F,S.* Modern measure and integration theory in abstract spaces. Probability measures, random variables, expectations. Distributions and characteristic functions. Modes of convergence. Independence, zero-one laws, laws of large numbers, three-series theorem. Central limit problem. Conditional expectations, martingales and martingale convergence theorems. Bhattacharyya, Wesler

ST (MA) 619 Topics in Advanced Probability. *Preq.: ST (MA) 618. 3(3-0).* Infinitely divisible distributions and stable laws. Stationarity, ergodic theorems. Markov chains. Weak convergence of probability measures on metric spaces, Brownian motion, invariance principles, law of the iterated logarithm. Wesler

ST 623 Statistics in Plant Science. *Preq.: ST 512 or equivalent. 3(3-0) F.* Principles and techniques of planning, establishing and executing field and greenhouse experiments. Size, shape and orientation of plots; border effects; estimation of size of experiments for specified accuracy; subsampling plots and yields for laboratory analysis; combining data from a

series of years and/or locations; rotation experiments; soil test correlation; multiple comparisons in variety trial results; selection of predictors in multiple regression; introduction to interspecies and intraspecies plant competition experiments and models. Nelson

ST (GN) 626 Statistical Concepts in Genetics. *Preq.: GN 506; Coreq.: ST 402 or equivalent. 3(3-0) S. Alt. yrs.* Migration, mutation, selection, drift, linkage, mating system and other processes that bear on rates of change in population frequencies, means and variances; magnitude and nature of genotypic and nongenotypic variability and their role in alternative procedures of plant and animal breeding; experimental and statistical approaches to the analysis of quantitative inheritance. Cockerham

ST 631 Theory of Sampling Applied to Survey Design. *Preqs.: MA 214 or equivalent; ST 402 or equivalent. 3(3-0) F.* Principles for interpretation and design of sample surveys. Estimator biases, variances and comparative costs. Simple random sample, cluster sample, ratio estimation, stratification, varying probabilities of selection. Multi-stage, systematic and double sampling. Response errors. Pollock, Proctor

ST 637 Advanced Statistical Inference. *Preqs.: ST 522, ST 617. 3(3-0) S.* This course will treat the classical areas of statistical inference, estimation and hypothesis testing, at the measure-theoretical level. Emphasis will be upon treatment of these areas in depth. Graduate Staff

ST 645 Statistical Computing. *Preq.: ST 681. 3(3-0) F. Alt. yrs.* The intent of the course is to provide the statistician with the computational tools for statistical research and applications using digital computing machinery. Topics to be covered include random number generation and Monte Carlo methods, regression computations and application to statistical methods of optimization, sorting and Fast Fourier transform. Monahan

ST (EB) 651 Econometrics. *3(3-0) F.* (See economics and business.)

ST (EB) 652 Topics in Econometrics. *3(3-0) S.* (See economics and business.)

ST 671 Advanced Analysis of Variance and Variance Components. *Preqs.: ST 402 or equivalent, ST 681. 3(3-0) S. Alt. yrs.* Expected mean squares, exact and approximate tests of hypotheses for balanced and unbalanced data sets. Fixed, mixed and random models. Randomization theory. Estimation of variance components using regression, MINQUE and general quadratic unbiased estimation theory. Giesbrecht

ST 674 Advanced Topics in Construction and Analysis of Experimental Designs. *Preqs.: ST 402 or equivalent, ST 681. 3(3-0). S. Alt. yrs.* Construction and analysis of multifactor designs, factorials, fractional factorials, balanced incomplete block designs, Latin squares, orthogonal arrays of strength d and response surface designs. Fractionating mixed level factorials, confounding and blocking techniques, study of robustness of designs to loss of design point. Manson

ST 681 Linear Models and Variance Components. *Preqs.: MA 405, ST 521; Coreq.: ST 522. 3(2-2) S.* Theory of estimation and testing in full and non-full rank linear models. Normal theory distributional properties. Least squares principle and the Gauss-Markoff theorem. Estimability and properties of best linear unbiased estimators. The general linear hypothesis. Application of dummy variable methods to elementary classification models for balanced and unbalanced data. Analysis of covariance. Variance components estimation for balanced data. Pantula

ST 682 Multivariate Linear Models and Nonlinear Models. *Preqs.: ST 512, ST 681. 3(3-0) F.* Inference for the multivariate general linear model. Normal theory distributional properties. Wishart matrices, Wilks' lambda criterion and Roy's maximum root test. Univariate and multivariate nonlinear models. Modified Gauss-Newton method for obtaining estimates. Asymptotic properties of estimators. Inference through the likelihood ratio test, the Lagrange multiplier test and the Wald test. Applications using computer implementation. Gallant

ST 683 Multivariate Analysis. *Preqs.: ST 522 and ST 682. 3(3-0) S. Alt. yrs.* Survey of multivariate statistical theory. Multivariate distributions including the multinormal, Wishart, Hotelling's T^2, Fisher-Roy-Hsu, Wilks' V and multivariate Beta distributions. Applications of maximum likelihood estimation, likelihood ratio testing and the union-intersection principle. Development of the theory of Hotelling's T^2 tests and confidence sets, discriminant analysis, canonical correlation, multivariate analysis of variance and principal components. Gerig, Monahan

ST 691 Advanced Special Problems. *Preqs.: ST 402 or equivalent, ST 681. 1-3 F,S,Sum.* Any new advance in the field of statistics which can be presented in lecture series as unique opportunities arise. Graduate Staff, Visiting Professors

ST 694 Seminar. *1(1-0) F,S.* Graduate Staff

ST 699 Research. *Credits Arranged. F,S,Sum.* Graduate Staff

Textiles

Professor R. A. Barnhardt, Dean

For a listing of Graduate Faculty and department information, see Textile Chemistry, Textile Engineering and Science, and Textile Management and Technology.

The College of Textiles offers programs leading to the Master of Science degree in the Departments of Textile Chemistry, Textile Engineering and Science, and Textile Management and Technology, the professional degree of Master of Textiles and the Doctor of Philosophy in fiber and polymer science. (See fiber and polymer science for a description of the program.) The College of Textiles also participates in the Master of Science in management program in which students combine studies in the Department of Economics and Business with courses from the Department of Textile Management and Technology (see management).

Students otherwise meeting the requirements of the Graduate School and with Bachelor of Science degrees with majors in textiles, the physical sciences or engineering will normally qualify for the graduate degree programs.

The minimum requirement for a Master of Textiles degree is the satisfactory completion of 33 semester hours of advanced courses. There is no thesis or foreign language requirement. This program offers the student advanced professional training with emphasis on management, quality or manufacturing control, technology, machine design or textile design.

The programs of study for the Master of Science degree include a minimum of 30 semester hours of advanced courses, including six semester hours devoted to a thesis based on research conducted by the student. There is no foreign language requirement. The plan of course work and the research activities for the Master of Science degree are designed to prepare the student for a career in research, development, management or other technical phases of the textile and allied industries. Students may minor in one or more of a number of associated fields.

Programs of study may be arranged to develop a broad background in three general areas: advanced textile materials science, production and marketing management of textiles and textile chemistry. Those students interested in the first of these may emphasize areas such as fiber and yarn processing operations,

mechanical and physical properties of fibers and textile structures and testing or quality control. Programs leading to the Master of Science degree in textile chemistry emphasize fiber and polymer chemistry in its own right and as a basis for dyeing and finishing treatments for textile materials. In the area of marketing and production management, the program emphasizes the applications of quantitative decision-making methods, including operations research and computer techniques, to the textile industry. Programs in this area normally terminate within the College of Textiles with a master's degree but may be structured to provide suitable backgrounds for students wishing to do further graduate work in the areas of economics and business, industrial management, industrial engineering or business administration.

Fiber and Polymer Science

See fiber and polymer science for a list of associated courses.

Textiles (General Courses)

SELECTED ADVANCED UNDERGRADUATE COURSES

T 401 Environmental Aspects of the Textile Industry. *Preq.: Sr. standing. 3(3-0) S.*

T 402 Introduction to the Theory and Practice of Fiber Formation. *Preqs.: CH 103, T 203, MA 212, PY 212. 3(3-0) S.*

T 491H Honors Seminar in Textiles. *By invitation into Honors Program in Textiles. 1(1-0) F,S.*

T 493 Industrial Internship in Textiles. *Preq.: Textile core courses. 3 F,S,Sum.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

T 500 Fiber and Polymer Microscopy. *Preqs.: MA 212, PY 212, T 203. 3(1-4) F.* The art and science of light and electron microscopy; theoretical and practical aspects of visibility, resolution and contrast. Laboratory practice in assembling, testing and using various microscopes and accessories in analyzing, describing and identifying unoriented and oriented crystalline or amorphous materials. Laboratory emphasis is on the study of fibers and polymers through transmission microscopy with polarized light. Tucker

Textile Chemistry

Professor C. D. Livengood, *Head*

Associate Professor G. N. Mock, *Graduate Administrator*

Professors: J. A. Cuculo, R. D. Gilbert, R. McGregor, M. H. Theil, C. Tomasino, W. K. Walsh; *Adjunct Professors:* J. E. Hendrix, T. Iijima, H. F. Mark; *Professors Emeriti:* K. S. Campbell, D. M. Cates, H. A. Rutherford, W. M. Whaley, R. W.

Work; *Associate Professors:* K. R. Beck, H. S. Freeman, C. B. Smith; *Adjunct Associate Professor:* L. D. Claxton; *Associate Professors Emeriti:* T. H. Guion, A. C. Hayes; *Assistant Professor:* J. W. Rucker; *Adjunct Assistant Professor:* A. W. deGroot

The field of textile chemistry embraces a number of disciplines and is concerned, in part, with those industrial processes that constitute the final steps in the preparation of textile materials for the consumer. Common terms applied to these processes are scouring, bleaching, printing, dyeing and finishing. Textile chemistry is also concerned with fiber-forming polymers and other types of polymers, both natural and man-made, and how the chemical and physical properties of such materials vary with structure. Students receive a fundamental knowledge of the underlying principles that relate to this derivative field and a perspective that includes the many interacting factors involved in the preparation and conversion of starting materials to useful products.

SELECTED ADVANCED UNDERGRADUATE COURSES

TC 405 Chemical and Physical Evaluation of Textiles. *Preqs.: T 250, TC 320 and TC 330 or T 301. 3(2-3) F.*

TC 406 Textile Chemical Technology Laboratory. *Preqs.: TC 320, 330 and sr. standing. 2(0-6) S.*

TC 412 Textile Chemical Analysis II. *Preq.: T 203. 3(2-3) S.*

TC 415 Principles and Practice of Textile Printing. *Preqs.: T 301 or TC 220 or PD(TX) 272. 3(2-2) F.*

TC 441 Theory of Physico-Chemical Processes in Textiles I. *Preqs.: MA 301 or 212, PY 205 or 211. 3(2-2) F.*

TC 442 Theory of Physico-Chemical Processes in Textiles II. *Preq.: TC 441. 3(2-2) S.*

TC 451 Computers in Textile Wet Processing. *Preqs.: MA 212, PY 212, T 301. 3(3-0) S.*

TC (CH) 461 Introduction to Fiber-Forming Polymers. *Preq.: CH 223. 3(3-0) F.*

TC 490 Special Topics in Textile Chemistry. *1-6 F,S.*

TC 491 Seminar in Textile Chemistry. *Preqs.: TC 320, TC 330 and sr. standing. 1(0-2) S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

TC 504 Fiber Formation—Theory and Practice. *Preqs.: MA 301, PY 208 or CI. 3(3-0) F.* Practical and theoretical analysis of the chemical and physical principles underlying the conventional methods of converting bulk polymer to fiber; rheology; melt, dry and wet polymer extrusion; fiber drawing; heat setting; general theory applied to unit processes.
Cuculo

TC 505 Theory of Dyeing. *Preq.: CH 433 or CI. 3(3-0) S.* Mechanisms of dyeing. Application of thermodynamics to dyeing systems. Kinetics of diffusion in dyeing processes.
McGregor

TC 506 Color Science. *Preq.: Sr. or grad. standing in TC; Coreq.: TC 507. 3(3-0) F.* Basis of modern techniques for color specification, measurement, control and communication.

Applications of color science to textiles, plastics, color reproduction, computer-based imaging and display systems. Basic concepts taught by computer color graphics. McGregor

TC 507 Color Laboratory. *Preq.: Sr. or grad. student in textile chemistry; Coreq.: TC 506. 1(0-2) F.* Exercises with modern methods and equipment to aid in understanding color perception, color science and color measurement. Computer color graphics exercises for comprehension of basic concepts. Independent projects in color science. Limited enrollment. Graduate Staff

TC 520 Chemistry of Dyes and Color. *Preqs.: CH 221 and CH 223. 3(3-0) S.* Correlation of color and chemical constitution, synthetic routes for popular dyes of all important types; electronic mechanisms for reactive dyes; chemistry of dye interactions with light, washing and other in-use influences; economic and environmental considerations. Freeman

TC 521 Dye Synthesis Laboratory. *Preq.: TC 520. 3(0-9) F.* Laboratory work in the preparation and analysis of synthetic dyes of a large number of types. Personal instruction in techniques and processes for preparation and purification of intermediates and dyes. Freeman

TC 530 The Chemistry of Textile Auxiliaries. *Preq.: One year of organic chemistry. 3(3-0) F.* Industrially important textile chemicals used for enhancing fiber and fabric properties such as durable press, water repellency, antisoiling, flame retardancy, softness, stiffness, lubricity and other uses will be studied. Correlation of effect with structure, end-use influences, interaction with fabric and fibers, sources and synthetic routes, economic and environmental considerations will be covered. Tomasino

TC 561 Organic Chemistry of High Polymers. *Preqs.: TC (CH) 461, CH 331 or CH 431. 3(3-0) S.* Principles of stepand chain-growth polymerizations; copolymerization theory; homogeneous free radical polymerization; emulsion polymerization; Ziegler-Natta polymerization; ionic polymerization. Gilbert, Theil

TC (CH) 562 Physical Chemistry of High Polymers—Bulk Properties. *Preqs.: CH 220 or 223, CH 331 or 431. 3(3-0) F.* Molecular weight; states of aggregation and their interconversion; rubbery, glassy and crystalline states; rubber elasticity; molecular friction; diffusion and viscosity; dynamics of network response; retardation- and relaxation-time spectra; thermodynamics of nucleation; kinetics of crystallization. Cates

TC 565 Polymer Applications and Technology. *Preqs.: One year of organic chemistry; TC 461. 3(3-0) S.* Poly(olefins), poly(vinyl chloride), poly(vinyl acetate), poly(urethanes), epoxies, silicones, styrene copolymers used as textile finishes, nonwoven binders, fabric coatings, composites, adhesives, foams, carpet backing adhesives. Synthesis, industrial processes, properties and products are emphasized. Graduate Staff

TC (CHE) 569 Polymers, Surfactants and Colloidal Materials. *3(3-0) F.* (See chemical engineering.)

TC (CHE) 570 Radiation Chemistry and Technology of Polymeric Systems. *3(3-0) S.* (See chemical engineering.)

TC 591 Special Topics in Textile Science. *Preqs.: Sr. or grad. standing and CI. 1-4 F,S.* Intensive treatments of selected topics in textile, polymer and fiber science. Graduate Staff

FOR GRADUATES ONLY

TC 662 Physical Chemistry of High Polymers—Solution Properties. *Preqs.: CH 433, TC (CH) 562. 3(3-0) S.* Sorption and diffusion; thermodynamics of polymer solutions; phase equilibria; configurational and frictional properties determination of molecular weight. Theil

TC (CHE) 669 Diffusion in Polymers. *2(2-0) S.* (See chemical engineering.)

TC (CHE) 671 Special Topics in Polymer Science. *1-3 F.* (See chemical engineering.)

TC (TES) 691 Special Topics in Fiber Science. *1-3 S.* (See textile engineering and science/textile management and technology.)

TC 698 Seminar for Textile Chemistry. *1(1-0) F,S.* Discussion of scientific articles and presentations; review and discussion of student papers and research problems.
Graduate Staff

TC 699 Textile Research for Textile Chemistry. *Credits Arranged.* Individual research in the field of textile chemistry. Graduate Staff

Textile Engineering and Science

Professor S. P. Hersh, *Head*

Professor B. S. Gupta, *Assistant Head and Graduate Administrator*

Professors: R. L. Barker, S. K. Batra, D. R. Buchanan, T. W. George, P. R. Lord, M. H. Mohamed; *Adjunct Professor:* M. W. Suh; *Professors Emeriti:* J. F. Bogdan, P. D. Emerson, D. S. Hamby, J. A. Porter Jr.; *Adjunct Associate Professor:* P. E. Sasser; *Associate Professor Emeritus:* T. G. Rochow; *Assistant Professors:* P. Banks-Lee, T. G. Clapp, H. Hamouda

SELECTED ADVANCED UNDERGRADUATE COURSES

TE 401 Textile Engineering Design I. *Preqs.: TE 302; MAE 208 or CE 215; MAE 314 or CE 313. 4(3-3) F.*

TE 402 Textile Engineering Design II. *Preq.: TE 401. 4(2-6) S.*

TE 403 Mechanics of Fibrous Structures. *Preqs.: TE 201, MA 301, MAE 314 or CE 313. 3(3-0) F.*

TE 404 Textile Process Quality Control. *Preqs.: ST 361; TE 302; ECE 331. 4(3-2) S.*

TES 405 Contemporary Nonwoven Textiles. *Preqs.: TES 305; sr. standing and CI. 3(3-0) S.*

TES (TMT) 420 Modern Developments in Yarn Manufacturing. *Preq.: Sr. standing. 3(3-0) S.*

TES (TMT) 425 Textured Yarn Production and Properties. *Preqs.: T 211, T 220, PY 211 (205); Coreq.: PY 212 (208). 3(2-2) F.*

TES 450 Advanced Weaving. *Preq.: TES (TMT) 351. 3(2-2) F. Alt. yrs.*

TES (TMT) 451 Advanced Woven Fabric Design. *Preq.: TES (TMT) 370. 3(2-2) S. Alt. yrs.*

TES 460 Physical Properties of Textile Fibers. *Preqs.: MA 212, PY 212. 3(3-0) F,S.*

TES 461 Mechanical Properties of Fibrous Structures. *Preqs.: MA 301, TES 460. 3(3-0) S.*

TES 490 Development Projects in Textile Engineering and Science. *Preqs.: Sr. standing and 2.75 GPA. 2-3 F,S,Sum.*

TES 491 Special Topics in Textile Engineering and Science. *Preq.: Sr. standing. 1-3 F,S.*

TES (TMT) 495 Senior Seminar in Textile Materials and Management. *Preqs.: Sr. standing and CI. 1(1-0) F.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

TES 505 Textile Instrumentation and Control Systems. *Preqs.: MA 301, PY 212 and one course in computer science. 3(3-0) F.* The theory and application of instruments and control systems used in modern textile plants. Basic instruments and computer systems are described along with their use in process control, production control, research and development. Grady

TES(TMT) 520 Yarn Processing Dynamics. *Preqs.: MA 301 and CI or grad. standing. 3(2-2) F.* Theoretical analysis of the dynamics and machine-fiber interactions of such functions as opening, cleaning, carding actions, fiber attenuation, ring spinning, open-end spinning, texturing and winding. The role of fiber placement, cohesion and lubrication on yarn processing and properties. Laboratory experiments are designed to verify the analysis discussed in the lectures. El-Shiekh

TES(TMT) 530 Textile Quality Control. *Preq.: TES(TMT) 330 or CI. 3(3-0) S.* Quality control systems for textile operations with emphasis on sampling plans for attributes and variables and on interpretation of data as related to identifying sources of product variability. Stuckey

TES(TMT) 541 Theory and Practice of Knitted Fabric Production and Control. *Preqs.: TES(TMT) 370 and CI. 3(3-0) F.* The technology and control systems for manufacturing simple and complex knitted fabrics; control and monitoring of yarn feeding systems; influence of yarn, machine, finishing and fabric structure on the fabric aesthetics, physical and mechanical properties; optimization of fabric properties and machine productivity, including costing; problems of jacquard fabric processing and control. Graduate Staff

TES(TMT) 555 Production Mechanics and Properties of Woven Fabrics. *Preqs.: MA 301 and CI or grad. standing. 3(2-2) S.* The interrelations between the mechanics of production and mechanical properties of woven fabrics; unit operations required to prepare yarns for weaving and the mechanisms employed in weaving; fabric structure, geometry and mechanical properties; designing for specific fabric properties. Mohamed

TES(TMT) 561 Mechanical and Rheological Properties of Fibrous Material. *Preq.: MA 301. 3(2-2) S.* In-depth study of the stress-strain, bending, torsional, dynamic and rheological behavior of natural and man-made fibers. Theoretical relations and advanced techniques are presented and discussed. Gupta, Hersh

TES(TMT) 562 Physical Properties of Fiber Forming Polymers, Fibers and Fibrous Structures. *Preqs.: MA 301, PY 208. 3(3-0) F.* Experimental results and theoretical considerations of the physical properties of fibers and fiber forming polymers will be discussed. This will include electrical, thermal, optical, frictional and moisture properties of these materials. The influence of chemical and molecular fine structure on these properties will be discussed. Buchanan, Gupta

TES(TMT) 563 Characterization of Structure of Fiber Forming Polymers. *Preqs.: MA 301, PY 208. 3(3-0) F.* Theories, experimental evidence and characterization methods of the molecular fine structure of fiber forming polymers in the solid state will be discussed. Characterization methods will include X-ray diffraction, microscopy, infrared, thermal and magnetic resonance. An introduction to nucleation theory of polymer systems will be presented. Buchanan, Gupta

TES 589 Special Studies in Textile Engineering and Science. *Preq.: Sr. or grad. standing. 1-4 F,S.* New or special course on developments in textile engineering and science. Specific topics and prerequisites identified will vary. Generally used for first offering of a new course. Graduate Staff

TES 590 Special Projects in Textile Engineering and Science. *Preqs.: Sr. standing or grad. standing, CI. 2-3 F,S,Sum.* Advanced studies will include current problems of the industry, independent investigations, seminars and technical presentations, both oral and written. Graduate Staff

FOR GRADUATES ONLY

TES(TMT) 603 Group Research in Textiles. *Preqs.: TES(TMT) 520 and TES(TMT) 555 or TES(TMT) 541. 3(2-3) F.* Group research under supervision in which each student will execute a portion of the research and will report to the whole group. Each student will be required to write a report on the whole project. There will be formal lectures on methodology, interpretation and application of research. Lord

TES(TMT) 621 Advanced Textile Testing. *Preqs.: TES(TMT) 530; ST 421 or CI. 3(2-2) S.* Design of textile laboratories required for specific needs; experimental design and performance of tests; analysis of data relating to industrial problems; specialized physical tests; interlaboratory correlations; development of standardized test methods. Stuckey

TES 631 Synthetic Fibers. *Preq.: TES(TMT) 425 or equivalent. 2(1-2) F,S,Sum.* Lectures and projects on advanced problems associated with the properties and processing of man-made continuous filament and staple fiber yarns. Hersh

TES(TMT) 640 Physical and Mechanical Properties of Knitted Fabric. *Preq.: TES(TMT) 541. 3(3-0) Alt. S.* Seminar discussions of research literature on studies of the physical and mechanical properties of knitted fabrics. Graduate Staff

TES(TMT) 651, 652 Fabric Development and Construction. *Preq.: Grad. standing. 3(1-4) F,S.* Application of advanced technology to the development and construction of woven fabrics. Graduate Staff

TES(TMT) 663 Mechanics of Twisted Structures. *Preq.: TES(TMT) 561 or equivalent. 3(3-0) S. Odd yrs.* Study of the basic mechanics of fibrous assemblies. Geometry and mechanics of twisted structures (yarns, cords, braids, etc.) and the translation of fiber properties into structural behavior. Batra, El-Shiekh

TES(TMT) 664 Mechanics of Fabric Structures. *Preq.: TES(TMT) 561 or equivalent. 3(3-0) S. Even yrs.* Analysis of the geometry and behavior of woven, knitted and nonwoven fabrics under various stress conditions and end use applications. Batra, El-Shiekh

TES (TC) 691 Special Topics in Fiber Science. *Preq.: CI. 1-3 S.* The study of selected topics of particular interest in various advanced phases of fiber science. Graduate Staff

TES 697 Independent Study in Textiles. *3(3-0) F,S,Sum.* Problems of specific interest in textiles will be assigned for study and investigation. The preparation of a report for publication will be required. Three hours maximum credit will be allowed toward Master of Textiles degree. No credit is allowed toward Master of Science in Textiles degree. Graduate Staff

TES 698 Seminar. *1(1-0) F,S.* Discussion of scientific articles of interest to the textile industry; review and discussion of student papers and research problems. Graduate Staff

TES 699 Textile Thesis or Dissertation Research. *Credits Arranged. F,S,Sum.* Problems of specific interest to the textile industry will be assigned for study and investigation. The use of experimental methods will be emphasized. Attention will be given to the preparation of reports for publication. The master's thesis may be based upon the data obtained. Graduate Staff

Textile Management and Technology

Professor G. A. Berkstresser III, *Head*

Associate Professor M. A. Robinson, *Assistant Head*

Professor P. A. Tucker, *Graduate Administrator*

Professors: R. A. Barnhardt, A. H. El-Shiekh, W. C. Stuckey; *Professor Emeritus:* A. B. Moss; *Associate Professors:* R. A. Donaldson, P. B. Hudson, T. J. Little; *Visiting Associate Professors:* N. A. Hunter, E. M. McPherson; *Adjunct Associate Professor:* D. M. Powell; *Assistant Professors:* A. C. Clapp, R. H. Johnson, G. W. Smith

FOR GRADUATES AND ADVANCED UNDERGRADUATES

TMT(TES) 520 Yarn Processing Dynamics. *Preqs.: MA 301 and CI or grad. standing. 3(2-2) F.* Theoretical analysis of the dynamics and machine-fiber interactions of such functions as opening, cleaning, carding actions, fiber attenuation, ring spinning, open-end spinning, texturing and winding. The role of fiber placement, cohesion and lubrication on yarn processing and properties. Laboratory experiments are designed to verify the analysis discussed in the lectures. El-Shiekh

TMT(TES) 530 Textile Quality Control. *Preq.: TMT(TES) 330 OR CI. 3(3-0) S.* Quality control systems for textile operations with emphasis on sampling plans for attributes and variables and on interpretation of data as related to identifying sources of product variability. Stuckey

TMT(TES) 541 Theory and Practice of Knitted Fabric Production and Control. *Preqs.: TMT(TES) 370 and CI. 3(3-0) F.* The technology and control systems for manufacturing simple and complex knitted fabrics; control and monitoring of yarn feeding systems; influence of yarn, machine, finishing and fabric structure on the fabric aesthetics, physical and mechanical properties; optimization of fabric properties and machine productivity, including costing; problems of jacquard fabric processing and control. Graduate Staff

TMT 549 Warp Knit Engineering and Structural Design. *Preq.: TMT 443. 3(3-0) S.* Engineering analysis of tricot and raschel machinery. Design of yarn let-off and fabric take-up mechanisms. Studies of fabric production techniques and quality control systems. Theory of production optimization and the properties of fabrics. Complex geometrical loop models and their application. Graduate Staff

TMT(TES) 555 Production Mechanics and Properties of Woven Fabrics. *Preqs.: MA 301 and CI or grad. standing. 3(2-2) S.* The interrelations between the mechanics of production and mechanical properties of woven fabrics; unit operations required to prepare yarns for weaving and the mechanisms employed in weaving; fabric structure, geometry and mechanical properties; designing for specific fabric properties. Mohamed

TMT(TES) 561 Mechanical and Rheological Properties of Fibrous Material. *Preq.: MA 301. 3(2-2) S.* In-depth study of the stress-strain, bending, torsional, dynamic and rheological behavior of natural and man-made fibers. Theoretical relations and advanced techniques are presented and discussed. Gupta, Hersh

TMT(TES) 562 Physical Properties of Fiber Forming Polymers, Fibers and Fibrous Structures. *Preqs.: MA 301, PY 208. 3(3-0) F.* Experimental results and theoretical considerations of the physical properties of fibers and fiber forming polymers will be discussed. This will include electrical, thermal, optical, frictional and moisture properties of these materials. The influence of chemical and molecular fine structure on these properties will be discussed. Buchanan, Gupta

TMT(TES) 563 Characterization of Structure of Fiber Forming Polymers. *Preqs.: MA 301, PY 208. 3(3-0) F.* Theories, experimental evidence and characterization methods of the molecular fine structure of fiber forming polymers in the solid state will be discussed. Characterization methods will include x-ray diffraction, microscopy, infrared, thermal and magnetic resonance. An introduction to nucleation theory of polymer systems will be presented. Buchanan, Gupta

TMT (EB) 585 Market Research in Textiles. *Preq.: TMT (EB) 482. 3(3-0) S.* A study and analysis of the quantitative methods employed in market research in the textile industry. The function of market research and its proper orientation to management and decision making. Berkstresser

TMT 589 Special Studies in Textile Management and Technology. *Preq.: Sr. or grad. standing. 1-4 F,S.* New or special course on developments in textile management and technology. Specific topics and prerequisites will vary. Graduate Staff

TMT 590 Special Projects in Textile Management and Technology. *Preqs.: Sr. standing or grad. standing, CI. 2-3 F,S,Sum.* Advanced studies on current problems of the industry, independent investigations, seminars and technical presentations, both oral and written. Graduate Staff

FOR GRADUATES ONLY

TMT(TES) 603 Group Research in Textiles. *Preqs.: TMT(TES) 520 and TMT(TES) 555 or TMT(TES) 541. 3(2-3) F.* Group research under supervision in which each student will execute a portion of the research and will report to the whole group. Each student will be required to write a report on the whole project. There will be formal lectures on methodology, interpretation and application of research. Lord

TMT(TES) 621 Advanced Textile Testing. *Preqs.: TMT(TES) 530; ST 421 or CI. 3(2-2) S.* Design of textile laboratories required for specific needs; experimental design and performance of tests; analysis of data relating to industrial problems; specialized physical tests; interlaboratory correlations; development of standardized test methods. Stuckey

TMT(TES) 640 Physical and Mechanical Properties of Knitted Fabric. *Preq.: TMT(TES) 541. 3(3-0) Alt. S.* Seminar discussions of research literature on studies of the physical and mechanical properties of knitted fabrics. Graduate Staff

TMT(TES) 651, 652 Fabric Development and Construction. *Preq.: Grad. standing. 3(1-4) F,S.* Application of advanced technology to the development and construction of woven fabrics. Graduate Staff

TMT(TES) 663 Mechanics of Twisted Structures. *Preq.: TMT(TES) 561 or equivalent. 3(3-0) F.* Study of the basic mechanics of fibrous assemblies. Geometry and mechanics of twisted structures (yarns, cords, braids, etc.) and the translation of fiber properties into structural behavior. Batra, El-Shiekh

TMT(TES) 664 Mechanics of Fabric Structures. *Preq.: TMT(TES) 561 or equivalent. 3(3-0) S.* Analysis of the geometry and behavior of woven, knitted and nonwoven fabrics under various stress conditions and end use applications. Batra, El-Shiekh

TMT 680 Special Projects in Textile Management. *Preq.: TMT (EB) 585. 1-3 F,S,Sum.* Special studies in textile management covering current problems of the industry, independent investigations, seminars and technical presentations, both oral and written. Graduate Staff

TMT 686 Advanced Textile Labor Management Seminar. *Preq.: TMT 487 or CI. 3(3-0) F,S.* A study of advanced labor management problems in the textile industry, with particular emphasis directed toward the application of the Occupational Safety and Health Act. Powell

TMT 687 Competitive Strategy and Planning for the Textile Firm. *Preq.: Completion of 18 credit hours in a graduate degree program, of which at least 6 hours must be in economics and related courses at the 500 level or higher. 3(3-0). F.* Elements of competitive strategy and planning methods within the textile complex with emphasis on the concepts of strategy in a mature industry, defining business in a global industry, resource allocation through strategic planning methods and implementing strategy in single business and multi-business firms. Moss

TMT 697 Independent Study in Textiles. *3(3-0) F,S,Sum.* Problems of specific interest in textiles will be assigned for study and investigation. The preparation of a report for publication will be required. Three hours maximum credit will be allowed toward Master of Textiles degree. No credit is allowed toward Master of Science in Textiles degree. Graduate Staff

TMT 698 Seminar. *1(1-0) F,S.* Discussion of scientific articles of interest to the textile industry; review and discussion of student papers and research problems. Graduate Staff

TMT 699 Textile Thesis or Dissertation Research. *Credits Arranged. F,S,Sum.* Problems of specific interest to the textile industry will be assigned for study and investigation. The use of experimental methods will be emphasized. Attention will be given to the preparation of reports for publication. The master's thesis may be based upon the data obtained. Graduate Staff

Toxicology

GRADUATE FACULTY

Professor E. Hodgson, *Chairman*

Professors: A. L. Aronson, W. C. Dauterman, W. E. Donaldson, F. E. Guthrie, P. B. Hamilton, H. M. Hassan, R. J. Kuhr, W. H. McKenzie, J. J. Perry, T. J. Sheets; *Professors (USDA):* W. W. Heck, D. E. Moreland; *Adjunct Professors:* M. W. Anderson, J. R. Fouts, J. E. Gibson, R. A. Neal, R. M. Philpot; *Professors Emeriti:* D. S. Grosch, D. W. Hayne, R. J. Monroe; *Associate Professor;* J. E. Riviere; *Adjunct Associate Professors:* T. E. Eling, H. B. Matthews Jr.; *Assistant Professors:* C. F. Brownie, C. L. Robinette, R. C. Smart; *Visiting Assistant Professor:* N. A. Monteiro-Riviere

Graduate study under the direction of the toxicology faculty may lead to the Master of Toxicology, Master of Science and the Doctor of Philosophy degrees. The toxicology faculty is an interdisciplinary group drawn from the following areas: biochemistry, botany, crop science, food science, genetics, entomology, microbiology, poultry science, statistics, and veterinary medicine. The student will be associated with one of the above programs and conduct his research in the laboratories of his chairman or co-chairman.

The degree program is cooperative with the University of North Carolina at Chapel Hill and students may take courses at either university as well as selected courses at Duke University. A core of 6 courses taught from offerings of these three universities is a minimal requirement for the Ph.D. degree. Students are expected to take additional courses necessary for a strong background in toxicology. Minors may be chosen from a wide range of programs including biochemistry, biotechnology, botany, entomology, epidemiology, genetics, microbiology, nutrition, pharmacology, physiology, statistics and zoology.

The program is also closely associated with major research organizations in the nearby Research Triangle Park, including the National Institute of Environmental Health Sciences, Environmental Protection Agency, Chemical Industry Institute of Toxicology and Burroughs Wellcome Foundation. These laboratories, plus the universities, offer an unusual range of research projects and facilities.

Prerequisites for admission include a strong background in biology and physical sciences. The Aptitude Test of the Graduate Record Examination is required and the Advanced Test in biology or chemistry is desirable.

Financial assistance for qualified students in the form of traineeships, fellowships and research assistantships is available through participating departments. Prospective students may obtain further information by writing to any of the graduate faculty listed above or to the Chairman, Toxicology Program, Box 7633, N. C. State University, Raleigh, N. C. 27695-7633.

FOR GRADUATES AND ADVANCED UNDERGRADUATES

TOX 510 Biochemical Toxicology. *Preqs.: Biochemistry, sr. standing. 3(3-0) S.* Emphasis is placed on the molecular events that occur during the toxic action of xenobiotics, including penetration phenomena, mechanisms involved in detoxication, and the mechanisms of action at the target site.

TOX 515 Environmental Toxicology. *Preq.: Two years of biology. 3(3-0) F.* The nature, distribution and significance of microchemical contamination will be evaluated. Emphasis will be placed on current, relevant problems.

TOX (ST) 563 Statistical Problems in Toxicology. *2(2-0) S. Alt. yrs.* (See statistics.)

TOX 590 Special Problems in Toxicology. *Preq.: Grad. standing. 1-3.*

FOR GRADUATES ONLY

TOX 690 Toxicology Seminar. *Preq.: Grad. standing. 1(1-0) S.*

TOX 699 Research. *Preq.: Grad. standing. Credits Arranged. F,S.* Original research in connection with thesis problem in toxicology.

COURSES FROM ASSOCIATED DEPARTMENTS

BCH 551 General Biochemistry I
BCH 652 Structures and Interactions of Biological Macromolecules
CH 428 Qualitative Organic Chemistry
ENT 622 Insect Toxicology
VMS 531 Mammalian Neuroanatomy
VMS 540 Research Animal Care and Use
VMS 553 Veterinry Immunology
VMS 560 Introductory Pharmacology
VMS 562 Systemic Pharmacology and Toxicology
VMS 563 Systemic Pharmacology and Toxicology Laboratory
VMS 690B Special Topics in Pathology
VMS 696A Seminar in Pharmacology
ZO 614 Advanced Cell Biology

SELECTED COURSES AT UNIVERSITY OF NORTH CAROLINA AT CHAPEL HILL

PHARM 216 Introductory Pharmacology
EPID 162 Epidemiology

SELECTED COURSE AT DUKE UNIVERSITY

PATH 382 Toxicological Pathology

Urban Design

For a listing of graduate faculty and departmental information, see architecture.

Veterinary Medical Sciences

GRADUATE FACULTY

Professor C. E. Stevens, *Coordinator*

Professors: W. M. Adams, R. A. Argenzio, A. L. Aronson, H. J. Barnes, P. J. Bentley, H. A. Berkhoff, C. W. Betts, E. B. Breitschwerdt, T. T. Brown Jr., P. B. Carter, L. Coggins, S. W. Crane, T. M. Curtin, R. C. Dillman, B. Hammerberg, B. D. Harrington, D. R. Howard, J. N. Kornegay, C. W. McPherson, D. J. Moncol, W. D. Oxender, M. C. Roberts, D. G. Simmons, J. E. Smallwood, J. Stevens, C.-S. Teng, D. E. Thrall; *Adjunct Professor:* F. Welsch; *Professor Emeritus:* E. G. Batte; *Associate Professors:* K. F. Bowman, W. T. Corbett, G. D. Dial, E. V. De Buysscher, D. J. DeYoung, J. P. Fetrow, R. B. Ford, B. A. Gilroy, H. D. Hilley, M. G. Levy, N. J. MacLachlan, D. J. Meuten, N. C. Olson, J. E. Riviere, E. A. Stone, M. D. Whitacre; *Adjunct Associate Professors:* G. A.

Boorman, T. E. Eling, M. S. Hand, E. E. McConnell, R. L. Peiffer, C. T. Teng; *Assistant Professors:* K. L. Anderson, P. J. Armstrong, S. A. Bai, L. M. Ballas, H. M. Berschneider, B. A. Breuhaus, C. F. Brownie, S. E. Bunch, S. T. Clarke, J. M. Cullen, M. D. Ficken, L. N. Fleisher, F. J. Fuller, J. E. Gadsby, J. S. Guy, E. M. Hardie, C. K. Henrikson, L. C. Hudson, E. Hunt, J. F. Levine, D. H. Ley, T. O. Manning, G. McCormick, M. R. Metcalf, R. E. Meyer, M. P. Nasisse, E. J. Noga, P. E. Orndorff, R. L. Page, D. C. Richardson, C. L. Robinette, V. J. Scheidt, K. A. Spaulding, C. R. Swanson, L. P. Tate Jr., S. J. Updike, S. D. Van Camp, R. Walker; *Visiting Assistant Professors:* D. P. Aucoin, W. M. Duckett, B. R. Grubb, P. J. Hoopes, M. C. McGahan, N. A. Monteiro-Riviere; *Adjunct Assistant Professor:* M. W. Dewhirst; *Electron Microscopy Director:* M. J. Dykstra

ASSOCIATE MEMBERS OF THE SCHOOL

Professor: R. F. Behlow; *Extension Professor:* J. R. Harris

Graduate study under the direction of the veterinary medical faculty may lead to the Master of Science and the Doctor of Philosophy degrees. The veterinary medical faculty is a multidisciplinary group drawn from the departments of the School of Veterinary Medicine: Anatomy, Physiological Sciences and Radiology; Microbiology, Pathology and Parasitology; Companion Animal and Special Species; and Food Animal and Equine Medicine. Students will be associated with members from the above departments and conduct their research in the laboratory of their committee chairman or co-chairman.

The program provides training in basic and applied veterinary medical research to qualified students with a baccalaureate, D.V.M. or equivalent degree. Major areas of concentration include morphology, pharmacology, pathology, veterinary microbiology and immunology, and epidemiology and population medicine. Minors may be chosen from a wide range of programs including animal science, biochemistry, genetics, nutrition, poultry science, physiology, statistics, toxicology and zoology.

Prerequisites for admission include a strong background in biological science. Verbal and quantitative tests of the Graduate Record Examination are required except for candidates with a DVM degree.

Financial assistance for qualified students in the form of graduate assistantships is available through the School of Veterinary Medicine and participating faculty. Prospective students may obtain further information by writing to one of the graduate faculty listed above or to the Coordinator, Veterinary Medical Sciences Program, College of Veterinary Medicine, North Carolina State University, 4700 Hillsborough Street, Raleigh, North Carolina, 27606

FOR GRADUATES AND ADVANCED UNDERGRADUATES

VMS 530 Veterinary Histology. *Preqs.: BCH 451 and CI. 3(2-4) F. Alt. yrs.* The structure of cells, tissues and organs of domestic animals is studied using light microscopy.
Henrikson

VMS 531 Mammalian Neuroanatomy. *Preqs.: VMA 811 or 812 or ZO 323 and grad. standing or CI. 3(2-2) F. Alt. yrs.* The course provides detailed information about the structure of the nervous system of nonprimate animals. Emphasis is on the dog and cat but other domestic and laboratory mammals are studied. Overviews of embryology, neurohistology and experimental techniques are included. Hudson

VMS 532 Electron Microscopy in Veterinary Medicine. *Preq.: CI. 4(2-4) S.* The course provides an introduction to ultramicrotomy, tissue processing for electron microscopy, theory and utilization of the transmission electron microscope and scanning electron microscope, darkroom techniques and an introduction to various specialized techniques for the preparation of samples for veterinary diagnostic and research electron microscopy. Dykstra

VMS 540 Research Animal Care and Use. *Preq.: ZO 201 or equivalent. 3(2-3) S. Alt. yrs.* The principles of the selection, care and use of animals in laboratory teaching and investigation are presented. Topics covered include the ethics of animal experimentation, selection of animal models, biology and care of laboratory animals, techniques of administration of substances and obtaining of specimens, producing surgical alterations and common laboratory animal health problems. McCormick, McPherson

VMS 541 Laboratory Animal Diseases. *Preqs.: MB 401, VMS 540, ZO 345 and grad. standing or CI. 3(2-3) S. Alt. yrs.* The diseases of common laboratory animals are studied by discussing their etiology, epizootiology, pathogenesis and clinical signs. The diagnosis of laboratory animal diseases by clinical examination of animals and post-mortem evaluation of gross and microscopic pathologic changes within animal tissues are emphasized. Procedures for disease prevention, treatment and control are also reviewed. McPherson, Wright

VMS 550 Veterinary Medical Virology I. *Preqs.: BCH 451, MB 401 and grad. standing. 2(2-0) S.* Basic principles of animal virology and the relationship of viruses to diseases in domestic animals are discussed. Fuller, Guy

VMS 551 Pathogenic Bacteriology and Mycology. *Preqs.: MB 411, grad. standing and CI. 3(2-2) F.* The lecture course covers the pathogenic bacteria and fungi important in medicine. Lectures are supplemented by laboratory exercises that provide students the opportunity to learn basic characteristics of these microorganisms and how they are isolated, cultivated and identified. Berkhoff, Carter

VMS 552 Diagnostic Bacteriology and Mycology. *Preqs.: Grad. standing, VMM 814 or VMS 551 and CI. 3(1-8) F,S.* Principles of specimen collection, selection and use of media, culture processing and identification of bacteria and fungi important in animal disease are presented. Berkhoff

VMS 553 Veterinary Immunology. *Preqs.: MB 501C and grad. standing. 2(2-0) S.* Basic and clinical immunology is presented. The role of the immune system in disease prevention, inflammation and autoimmune diseases is discussed. Clarke, De Buysscher

VMS 554 Principles of Epidemiology. *Preq.: Grad. standing or CI. 3(2-4) F. Alt. yrs.* Principles of epidemiology related to the investigation of disease involving the agent-host-environment concepts are presented. Epidemiological techniques and experimental design are stressed. Descriptive, analytical and experimental epidemiology pertinent to disease etiology and prevention are the main focus. Corbett

VMS 560 Introductory Pharmacology. *Preqs.: BCH 451, grad. standing or CI. 5(4-1) F.* The action of drugs in animals and man including basic principles of drug disposition and pharmacokinetics is discussed. Modification of physiological processes by drugs influencing coordination by the nervous, endocrine and circulatory system is described. Fleisher

VMS 561 Instrumentation in Pharmacological Research. *Preqs.: BCH 452B or CH 315 and grad. standing or CI. 2(1-4) F.* The theory and applications of modern scientific instrumentation to the analysis of tissues, body fluids and drugs in pharmacological research are described. Appropriate aspects of the pharmacological use of spectroscopy, microscopy, chromatography, electrophoresis, radioisotope usage and centrifugation are discussed. Robinette

VMS 562 Systemic Pharmacology and Toxicology. *Preq.: VMS 560 or equivalent. 3(3-0) S. Alt. yrs.* Drug and toxicant action at the organ systems level are discussed in terms of underlying physiological mechanisms and responses. Emphasis is placed on the kidney and liver with additional consideration given to the respiratory, reproductive, gastrointestinal, hematologic and immune systems. Methods for assessing function of these systems are presented. Riviere, Graduate Staff

VMS 563 Systemic Pharmacology and Toxicology Laboratory. *Preqs.: VMS 560, VMS 562 and grad. standing. 1(0-4) F. Alt. yrs.* A series of laboratory exercises are given which are designed to complement the lecture course in Introductory Pharmacology (VMS 560) and Systemic Pharmacology and Toxicology (VMS 562).
Bentley, Riviere, Graduate Staff

VMS 590 Special Topics in Veterinary Medical Sciences. *Preq.: Sr. or grad. standing. 1-3 F,S,Sum.* A course designed to present new or special subject matter within the scope of pathology, veterinary microbiology, morphology or pharmacology. The studies may include independent investigations, seminars and/or formal lectures. Graduate Staff

FOR GRADUATES ONLY

VMS 630 Cell Structure. *Preqs.: BCH 451 and VMS 530 or VMA 812 and VMA 822 and CI. 3(2-3) F. Alt. yrs.* The internal components and surface morphologies of the major cell types are studied by analyzing and interpreting photographs taken with the transmission and scanning electron microscopes. Structure-function relationships are stressed. (Techniques of electron microscopy are not taught and electron microscopes are not used in this course.) Henrikson

VMS 631 Applied Veterinary Anatomy I. *Preqs.: DVM or equivalent and CI. 4(2-8) F. Alt. yrs.* This course provides the graduate veterinarian with detailed anatomic information relevant to surgical and medical problems in domestic carnivores. It is designed for graduate veterinarians in pursuit of advanced training in the areas of anatomy, physiology, surgery, radiology and pathology. Smallwood

VMS 640 Cellular and Subcellular Pathology. *Preqs.: VMS 630 and CI. 2(2-0) S. Alt. yrs.* Ultrastructural and biochemical changes occurring in cell injury are studied by the evaluation and interpretation of electron and scanning photomicrographs.
Brown, Graduate Staff

VMS 642 Advanced Systemic Histopathology. *Preq.: Grad. students holding DVM or equivalent degree and CI. 2(1-3) S. Alt. yrs.* Histopathologic changes associated with diseases of various organ systems. The pathogenesis and morphologic changes associated with selected diseases are emphasized. MacLachlan

VMS 650 Bacterial Pathogenic Mechanisms. *Preqs.: MB 501, VMS 552 or VMM 814. 2(2-0) S. Alt. yrs.* Principles of pathogenesis and host-response in bacterial infections of animals are discussed. Berkhoff, Carter

VMS 651 Veterinary Medical Virology II. *Preq.: VMM 824 or VMS 550 or CI. 3(2-4) F. Alt. yrs.* Principles of animal viral pathogenesis and host-response to viral infection are presented. The biology of selected viral groups including oncogenic viruses and persistent viruses are discussed. Common laboratory techniques used in virology are stressed.
Coggins, Fuller, Simmons

VMS 653 Advanced Immunology. *Preq.: VMS 553 or VMM 815 or MB 551 or equivalent or CI. 3(3-0) F. Alt. yrs.* The ontogeny and phylogeny of self and non-self recognition will be studied. Emphasis will be placed on basic mechanisms that evolved during the evolution of the species. Speciality areas such as immunology of reproduction and genetic regulation of the immune response will be studied. DeBuysscher

VMS 654 Epidemiology of Infectious Diseases of International Importance. *Preq.: CI. 3(2-4) F. Alt. yrs.* Infectious diseases and epidemiological principles are discussed. Selected enteric, zoonotic, nosocomial diseases of worldwide importance are stressed. Population dynamic techniques related to host-vector-agent are considered.
Corbett

VMS 660 Advanced Pharmacology. *Preqs.: VMS 560 or equivalent and CI. 2(2-0) S. Alt. yrs.* An in-depth study of current topics in pharmacology. Subjects include but are not limited to: the actions of drugs on ion permeability, prostaglandins, receptors, pharmacologically active peptides, toxicity of heavy metals and anti-fertility drugs. Graduate Staff

VMS 661 Pharmacokinetics. *Preqs.: VMS 560 or equivalent, working knowledge of calculus and CI. 3(3-0) F. Alt. yrs.* A course on mathematical models to describe the disposition of drugs and toxic chemicals in the animal body. Areas covered include classic compartmental and nonlinear models as well as physiological approaches. The application of these techniques to toxicologic studies is discussed. Bai

VMS 690A Special Topics in Veterinary Microbiology. *Preq.: Grad. standing. 1-3 F,S.* Specific topics of study are assigned in various laboratories involved in veterinary microbiology investigation. Students conduct in-depth studies of assigned problem areas.
Graduate Staff

VMS 690B Special Topics in Pathology. *Preqs.: Those holding DVM degree and CI. 1-4 F,S,Sum.* Students perform necropsies, microscopically evaluate tissue changes and prepare written reports of findings. Students conduct in-depth studies of each assigned case.
Brown, Graduate Pathology Staff

VMS 690C Special Topics in Laboratory Pharmacology. *Preqs.: Grad. standing and CI. 1-3 F,S,Sum.* The course involves practical participation in the normal research activities of different laboratories working in pharmacological research. Students pursue a semi-independent project. Graduate Staff

VMS 691 Advanced Topics in Immunology and Biotechnology. *Preqs.: VMS 553, MB 551 or CI. 1(1-0) F,S,Sum.* A study of selected topics of current interest in immunology/biotechnology. A new topic will be selected each semester to keep the advanced graduate students up to date on the most recent developments in these fields.
Clarke, DeBuysscher

VMS 694A Seminar in Necropsy Pathology. *Preqs.: Those holding the DVM or equivalent degree and CI. 1(1-0) F,S,Sum.* Description and interpretation of gross changes in tissues from diseased domestic animals. Students attend daily (M-F) 15 to 30 minute review of necropsy lesions presented by a member of the graduate staff.
Brown, Graduate Pathology Staff

VMS 694B Seminar in Surgical Pathology. *Preqs.: Those holding the DVM or equivalent degree and CI. 1(1-0) F,S,Sum.* Description and interpretation of microscopic changes in tissues from diseased domestic and laboratory animals. Students attend and participate in a one-hour weekly seminar where microscopic lesions are described, interpreted and discussed. Brown, Graduate Pathology Staff

VMS 695A Seminar in Veterinary Microbiology. *Preq.: Grad. standing. 1(1-0) F,S.* Presentation of ongoing research and current topics in microbiology. Graduate Staff

VMS 696A Seminar in Pharmacology. *Preqs.: Grad. standing and CI. 1(1-0) S.* Presentations and discussions of pharmacological topics of current interest and importance are made. Graduate Staff in Pharmacology

VMS 699 Research in Veterinary Medical Sciences. *Preq.: Grad. standing. 1-3 F,S,Sum.* Original research in connection with thesis or dissertation problems in veterinary medical sciences. Graduate Staff

Water Resources

(An interdepartmental graduate program)

WATER RESOURCES COMMITTEE

Dr. E. H. Wiser (Biological and Agricultural Engineering), *Chairman*

Dr. B. A. Cigler (Political Science and Public Administration), Dr. J. W. Gilliam (Soil Science), Dr. J. D. Gregory (Forestry), Dr. M. T. Huish (Zoology), Dr. V. A. Jones (Food Science), Dr. D. B. Marsland (Chemical Engineering), Dr. H. H. Neunzig (Entomology), Dr. R. B. Palmquist (Economics and Business), Dr. E. D. Seneca (Botany), Dr. T. J. Sheets (Pesticide Residue Research Laboratory), Dr. W. S. Galler (Civil Engineering), Dr. C. W. Welby (Marine, Earth and Atmospheric Sciences), Prof. R. R. Wilkinson (Landscape Architecture)

Water resources management is a major issue throughout the country and national policy supports strong water resources programs at all levels of government. These are multidisciplinary and require understanding of the complex effects of conservation and development. They require well-trained specialists in engineering and the physical, biological and social sciences who also possess a sound grasp of overall and a full appreciation of the respective roles of the participating disciplines.

Water resources is generally considered to be an area of specialization and not a discipline. Graduate education provides an opportunity for broad exposure to water-related subjects along with intensive study in the major disciplines. Students are encouraged to reach beyond their own departments for courses to extend their range of understanding and to participate in water resources courses and seminars designed to develop interdisciplinary communication and a basis for future working relationships.

A large number of courses related to water resources management are currently offered on the campus of North Carolina State University. Supplementary courses are also available at the University of North Carolina at Chapel Hill through Interinstitutional Registration.

The program offers a strong graduate minor in water resources, with the major in any of the basic disciplines contributing to water resources planning, conservation, development and management. The graduate courses currently

offered on both campuses have been separated into the following general areas: water law and institutions, planning of water resources and related systems, municipal and industrial water management, agricultural and forest water management, aquatic biology and ecology, hydrology and hydrogeology.

Graduate students majoring in any discipline closely allied with one of the designated water resource areas will be qualified for admission to the program. They will be expected to select their water resources minor courses from one or more areas outside their major. The cohesive elements in the graduate program will be two interdisciplinary core courses including a water resources seminar and a course in water resources planning or water resources economics.

The minimal course requirements for a graduate minor in water resources are: *Master's Degree*—The two core courses in water resources plus two courses in water resource areas outside the major discipline approved by the student's advisory committee; *Ph.D. Degree*—The two core courses in water resources plus five other courses in water resource areas outside the major discipline approved by the student's advisory committee. The complete listing of courses available under this program follows.

WATER RESOURCES CORE COURSES

*Campus	Course	Title
R	CE 591	Civil Engineering Seminar. (Water Resources Seminar)
R	EB 515	Environmental and Resource Policy.
CH	PLAN 234 (ENVR 284)	Water Resources Planning and Policy Analyses.
LAW AND INSTITUTIONS OF WATER RESOURCES		
R	PA 508	Urban Politics.
R	PA 511	Public Administration.
R	PA 516	Public Policy Analysis.
R	PA 520	Environmental Policy.
R	PA 613	Government and Planning.
CH	ENVR 283 (PLAN 233)**	Natural Resource Law and Policy.
CH	POLI 209	Planning and Government.
CH	POLI 213	Public Administration and Policy Making.
CH	POLI 214	Budgeting and Financial Management.
CH	POLI 238	Intergovernmental Relations.
PLANNING OF WATER RESOURCES AND RELATED SYSTEMS		
R	CE 575**	Civil Engineering Systems.
R	CE 671	Advanced Water Management Systems.
R	EB 401	Economic Analysis for Nonmajors.
R	EB 435	Urban Economics.
R	EB 436	Environmental Economics.
R	EB 490	Senior Seminar in Economics.
R	FOR (UNI) 584	The Practice of Environmental Impact Assessment.
CH	ENVR 278	Development of a Water Project.
CH	PLAN 219	Environmental Systems Analysis.
CH	PLAN 232 (ENVR 282)**	Public Investment Theory and Techniques.

MUNICIPAL AND INDUSTRIAL WATER MANAGEMENT

R	BAE (CE) 578	Agricultural Waste Management.
R	CE 484	Water Resources Engineering II.
R	CE 486	Sanitary Engineering Measurements of Water Quality.
R	CE (BAE, MB) 570	Sanitary Microbiology.
R	CE 571	Theory of Water and Waste Treatment.
R	CE 572	Design of Water and Wastewater Facilities.
R	CE 573	Unit Operations and Processes in Waste Treatment.
R	CE 672	Advanced Water and Waste Treatment: Principles and Design.
R	CE 673	Industrial Water Supply and Waste Disposal.
R	CE 674	Stream Sanitation.
R	FS 690	Seminar in Food Science.
R	WPS 525	Pollution Abatement in Forest Products Industries.
CH	ENVR 122	Water Chemistry.
CH	ENVR 134**	Environmental Microbiology.
CH	ENVR 171**	Water Quality Evaluation and Control.
CH	ENVR 174	Water and Waste Treatment Processes.
CH	ENVR 176	Hydraulics and Hydrology.
CH	ENVR 223	Trace Elements in the Environment.
CH	ENVR 271	Engineering Models for Aquatic Systems.
CH	ENVR 272**	Design of Water Systems.
CH	ENVR 273	Water and Wastewater Treatment Plant Design.
CH	ENVR 276	Industrial Water Quality Management.

AGRICULTURAL AND FOREST WATER MANAGEMENT

R	BAE (SSC) 321***	Water Management.
R	BAE 471	Soil and Water Engineering.
R	FOR 303	Silvics and Forest Ecology.
R	FOR 401	Forest Hydrology and Watershed Management
R	FOR 472	Renewable Resource Policy and Management
R	SSC 461	Soil Physical Properties and Plant Growth.
R	SSC 511	Soil Physics.

AQUATIC BIOLOGY AND ECOLOGY

R	BO (ZO) 560**	Principles of Ecology.
R	BO (MB) 574	Phycology.
R	BO 662	Applied Coastal Ecology.
R	MEA (ZO) 520	Principles of Biological Oceanography.
R	MEA 693	Advanced Special Topics. (Estuarine Ecology)
R	ZO (FW) 420	Fishery Science.
R	ZO (ENT) 509	Ecology of Stream Invertebrates.
R	ZO (FW) 515	Growth and Reproduction of Fishes.
R	ZO (FW) 586	Aquaculture I.
R	ZO 619	Advanced Limnology.
R	ZO 621	Fishery Science.
R	ZO (MEA) 624	Ecology of Fishes.

CH	BIOL 109**	Introduction to Hydrobiology.
CH	BIOL 126 (MSCS 101)**	Oceanography.
CH	BIOL 140 (MSCS 140)**	Biological Oceanography.
CH	BIOL 141S	Special Problems in Marine Biology.
CH	BIOL 146	Marine Ecology.
CH	BIOL 186	Systems Ecology.
CH	BIOL 213	Advanced Marine Ecology.
CH	ENVR 123	Organic Materials in Natural Waters.
CH	ENVR 128 (MSCS 105)	Chemical Oceanography.
CH	ENVR 132**	Limnology and Water Pollution.
CH	ENVR 137	Ecology of Wetlands.
CH	ENVR 231	Limnological Methods.
CH	ENVR 233	Microbial Ecology.
CH	ENVR 235	Ecology of Phytoplankton.

HYDROLOGY AND HYDROGEOLOGY

R	BAE (SSC) 671	Theory of Drainage—Saturated Flow.
R	BAE (SSC) 674	Theory of Drainage—Unsaturated Flow.
R	CE 383**/***	Water Resources Engineering I.
R	CE 580	Flow in Open Channels.
R	CE 585	Urban Stormwater Management.
R	CE 644	Ground Water Engineering.
R	MEA 300***	Environmental Geology.
R	MEA 311***	Physical Climatology.
R	MEA 481	Principles of Geomorphology.
R	MEA 555	Meteorology of the Biosphere.
R	MEA 562	Applied Sedimentary Analysis.
R	MEA 565**	Hydrogeology.
R	MEA 566**	Hydrogeology of Groundwater Pollution and Protection.
R	MEA 567**	Geochemistry.
R	MEA 580	Remote Sensing.
R	SSC 511	Soil Physics.
CH	ENVR 281	Topics in Advanced Hydrology.
CH	GEOG 110	Meteorology.
CH	GEOG 112	Micrometeorology.
CH	GEOG 115	Climatology.
CH	GEOG 117	Soils.
CH	GEOG 156	Natural Resources.
CH	GEOL 138	Geomorphology.
CH	GEOL 145	Principles of Geochemistry.
CH	GEOL 188 (MSCS 103)	Geological Oceanography.
CH	MSCS 122	Physical Oceanography.
CH	MSCS 206	Seminar on Oceanography.

Requests for information regarding the water resources graduate programs should be directed to the Chairman of the Water Resources Committee, the departments represented on the Water Resources Committee or the Water Resources Research Institute, 225 Page Hall, North Carolina State University, Raleigh, N. C. 27695-7912.

*Courses bearing the prefix "R" are taught at Raleigh and those bearing "CH" at Chapel Hill. Unlisted courses can be substituted for listed courses with the approval of the student's advisory committee.

**Courses from which requirements for master's degree minor will normally be met. Substitutions can be made with approval of the student's advisory committee.

***Not graduate level courses.

Wildlife Biology

GRADUATE FACULTY

Professor R. L. Noble, *Coordinator*

Professors: D. A. Adams, B. J. Copeland, P. D. Doerr, J. M. Miller, K. H. Pollock; *Professor (USDI):* M. T. Huish; *Professor Emeritus:* D. W. Hayne; *Associate Professors:* L. B. Crowder, R. G. Hodson, R. A. Lancia, S. C. Mozley, R. A. Powell, G. J. San Julian, J. R. Walters; *Associate Professor (USDI):* J. H. Kerby; *Assistant Professor:* J. A. Rice

The Fisheries and Wildlife Sciences Program is an interschool program jointly administered by the Departments of Forestry and Zoology. Graduate study under direction of the fisheries and wildlife sciences faculty may lead to the Master of Science in Wildlife Biology, Forestry or Zoology and the Master of Wildlife Biology, Master of Life Sciences or Master of Forestry. The Doctor of Philosophy degree may be pursued in either the Departments of Forestry or Zoology with emphasis on fisheries and wildlife sciences. The program emphasizes assessment, biology, ecology and management of fish and wildlife species and their habitat. In addition, work can be undertaken in the Institute of Statistics, home of the Southeastern Cooperative Wildlife and Fisheries Statistics Project.

Research facilities near campus include an aquaculture laboratory, the Biology Field Laboratory consisting of environmental chambers, a 20-acre pond and associated forest, the Harris Lands natural area and the Schenck Forest. Off-campus research is conducted at several of the university farms and forests and at the facilities of state and federal agencies and private organizations throughout the Southeast.

Teaching and research assistantships are available for qualified students through participating departments. Prospective students may obtain further information by writing to Coordinator, Fisheries and Wildlife Sciences Program, Box 7617, North Carolina State University, Raleigh, NC 27695-7617.

SELECTED ADVANCED UNDERGRADUATE COURSES

FW(FOR) 404 Forest Wildlife Management. *Preqs.: BS 100 or equivalent plus 8 hours of biological sciences; advanced undergrad. or grad. student. 3(3-0) S.*

FW(FOR) 420 Fishery Science. *Preqs.: ZO 201 or 303, ZO 360. 3(2-2) F.*

FW(FOR) 430 Fisheries and Wildlife Administration. *Preqs.: Political science course and either FW (ZO) 420 or FW (ZO) 353; advanced undergrad. or grad. standing. 3(3-0) S.*

FW(AC) 485 Natural Resources Advocacy. *Preqs.: ENG 321; jr. or sr. level with at least 10 hours of biology. 3(2-3) S.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

FW(ZO) 515 Growth and Reproduction of Fishes. *3(2-3) S. Alt. yrs.* (See zoology.)

FW(ZO) 553 Principles of Wildlife Science. *3(2-3) F.* (See zoology.)

FW(ZO) 554 Wildlife Field Studies. *3(2-3) S. Odd yrs.* (See zoology.)

FW(FOR) 585 Advanced Wildlife Habitat Management. *3(2-3) S. Alt. yrs.* (See forestry.)

FW(ZO) 586 Aquaculture I. *3(3-0) F.* (See zoology.)

FW(ZO) 587 Aquaculture I Laboratory. *1 (0-3) F.* (See zoology.)

FW(FOR) 594 Seminar in Wildlife Management. *1(1-0) S. Alt. yrs.* (See forestry.)

COURSES FROM ASSOCIATED DEPARTMENTS

FOR 572A,B Forest Management Policies on the Public Lands. *2(2-0) S.*
FOR(UNI) 584 The Practice of Environmental Impact Assessment. *4(0-8) F. Alt. yrs.*
PA 522 Natural Resources Policy and Administration. *3(3-0) S.*
ZO 501 Ornithology. *3(2-3) S.*
ZO(ST) 506 Sampling Animal Populations. *3(3-0) F. Alt. yrs.*
ZO(ENT) 509 Ecology of Stream Invertebrates *4(2-6) S. Alt. yrs.*
ZO 519 Limnology. *4(3-3) F.*
ZO(MEA) 520 Principles of Biological Oceanography. *3(3-0) S.*
ZO 542 Herpetology. *3(2-3) S. Even yrs.*
ZO 544 Mammalogy. *4(3-3) F.*
ZO 593 Aquatic Ecology Seminar. *1-3. F,S.*
ZO 619 Advanced Limnology. *3(3-0) S. Alt. yrs.*
ZO 621 Fishery Science. *3(2-3) F. Alt. yrs.*
ZO(MEA) 624 Ecology of Fishes. *3(3-0) F.*
ZO 644 Advanced Topics in the Study of Mammals. *3(2-3) S.*

Wood and Paper Science

GRADUATE FACULTY

Professor R. J. Thomas, *Head*

Professor R. G. Pearson, *Graduate Administrator*

Professors: H.-m. Chang, E. B. Cowling, E. L. Ellwood, I. S. Goldstein, J. S. Gratzl, C. A. Hart, T. W. Joyce, M. W. Kelly, M. P. Levi, H. G. Olf, E. A. Wheeler; *Adjunct Professors:* L. L. Edwards, T. K. Kirk, W. T. McKean Jr., R. P. Singh; *Professors Emeriti:* A. C. Barefoot Jr., R. G. Hitchings; *Associate Professors:* E. L. Deal Jr., J. A. Heitmann Jr., H. Jameel, D. H. J. Steensen; *Adjunct Associate Professor:* R. B. Phillips; *Associate Professor Emeritus:* C. G. Landes; *Assistant Professor:* J. Denig; *Research Associate:* C. L. Chen

Graduate study programs leading to the Master of Science and the Doctor of Philosophy degrees are offered for students in a wide variety of areas in the field of wood and paper science. The Master of Wood and Paper Science is available for students who do not wish to emphasize research in their graduate study programs.

Because the field of wood and paper science is a derived science, considerable emphasis is placed upon developing a strong minor in the graduate program in any one or more of the supporting disciplines such as organic chemistry, polymer chemistry, chemical engineering, mathematics, statistics, biology, engineering mechanics, mechanical engineering, physics, economics or business administration.

Areas of study and research in pulp and paper science and technology cover wood and fiber chemistry, lignin and carbohydrate chemistry, pulping chemistry, pollution abatement processes, fiber and paper properties and paper coatings and additives. In wood science and technology, study and research areas include wood physics (especially wood liquid relations), wood chemistry, wood biology, wood mechanics and engineering, manufacturing processes, wood-based industry economics and marketing.

Modern facilities equipped to conduct education and research in all forms of wood and fiber processing are available. Included are specialized laboratories for the study of wood physics, wood anatomy, wood processing, wood engineering, wood chemistry, pulping, papermaking, paper testing and paper coating. Equipment available includes optical and electron microscopes, a range of spectrometers, gas, liquid and ion chromatographs, ultracentrifuge, membrane osmometers, electron spin resonance, nuclear magnetic resonance apparatus weatherometer, a range of lumber and paper testing machines, molecular filtration equipment and excellent computer and computer graphics facilities.

The prerequisite for graduate study in the department is an undergraduate degree in wood science, pulp and paper science or in related disciplines such as any of a number of branches of science or engineering.

SELECTED ADVANCED UNDERGRADUATE COURSES

WPS 403 Paper Process Analysis. *Preqs.: WPS 321, 322. 3(1-6) S.*

WPS 410 Pulp and Paper Systems Analysis and Control. *Preq.: WPS 322 or WPS 360. 3(3-0) F.*

WPS 413 Paper Properties and Additives. *Preq.: Sr. standing. 3(1-6) F.*

WPS 415 Project Management and Analysis I. *Preq.: Sr. standing in pulp and paper science and technology. 2(2-0) F.*

WPS 416 Project Management and Analysis II. *Preq.: WPS 415. 2(2-0) S.*

WPS (FOR) 434 Quantitative Methods of Decision Making for Forest Products. *Preqs.: MA 113 and 114 and WPS (FOR) 273. 3(3-0) S.*

WPS 441 Introduction to Wood Mechanics. *Preqs.: MA 212, PY 221 or 211. 3(3-0) F.*

WPS 442 Wood Mechanics and Structural Design. *Preq.: CE 211 or WPS 441. 3(2-3) S.*

WPS 471 Pulping Process Analysis. *Preqs.: WPS 321, WPS 322. 3(1-6) F.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

WPS 513 Tropical Woods. *Preq.: WPS 202. 2(1-3) F. Alt. yrs.* Structure, identification, properties, characteristics and use of tropical woods, especially those used in plywood and furniture. Wheeler

WPS 515 Surface and Colloid Chemistry of Papermaking. *Preq.: CH 331 or CH 431. 3(3-0) S.* The fundamental principles of surface and colloid chemistry important in papermaking and their application to optimizing wet-end processes. The electrokinetic basis of flocculation, retention and other wet-end phenomena and the science of wet-end additives. Olf

WPS 521 Chemistry of Wood Polysaccharides. *Preqs.: CH 223 and WPS 332 or BCH 451. 3(3-0) F. Alt. yrs.* Fundamental chemistry and physical chemistry of monosaccharides and polysaccharides with emphasis on hemicellulose and cellulose. Topics include construction and configuration, stereochemistry, solution properties, molecular weight determination and reactivity. Chang, Gratzl

WPS 522 Chemistry of Lignin and Extractives. *Preqs.: CH 223 and WPS 332 or BCH 451. 3(3-0) S. Alt. yrs.* A study of the biosynthetic pathways, structure and reactivity of lignin and wood extractives with emphasis on topics important to pulping and conversion to useful by-products. Chang, Gratzl

WPS 525 Pollution Abatement in Forest Products Industries. *Preq.: Grad. or advanced undergrad. standing in science or engineering curricula. 3(3-0) S.* Pollution sources, inplant control and treatment of water and air pollution in forest products with concentration on the pulp and paper industry. Joyce

WPS 533 Advanced Wood Anatomy. *Preq.: WPS 202 or CI. 3(1-6) S. Alt. yrs.* Fundamental wood anatomy and cell wall ultrastructure. Laboratory techniques for light and electron microscopic studies of wood. Wheeler

WPS 540 Wood Composites. *Preqs.: WPS 441; grad. or advanced undergrad. standing. 3(3-0) S. Alt. yrs.* This course is designed to acquaint advanced undergraduate and graduate students with the rapidly expanding field of wood composites. Production processes for particleboard, plywood, hardboard, fiberboard, and other wood composites are presented. Elastic theory for the stiffness, strength, and buckling resistance of composites will be developed. Test procedures for determining mechanical properties and design procedures for glued laminated members, panel products, and built-up members, including I- and box-beams, stressed-skin panels and sandwich panels, will be outlined. Kelly, Pearson

WPS 560 Advanced Pulp and Paper Process Analysis. *Preqs.: WPS 321 and 322. 3(3-0) S.* Design and analysis of pulp and paper mill processes; process control applications in pulping, chemical recovery, bleaching and papermaking; principles of pulp mill chemical and energy recovery; and new alkaline pulping recovery technology. Kirkman

WPS 591 Wood and Paper Science Problems. *Preq.: Sr. or grad. standing. Credits Arranged.* Assigned or selected problems in the field of silviculture, logging, lumber manufacturing, pulp technology or forest management. Graduate Staff

WPS 599 Methods of Research in Wood and Paper Science. *Preq.: Advanced undergrad. or grad. standing. Credits Arranged.* Research procedures, problem outlines, presentation of results; consideration of selected studies by forest research organizations; sample plot techniques. Graduate Staff

FOR GRADUATES ONLY

WPS 604 Timber Physics. *Preqs.: MA 212, PY 221, WPS 202. 3(3-0) F. Alt. yrs.* Density, specific gravity and moisture content variation affecting physical properties; physics of drying at high and low temperatures; thermal, sound, light and electrical properties of wood. Hart

WPS 691 Graduate Seminar. *Preq.: Grad. standing. 1(1-0) F,S.* Presentation and discussion of progress reports on research, special problems and outstanding publications. Graduate Staff

WPS 693 Advanced Wood and Paper Science Problems. *Preq.: Grad. standing. Credits Arranged. F,S.* Selected problems in the field of wood and paper science.
Graduate Staff

WPS 699 Problems and Research. *Preq.: Grad. standing. Credits Arranged.* Specific problems that will furnish material for a thesis. Graduate Staff

Zoology

GRADUATE FACULTY

Professor J. G. Vandenbergh, *Head*

Professor G. C. Miller, *Graduate Administrator*

Professors: G. T. Barthalmus, P. C. Bradbury, B. J. Copeland, P. D. Doerr, W. C. Grant, C. F. Lytle, J. M. Miller, R. L. Noble, K. H. Pollock, J. F. Roberts, D. E. Smith, H. A. Underwood Jr., T. G. Wolcott; *Professor (USDI):* M. T. Huish; *Adjunct Professors:* F. A. Cross, J. B. Funderburg, J. D. Hair, G. R. Huntsman; *Professors Emeriti:* D. E. Davis, W. W. Hassler, T. L. Quay; *Associate Professors:* B. L. Black, L. B. Crowder, M. N. Feaver, R. M. Grossfeld, R. G. Hodson, R. A. Lancia, S. C. Mozley, R. A. Powell, L. A. Real, G. J. San Julian, J. R. Walters; *Associate Professor (USDI):* J. H. Kerby; *Adjunct Associate Professors:* D. E. Hoss, C. S. Manooch III, D. S. Peters, L. W. Reiter, G. M. Thayer; *Assistant Professors:* D. M. Miller, J. A. Rice; *Adjunct Assistant Professor:* D. R. Colby

The Department of Zoology offers the Master of Life Science, Master of Science and Doctor of Philosophy degrees. Areas of concentration in the department include: cellular biology and physiology, ecology and behavior, and fisheries and wildlife biology. Within these areas students can specialize in such topics as: developmental biology at the cellular or gene level, cell membrane transport systems, protozoology, parasitology, reproductive physiology, biorhythms, theoretical or applied studies in ecology, wildlife management, aquaculture, and many others. Graduate students in the department may pursue the Master of Wildlife Biology, Master of Science in Wildlife Biology or Master of Science in Ecology.

Excellent research facilities for cellular and organismic work are available in Gardner Hall. Field work can be conducted at near-by research stations and at various state and federal laboratories associated with the department.

Applicants should have a strong background in the biological sciences. Stipends are available for qualified individuals. Application at least six months before the anticipated enrollment date is encouraged.

SELECTED ADVANCED UNDERGRADUATE COURSES

ZO 410 Introduction to Animal Behavior. *Preqs.: BS 100 and either ZO 201 or ZO 303. 3(3-0) F.*

ZO (BO) 414 Cell Biology. *Preqs.: CH 223, PY 212, ZO 201 or ZO 303. 3(3-0) S.*

ZO (FW) 420 Fishery Science. *Preqs.: ZO 201 or ZO 303; ZO (BO) 360. 3(2-2) F.*

ZO 421 Vertebrate Physiology. *Preqs.: CH 223, PY 212, ZO 201 or ZO 303. 3(3-0) F,S,Sum.*

ZO (ENT) 425 General Entomology. *Preq.: ZO 201 or equivalent. 3(2-3) F,Sum.*

ZO 441 Biology of Fishes. *Preqs.: BO (ZO) 360. 3(3-0) F.*

ZO 442 Biology of Fishes Laboratory. *Preq.: BO (ZO) 360; Coreqs.: ZO 441. 1(0-3) F.*

FOR GRADUATES AND ADVANCED UNDERGRADUATES

ZO 501 Ornithology. *Preqs.: ZO 201 or 303; BO(ZO) 360. 3(2-3) S.* The biology of birds, including evolution, functional morphology, physiology, ecology and behavior. Field and museum laboratories emphasize particular aspects of morphology, ecology and behavior, as well as taxonomy and identification. One coastal weekend field trip is required.

ZO (PHY) 503 General Physiology I. *3(3-0) F.* (See physiology.)

ZO (PHY) 504 General Physiology II. *3(3-0) S.* (See physiology.)

ZO (ST) 506 Sampling Animal Populations. *3(3-0) F. Alt. yrs.* (See statistics.)

ZO (ENT) 509 Ecology of Stream Invertebrates. *Preqs.: ZO 201 or 302, BO (ZO) 360 or equivalent. 4(2-6) S. Odd yrs.* Introduction to stream ecology and analysis of animal communities. Lectures cover community structure and function, life histories of dominant animals, sampling design and techniques and responses to pollution. Laboratory exercises include field collections, identification of animals and quantitative research techniques. A personal collection of animals and a weekend field trip to mountain streams are required.
Mozley

ZO 512 Animal Symbiosis. *Preq.: 12 hrs. of biology and zoology. 3(3-0) S. Odd yrs.* Symbiotic associations of animals including mutualism, commensalism and parasitism. The morphological, physiological, behavioral and ecological adaptations of symbionts and the complex interactions between partner species.
Lytle, G. Miller

ZO (PHY) 513 Comparative Physiology. *Preq.: ZO 421 or CI. 3(3-0) S.* A comparative study of the organ systems of vertebrates and the physiological processes involved in maintaining the homeostatic state. The various compensatory mechanisms employed during environmental stress are included.
Graduate Staff

ZO (FW) 515 Growth and Reproduction of Fishes. *Preqs. or coreqs.: GN 411, ZO 420, 421, 441. 3(2-3) F. Even yrs.* The biology of fishes: physiology, anatomy, pathology, behavior and genetics. This course is designed especially for graduate students in fisheries. Several trips to research laboratories are taken.
Kerby

ZO 517 Population Ecology. *Preqs.: ZO (BO) 360 and ST 511 or equivalent. 3(3-0) F.* The dynamics of natural populations. Current work, theories and problems dealing with population growth, fluctuation, limitation and patterns of dispersion, species interactions, community structure and ecological genetics.
Real

ZO 519 Limnology. *Preqs.: Grad. standing and CI. Credit in both ZO 419 and ZO 519 is not allowed. 4(3-3) F.* Structure and function of lakes and ponds, including physical, chemical and biological controls of productivity and species composition of aquatic plants and animals and effects of pollution on water quality. One local weekend field trip is required. Mozley

ZO (MEA) 520 Principles of Biological Oceanography. *3(3-0) S.* (See marine, earth and atmospheric sciences.)

ZO (PO) 524 Comparative Endocrinology. *4(3-3) S.* (See poultry science.)

ZO (MEA) 534 Marine Benthic Ecology. *3(3-0) S. Alt. yrs.* (See marine, earth and atmospheric sciences.)

ZO (GN) 540 Evolution. *3(3-0) F.* (See genetics.)

ZO 542 Herpetology. *Preqs.: ZO 323 or 303, ZO 421. 3(2-3) S. Alt. even.* The biology of the amphibians and reptiles: systematics, life history, anatomy, behavior, physiology and ecology. Graduate Staff

ZO 544 Mammalogy. *Preq.: ZO 323 or ZO 303. 4(3-3) F.* The biology of mammals: evolution, functional morphology, reproduction, behavior, ecology, population biology, classification and identification. One weekend field trip is planned. Powell

ZO (FW) 553 Principles of Wildlife Science. *Preq.: ZO (BO) 360. 3(2-3) F.* The principles of wildlife management and their application are studied in the laboratory and in the field. Doerr

ZO (FW) 554 Wildlife Field Studies. *Preqs.: ZO 553, ST 311; CI. 3(2-3) S. of odd yrs.* Field application of methods for studying vertebrate wildlife populations; sampling methods, data gathering, analysis and interpretation of results are practiced. Participation in field laboratories and one or two weekend field trips is required. Doerr

ZO (MB) 555 Protozoology. *Preq.: CI. 4(2-6) S. Alt. odd.* The biology of the Protozoa: lectures include morphology, physiology, ecology, genetics, reproduction, evolution, systematics and life-cycles of both free-living and parasitic taxa; laboratory will stress recognition of selected forms and demonstrate techniques used to prepare specimens for microscopic examination. Bradbury

ZO (BO) 560 Principles of Ecology. *Preq.: Three semesters of college-level biology courses. 4(3-3) F.* A consideration of the principles of ecology at the graduate level. Each of the major subject areas of ecology is developed in sufficient depth to provide a factual and philosophical framework for the understanding of ecology. Graduate Staff

ZO 581 Helminthology. *Preqs.: ZO 323 or 303, ZO 315 or equivalent. 4(2-4) F. Alt. odd.* The study of the morphology, biology and control of parasitic helminths. G. Miller

ZO (ENT) 582 Medical and Veterinary Entomology. *3(2-3) S.* (See entomology.)

ZO (FW) 586 Aquaculture I. *Preqs.: ZO (BO) 360, sr. or grad. standing. 3(3-0) F. Even yrs.* The biological and general principles of aquaculture. Lectures emphasize the present status of aquaculture, species involved, techniques employed, and problems encountered. Recent advances in research and development are discussed and areas of future research and development are identified. Graduate Staff

ZO (FW) 587 Aquaculture I Laboratory. *Preqs.: ZO (BO) 360, sr. or grad. standing; Coreq.: ZO 586. 1(0-3) F. Even yrs.* Methods and techniques of cultivating aquatic organisms. Field trips and reports on local hatcheries and facilities are required. (Three to four overnight field trips will be taken on week days to coastal areas, state hatcheries, and

private hatcheries; students are responsible for shared room costs and their meals. Four field trips will also be taken on laboratory day within driving range of Raleigh.)
Graduate Staff

ZO 590 Special Studies. *Preqs.: Twelve hours ZO, CI. Credits Arranged. F,S.* A directed individual investigation of a particular problem in zoology, accompanied by a review of the pertinent literature. A maximum of three hours is allowed toward the master's degree.
Graduate Staff

ZO 592 Topical Problems. *2Preq.: CI. 1-3 F,S.* Organized, formal lectures and discussion of a special topic. Graduate Staff

ZO 593 Aquatic Ecology Seminar. *Preqs.: Grad., PBS or sr. standing; one course in aquatic, marine or fisheries areas. 1-3 F.S.* Presentations and discussions of recent research and topical issues in aquatic and marine sciences. Each student enrolled for credit must make at least one presentation. Mozley

FOR GRADUATES ONLY

ZO 614 Advanced Cell Biology. *Preq.: ZO (BO) 414 or equivalent. 3(3-0) S. Alt. yrs.* A study of the current problems of cell biology including the problems of the molecular organization and functions of membrane systems, subcellular organelles and specialized cells. Roberts, Smith

ZO 618 Community Ecology. *Preqs.: BO (ZO) 360, BO (ZO) 560 or equivalent; BO (ZO) 365 or equivalent. 3(3-0) S. Odd yrs.* Animal community structure and function. Effects of competition, predation, coevolution and disturbance on community composition. Ecological and evolutionary controversies emphasized from empirical and theoretical approaches.
Graduate Staff

ZO 619 Advanced Limnology. *Preq.: ZO 419. 3(3-0) S. Even yrs.* Recent topics in limnological research. Lectures and discussion will draw from journal articles on physical, chemical and biological aspects, including nutrient control of productivity, predator control of community structure and determinants of water quality. A research paper or project is required. Mozley

ZO 621 Fishery Science. *Preqs.: ST 511, ZO 420, a course in calculus. 3(2-3) F. Even yrs.* An analysis of fishery research methods. Population enumeration and dynamics. The relationship between fluctuations in natural populations and environmental factors.
Graduate Staff

ZO (MEA) 623 Advanced in Marine Community Ecology. *3(3-0) S. Alt. yrs.* (See marine, earth and atmospheric sciences.)

ZO (MEA) 624 Ecology of Fishes. *3(3-0) F.* (See marine, earth and atmospheric sciences.)

ZO 644 Advanced Topics in the Study of Mammals. *Preq.: ZO 544. 3(2-3) S. Even yrs.* Current topics in the study of mammals with concentration each year on a different topic, such as community ecology, population biology, evolution or functional morphology. Student research projects required. Powell

ZO (BO) 660 Advanced Topics in Ecology I. *3(3-0) S.* (See botany.)

ZO (BO) 661 Advanced Topics in Ecology II. *Preq.: ZO (BO) 560 or equivalent. 4(3-3) S. Alt. yrs.* Reports and seminar discussions of five major topics, such as secondary productivity, competitive exclusion, predator-prey and other interspecies relationships, regulation of populations, physiological ecology and management of resources. Some field trips. Laboratory provides experience in analysis of ecological systems, modeling and computer simulation. Graduate Staff

ZO 690 Seminar. *1(1-0) F,S.* The presentation and defense of original research and current literature. Graduate Staff

ZO 691 Topics in Animal Behavior. *Preq.: Grad. standing. 3(3-0) F. Even yrs.* Intensive examination of selected aspects of animal behavior and their relationship to physiology, ecology and other biological fields. May be repeated for credit when topic changes. Walters

ZO 699 Research in Zoology. *Preqs.: Twelve semester credits in ZO and CI. Credits Arranged. F,S.* Graduate Staff

GRADUATE FACULTY*

NORTH CAROLINA STATE UNIVERSITY

Abbate, Angelo Rudy, Associate Professor of Landscape Architecture. M.L.A., University of Pennsylvania.

Abdel-Wahab, Hussein M., Visiting Associate Professor of Computer Science. Ph.D., University of Waterloo, Ontario, Canada.

Abernathy, Hiller S., Assistant Professor of Curriculum and Instruction. Ph.D., University of South Carolina.

Abrams, Charlie Frank, Jr., Professor of Biological and Agricultural Engineering. Ph.D., North Carolina State University.

Adams, David Arthur, Professor of Forestry and University Studies. Ph.D., North Carolina State University.

Adams, William M., Professor of Food Animal and Equine Medicine; Associate Dean of Veterinary Medicine and Director of Veterinary Medical Services. V.M.D., University of Pennsylvania.

Afify, Elsayed M., Professor of Mechanical and Aerospace Engineering. Ph.D., University of Michigan.

Agrawal, Dharma Prakash, Professor of Electrical and Computer Engineering. Ph.D., Federal Institute of Technology, Lausanne, Switzerland.

Ahmad, Shuaib Haroon, Associate Professor of Civil Engineering. Ph.D., University of Illinois.

Alegre, Julio Cesar, Visiting Assistant Professor of Soil Science. Ph.D., North Carolina State University.

Alexander, Samuel Thomas, Associate Professor of Electrical and Computer Engineering. Ph.D., North Carolina State University.

Alexander, Winser E., Professor of Electrical and Computer Engineering. Ph.D., University of New Mexico.

Allen, Howard Lee, Jr., Associate Professor of Forestry and Soil Science; Director of the Forest Fertilization Cooperative. Ph.D., North Carolina State University.

Allen, Steven G., Professor of Economics and Business. Ph.D., Harvard University.

Altman, Richard S., Lecturer in Design. M. Arch., Washington University.

Alvarez, Raul Eduardo, Professor of Industrial Engineering. M.S., North Carolina State University.

Ambrose, John Thomas, Professor of Entomology. Ph.D., Cornell University.

Amein, Michael, Professor of Civil Engineering and Marine, Earth and Atmospheric Sciences. Ph.D., Cornell University.

Amerson, Henry Van, Associate Professor of Botany and Forestry. Ph.D., North Carolina State University.

Amoozegar, Aziz, Assistant Professor of Soil Science. Ph.D., University of Arizona.

Anderson, Charles Edward, Professor of Marine, Earth and Atmospheric Sciences. Ph.D., Massachusetts Institute of Technology.

Anderson, Charles Eugene, Professor of Botany. Ph.D., Purdue University.

Anderson, Clifton A., Professor Emeritus of Industrial Engineering. Ph.D., Ohio State University.

Anderson, James Michael, Assistant Professor (USDA) of Botany and Crop Science. Ph.D., Purdue University.

Anderson, John R., Jr., Associate Professor of Crop Science. Ph.D., University of Illinois.

Anderson, Kevin Lindsay, Assistant Professor of Food Animal and Equine Medicine. Ph.D., University of Illinois.

Anderson, Marshall W., Adjunct Professor of Biomathematics. Ph.D., University of Tennessee.

*Membership in the graduate faculty may be in either of two categories: (1) full status or (2) associate status. Full status permits a faculty member to engage in any and all phases of the graduate programs of the University. Associate members may teach courses at the graduate level and serve as chair of master's advisory committees.

Anderson, Norman Dean, Professor of Mathematics and Science Education. Ph.D., Ohio State University.
Anderson, Ronald F., Adjunct Assistant Professor of Counselor Education. Ph.D., University of Florida.
Anderson, Ruth D., Associate Professor of Speech-Communications. Ph.D., University of Oregon.
Andrews, Grover J., Visiting Associate Professor of Adult and Community College Education and Associate Vice Chancellor for Extension and Public Service. Ed.D., North Carolina State University.
Aneja, Viney P., Visiting Associate Professor of Marine, Earth and Atmospheric Sciences. Ph.D., North Carolina State University.
Antin, Jonathan Frank, Assistant Professor of Industrial Engineering. Ph.D., Virginia Polytechnic Institute and State University
Antonelli, Douglas C., Adjunct Associate Professor of Marine, Earth and Atmospheric Sciences. Ph.D., North Carolina State University.
Apperson, Charles Smith, Professor of Entomology. Ph.D., University of California at Riverside.
Apple, Jay Lawrence, Professor of Genetics and Plant Pathology; Coordinator of International Programs. Ph.D., North Carolina State University.
Archie, Joseph Patrick, Jr., Adjunct Associate Professor of Mechanical and Aerospace Engineering. Ph.D., North Carolina State University.
Ardalan, Sasan H., Visiting Assistant Professor of Electrical and Computer Engineering. Ph.D., North Carolina State University.
Arends, James Jay, Associate Professor of Entomology and Microbiology, Pathology and Parasitology. Ph.D., Oklahoma State University.
Argenzio, Robert Alan, Professor of Anatomy, Physiological Sciences and Radiology. Ph.D., Cornell University.
Armstrong, Frank Bradley, University Professor of Biochemistry, Genetics and Microbiology. Ph.D., University of California at Berkeley.
Armstrong, Jeffrey D., Assistant Professor of Animal Science. Ph.D., North Carolina State University.
Armstrong, Pamela Jane, Assistant Professor of Companion Animal and Special Species Medicine. D.V.M., Ontario Veterinary College, Guelph, Ontario, Canada.
Arnold, John F., Associate Professor of Curriculum and Instruction. Ph.D., University of Connecticut.
Aronson, Arthur L., Professor of Anatomy, Physiological Sciences and Radiology and Head of the Department. Ph.D., University of Minnesota.
Arya, Satya Pal Singh, Professor of Marine, Earth and Atmospheric Sciences. Ph.D., Colorado State University.
Atchley, William R., Professor of Genetics and Head of the Department. Ph.D., University of Kansas.
Ater, Steven K., Assistant Professor of Product/Visual Design. M.F.A., University of Illinois.
Atkinson, Maxine P., Associate Professor of Sociology and Anthropology. Ph.D., Washington State University.
Aubrecht, Lyn G., Visiting Assistant Professor of Curriculum and Instruction. Ph.D., Ohio State University.
Auciello, Orlando Hector, Associate Professor of Nuclear Engineering. Ph.D., National University of Cuyo, Bariloche, Argentina.
Aucoin, David P., Visiting Assistant Professor of Anatomy, Physiological Sciences and Radiology. D.V.M., Michigan State University.
Aurand, Leonard William, Professor of Food Science and Biochemistry. Ph.D., Pennsylvania State University.
Austin, William Wyatt, Jr., Professor Emeritus of Materials Science and Engineering. Ph.D., Vanderbilt University.
Averre, Charles Wilson, III, Professor of Plant Pathology. Ph.D., Purdue University.
Axtell, Richard Charles, Professor of Entomology. Ph.D., Cornell University.
Aycock, Robert, Professor Emeritus of Plant Pathology. Ph.D., North Carolina State University.

Ayoub, Mahmoud Amin, Professor of Industrial Engineering. Ph.D., Texas Technological University.
Babcock, Bruce, Assistant Professor of Economics and Business. Ph.D., University of California at Berkeley.
Babcock, Willard Farrington, Professor Emeritus of Civil Engineering. S.M., Massachusetts Institute of Technology.
Bacheler, Jack S., Professor of Entomology. Ph.D., University of Florida.
Bachmann, Klaus Jurgen, Professor of Chemistry and Materials Science and Engineering. Ph.D., Freie Universitat, Berlin, West Germany.
Bahler, Dennis R., Assistant Professor of Computer Science. Ph.D., University of Virginia.
Bai, Stephen A., Assistant Professor of Anatomy, Physiological Sciences and Radiology. Ph.D., George Washington University.
Bailey, Jack Eugene, Associate Professor of Plant Pathology. Ph.D., Michigan State University.
Bailey, John Albert, Professor of Mechanical and Aerospace Engineering and Head of the Department. Ph.D., University College of Swansea.
Baines, Barbara Joan, Professor of English. Ph.D., Ohio University.
Baird, Jack Vernon, Extension Professor of Soil Science and Specialist-in-Charge. Ph.D., Washington State University.
Baker, James Robert, Professor of Entomology. Ph.D., University of Kansas.
Baker-Ward, Lynne, Assistant Professor of Psychology. Ph.D., University of North Carolina at Chapel Hill.
Balik, Charles Maurice, Assistant Professor of Chemical Engineering and Materials Science and Engineering. Ph.D., Case Western Reserve University.
Ball, David Stafford, Associate Professor of Economics and Business. Ph.D., University of North Carolina at Chapel Hill.
Ball, Hershell Ray, Jr., Professor of Food Science and Poultry Science. Ph.D., University of Missouri.
Ballas, Lawrence M., Assistant Professor of Anatomy, Physiological Sciences and Radiology. Ph.D., Cornell University.
Ballenger, William L., Lecturer in Educational Leadership and Program Evaluation. Ph.D., North Carolina State University.
Ballinger, Walter Elmer, Professor Emeritus of Horticultural Science. Ph.D., Michigan State University.
Ballington, James Ralph, Associate Professor of Horticultural Science. Ph.D., North Carolina State University.
Bandy, Dale Eugene, Visiting Associate Professor of Soil Science. Ph.D., Cornell University.
Banker, James Roderick, Associate Professor of History and Assistant Head of the Department. Ph.D., University of Rochester.
Banks-Lee, Pamela, Assistant Professor of Textile Engineering and Science. Ph.D., North Carolina State University.
Barclay, William John, Professor Emeritus of Electrical and Computer Engineering. Ph.D., Stanford University.
Barefoot, Aldos Cortez, Jr., Professor Emeritus of University Studies. D.F., Duke University.
Barker, James Cathey, Extension Professor of Biological and Agricultural Engineering. Ph.D., University of Tennessee.
Barker, Kenneth Reece, Professor of Plant Pathology. Ph.D., University of Wisconsin.
Barker, Roger Lee, Professor of Textile Engineering and Science. Ph.D., Clemson University.
Barkley, Key Lee, Professor Emeritus of Psychology. Ph.D., University of North Carolina at Chapel Hill.
Barnes, Donald Warren, Jr., Associate Professor Emeritus of Architecture. Ph.D., Texas A&M University.
Barnes, Harold John, Professor of Food Animal and Equine Medicine. Ph.D., Ahmadu Bello University, Zaira, Nigeria.
Barnhardt, Robert Alexander, Professor of Textile Management and Technology and Dean of the College of Textiles. Ed.D., University of Virginia.

Barnwell, Richard W., Adjunct Associate Professor of Mechanical and Aerospace Engineering. Ph.D., Virginia Polytechnic Institute and State University.
Barrax, Gerald W., Associate Professor of English. M.A., University of North Carolina at Chapel Hill.
Barrick, Elliott Ray, Professor Emeritus of Animal Science. Ph.D., Purdue University.
Barthalmus, George Timothy, Professor of Zoology. Ph.D., Pennsylvania State University.
Bartholomew, William Victor, Professor Emeritus of Soil Science. Ph.D., Iowa State University.
Bassett, John E., Professor of English and Head of the Department. Ph.D., University of Rochester.
Batchelor, Peter, Professor of Architecture. M.C.P., University of Pennsylvania.
Bateman, Durward F., Professor of Plant Pathology and Dean of the College of Agriculture and Life Sciences. Ph.D., Cornell University.
Batra, Subhash K., Professor of Textile Materials and Management. Ph.D., Rensselaer Polytechnic Institute.
Batte, Edward Guy, Professor Emeritus of Veterinary Medicine. D.V.M., Texas A&M University.
Baughman, Gerald Robert, Associate Professor of Biological and Agricultural Engineering. Ph.D., Ohio State University.
Baumer, David L., Associate Professor of Economics and Business. Ph.D., University of Virginia.
Beck, Keith R., Associate Professor of Textile Chemistry. Ph.D., Purdue University.
Beckmann, Robert Lee, Jr., Associate Professor of Botany. Ph.D., Vanderbilt University.
Bedair, Salah Mohamed, Professor of Electrical and Computer Engineering. Ph.D., University of California at Berkeley.
Beeler, Joe Robert, Jr., Professor of Materials Science and Engineering. Ph.D., Kansas State University.
Beers, Burton Floyd, Professor of History. Ph.D., Duke University.
Beezer, Bruce Gerald, Associate Professor of Educational Leadership and Program Evaluation. Ed.D., University of Arizona.
Beezley, William H., Professor of History. Ph.D., University of Nebraska.
Behlow, Robert Frank, Professor Emeritus of Animal Science. D.V.M., Ohio State University.
Belcher, Clifton Beryl, Adjunct Assistant Professor of Occupational Education. Ed.D., North Carolina State University.
Bell, Norman Robert, Associate Professor Emeritus of Electrical and Computer Engineering. M.S., Cornell University.
Bell, Thomas Alexander, Professor Emeritus of Food Science. M.S., North Carolina State University.
Bend, John Richard, Adjunct Professor of Entomology. Ph.D., Sydney University, Sydney, Australia.
Bengston, Neal M., Assistant Professor of Computer Science and Industrial Engineering. Ph.D., Purdue University.
Benson, David Michael, Professor of Plant Pathology and Graduate Studies Coordinator. Ph.D., Colorado State University.
Benson, Geoffrey Alan, Associate Professor of Economics and Business. Ph.D., Pennsylvania State University.
Benson, Ray Braman, Jr., Professor of Materials Science and Engineering. Ph.D., University of California at Berkeley.
Bent, Henry Albert, Professor of Chemistry. Ph.D., University of California at Berkeley.
Bentley, Peter John, Professor of Anatomy, Physiological Sciences and Radiology. Ph.D., University of Western Australia, Nedlands, Australia.
Bereman, Robert Deane, Professor of Chemistry and Associate Dean for Academic Affairs, College of Physical and Mathematical Sciences. Ph.D., Michigan State University.
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Williams, Kathleen Marie, Assistant Professor of Horticultural Science. Ph.D., Cornell University.
Williams, Mary Cameron, Professor of English. Ph.D., University of North Carolina at Chapel Hill.
Williams, Paul F., Associate Professor of Economics and Business. University of North Carolina at Chapel Hill.
Williams, Porter, Jr., Professor Emeritus of English. M.A., University of Virginia.
Williams, Robert Travis, Lecturer in Educational Administration and Supervision and Associate Dean of the School of Education. Ed.D., University of North Carolina at Chapel Hill.
Williamson, James Claude, Jr., Professor Emeritus of Economics and Business. M.S., North Carolina State University.
Williamson, Norman Francis, Jr., Assistant Professor of Computer Science. Ph.D., North Carolina State University.
Willis, William Edward, Jr., Lecturer in Chemical Engineering and Coordinator of Computer Operations for Engineering. Ph.D., North Carolina State University.
Willits, Daniel Hoover, Professor of Biological and Agricultural Engineering. Ph.D., University of Kentucky.
Wilson, Beth Evelyn, Assistant Professor of Recreation Resources Administration. Ph.D., North Carolina State University.
Wilson, Jack W., Associate Professor of Economics and Business. Ph.D., University of Oklahoma.
Wilson, James Blake, Professor Emeritus of Mathematics. Ph.D., University of Florida.
Wilson, Karen Giroux, Adjunct Asssistant Professor of Entomology. Ph.D., North Carolina State University.
Wilson, Lorenzo George, Professor of Horticultural Science. Ph.D., Michigan State University.
Wilson, Richard Ferrol, Professor (USDA) of Crop Science. Ph.D., University of Illinois.
Wimberley, Ronald Coleman, Professor of Sociology and Anthropology. Ph.D., University of Tennessee.
Winstead, Nash Nicks, Professor of Plant Pathology; Provost and Vice Chancellor. Ph.D., University of Wisconsin.
Winston, Hubert Melvin, Associate Professor of Chemical Engineering. Ph.D., North Carolina State University.
Winton, Lowell Sheridan, Professor Emeritus of Mathematics. Ph.D., Duke University.
Wise, George Herman, Professor Emeritus of Animal Science. Ph.D., University of Minnesota.

Wiser, Edward Hempstead, Professor of Biological and Agricultural Engineering. Ph.D., North Carolina State University.
Wishy, Bernard W., Professor of History. Ph.D., Columbia University.
Witherspoon, Augustus McIver, Professor of Botany and Associate Dean of the Graduate School. Ph.D., North Carolina State University.
Witt, Mary Ann Frese, Associate Professor of Foreign Languages and Literatures. Ph.D., Harvard University.
Wittkamp, Joel M., Associate Professor of Product/Visual Design. M.F.A., Royal College of Art, London, England.
Wohlgenant, Michael K., Associate Professor of Economics and Business. Ph.D., University of California at Davis.
Wolcott, Donna Lee Riley, Visiting Associate Professor of Marine, Earth and Atmospheric Sciences. Ph.D., University of California at Berkeley.
Wolcott, Thomas G., Professor of Marine, Earth and Atmospheric Sciences and Zoology. Ph.D., University of California at Riverside.
Wollum, Arthur George, II, Professor of Soil Science and Forestry; Chairman of the Ecology Program. Ph.D., Oregon State University.
Woltz, William Garland, Professor Emeritus of Soil Science. Ph.D., Cornell University.
Won, Ihn Jae, Professor of Marine, Earth and Atmospheric Sciences. Ph.D., Columbia University.
Wood, Denis, Associate Professor of Landscape Architecture. Ph.D., Clark University.
Woodburn, James, Professor Emeritus of Mechanical and Aerospace Engineering. D.Eng., Johns Hopkins University.
Woodhouse, William Walton, Jr., Professor Emeritus of Soil Science. Ph.D., Cornell University.
Woodman, James Nelson, Associate Professor of Forestry. Ph.D., University of Washington.
Woodrum, Eric M., Associate Professor of Sociology and Anthropology. Ph.D., University of Texas.
Work, Robert Wyllie, Professor Emeritus of Textile Research. Ph.D., Cornell University.
Worsham, Arch Douglas, Professor of Crop Science. Ph.D., North Carolina State University.
Wortman, Jimmie Jack, Professor of Electrical and Computer Engineering. Ph.D., Duke University.
Wright, Charles Gerald, Professor of Entomology. Ph.D., North Carolina State University.
Wright, Stephen Joseph, Assistant Professor of Mathematics. Ph.D., University of Queensland, St. Lucia, Australia.
Wynn, Tommy Elmer, Associate Professor of Botany and Graduate Administrator. Ph.D., Purdue University.
Wynne, Johnny Calvin, Professor of Crop Science. Ph.D., North Carolina State University.
Wyrick, Deborah Baker, Assistant Professor of English. Ph.D., Duke University.
York, Alan Clarence, Associate Professor of Crop Science. Ph.D., University of Illinois.
Young, Clyde Thomas, Professor of Food Science. Ph.D., Oklahoma State University.
Young, David Allen, Jr., Professor Emeritus of Entomology. Ph.D., Kansas State University.
Young, Eric, Associate Professor of Horticultural Science. Ph.D., Michigan State University.
Young, James Herbert, Professor of Biological and Agricultural Engineering. Ph.D., Oklahoma State University.
Young, James Neal, Professor Emeritus of Sociology and Anthropology. Ph.D., University of Kentucky.
Young, Robert Vaughan, Jr., Professor of English. Ph.D., Yale University.
Zeiger, Donald Carl, Associate Professor Emeritus of Horticultural Science. Ph.D., Rutgers University.
Zering, Kelly Douglas, Assistant Professor of Economics and Business. Ph.D., University of California at Davis.
Zia, Paul Zung-Teh, Professor of Civil Engineering and Head of the Department. Ph.D., University of Florida.

Zingraff, Matthew Thomas, Associate Professor of Sociology and Anthropology. Ph.D., Bowling Green State University.

Zobel, Bruce John, Professor Emeritus of Forestry and Genetics. Ph.D., University of California at Berkeley.

Zorowski, Carl Frank, R. J. Reynolds Industries Professor of Mechanical and Aerospace Engineering and Director of the Integrated Manufacturing Systems Engineering Institute. Ph.D., Carnegie-Mellon University.

Zuckerman, Gilroy Joel, Associate Professor of Economics and Business. Ph.D., North Carolina State University.

Zumwalt, Lloyd Robert, Professor Emeritus of Nuclear Engineering. Ph.D., California Institute of Technology.

The University of North Carolina

Sixteen Constituent Institutions

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ROY CARROLL, B.A., M.A., Ph.D., *Vice President for Planning*
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JASPER D. MEMORY, B.S., Ph.D., *Vice President for Research*
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JOHN W. DUNLOP, B.A., *Director, The University of North Carolina Center for Public Television*

HISTORY OF THE UNIVERSITY

The University of North Carolina is comprised of all the public institutions of higher education in North Carolina that confer degrees at the baccalaureate level or higher. The University was authorized by the State Constitution in 1776, and it was chartered in 1789 by the General Assembly.

The University of North Carolina opened its doors to students at Chapel Hill in 1795. Thereafter, beginning in the latter part of the nineteenth century, the General Assembly of North Carolina has established and supported fifteen other public senior institutions in keeping with Article IX, Section 8, of the Constitution of North Carolina which provides that the "General Assembly shall maintain a public system of higher education, comprising The University of North Carolina and such other institutions of higher education as the General Assembly may deem wise."

By 1969, The University of North Carolina included six constituent institutions, governed by a single Board of Trustees. This multi-campus University had its beginnings in legislation enacted in 1931 that defined The University of North Carolina to include The University of North Carolina at Chapel Hill, North Carolina State University at Raleigh, and The University of North Carolina at Greensboro. In the 1960's three additional campuses were added: The University of North Carolina at Charlotte, The University of North Carolina at Asheville, and The University of North Carolina at Wilmington.

Beginning in 1877, the General Assembly of North Carolina established or acquired ten additional separately governed state-supported senior institutions of higher education. They are: Appalachian State University, East Carolina University, Elizabeth City State University, Fayetteville State University, North Carolina Agricultural and Technical State University, North Carolina Central University, North Carolina School of the Arts, Pembroke State University, Western Carolina University, and Winston-Salem State University. Then, in 1971, the General Assembly redefined The University of North Carolina, and under the terms of that legislation all sixteen public senior institutions became constituent institutions of The University of North Carolina.

The constitutionally authorized Board of Trustees of the six-campus University of North Carolina was designated the Board of Governors and this body is by law The University of North Carolina. The Board of Governors consists of thirty-two members elected by the General Assembly, and it is charged with "the general determination, control, supervision, management and governance of all affairs of the constituent institutions." The chief executive officer of The University is the President.

Each constituent institution of The University has its own faculty and student body. The chief administrative officer of each institution is the chancellor, and the chancellors are responsible to the President.

Each constituent institution also has a board of trustees composed of thirteen members: eight elected by the Board of Governors, four appointed by the Governor, and the elected president of the student body *ex officio*. (The School of the Arts has two additional *ex officio* trustees.) The principal powers of these institutional boards are exercised under a delegation of authority from the Board of Governors.

BOARD OF TRUSTEES

North Carolina State University

	Term expires
E. I. Weisiger, *Charlotte, Chairman*	1989
John N. Gregg, *Valley Forge, PA, Vice Chairman*	1989
Alan T. Dickson, *Charlotte, Secretary*	1991
William L. Burns Jr., *Durham*	1991
Wallace J. Conner, *Newport*	1989
Troy A. Doby Sr., *Raleigh*	1989
Daniel C. Gunter, *Gastonia*	1989
Elizabeth B. Lee, *Lumberton*	1991
Clarence Lightner, *Raleigh*	1991
Gerald H. Long, *Winston-Salem*	1989
C. Richard Vaughn, *Mt. Airy*	1991
Edgar S. Woolard Jr., *Wilmington, DE*	1991
Kevin D. Howell, *President, Student Government, NCSU*	1988

BOARD OF GOVERNORS

The University of North Carolina

Philip G. Carson, *Chairman*
David J. Whichard II, *Vice Chairman*
Mrs. Geneva J. Bowe, *Secretary*

Term expires

Class of 1989

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Philip G. Carson, *Asheville*
Walter R. Davis, *Midland, TX*
R. Phillip Haire, *Sylva*
Mrs. Julia T. Morton, *Linville*
Asa T. Spaulding Jr., *Durham*
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William K. Woltz, *Mt. Airy*

Class of 1991

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Mrs. Betty R. McCain, *Wilson*
Samuel H. Poole, *Southern Pines*
W. Travis Porter, *Durham*
J. Aaron Prevost, *Hazelwood*
Louis T. Randolph, *Washington*
Joseph E. Thomas, *Vanceboro*
Gus H. Tulloss, *Rocky Mount*

Class of 1993

Roderick D. Adams, *Durham*
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Maceo A. Sloan, *Durham*
Ms. Ruth Dial Woods, *Pembroke*

Members Emeriti

William A. Dees Jr., *Goldsboro*
William A. Johnson, *Lillington*

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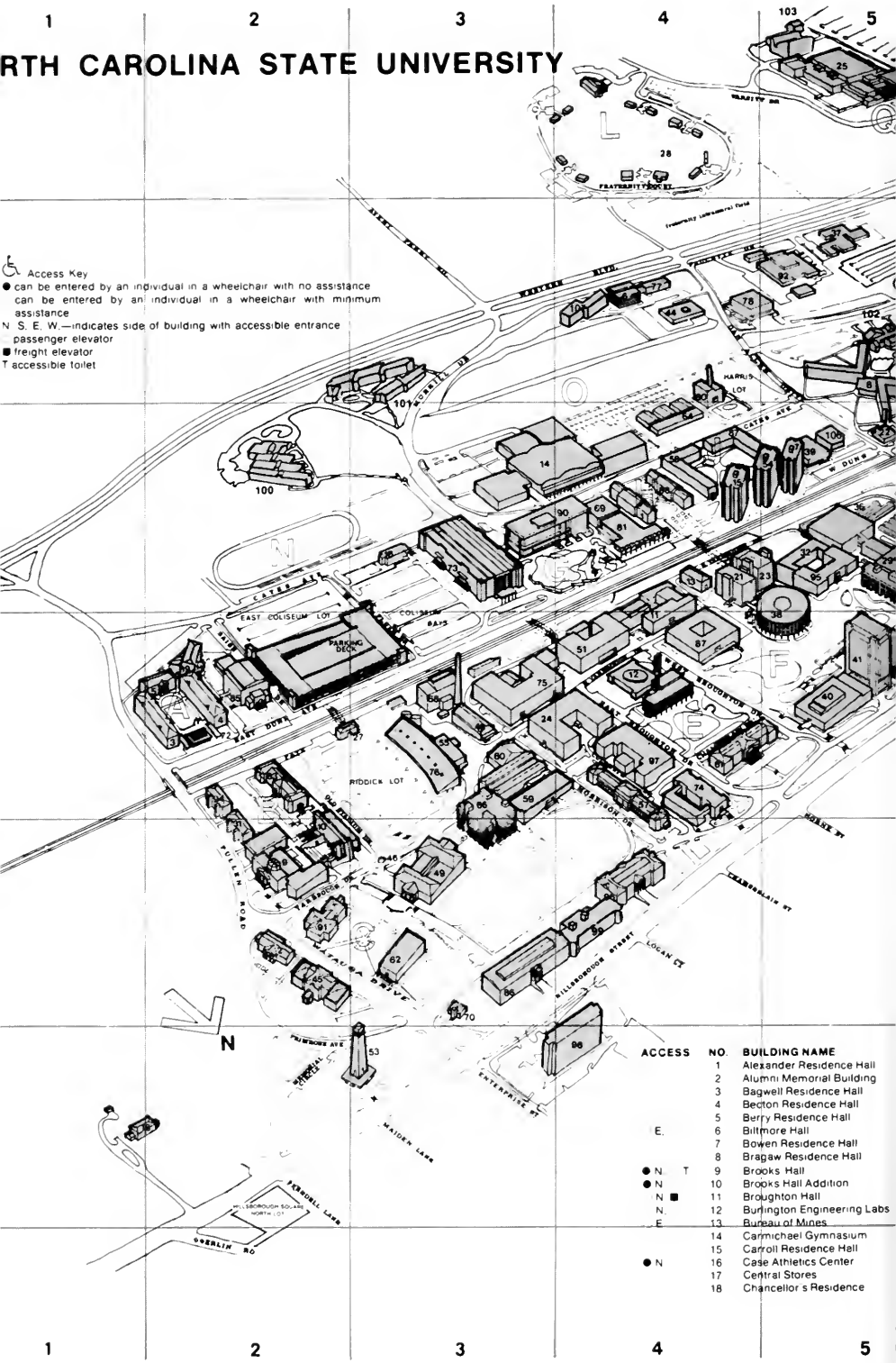
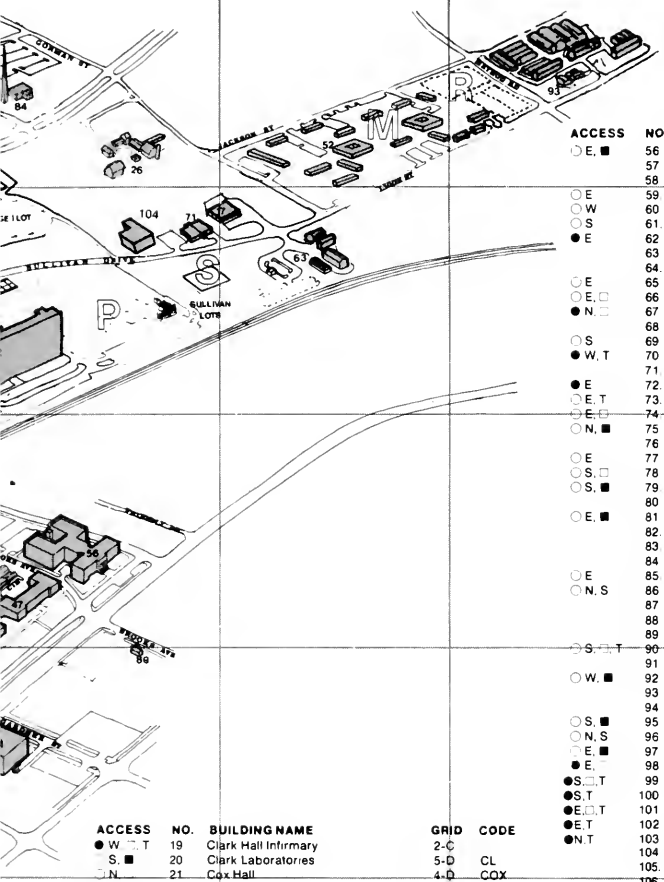
NOTES

RTH CAROLINA STATE UNIVERSITY



ACCESS	NO.	BUILDING NAME
	1	Alexander Residence Hall
	2	Alumni Memorial Building
	3	Bagwell Residence Hall
	4	Becton Residence Hall
	5	Berry Residence Hall
E.	6	Biltmore Hall
	7	Bowen Residence Hall
	8	Bragaw Residence Hall
● N. T	9	Brooks Hall
● N	10	Brooks Hall Addition
N. ■	11	Broughton Hall
N.	12	Burlington Engineering Labs
E	13	Bureau of Mines
	14	Carmichael Gymnasium
	15	Carroll Residence Hall
● N	16	Case Athletics Center
	17	Central Stores
	18	Chancellor s Residence



ACCESS	NO.	BUILDING NAME	GRID	CODE
○ E, ■	56	Nelson Textile Building	6-D	N
	57	1911 Building	4-C	
	58	Owen Residence Hall	4-D	
○ E	59	Pege Hall	3-C	PA
○ W	60	Park Shops	3-C	PS
○ S	61	Patterson Hall	4-C	PT
● E	62	Peele Hall	3-B	
	63	Physical Plant Maint. Center	7-E	
	64	Physical Plant Shops (Armory)	4-D	
○ E	65	Phytotron	5-D	PHY
○ E, □	66	Poe Hall	3-C	POE
● N, □	67	Polk Hall	4-C	PK
	68	Power Plant	3-C	
○ S	69	Price Music Center	4-D	PMC
● W, T	70	Primrose Hall	3-B	
	71	Print Shop/University Graphics	6-E	
● E	72	Quad. Snack Bar	2-C	
○ E, T	73	Wm. Neal Reynolds Coliseum	3-D	
○ E, □	74	Ricks Hall	4-C	RI
○ N, ■	75	Riddick Engineering Labs	3-C	RD
	76	Riddick Stadium	3-C	
○ E	77	Robertson Wing, Biltmore Hall	4-E	
○ S, □	78	Schaub Food Science Building	4-E	SFS
○ S, ■	79	Scott Hall	5-D	SC
	80	Steam Plant	4-E	
○ E, ■	81	NCSU Bookstores	4-D	
	82	Sullivan Residence Hall	6-E	
	83	Syme Residence Hall	2-C	
	84	Television Center	6-F	TVS
○ E	85	Thompson Theater/Craft Center	2-C	TT
○ N, S	86	Tompkins Hall	3-B	T
	87	Tucker Residence Hall	4-D	
	88	Turlington Residence Hall	4-D	
	89	Turner House	6-C	
○ S, □, T	90	University Student Center	3-D	USC
	91	Watauga Hall	2-B	
○ W, ■	92	Weaver Laboratories	5-E	DSW
	93	Weed Control Laboratories	8-F	
	94	Welch Residence Hall	2-C	
○ S, ■	95	Williams Hall	5-D	WMS.
○ N, S	96	Winston Hall	4-B	WN
○ E, ■	97	Withers Hall	4-C	WI
● E,	98	North Residence Hall	3-A	
● S, □, T	99	Caldwell Hall	4-B	
● S, T	100	Weisiger-Brown Building (GAF)	2-D	
● E, □, T	101	South Residence Hall	3-D	
● E, T	102	Dining Hall	5-E	
● N, T	103	Solar Demonstration House	5-F	
	104	Administrative Services Center	6-E	
	105.	Research Facility (on Centennial Campus) (Not Shown)		
	106.	Student Service Center		
	107.	Natural Resources Research Center		

ACCESS	NO.	BUILDING NAME	GRID	CODE
● W, □, T	19	Clark Hall Infirmary	2-C	
S, ■	20	Clark Laboratories	5-D	CL
□ N,	21	Cox Hall	4-D	COX
□ N, T	22	Cultural Center	5-D	
□ N,	23	Dabney Hall	4-D	DAB
● W, ■	24	Daniels Hall	4-C	DAN
● W, □, T	25	McKimmon Extension Continuing Education Center	5-F	
	26	Farm Unit 5	6-F	
N	27	Field House	2-C	
	28	Fraternity Court	4-F	
○ S, ●	29	Gardner Hall	5-D	GA
● N, □, T	30	Bostian Hall	5-D	
	31	Gold Residence Hall	2-C	
	32	Williams Hall Addition	5-D	AGH
	33	Greenhouse—Biological Sciences	5-D	BSG
	34	Greenhouse—Horticulture	5-D	HGH
	35	Greenhouse—840 Method Rd	8-F	
	36	Greenhouse—Plant Pathology	5-D	PPG
□ E	37	Grinnells Animal Health Lab	5-E	GHL
□ N, □, T	38	Harrelson Hall	5-D	HA
● N, □, T	39	Harris Hall	5-D	
□ W	40	D. H. Hill Library—Original Wing	5-C	DHL
W, □, T	41	D. H. Hill Library—Book Stack Tower	5-C	
N, S, □	42	D. H. Hill Library—Erdahl-Cloyd Wing	5-C	
		North Campus Bookshop	5-C	
● N, □, T	43	Hillsborough Building	5-C	HLB
□ W	44	Hodges Wood Products Lab	4-E	HWP
	45	Holladay Hall	2-B	
	46	Information Center, Visitor Parking	3-B	
S, ■	47	Kilgore Hall	6-D	KI
	48	Laundry/Copy Center	3-C	
	49	Leazar Hall	3-B	LEZ
	50	Lee Residence Hall	5-E	
● S, □	51	Mann Hall	4-C	MN
	52	E. S. King Village (17 Apt. Bldgs. A-Q)	7-F	
	53	Memorial Tower	3-A	
	54	Metcalf Residence Hall	4-D	
● S	55	Morris Building	3-C	

COURTS AND FIELDS	GRID
A. Bagwell-Becton-Berry Quad	2-C
B. Gold-Welch-Syme-Brooks Court	2-C
C. Mery E. Yerbrough Court	3-B
D. Court of North Carolina	3-B
E. Gardner Arboretum	4-C
F. University Plaza (Brickyard)	5-C
G. University Student Center Plaza	4-D
H. Turlington-Alexander Court	4-D
J. Tucker-Owen Court	4-D
K. Lee-Sullivan-Bragaw Court	5-E
L. Fraternity Court	4-F
M. E. S. King Village Court	7-F
N. Paul H. Derr Track	2-D
O. Miller Fields	4-E
P. Doak Field	6-E
Q. McKimmon Center Court	5-F
R. The Big Acre	8-F
S. Tennis Courts	6-E

PARKING LOTS	GRID
Brooks Ave. Lot	6-C
Carmichael Lot	3-D
Coliseum Bays	3-D
East Coliseum Lot	2-C
Friendly Drive Lot	6-D
Harris Lot	4-E
Hillsborough Building Lots	6-C
Parking Deck	2-C
Riddick Lot	3-C
Sullivan Lots	6-E
West Lot	6-E
Additional West Lot Parking	5-E
Yarbrough Lot	3-C
Hillsborough Square North	2-A

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The Graduate School
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