Rice University

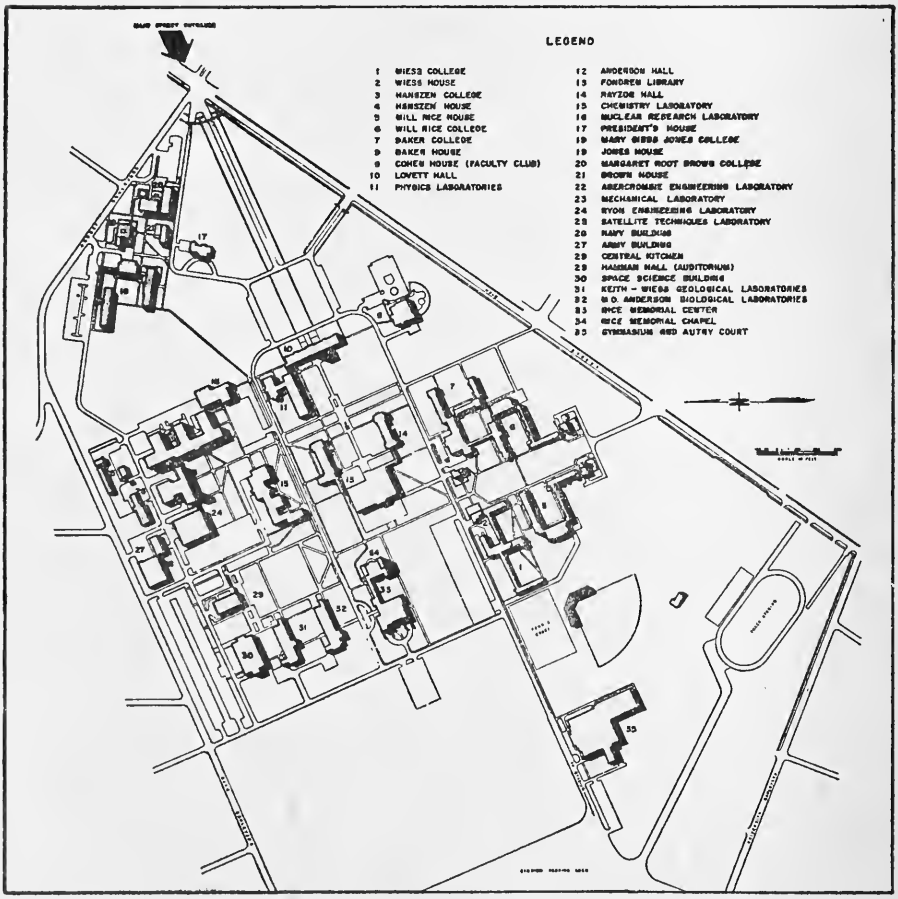
GENERAL ANNOUNCEMENTS

for the

Academic Year 1966-1967

RICE UNIVERSITY CAMPUS

HOUSTON, TEXAS

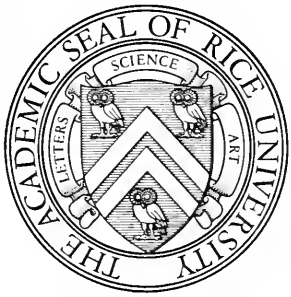


William Marsh Rice University

GENERAL ANNOUNCEMENTS

for the

Academic Year 1966-1967



FOUNDED BY WILLIAM MARSH RICE

OPENED FOR THE RECEPTION OF STUDENTS IN THE AUTUMN OF NINETEEN HUNDRED AND TWELVE

DEDICATED TO THE ADVANCEMENT OF LETTERS, SCIENCE, AND ART

Houston, Texas

1966

Contents

1966

JULY

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

AUGUST

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

SEPTEMBER

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

OCTOBER

S	M	T	W	T	F	S
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2	3	4	5	6	7	8
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16	17	18	19	20	21	22
23	24	25	26	27	28	29
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S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
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27	28	29	30			

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S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

1967

JANUARY

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
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22	23	24	25	26	27	28
29	30	31				

FEBRUARY

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
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			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
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26	27	28	29	30	31	

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S	M	T	W	T	F	S
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2	3	4	5	6	7	8
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16	17	18	19	20	21	22
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S	M	T	W	T	F	S
	1	2	3	4	5	6
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28	29	30	31			

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S	M	T	W	T	F	S
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4	5	6	7	8	9	10
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S	M	T	W	T	F	S
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10	11	12	13	14	15	16
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S	M	T	W	T	F	S
1	2	3	4	5	6	7
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NOVEMBER

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DECEMBER

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24	25	26	27	28	29	30
31						

Academic Calendar
1966-67

First Semester

Thursday, September 1	Last Day for Returning Registration Cards
Sunday, September 11	Arrival of Freshmen
Monday, September 12-17	Freshmen Week
Monday, September 12	Matriculation Address, 5:00 P.M.
Monday, September 19	Opening of Courses
Wednesday, November 23	Beginning of Thanksgiving Recess, 6:00 P.M.
Monday, November 28	Resumption of Courses, 8:00 A.M.
Friday, December 16	Beginning of Christmas Recess, 6:00 P.M.
Monday, January 2	Resumption of Courses, 8:00 A.M.
Saturday, January 14	Last Day of First-Term Classes
Tuesday, January 17	Beginning of Mid-Year Examinations

Second Semester

Monday, January 30	Resumption of Courses, 8:00 A.M.
Saturday, March 18	Beginning of Easter Recess, 12:00 NOON
Tuesday, March 28	Resumption of Courses, 8:00 A.M.
Tuesday, May 16	Last Day of Classes
Thursday, May 18	Beginning of Final Examinations
Friday, June 2	Baccalaureate Exercises
Saturday, June 3	Fifty-fourth Commencement

Summer, 1967

June-July	Teaching Apprentice Session

Part One

Administration and Staff

Officers of Administration
Board of Governors
The Rice University Associates
The Rice University Research Sponsors
The College Masters
The Instructional and Research Staff
University Standing Committees

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Honorary Chancellor

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Dean of Graduate Studies

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Dean of Engineering and Science

To be Announced
Dean of Humanities

MICHAEL VINCENT MCENANY, M.A.
Dean of Undergraduate Affairs

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Director of School of Architecture

PAUL EDWIN PFEIFFER, PH.D.
Dean of Students

ALMA LOUISE LOWE, PH.D.
Dean of Women

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Director of Admissions

JAMES CADDALL MOREHEAD, JR., B.ARCH.
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Campus Business Manager

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Director of Development

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Mrs. Wheeler Nazro
Mr. Fred M. Nelson
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Mr. Gustav M. O'Keiff
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Mr. Jess Newton Rayzor
Mr. and Mrs. T. R. Reckling, III
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Mr. and Mrs. Lawrence S. Reed
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Mr. and Mrs. Raymond D. Reynolds
Mrs. Edward S. Rothrock
Mr. Clive Runnells, Jr.
Mr. and Mrs. Patrick R. Rutherford
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Mr. and Mrs. Thomas H. Shartle
Mrs. James L. Shepherd, Jr.
Mr. and Mrs. Stuart Sherar
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Mr. and Mrs. Irvin M. Shlenker
Mr. William A. Smith
Mr. and Mrs. W. McIver Streetman

Mr. and Mrs. H. Gardiner Symonds
Mr. Ben Taub
Mr. and Mrs. Henry J. N. Taub
Mr. and Mrs. Howard T. Tellepsen
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The College Masters

BAKER COLLEGE

Carl Riehle Wischmeyer. B.S., M.Eng., E.E. *Professor of Electrical Engineering*

BROWN COLLEGE

Frank Everson Vandiver. M.A., Ph.D. *Professor of History*

HANSZEN COLLEGE

Ronald L. Sass. A.B., Ph.D. *Associate Professor of Chemistry*

JONES COLLEGE

Trenton William Wann. A.B., Ph.D. *Professor of Psychology*

WIESS COLLEGE

Roy VanNeste Talmage. A.B., M.A., Ph.D. *Professor of Biology*

WILL RICE COLLEGE

James Street Fulton. B.A., M.A., Ph.D. *Professor of Philosophy*

The Instructional and Research Staff

Emeritus Faculty

ALTENBURG, EDGAR. *Professor Emeritus of Biology*
A.B. (Columbia) 1911; A.M. (Columbia) 1912; Ph.D. (Columbia) 1916

BATTISTA, JOSEPH LLOYD. *Associate Professor Emeritus of Romance Languages*
Certificat d'Études Françaises (Bordeaux) 1919; Diplôme d'Études Supérieures (Bordeaux) 1919; B.A. (Michigan) 1920; M.A. (Washington University) 1923; M.A. (Harvard) 1929

DEAN, ALICE CROWELL. *Librarian Emerita*
B.A. (Rice) 1916; M.A. (Rice) 1919

FREUND, FRIEDRICH ERNST MAX. *Professor Emeritus of German*
Ph.D. (Leipzig) 1902

HARTSOOK, ARTHUR J. *Professor Emeritus of Chemical Engineering*
A.B. (Nebraska Wesleyan) 1911; B.S. in Ch.E. (M.I.T.) 1920; M.S. (M.I.T.) 1921

MCCANTS, JOHN THOMAS. *Bursar Emeritus and Honorary Associate of Baker College*
B.S. (Marion Institute) 1902; B.A. (Marion Institute) 1905; M.A. (Virginia) 1906; M.A. (Yale) 1909

MORAUD, MARCEL. *Professor Emeritus of French*
Agrégé de l'Université (Paris) 1919; Docteur ès Lettres (Paris) 1933

NICHOLAS, HENRY OSCAR. *Associate Professor Emeritus of Chemistry*
A.B. (Oberlin) 1919; Ph.D. (Yale) 1923

RYON, LEWIS BABCOCK. *Professor Emeritus of Civil Engineering and Honorary Associate of Hanszen College*
C.E. (Lehigh) 1917

WELSH, HUGH CLAYTON. *Lecturer Emeritus in Biology and Medical Adviser*
M.D. (Texas) 1923

Faculty

ADAMS, JOHN ALLAN STEWART. *Professor of Geology*
Ph.B. (Chicago) 1946; B.S. (Chicago) 1948; M.S. (Chicago) 1949; Ph.D. (Chicago) 1951

AKERS, WILLIAM WALTER. *Professor of Chemical Engineering and Faculty Associate of Brown College*
B.S. in Ch.E. (Texas Tech.) 1943; M.S. in Ch.E. (Texas) 1944; Ph.D. (Michigan) 1950

AMBLER, JOHN S. *Assistant Professor of Political Science and Faculty Associate of Brown College*
B.A. (Willamette) 1953; A.M. (Stanford) 1954; Certificat d'Études Politiques (Bordeaux) 1955; Ph.D. (California) 1964

ANDERSON, HUGH R. *Assistant Professor of Space Science*
B.A. (Iowa) 1954; M.A. (Iowa) 1958; Ph.D. (California Inst. of Tech.) 1961

ANSEVIN, KRYSTYNA D. *Lecturer in Biology*
B.S. (Jagellonian) 1950; M.S. (Jagellonian) 1950; Ph.D. (Pittsburgh) 1961

AUSTIN, WALTER JAMES. *Professor of Civil Engineering*
B.S. in C.E. (Rice) 1941; M.S. in C.E. (Illinois) 1946; Ph.D. (Illinois) 1949

AUSTIN, WILLIAM HARVEY. *Instructor in Philosophy and Resident Associate of Hanszen College*
B.A. (Wesleyan) 1957; B.D. (Yale) 1960

AWAPARA, JORGE. *Professor of Biochemistry and Faculty Associate of Jones College*
B.S. (Michigan State) 1941; M.S. (Michigan State) 1942; Ph.D. (Southern California) 1947

BAKER, STEPHEN D. *Lecturer in Physics*
B.S. (Duke) 1957; M.S. (Yale) 1959; Ph.D. (Yale) 1963

BAKER, STEWART A. *Assistant Professor of English*
B.A. (Columbia) 1960; M.A. (Yale) 1961; Ph.D. (Yale) 1964

BANNISTER, RONALD J. *Visiting Lecturer in Accounting*
B.B.A. (Tulane) 1946

BARKER, J. R. *Assistant Professor of Health and Physical Education*
B.S. in P.E. (Rice) 1949; M.Ed. (Texas) 1954

BARNARD, ANTHONY CHARLES LANGRISH. *Assistant Professor of Physics and Nonresident Associate of Weiss College*
B.Sc. (Birmingham) 1953; Ph.D. (Birmingham) 1957

BARRATT, ERNEST STOELTING. *Lecturer in Psychology*
B.A. (Texas Christian) 1947; M.A. (Texas Christian) 1949; Ph.D. (Texas) 1952

BARTHOLOMEW, BARBARA GRAY. *Instructor in English*
B.A. (Texas) 1957; M.A. (Tulane) 1958; Ph.D. (Tulane) 1962

BAUM, ERNEST ROY. *Lecturer in Education*
B.A. (Trinity University) 1956; M.A. (Texas) 1961

BEARDEN, FRANCIS W. *Associate Professor of Health and Physical Education and Nonresident Associate of Will Rice College*
B.S. (Texas Tech.) 1947; M.A. (Columbia) 1949; Ed.D. (Columbia) 1954

BECKMANN, HERBERT W. K. *Professor of Mechanical Engineering*
Dipl. Ing. (Hanover) 1944; Dr. Ing. (Hanover) 1957

BEDFORD, R. WAYNE. *Lecturer in Music*
B.S. (Houghton) 1938; M.A. (North Texas) 1955; Ph.D. (Midwestern) 1950

BESEN, STANLEY M. *Assistant Professor of Economics*
B.B.A. (City College of N.Y.) 1958; M.A. (Yale) 1960; Ph.D. (Yale) 1964

BISHOP, MORRIS GILBERT. *Visiting Professor of French*
A.B. (Cornell) 1913; A.M. (Cornell) 1914; Ph.D. (Cornell) 1926

BLAND, ROBERT LESTER. *Assistant Professor of Health and Physical Education and Nonresident Associate of Hanszen College*
B.A. (Central Washington) 1953; M.A. (Columbia) 1954

BOLLING, EMMA DOMINY. *Lecturer in Education*
B.S. (Texas) 1935; M.S. (Houston) 1941

BOURGEOIS, ANDRÉ MARIE GEORGES. *Professor of French*
Bachelier ès Lettres (Paris) 1921; Bachelier en Droit (Paris) 1923; Certifié d'Études Supérieures de Lettres (Paris) 1930; M.A. (Texas) 1934; Docteur de l'Université (Paris) 1945; Officier de l'Instruction Publique 1945

BOURNE, HENRY CLARK, JR. *Professor of Electrical Engineering and Nonresident Associate of Baker College*
S.B. (M.I.T.) 1947; S.M. (M.I.T.) 1948; Sc.D. (M.I.T.) 1952

BRAY, HUBERT EVELYN. *Trustee Distinguished Professor of Mathematics and Faculty Associate Emeritus of Jones College*
B.A. (Tufts) 1910; M.A. (Harvard) 1916; Ph.D. (Rice) 1918

BRINKMANN, HANS-BERNDT. *Visiting Assistant Professor of Mathematics*
Diplom-Mathematiker (Bonn) 1960; Dr.rer.nat. (Saarbrucken) 1964

BROOKS, PHILIP R. *Assistant Professor of Chemistry*
B.S. (California Inst. of Tech.) 1960; Ph.D. (California) 1964

BROTHERS, DWIGHT STANLEY. *Professor of Economics*
B.A. (Colorado College) 1951; M.A. (Princeton) 1954; Ph.D. (Princeton) 1957

BROTZEN, FRANZ RICHARD. *Professor of Materials Science and Faculty Associate of Jones College*
B.S. (Case Institute) 1950; M.S. (Case Institute) 1953; Ph.D. (Case Institute) 1954

BROWN, KATHERINE TSANOFF. *Lecturer in Fine Arts and Nonresident Associate of Hanszen College*
B.A. (Rice) 1938; M.F.A. (Cornell) 1940

BRYAN, ANDREW BONNELL. *Lecturer in Physics*
B.A. (Rice) 1918; M.A. (Rice) 1920; Ph.D. (Rice) 1922

BURCHFIEL, BURRELL CLARK. *Assistant Professor of Geology*
B.S. (Stanford) 1957; M.S. (Stanford) 1958; Ph.D. (Yale) 1961

BURRUS, C. SIDNEY. *Assistant Professor of Electrical Engineering*
B.A. (Rice) 1958; B.S. (Rice) 1958; M.S. (Rice) 1960; Ph.D. (Stanford) 1965

BUSCH, ARTHUR WINSTON. *Professor of Environmental Engineering*
B.S. (Texas Tech.) 1950; S.M. (M.I.T.) 1952

CAMDEN, CARROLL. *Professor of English and Nonresident Associate of Hanszen College*
A.B. (Centre) 1925; M.A. (Iowa) 1928; Ph.D. (Iowa) 1930

CAMPBELL, JAMES WAYNE. *Associate Professor of Biology*
B.S. (Southwest Missouri) 1953; M.S. (Illinois) 1955; Ph.D. (Oklahoma) 1958

CANNADY, WILLIAM TILLMAN. *Assistant Professor of Architecture*
B.Arch. (California) 1961; M.Arch. (Harvard) 1962

CANTRELL, THOMAS S. *Assistant Professor of Chemistry*
B.S. (South Carolina) 1958; M.S. (South Carolina) 1959; Ph.D. (Ohio State) 1964

CASON, CAROLYN. *Director of Food Service and Lecturer in Dietetics*
B.S. (Texas) 1934; M.A. (Columbia) 1939

CASTAÑEDA, JAMES A. *Associate Professor of Spanish and Nonresident Associate of Will Rice College*
B.A. (Drew) 1954; M.A. (Yale) 1955; Ph.D. (Yale) 1958

CAUDILL, WILLIAM W. *William Ward Watkin Professor of Architecture and Director of the School of Architecture*
B.Arch. (Oklahoma State) 1937; M.Arch. (M.I.T.) 1939; LL.D. (Eastern Michigan) 1957

CHALMERS, DAVID J. *Instructor in Chemistry*
B.S. (Aberdeen) 1962; D.Phil. (Oxford) 1965

CHAPMAN, ALAN JESSE. *Professor of Mechanical and Aerospace Engineering and Faculty Associate of Brown College*
B.S. in M.E. (Rice) 1945; M.S. (Colorado) 1949; Ph.D. (Illinois) 1953

CHARLTON, NORMAN W. *Lecturer in Health and Physical Education*
B.S. (Rice) 1961

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WILLIAMS, C. HERNDON. *Research Associate in Chemistry*
B.A. (St. Thomas) 1958; Ph.D. (Brown) 1964

WOOD, JAMES LEE. *Postdoctoral Fellow in Chemistry*
B.A. (Vanderbilt) 1958; Ph.D. (Vanderbilt) 1966

ZMBOV, KIRO. *Research Associate in Chemistry*
B.Sc. (Belgrade) 1955; Ph.D. (Belgrade) 1963

ZOLLER, KARL. *Postdoctoral Fellow in Chemistry*
B.Sc. (Stuttgart) 1958; M.Sc. (Stuttgart) 1962; Ph.D. (Technische Hochschule, Aachen) 1964

Staff of the Library

ALLSPACH, ELIZABETH ANN. *Catalog Librarian*
B.A. (Rice) 1960; M.L.S. (California) 1961

ALONSO, GEORGINA AIDA. *Catalog Librarian*
B.L.S. (Escuela Cubana) 1951; Diplom. Lang. (Havana) 1956

BAXTER, SUSANNA GORTON. *Bibliographer*
B.A. (Texas) 1927; M.A. (Texas) 1935; M.L.S. (Texas) 1959

BISHOP, MARTHA. *Head of Catalog Department*
Ph.D. (Munich) 1947

BRAND, MARVINE. *Science Librarian*
B.A. (Mississippi) 1946

BULAS, CASIMIR. *Acquisitions Research Librarian*
Ph.D. (Cracow) 1927

CHANG, NANCY WANG. *Catalog Librarian*
B.A. (Tunghai) 1961; M.A. in L.S. (Peabody) 1963

CRAIG, HARDIN, JR. *Librarian*
A.B. (Princeton) 1929; A.M. (Harvard) 1931; Ph.D. (Harvard) 1937

DEAN, ALICE CROWELL. *Librarian Emerita and Archivist*
B.A. (Rice) 1916; M.A. (Rice) 1919

DE ZURKO, MADITH SMITH. *Music and Fine Arts Librarian*
B.S. in Mus. Ed. (Illinois) 1941

GLASS, GEORGE WILLIAM. *Catalog Librarian*
B.A. (Rice) 1948

HAMILTON, MARY ALICE. *Gifts and Exchanges Librarian*
B.A. (Rice) 1932

HO, MARGARET SHU-FEN. *Catalog Librarian*
B.A. (Scarritte) 1963; M.A. in L.S. (Peabody) 1964

JAMESON, FLORENCE. *Serials Librarian*
B.A. (Rice) 1918

LANE, SARAH LOUISE. *Circulation Librarian*
B.A. (Rice) 1919; B.S. in L.S. (Columbia) 1932

MCGEEVER, NANCY BOOTHE. *Acquisitions Librarian*
B.A. (Rice) 1952; M.S. in L.S. (Catholic University) 1965

MAYFIELD, JAMES LEE. *Head of Circulation Department*
B.A. (Colorado State) 1958; M.A. in L.S. (Denver) 1960

O'KEEFFE, RICHARD L. *Associate Librarian*
Ph.B. (Mount Carmel) 1949; M.S. in L.S. (Louisiana State) 1956

PERRINE, RICHARD H. *Reference Librarian*
B.F.A. (Yale) 1940; M.L.S. (Texas) 1961

REDMON, ALICE JANE. *Catalog Librarian*
B.A. (Denver) 1937

REINDL, ELLENE A. *Acquisitions Librarian*
B.A. (Rice) 1956; M.L.S. (Columbia) 1962

RUECKING, FREDERICK, C., JR. *Head of Data Processing*
B.A. (Texas) 1952; M.A. (Texas) 1955; A.M.L.S. (Michigan) 1963

SILVERSTEEN, SOPHIE. *Catalog Librarian*
B.A. (Rice) 1952; M.S. (Texas) 1954; M.L.S. (Texas) 1964

SMITH, JOSEPHINE. *Catalog Librarian*
B.A. (Texas Woman's) 1939; M.L.S. (Texas Woman's) 1965

TURNBULL, PENDER. *Bibliographer and Curator of Rare Book Room*
B.A. (Rice) 1919

UHRIG, SUSIE. *Serials Librarian*
B.A. (Rice) 1927

VERMEULEN, JUNE. *Acquisitions Librarian*
B.A. (Nottingham) 1956

ZINGLER, GILBERTA M. *Head of Acquisitions Department*
A.B. (Butler) 1932; B.S. in L.S. (Illinois) 1935

Staff of the Health Service

SKAGGS, RAY HAMILTON. *Medical Director, Student Health Service*
B.A. (Rice) 1942; M.D. (Texas) 1945

SMITH, EDWARD THOMAS. *Athletic Team Physician*
M.D. (Baylor) 1929

Staff of the Athletic Department

BALE, ALLEN MELBERT. *Assistant Coach of Football*

BRUNSON, EMMETT EVANDER. *Business Manager of Athletics and Coach of Track and Field*

CARLISLE, GEORGE BARBER. *Head Basketball Coach*

DAVIS, ALLEN BAKER. *Coach of Freshman Football and Assistant Basketball Coach*

DAVIS, JOE WALLACE. *Line Coach of Football*

ERFURTH, AUGUST FRED, JR. *Assistant Coach of Track and Field and Concessions Manager*

GIAMMALVA, SAMUEL ANTONE. *Coach of Tennis*

GRIGG, CECIL BURKETT. *Assistant Coach of Football*

HAGAN, HAROLD B. *Backfield Coach of Football*

LANZA, NICK. *Assistant Coach of Football*

MOORE, CHARLES EDWARD, JR. *Assistant Coach of Football*

NEELY, JESS CLAIBORNE. *Director of Athletics, Head Coach of Football, and Faculty Associate of Brown College*

OSBURN, DOUGLAS EDWARD. *Coach of Baseball*

WHITMORE, WILLIAM ROGERS. *Athletic Publicity Director*

WOJECKI, EDWARD J. *Head Athletic Trainer and Lecturer in Physical Therapy*

University Standing Committees 1965-66

The President is an *ex officio* member of all committees.

Committee on Admissions: Mr. Giles, *chairman;* Messrs. Busch, Grob, Hellums, Kilpatrick, Louis, Matusow, Merwin, Morehead, Rogers, Talmage; Mrs. Goodman and Mrs. Lowe; Dean of Undergraduate Affairs, *ex officio.*

Committee on Campus Safety: Mr. W. J. Austin, *chairman;* Captain Francis; Messrs. Franklin, Johnston, Legg, and Sims; Dr. Skaggs.

Committee on Computers: Mr. Rachford, *chairman;* Messrs. Deans, DeBremaecker, Graham, Haymes, Holt, Phillips, Robinson, and Salsburg; the Dean of Engineering and Science, *ex officio.*

Education Council: Mr. McEnany, *chairman;* Messrs. Ambler, Bearden, Bryan, Castañeda, Durst, Dvoretzky, Levin, Parish, Sass, Shelton, Wood, and Woodward; the Dean of Humanities, *ex officio.*

Committee on Examinations and Standing: Mr. McEnany, *chairman;* Messrs. Awapara, Bourne, Huddle, Kobayashi, Straka, and Ward; the Registrar, *ex officio.* (This committee also serves as the *Professional Advisory Committee* and as the *Committee on Schedules.*)

Faculty Council: The President, *chairman;* the Chancellor; the Dean of Graduate Studies; the Dean of Humanities; the Dean of Engineering and Science; Messrs. Read (1966), Rorschach (1967), Vandiver (1967), Salsburg (1968), Leland (1969), and Robinson (1969).

Graduate Council: Mr. Pitzer, *chairman;* Mr. Richter, *executive officer;* Messrs. Dowden, Dyer, Edwards, Leland, Walters, and Wierum.

Committee on Interdepartmental Research Grants and Contracts: Mr. Brotzen, *chairman;* Messrs. Chapman, Dessler, Levy, Read, and Rorschach.

Committee on the Library: Mr. Mackey, *chairman;* Messrs. Barnard, Clayton, Doughtie, Goldwyn, Loewenheim, Norbeck, Rath, and Wadsworth; Mr. Craig, *consultant.*

The Rice University Marshals: Mr. Dvoretzky, *Chief Marshal;* Messrs. Sass, Rogers, Roberts, Hole, Hudson, and Thibodeaux; Mr. Sims, *consultant.*

Committee on Outdoor Sports: Mr. Chapman, *chairman;* Messrs. Castañeda, Rorschach, and Vandiver; the chairman of the Department of Health and Physical Education, *ex officio* (non-voting); Mr. W. L. McKinnon (representative of the R Association); Mr. James K. Nance (representative of the Alumni Association); and Mr. Robert H. Ray (representative of the Board of Governors).

Committee on Religious Activities: Mr. Nielsen, *chairman*; Messrs. W. H. Austin, Class, Rimlinger, Schorre, and Tsanoff.

R. O. T. C. Committee: Mr. Adams, *chairman;* the Professor of Military Science; the Professor of Naval Science; Messrs. Ambler, Krahl, Michel, Pfeiffer, Rudee, and Talmage.

Committee on Scholarships and Awards: Mr. McEnany, *chairman;* Messrs. Beckmann, DeBremaecker (fall semester) Heath, Kahn, and Risser (spring semester); Mr. Wilkens, *consultant.*

Committee on Student Financial Aid: Mr. McEnany, *chairman;* Messrs. Giles, Higginbotham (fall semester), Hodges, Pfeiffer, Risser (spring semester), Sims; Mr. Wilkens, *consultant.*

Committee on Student Health: Mr. Wann, *chairman;* Dr. Skaggs; Messrs. Class, Garner, and Price-Williams; Mrs. Poindexter; Miss Cason; the Dean of Students, *ex officio;* the Chairman of the College Masters, *ex officio.*

Committee on Rice University Studies: Mr. Norbeck, *chairman*; Mrs. Drew, *associate chairman;* Messrs. Donnelly, Higginbotham, and Williams.

Committee on Undergraduate Curriculum: Mr. Margrave, *chairman;* Messrs. Curtis, Deans, Mackey, Muir, Rimlinger, and Trammell; the Dean of Undergraduate Affairs, *ex officio.*

Committee on University Welfare: Faculty Council representatives Messrs. Leland, Robinson, and Salsburg; Messrs. Parsons, Donoho (1966), Hole (1967), Woodward, *chairman;* Isle (1968), and Sass (1968).

Part Two

General Information

The University and Its Campus

Historical Sketch of the University

William Marsh Rice University was founded in Houston, Texas, as the Rice Institute by William Marsh Rice. The founder did not live to see the beginning of instruction at the institution, but his ashes rest in the base of a bronze statue by John Angel located in the center of the Academic Court. The Rice Institute became William Marsh Rice University on July 1, 1960.

The Rice Institute was incorporated in 1891 under a charter permitting large freedom in the organization of a university to be dedicated to the "Advancement of Literature, Science, and Art." The Board of Trustees on December 28, 1907, appointed Dr. Edgar Odell Lovett, professor of mathematics and head of the astronomy department at Princeton University, to be the first president of the Rice Institute. After careful and extended planning, the new university was opened in Septmber, 1912, to an entering class of seventy-seven students. A three-day academic festival was held on October 10-12, 1912, as a formal celebration of the opening. A similar festival on October 10-12, 1962, commemorated the fiftieth anniversary of the University.

Enrollment expanded rapidly during the early years, and by 1924 a policy was established of admitting annually only about 450 undergraduate students. No restriction was placed on the admission of qualified graduate students. Under the Ten Year Plan adopted by the Board of Governors in the summer of 1964, enrollment will be expanded gradually until it reaches approximately 4,000 by 1975, of which approximately 28 per cent will be graduate students. Beginning with the year 1965-66, tuition was charged by the University and a very liberal program of tuition scholarships established to carry out the intention of the Board that no qualified student be denied admission because of inability to pay tuition.

Dr. Lovett, who died in 1957, became president emeritus in 1946, when Dr. William V. Houston, professor of physics at the California Institute of Technology, assumed the presidency. When Dr. Houston retired as president in 1960, Dr. Carey Croneis, provost and professor of geology at Rice, served as acting president. In July, 1961, Dr. Kenneth S. Pitzer, professor of chemistry and dean of the College of Chemistry at the University of California at Berkeley, became Rice's third president and chief executive officer. At that time Dr. Croneis became chancellor and Dr. Houston honorary chancellor of the University.

A new era of rapid development for the University began at the close of World War II. The Board of Trustees developed during the war years a long-range plan based upon the goal of providing especially good training for a limited number of students, "with a well-developed and strong curriculum in the arts and letters and with the emphasis on science and research that is required to meet changing circumstances." These plans were vigorously executed. New departments were added, the faculty was increased from less than seventy to more than two hundred, admission requirements were raised, curricula were revised, and a great expansion was made in graduate study and research. In the academic year 1965-66 there were nearly six hundred students working for the master's or the doctor's degree. Nearly sixty postdoctoral fellows and research associates were engaged in investigations in the University laboratories.

The University in 1961 made available to the National Aeronautics and Space Administration a site on Clear Lake near Houston for the construction of an $80,000,000 Manned Space Flight Laboratory, and in 1962-63 it established a Department of Space Science at the graduate level to give training in this field.

Following the arrival of President Pitzer, the preparation of a long-range plan for the future of the University was begun by a study committee in 1962. The completed projection was adopted by the Board of Governors on August 19, 1964, under the title of "A Ten Year Plan for Rice University, 1965-1975."

The plan was developed in conformity with the following statement of purpose: "Rice University's goal and aspiration is to be a university of the highest quality serving not only as an educational center of excellence for selected students of high intellectual ability, motivation, and personal qualifications, but also as a center of creativity where new knowledge and new ideas result from research and other scholarly-creative activities." The plan emphasizes the interaction of graduate and undergraduate education and seeks to encourage the "increasing interdependence of teaching and research for students and faculty." To realize these objectives, the faculty will be increased from approximately 225 in 1964 to just under 400 in 1975, and the number of students will be raised to some 4,000 from the present level of about 2,400. Priority is given to the strengthening of the traditional core of academic studies, but the plan also envisions the possible creation at the graduate level of selected professional schools.

Since 1949 the directing body of the University has been the Board of Governors of fifteen members. This consists of the seven permanent trustees and of eight governors appointed by the trustees for staggered terms of four years. A new body, the Rice University Associates, was formed in 1954 to provide a channel for the free exchange of ideas between the faculty and a group of representative citizens with influence in the civic, cultural, and educational affairs of the region.

The University Campus and Physical Facilities

Rice University occupies a spacious and well-kept campus of some three hundred acres on South Main Street about three miles from the center of the city of Houston. There are at present more than thirty major buildings and groups of buildings exclusive of the Rice Stadium. The harmonious proportions of these buildings and their intriguing architectural features combine with the natural beauty of the campus to form a setting of rare charm in which the students and faculty may pursue their respective tasks.

Architectural distinction was an acknowledged goal of the trustees in 1910 when they accepted a general long-range plan prepared by Ralph Adams Cram, which combined beauty and utility and exhibited attractive elements of Italian, French, and Spanish architecture. When the Rice Institute was formally opened in the fall of 1912, the administration building (now Lovett Hall), the mechanical engineering building and powerhouse, and two residential halls for men had been completed—all in a style inspired by the Romanesque of Lombardy. The same style of architecture was exhibited in the physics and chemistry laboratories, two additional residential halls, and Cohen House (the faculty club) erected during the period from 1915 to 1928.

There was little further change in the campus until after World War II, but there has been a spectacular growth in the physical plant since that time as the long-range plans of the trustees began to be implemented. The new buildings are somewhat less ornate than the older ones, but they have all been carefully designed to harmonize with them, and they exhibit architectural excellence in their own right. Anderson Hall (an office and classroom building), the Abercrombie Engineering Laboratory, the Fondren Library, Wiess Hall (a residential hall for men), and the president's home were built between 1947 and 1949. In the next three years the 70,000-seat Rice Stadium, a new Gymnasium, and a nuclear research laboratory with a six-million-volt Van de Graaff generator were constructed. A twelve-million-volt Van de Graaff tandem generator was added to the laboratory in 1961.

The establishment of residential colleges in 1956 and 1957 gave a new direction to student life, and it added many new structures to the campus. The existing residential halls for men were enlarged; dining rooms, lounges, and houses for the masters were added; and from this came the four men's residential colleges—Baker, Hanszen, Wiess, and Will Rice. Women students were housed on the campus for the first time in 1957 with the opening of Mary Gibbs Jones College. The Margarett Root Brown College for women students was opened in

the fall of 1965. It was made possible by a gift of one million dollars from the Brown Foundation of Houston, Texas.

In 1958 the Hamman Hall auditorium, the Keith-Wiess Geological Laboratories, and the M. D. Anderson Biological Laboratories were opened. The Rice Memorial Center and the Rice Memorial Chapel were completed the following year. Rayzor Hall (an office and classroom building) was opened in 1962 and the Satellite Techniques Laboratory in 1963. The Ryon Engineering Laboratory, financed in part by a gift of $750,000 from Professor Emeritus and Mrs. L. B. Ryon, was dedicated on November 12, 1965. A Space Science and Technology Laboratory is now under construction. The long-range plan for the next ten years envisions construction of a major addition to the Fondren Library, additional buildings for research and instruction, additional student housing, and a larger auditorium.

Collections at the Fondren Library now number 514,242 volumes. There are extensive collections of books and periodicals in the sciences, technical fields, and the humanities as well as considerable holdings of books and manuscripts on microtext.

Chairs and Lectureships

Throughout its history, Rice University has been especially fortunate in the number of its friends and benefactors. Some of these are memorialized in the names of buildings and special physical facilities; others have generously provided for the enrichment of the University's intellectual life by establishing chairs and lectureships either on temporary or permanent bases. Rice takes pleasure in recognizing on these pages some of these contributors to its academic excellence.

The Brown and Root Chair of Engineering

The Halliburton Education Foundation established the Brown and Root chair in 1965. The first appointment was made in November, 1965.

The Reginald Henry Hargrove Chair of Economics

The Hargrove chair was established in 1958 in memory of Mr. Hargrove by Mrs. R. H. Hargrove and the Texas Eastern Transmission Corporation. The Hargrove Professor took up residence in 1959.

Chairs of Instruction Established by Mrs. Mamie Twyman Martel

A bequest by Mrs. Mamie Twyman Martel provides for four chairs of instruction in fields of humanistic study. Two were established in September, 1962: the Henry S. Fox, Sr., Chair of Instruction in Economics and the Lena Gohlman Fox Chair of Instruction in Sociology. It is expected that the two additional chairs of instruction will be established in the future when sufficient funds become available.

The Harris Masterson, Jr., Chair in History

The late Reverend Harris Masterson, Jr., was deeply interested in Rice University through his activities as director of Autry House and his close personal association with Rice students through many years. His will provided a bequest to the University with which the Board of Governors established a memorial to him in this chair.

Moody Foundation Chairs

In 1964 the Moody Foundation established the Libbie Shearn Moody Professorship of English and the W. L. Moody, Jr., Professorship of Mathematics.

The J. Newton Rayzor Chair in Philosophy and Religious Thought

This chair was established in 1953 by Mr. J. Newton Rayzor, a trustee of Rice University. Its purpose is to provide in the Rice cur-

riculum for distinguished instruction in religious and philosophical ideas which have powerfully influenced the history of civilization.

The Albert Thomas Chair of Political Science

A gift from the Brown Foundation created the Albert Thomas chair in 1965 honoring the late Congressman Albert Thomas.

The Robert A. Welch Chair in Chemistry

The Robert A. Welch Foundation, in advancing the cause of basic chemical research in the Southwest, endowed a professorship in chemistry which was first filled in 1963.

The Harry Carothers Wiess Chair of Geology

In 1952 Mrs. Olga Keith Wiess gave a substantial endowment to the University for the establishment of a chair of geology to be named in memory of her husband, late Vice Chairman of the Board of Governors of the University, in recognition of his profession and of his distinguished service to the University. Work in this department was inaugurated at both graduate and undergraduate levels in 1954.

The Bartlett Aesthetics Program

Chamber music concerts and lectures have been sponsored from time to time by Dr. and Mrs. H. L. Bartlett. The first three Bartlett Lecturers were Dr. Theodore Greene, Dr. Iredell Jenkins, and Dr. Radoslav A. Tsanoff.

The Rockwell Lectures

These lectures are made possible by the Rockwell Fund, Inc. They were inaugurated by Sir Robert Alexander Falconer in April, 1938. Among the distinguished lecturers in the series have been Dean Roscoe Pound, Professor William Ernest Hocking, Dr. Ralph W. Sockman, Dr. George A. Buttrick, Professor Charles W. Hendel, Professor Kenneth S. Latourette, Mr. Charles P. Taft, Dr. Henry P. Van Dusen, Dr. Conyers Read, Professor Theodore Greene, Dr. Joseph Sittler, Dr. J. W. F. Albright, Dr. Julian N. Hartt, Dr. Paul Ricoeur, and Dr. Albert Outler.

The Shepherd School of Music

Mrs. Sally Shepherd Perkins of Asheville, North Carolina, provided in 1950 for the establishment of a school of music at the University. It is contemplated that when the income from this endowment is of sufficient size, appropriate buildings and other facilities will be provided for outstanding instruction in musical theory and appreciation. At present, income from gift maintains a professorship and a number of courses and activities in music.

The Rice University Lectures

From time to time Rice University invites scholars of distinction to lecture for varying periods. In most cases these lectures are open to the public as well as to the faculty and students.

The Rice Television Series

For several years Rice University has presented a series of programs in cooperation with KTRK-TV, Houston. Various aspects of research in science, engineering, and the humanities at the University are discussed, as well as other topics of interest to the community.

The Academic Program

Curricula and Degrees

Rice University offers baccalaureate degrees in arts and sciences, engineering, architecture, accounting, commerce, and health and physical education. Students completing the requirements for the Bachelor of Arts degree with outstanding records are given recognition with a designation of *summa cum laude, magna cum laude,* or *cum laude* when the degree is awarded. Majors may be taken in anthropology, architecture, art and history of art, biochemistry, biology, chemical physics, chemistry, classics, economics and business administration, English, French, geology, German, history, mathematics, philosophy, physics, political science, psychology, sociology, or Spanish. Curricula leading to the Bachelor of Science degree in engineering require five years for completion. Degrees are available in chemical engineering, civil engineering, electrical engineering, and mechanical engineering. Course work is offered in aerospace, nuclear, and environmental engineering, and in materials science. The Bachelor of Arts degree is awarded on successful completion of four years of study in engineering curricula. The course of study in architecture is of five years' duration and leads to the professional degree of Bachelor of Architecture; the Bachelor of Arts is conferred upon those who have satisfactorily completed the first four years in this curriculum. A five-year program in accounting leads to a professional Bachelor of Science degree in that field; those who have completed the first four years in this curriculum receive the Bachelor of Arts degree. The degrees of Bachelor of Commerce and Bachelor of Science in Health and Physical Education are awarded after four years of study in their respective curricula. A program of teacher training within the Bachelor of Arts curriculum may be followed by those interested in teaching in the secondary schools. Similarly, programs satisfying requirements for admission to dental, medical, and law schools are available.

A special program of accelerated study is offered by Rice University for students interested in careers as college or university professors. By various methods—a rearrangement of curriculum, small classes and seminars in which student participation is emphasized, close contact with the faculty in methods of research, and extra reading and summer research projects—the student is enabled to complete some work on the graduate level before the end of his Senior year, pass one or perhaps two of the language requirements of an advanced degree

while still an undergraduate and thus enter graduate study with advanced standing. In some instances this program enables the student to shorten by as much as one year the time required for completion of the doctorate.

Presently, the program includes majors in behavioral sciences, biology, economics, English, French, geology, German, history, mathematics, philosophy, and physics.

Graduate studies leading to Master of Arts and Doctor of Philosophy degrees are offered in biology, chemistry, economics, English, ethnopsychology, French, geology, German, history, mathematics, philosophy, physics, and space science. In engineering, study may lead to the Master of Science and Doctor of Philosophy degrees. The graduate program in architecture may lead to the degree of Master in Architecture.

Courses of Study

Undergraduate Programs

During their first two years the students are registered in the five basic curricula—humanities (academic), science-engineering, architecture, commerce, and health and physical education. A considerable part of the work is prescribed during these two years, but throughout his four-year course each student pursues a broad program in the fundamental sciences and humanities rather than a narrow course of specialization. In each of the last two years, however, the schedule of every student must be approved by his department of specialization.

To assure that students will distribute choices of electives over an adequate range of subjects, courses are divided into three groups, and certain minimum requirements are specified in each group. The groups are:

Group A—architecture, classics, English, fine arts, foreign languages, history, humanities, music, and philosophy

Group B—anthropology, economics and business administration, education, linguistics, political science, psychology, and sociology

Group C—biology, chemistry, engineering, geology, mathematics, and physics

Teacher Certification. Programs of study are offered to fulfill the Texas State requirements for teaching certificates on the secondary level in biology, chemistry, English, French, general science, German, health and physical education, history, Latin, mathematics, physics, social studies, and Spanish. See page 126 for details.

Premedical and Prelaw Studies. Courses required for admission to any accredited American medical or law school can be met by proper selection of electives in the academic or science curricula. Interested students are encouraged to seek information and advice about courses and procedures from the Dean of Undergraduate Affairs.

Humanities (Academic)

Forty courses, each of at least three semester hours, or the equivalent, must be passed to satisfy the requirements for the Bachelor of Arts degree. Each student must attain a level of competence equivalent to completion of a third-year college course in a foreign language. Other specific requirements are detailed below.

First Year

(1) Fundamental Concepts of Mathematics (Mathematics 101) or Elementary Analysis (Mathematics 100)
(2) General Biology (Biology 100), Introductory and Analytical Chemistry (Chemistry 120), Mechanics, Heat, and Sound (Physics 100), or Introductory Survey of Physics (Physics 101)
Students may elect to substitute a general Humanities course (Humanities 100 or 101) for either (1) or (2). However, either (1) or (2), if not taken in the first year, must be taken in place of an elective in the second or third year.
(3) Introduction to Critical Reading, Thinking, and Writing (English 100)
(4) Europe since 1500 (History 100) or American History (History 110)
(5) Foreign language. (Students having two or more high school units in a foreign language are not permitted to enroll in a beginning course in that language.)
(6) Basic Health and Physical Education (H. & P. E. 101a, 102b)
(7) R.O.T.C., if elected

Second Year

(1) Science or Mathematics
(2) Group A elective (The same course may not be used to satisfy both this requirement and the Sophomore foreign language requirement.)
(3) Foreign language
(4) Elective in Group B
(5) Elective
(6) R.O.T.C., if elected
NOTE: No second-year student may take more than two courses in one department of the University.

Third and Fourth Years

Majors are offered in anthropology, art and history of art, biology, classics, economics and business administration, English, French, German, history, mathematics, philosophy, political science, psychology, sociology, and Spanish. A major in biology, geology, or mathematics may be taken in either a humanities (academic) or science curriculum.

Twenty courses are required of at least three semester hours each, including four in Group A and four in Group B. At least fourteen of the twenty courses must be advanced (numbered 300 or higher). Not less than six nor more than ten of the third- and fourth-year courses and not more than twelve of the total courses offered in fulfillment of the requirements for the degree may fall within a student's major field.

At the discretion of his major department, a student in R.O.T.C. may substitute military science or naval science courses for one of the requirements in each semester of the last two years, except that substitution may not be made in the same elective group both years. For example, a student is not permitted to substitute military science or naval science for all Group A electives.

Fifth Year in Accounting

The fifth year of the professional accounting program is open to all Rice students, including those who major in fields other than economics and business administration, who take the prerequisite undergraduate accounting courses and are seeking intensive preparation for careers in or related to professional accounting.

In the fifth year, ten semester-courses are required: six in accounting, two in economics, and Political Science 310a and b (Law and Society), if not previously taken. The accounting courses cover managerial accounting, auditing, federal taxes, quantitative methods, and accounting theory. The degree awarded is the Bachelor of Science in Accounting.

Students planning to enter this program should consult the Department of Economics and Business Administration for further information, including details on the prerequisite undergraduate accounting courses.

Science and Mathematics

Students majoring in science register in the basic science-engineering curriculum specified below in the first two years. Before selecting electives in the Sophomore year, the student should seek advice from the chairman of the department of his intended major.

In the Junior and Senior years specific requirements in the major field and in related subjects are determined in consultation with an

appointed adviser in the appropriate department. The student's registration in each of these years must be approved by his adviser.

First Year

(1) Elementary Analysis (Mathematics 100) or, if eligible, Analysis (Mathematics 220)
(2) Mechanics, Heat, and Sound (Physics 100)
(3) Introductory and Analytical Chemistry (Chemistry 120)
(4) Europe since 1500 (History 100) or American History (History 110)
(5) Introduction to Critical Reading, Thinking, and Writing (English 100)
(6) Basic Health and Physical Education (H. & P. E. 101a, 102b)
(7) R.O.T.C., if elected

Second Year

(1) Advanced Analysis (Mathematics 200 or 210. Students who have taken Mathematics 220 in the Freshman year may take advanced mathematics or an elective.)
(2) Electricity and Magnetism (Physics 200 or 210)
(3) German, French, or Russian (Students having two or more high school units in a foreign language are not permitted to enroll in a beginning course in that language.)
(4) Group A elective (The same course may not be used to satisfy both this requirement and the Sophomore foreign language requirement.)
(5) Elective
(6) R.O.T.C., if elected

Third and Fourth Years

Science majors are available in biochemistry, biology, chemical physics, chemistry, geology, mathematics, and physics. A major in biology, geology, or mathematics may also be taken in the humanities (academic) curriculum.

Twenty courses (or equivalent) are required of at least three semester hours, including at least eight in the major field of study, four in Group C outside the major field, two in the language started in the sophomore year, and of the remaining six courses, four must be chosen from Group A or B. Fourteen of these twenty courses must be advanced (numbered 300 or higher). Not more than twelve of the total courses in fulfillment of the requirements for the Bachelor of Arts degree may fall within the major field.

At the discretion of his major department, a student in R.O.T.C. may substitute military science or naval science courses for one of the requirements in each semester of the last two years.

Engineering

During the first two years students with an interest in engineering register in the basic science-engineering curriculum. They should consult with the chairman of the department of interest or the Dean of Engineering and Science for information and advice about details of the program and choice of electives, and about engineering as a profession. In each of the third and fourth years every student's registration must be approved by an adviser in his major department.

On completion of the Bachelor of Arts degree at the end of the fourth year the student is expected to have a firm foundation in basic engineering principles and fundamental sciences and a broad understanding of the humanities. All students desiring admission to fifth-year studies must apply to the Committee on Examinations and Standing. Students transferring from other institutions or from other courses of study within the University who have not completed work equivalent to the first four years of the Rice University engineering curriculum must also submit transcripts of all previous work with their application for admission. Acceptance or rejection is determined after consideration of past academic performance and the recommendation of the department concerned.

First Year

(1) Elementary Analysis (Mathematics 100) or, if eligible, Analysis (Mathematics 220)
(2) Mechanics, Heat, and Sound (Physics 100)
(3) Introductory and Analytical Chemistry (Chemistry 120)
(4) Europe since 1500 (History 100) or American History (History 110)
(5) Introduction to Critical Reading, Thinking, and Writing (English 100)
(6) Basic Health and Physical Education (H. & P. E. 101a, 102b)
(7) R.O.T.C., if elected

Second Year

(1) Advanced Analysis (Mathematics 200 or 210. Students who have taken Mathematics 220 in the Freshman year may take advanced mathematics or an elective.)
(2) Electricity and Magnetism (Physics 200 or 210)
(3) German, French, or Russian (Students having two or more high school units in a foreign language are not permitted to enroll in a beginning course in that language.)
(4) Group A elective (The same course may not be used to satisfy both this requirement and the Sophomore foreign language requirement.)

(5) Elective
(6) R.O.T.C., if elected

Third and Fourth Years

Twenty courses are required, each of at least three semester hours, for the completion of the Bachelor of Arts degree, fourteen to be in Group C and four chosen from Groups A or B. The others are undesignated. At least fourteen courses must be advanced (numbered 300 or higher).

At the discretion of his major department, a student in R.O.T.C. may substitute military science or naval science courses for one of the requirements in each semester of the last two years.

Fifth Year

Chemical Engineering. Five advanced year-courses in engineering, science, and economics approved by the major department plus a departmental seminar. For particularly qualified students with directed interests, flexibility in course planning may permit some specialization during this year in nuclear, petroleum, process, or environmental engineering.

Although separate curricula are not offered in *nuclear engineering* or *environmental engineering*, these two branches of the sciences are available as options within the chemical engineering program with somewhat more emphasis than is possible in other specializations of this branch. Those interested in learning more details of either of these branches should write the chairman of the department.

Civil Engineering. Ten advanced semester-courses in engineering or science, as approved by the major department, plus associated laboratories and a departmental seminar. Flexibility in course requirements permits some specialization in structural engineering, structural mechanics, or soil mechanics and foundation engineering.

Electrical Engineering. Ten advanced semester-courses in engineering or science approved by the major department. Technical electives permit some specialization in the general areas of systems and information theory, solid-state and physical electronics, and computer science.

Mechanical Engineering. Ten advanced semester-courses in engineering or science approved by the major department plus associated laboratories and departmental seminar. For properly qualified and prepared students, flexibility in course requirements permits specialization in aerospace engineering, engineering mechanics, thermodynamics, heat transfer, or materials science.

Architecture

First Year

(1)*Elementary Analysis (Mathematics 100) or Fundamental Concepts of Mathematics (Mathematics 101)

(2)*Mechanics, Heat, and Sound (Physics 100) or Introductory Survey of Physics (Physics 101)
(3) Introduction to Critical Reading, Thinking, and Writing (English 100)
(4)*Europe since 1500 (History 100), American History (History 110), or Ancient History (History 200)
(5) Principles of Architecture I (Architecture 100)
(6) Basic Health and Physical Education (H. & P. E. 101a, 102b)
(7) R.O.T.C., if elected

*One of these courses may be postponed until the second year if the student wishes to continue the high school language at the second year or more advanced level.

Second Year

(1) Ancient Art (History of Art 215)
(2)**Foreign language
(3) Elective in Group A, B, or C, not in Art or History of Art
(4) Principles of Architecture (Architecture 200)
(5) Drawing I (Art 225)
(6) R.O.T.C., if elected

**If a language is taken in the first year, this requirement in the second year will be filled by that subject postponed from the first year.

Third Year

(1) Principles of Architecture (Architecture 300)
(2) Drawing II (Art 325)
(3) Elective in Group A, B, or C
(4) Foreign language, or elective, if language requirement has been completed R.O.T.C.

Fourth Year

(1) Principles of Architecture (Architecture 400)
(2) Sculpture I (Art 435)
(3) Medieval Art (History of Art 315)
(4) Elective in Group A, B, or C, or R.O.T.C., unless R.O.T.C. was substituted in the third year. This elective may not be in the same group at that taken in the third year.

NOTE: At least two semester-courses of the elective in the second, third, or fourth years must be in Group B.

Fifth Year

(1) Principles of Architecture (Architecture 500)
(2) Elective in Group A, B, or C
(3) Renaissance and Baroque Art (History of Art 415)

Commerce

With the approval of the department chairman appropriate courses in the science-engineering and humanities (academic) curricula may be substituted for required commerce courses. Seven of the ten courses of the last two years must be numbered 300 or higher. Not less than three nor more than six of the total courses offered in fulfillment of the degree requirements may be in commerce. With the approval of the department chairman, students in R.O.T.C. may substitute military science or naval science courses for one of the requirements each year, but two substitutions may not be made in the same subject or group, as, for instance, the foreign language or Group B.

First Year

(1) Business Mathematics (Commerce 110), Elementary Analysis (Mathematics 100), or Fundamental Concepts of Mathematics (Mathematics 101)
(2) Science elective
(3) Introduction to Critical Reading, Thinking, and Writing (English 100)
(4) Foreign language. (Students having two or more high school units in a foreign language are not permitted to enroll in a beginning course in that language.)
(5) Introduction to Business (Commerce 100)
(6) Basic Health and Physical Education (H. & P. E. 101a, 102b)

Second Year

(1) Laboratory science or mathematics elective
(2) English elective
(3) Language elective (continuation of language elected in first year)
(4) Elective
(5) Financial Control (Commerce 200)

Third Year

(1) Group A elective
(2) Group B elective
(3) Group C elective
(4) Elective
(5) Business Statistics (Commerce 310a, first semester); Finance and Banking (Commerce 315b, second semester)

Fourth Year

(1) American History (History 110)
(2) Law and Society (Political Science 310)
(3) Group A elective

(4) Marketing (Commerce 410a, first semester); Business Finance (Commerce 415b, second semester)
(5) Business Organization I (Commerce 420a, first semester); Business Organization II (Commerce 425b, second semester)

Health and Physical Education

First Year

(1) Introduction to Critical Reading, Thinking, and Writing (English 100)
(2) Fundamentals of the Physical Sciences (Physical Science 110)
(3) Foundations of Physical Education (H. & P. E. 100a, first semester); Foundations of Health Education (H. & P. E. 110b, second semester)
(4) Laboratory (H. & P. E. 125)
(5) General Biology (Biology 100)
(6) Foreign language or Military Science or Naval Science. (Students having two or more high school units in a foreign language are not permitted to enroll in a beginning course in that language.)

Second Year

(1) English or literature elective
(2) Principles and Philosophy of Physical Education in the United States (H. & P. E. 200a, first semester); Intramural Sports, School-Community Recreation Programs, and Safety Education (H. & P. E. 210b, second semester).
(3) Laboratory (H. & P. E. 225)
(4) Foreign language (continuation of language begun in first year)
(5) American History (History 110)
(6) Elective or Military Science or Naval Science

Third and Fourth Years

At least twenty semester-courses are required, including at least six with associated laboratory work in the major, two in behavioral science, and two in political science. A minimum of fourteen of the twenty courses must be advanced (numbered 300 or higher).

Students planning to enter educational work should consult the teacher-training adviser of the department.

Graduate Degrees

Fields of Study

The degree of Doctor of Philosophy may be awarded in the fields of biology, chemical engineering, chemistry, civil engineering, economics, electrical engineering, English, ethnopsychology, French, geology, German, history, mathematics, mechanical engineering, philosophy,

physics, or space science. This degree is awarded after the successful completion of a program of advanced study extending to the frontier of knowledge and an original investigation reported in an approved thesis. Normally, three or more years of study are required after the award of a suitable bachelor's degree. At least two years of full-time study, or the equivalent of 60 semester hours, must be in residence at Rice. As final evidence of his preparation for this degree, the candidate must pass a public oral examination.

The degree of Master of Arts is available in the humanities and scientific fields of study, and the degrees of Master in Architecture or Master of Science may also be obtained, the latter being awarded in chemical, civil, electrical, or mechanical engineering. Each of these degrees represents the completion of at least 30 semester hours including the thesis, 24 of which must be done in residence at Rice. Programs will generally include a piece of original work embodied in a thesis, and the candidate's preparation will be evidenced by a public examination. Students whose undergraduate preparation has not included sufficient specialized work, or whose time is partly occupied with teaching duties, usually will require at least two years to complete the requirements for a master's degree.

Normally, departments will provide all graduate students with a limited amount of teaching experience as part of their training for advanced degrees.

Interdisciplinary programs in systems theory leading to the degree of Doctor of Philosophy are open to students with backgrounds in mathematics, applied mathematics, engineering, physical science, or social sciences. Programs of instruction utilize common courses in systems theory and applied mathematics, as well as specialized courses in the areas of principal research interest. A student working in systems theory is enrolled in one of the participating departments offering an advanced degree program in systems theory. Currently, these programs are available in the departments of Chemical Engineering, Economics and Business Administration, and Electrical Engineering. These programs are highly interdisciplinary in nature and do not necessarily require an undergraduate major in the area of primary interest to the department. Supporting courses and research activities are available in a number of cooperating departments, including mathematics and the behavioral sciences. Courses and research interests include: Algorithm Theory, Artificial Intelligence, Biological Systems, Chemical Systems, Economic Development, Information Theory, Mathematical Programming, Modelling, Modern Control Theory, Network Theory, Operations Research and Economics, Optimization, Stability Theory, and Statistical Communication Theory. For applications or additional information, contact the chairman of one of the following departments: Chemical Engineering, Economics and Business Administration, or Electrical Engineering.

Language Requirements

A candidate for the master's degree will be required to demonstrate a reading knowledge of one foreign language.

A candidate for the degree of Doctor of Philosophy will be required to demonstrate a reading knowledge of two foreign languages, usually French and German. Other foreign languages may be substituted if it can be shown that they are essential for the development of the thesis.

The Graduate Council has authorized three scheduled periods for the language examinations required of all candidates for the master's and doctor's degrees. The initial examination will be held during the first week after registration. This is the latest period in which Ph.D. candidates may fulfill the language requirements for graduation the following June. A second examination will be scheduled during the first week of the second semester, and the third examination will be conducted in the first week of May. Candidates for the master's degree must satisfy the language requirements not later than one semester prior to graduation.

Graduate students must consult with the language department to determine the exact time and place of these examinations and must inform their major departments, which will supply suitable material for examinations in the disciplines concerned. Examination results will be reported to the student's department.

Approval of Candidacy

Students seeking the master's or doctor's degree must submit a petition through their departmental chairman to the Graduate Council for the approval of candidacy. The chairman will certify that the applicant has fulfilled the University requirement of the qualifying examination, that he has passed the foreign language tests, and that the character of his own work within the department is of high quality.

The final thesis oral examination can be given only after the candidacy has been approved by the Graduate Council.

Applications for the approval of candidacy for the Ph.D. degree must be filed in the Graduate Office prior to November 15, and for the master's degree prior to March 15, of the academic year in which graduation is expected. The student must have been approved for the candidacy for the Ph.D. before the end of his sixth semester of residence at Rice in order to be eligible for continued financial support. Appointments and support of graduate study are not continued for more than four years except in legitimate cases approved by the Graduate Council.

Oral Examinations

The committee for the oral examination is appointed by the Graduate Council at the time the candidacy is approved. The oral com-

mittee consists of at least three members: the thesis director, one other member from the department, and one member in a related field outside the department.

It is the responsibility of the candidate to inform the members of his committee of the nature of his research and his progress; before April 1 the members of his committee must approve his thesis in preliminary form.

The oral examination may be scheduled at any time prior to the first Friday of Examination Week of the academic year in which the degree is expected, provided that the examination is announced in the Rice weekly Calendar of Events the previous week. In appropriate circumstances an oral examination may be scheduled during the summer. The posting of notice of the time and place of the examination on the bulletin board of Fondren Library the preceding week will be acceptable as the public announcement.

The length of the examination and the character of the subject matter on which the candidate will be examined is left to the judgment of the committee. In the event of the failure of the candidate, the chairman may reschedule the examination a second time. In the event of a second failure, the student will be required to withdraw from the University.

Thesis Regulations and Procedure

The thesis is the principal record of work for an advanced degree. It will be bound in buckram and permanently preserved in the library, and it is important that the standard form indicated in the directions provided upon approval of candidacy be followed. Copies of these instructions may be obtained from the Graduate Office.

More specific information about requirements for advanced degrees in each field of study is given under department headings in the section of this catalog describing course offerings, which begins on page 97.

By special arrangement with the head of the department in which he is specializing, a graduate student who is already a candidate for an advanced degree may enroll in an approved research course during the summer. Such enrollment will be for a twelve-week period starting with the end of the regular academic year. The registration fee and appropriate laboratory fees will be charged.

Reserve Officers' Training Corps Programs

Rice University offers two Reserve Officers' Training Corps programs—the Army and the Navy. The mission of these programs is to train college students so that they may qualify upon graduation as commissioned officers in a component of the United States Army or Navy. Upon successful completion of one of the R.O.T.C. programs and graduation with a baccalaureate degree, the student may be given a commission in the appropriate service. The Navy has two categories of midshipmen, one working toward a reserve commission and the other toward a regular commission. The Army normally awards reserve commissions; however, certain selected distinguished military students may be offered commissions in the Regular Army.

Any student suspended by the University for academic failure or other cause is immediately disenrolled from the R.O.T.C. programs. Any student performing unsatisfactory work in military or naval science courses, or possessing unsatisfactory officerlike qualities may be disenrolled from R.O.T.C. programs regardless of the quality of his academic work. Enrollment in the R.O.T.C. programs at Rice University is made at the beginning of the fall term only.

Military Science

The Department of Military Science was established in the fall of 1951. A U. S. Army officer, designated the Professor of Military Science, with assistance of officers and men of the U. S. Army, administers the program. Training in military leadership is emphasized, with instruction being given in subjects common to all branches of the Army. The Army R.O.T.C. course consists of two main subdivisions: (1) Basic and (2) Advanced. Students electing the Army R.O.T.C. program first elect the Basic Course, which may be completed by either of two methods: on campus during the Freshman and Sophomore years or off campus at a six-week summer camp between the Sophomore and Junior years. Upon completion of the Basic Course by either of these methods, the student, if recommended for further training, may elect the Advanced Course. All on-campus courses include one hour of drill per week.

In the on-campus Basic Course, Freshmen attend class one hour per week and Sophomores two hours per week.

The Advanced Course includes three classroom hours per week during the Junior and Senior years in management and command responsibilities and a six-week summer camp, normally between the Junior and Senior years, in practical military instruction.

A flight training program including thirty-five hours of ground instruction and thirty-six hours of flight instruction is available to physically qualified Army R.O.T.C. students during the second year of their Advanced Course. All textbooks, flight clothing, and equipment required for the program are provided at no cost to the student.

Four-year Army R.O.T.C. scholarships are available for award on a nationwide competitive basis to students who plan to take the Basic Course on campus, and two-year scholarships are available to Advanced Course students who have completed the Basic Course on campus.

Each scholarship student receives retainer pay of $50.00 per month with all tuition, fees, books, and equipment paid for by the Army for the period of his scholarship. Nonscholarship students receive $40.00 per month during the two years of the Advanced Course.

Graduates of this program are commissioned in the various branches of the Army based upon the preference of the individual, his academic major, and his demonstrated leadership and technical qualification.

Naval Science

The Department of Naval Science at Rice University was established in the fall of 1941 and is an integral part of the organization of the University. It is administered by a senior U. S. naval officer who is the Professor of Naval Science. He is assisted by officers and men of the U. S. Navy and Marine Corps. The purpose of the Naval Reserve Officers' Training Corps is to train highly select young men for either naval service as commissioned officers of the Regular Navy and Marine Corps (Regular Program) or as reserve officers.

Students taking five-year courses are considered eligible for enrollment at the beginning of their first or second year. In view of the heavy academic loads for fifth-year engineering students and scheduling difficulties, all students are encouraged to enroll in the regular manner during Freshman matriculation.

There are two categories of N.R.O.T.C. students: (1) Regular; (2) Contract.

Regular Students. A regular N.R.O.T.C. student is appointed a Midshipman, U. S. Naval Reserve, on a nationwide competitive basis and receives retainer pay at the rate of $50.00 per month for a maximum of four years, with all tuition, fees, books, and equipment paid for by the government. Required uniforms are furnished. He is required to complete twenty-four semester hours of naval science subjects (one course per term, including those courses taught by the

civilian faculty which are a part of the Navy curricula) and other training prescribed during the summer months, and upon graduation with a baccalaureate degree to accept a commission as Ensign in the U. S. Navy or Second Lieutenant in the U. S. Marine Corps.

Contract Students. Contract students are civilian college students who enter into a mutual contract with the Secretary of the Navy in which they obligate themselves to take naval science courses and drills and one summer training cruise. They must also agree to enlist in the Naval or Marine Reserve prior to starting the third year of Naval Science. Enlisted time during Junior and Senior years does not count in computing length of service. Should the student be dropped from the program through no fault of his own, he will be discharged from the Naval Reserve if he so desires. In return, the Navy provides the required uniforms, pays retainer pay at the rate of not less than $40.00 per month during the Junior and Senior years, and offers a reserve commission in the Navy or Marine Corps upon graduation.

Contract students are *not* selected by the competitive procedure indicated above for Regular students; rather they are selected by the Commanding Officer (Professor of Naval Science) from among those students who apply who are either selected for admission by Rice University or who are already in attendance.

U. S. Marine Corps. N.R.O.T.C. students, either Regular or Contract, may apply for transfer to the Marine Corps program during the Sophomore year. Such selectees are referred to as Marine Corps option students and attend separate classes under a Marine officer instructor during their Junior and Senior years.

The N.R.O.T.C. course of training consists of courses of instruction, laboratory periods, and drill, together with such training duty or training cruises as may be prescribed. One of several appropriate courses offered by the Department of Psychology is substituted for one semester of Naval Science.

The Navy prescribes certain course requirements for N.R.O.T.C. students as follows:

1. By the end of the Sophomore year each Regular student must have satisfactorily completed one year each of college physics and mathematics.
2. Every student must achieve proficiency in written and oral expression.

Rice University will prescribe standards of proficiency and determine procedures necessary to achieve them.

Academic Regulations

All students seeking a bachelor's degree are subject to the academic regulations of the faculty. The Committee on Examinations and Standing administers the rules described below. Under unusual circumstances any student may submit a written petition to the committee requesting special consideration.

Registration

All currently enrolled students register in May for the following academic year except for payment of fees. The University assumes that a student who does not register in May intends to withdraw from the University. Entering students are sent preliminary registration materials during the summer, but course registration is completed during Freshman Week. All tuition and fees must be paid by September 1, except where a special tuition plan has been elected.

The course registration card of each student must be approved and signed by an adviser. Registrations of Freshman and Sophomore students are approved by faculty advisers appointed in the colleges; others are approved by an adviser appointed by the chairman of the department of the student's major field of study.

No student can be registered in or allowed to enter any course or section later than two weeks after the date of opening of courses as given in the Academic Calendar (page v). A student who makes a change of course or section after the first day of classes of a term is charged a fee of $10.00 per course. This fee is not charged when a change in student's registration is a result of modification of the course offerings or class schedules of the University. However, any stipulation of this paragraph may be waived at the discretion of the Committee on Examinations and Standing.

Course Programs

Any variation from normal course programs, including reduced course loads, must be approved by the Committee on Examinations and Standings. The committee will approve a reduced load upon presentation of a request from a physician or other evidence that carrying a normal load will subject the student to undue hardship; this will not, however, entitle the student to any reduction of tuition or fees.

A student failing to complete a first baccalaureate degree within four full years is permitted to register for only those courses actually

needed for graduation, provided he is not on probation. His tuition will be determined as specified on page 72.

Approval of Majors

In the second semester of the Sophomore year, each student is required to submit his choice of major to the Committee on Examinations and Standing. The committee's action is guided by (1) aptitude shown by the student's record during the first two years; (2) limitations of departmental capacities for receiving students in the various major programs. Until a student's major has been approved he cannot enter the Junior courses of that curriculum.

Change of Curriculum

Any proposed change of curriculum is subject to the approval of the Committee on Examinations and Standing. At its discretion, the committee may require any student to change his curriculum when his work is unsatisfactory.

Examinations

Written three-hour examinations are given in all undergraduate courses at the close of each semester. Late semester examinations are given only when an examination is missed because of illness or some other unavoidable circumstance, and only on approval of the Committee on Examinations and Standing.

Other tests are given from time to time at periods decided by the instructors. All tests and examinations are conducted under a student honor system (*see* p. 90). In determining grades, instructors consider both performance during the term and the record of examinations.

Grade Symbols

Grade symbols have the following meanings: 1—Very high standing; 2—High standing; 3—Satisfactory standing; 4—Poor standing; 5—Failure. Many courses require two consecutive semesters for completion. A student who fails the first semester of a two-semester course will not be permitted to continue in the second semester, except with the written recommendation of the course instructor. Grades are recorded for the first semester in February and for the school semester in June.

President's Honor Roll

Outstanding students are honored each semester through the publication of the President's Honor Roll, which includes all students who have no grade less than 2 in any course, and also those students who have made no grade below 3 and have earned twice as many grades of

1 as of 3. This distinction is made a part of the student's permanent record. A student who carries a reduced schedule is not eligible for the President's Honor Roll.

Probation

A student who fails to do academic work of high quality is placed on probation by the Committee on Examinations and Standing if:

(1) he does not earn passing grades in at least 75 per cent of his full schedule in any semester.
(2) he does not earn grades of 3 or higher in at least 50 per cent of his normal course program in any semester.

The period of probation extends to the end of the next semester in which the student is enrolled in the University. A student is not placed on probation more than twice during his residence, but instead of a third probation is placed on academic suspension.

A student who goes on probation at the end of the year in which he is a degree candidate but who is eligible to reregister may complete his degree requirements by earning grades, in a program of at least four additional courses, that remove him from probation.

A student on probation, either academic or disciplinary, is not permitted to be a candidate for or to hold any elective or appointive office or honor, or to serve as editor, assistant editor, business manager, or assistant business manager of any University publication.

Academic Suspension

Any student whose academic standing is unsatisfactory may be suspended from the University. A student's standing is considered unsatisfactory:

(1) at any time he is failing in one-half or more of the work in which he is enrolled. This clause does not apply to an undergraduate student at the end of his first semester at the University.
(2) when, after having been placed on probation twice he fails to maintain passing grades in at least 75 per cent and grades of 3 or higher in at least 50 per cent of the semester hours in which he is enrolled.
(3) if he fails to assume his responsibilities as a student as evidenced by excessive absence from classes or laboratory sessions or continued failure to perform required assignments.

A student who has been suspended may re-enter at the beginning of the next fall semester following one year's absence from the University, unless the Committee on Examinations and Standing stipulates a different period of suspension. When a different period is under consideration, the committee will request reports and recommendations from the members of the faculty acquainted with the student and his

work and the appropriate College Master. In some instances, suspension may be permanent.

Special Probation

At its discretion, the Committee on Examinations and Standing may grant the privilege of special probation to an individual student who otherwise would not be permitted to continue at Rice University in his desired program. Special probation requires that a student shall have no grade less than 3 during the period of his special probation and, further, that he must remain off probation thereafter.

Voluntary Withdrawal and Readmission

A student who withdraws voluntarily while not on probation will ordinarily be readmitted within three years. Any student desiring to withdraw voluntarily from the University must do so in person or by letter at the Registrar's Office *to be eligible for readmission.* If withdrawal occurs within five weeks of the beginning of any semester examination period, grades as of the date of withdrawal may be used to determine eligibility for readmission.

Removal of Course Deficiencies

Course deficiencies resulting from failing grades or changes in curriculum may be removed by satisfactory work in summer school. To obtain credit for summer school work, prior approval of the Committee on Examinations and Standing for specific courses must be obtained, and a transcript showing the student has satisfied all conditions stipulated by the committee must be submitted. Credit is not given for more than two summer school courses taken to remove deficiencies, nor is credit for future courses in a student's program granted for work done in summer school.

Graduation

To be recommended for any bachelor's degree, a student must have earned grades of 3 or better in at least 50 per cent of work prescribed for that degree, including grades of 3 or better in at least 50 per cent of work undertaken in his major field after completion of the Sophomore year. He must not go on probation at the end of the year in which he is a degree candidate.

Honors

The Committee on Examinations and Standing reviews each student's record at the time of graduation and recommends to the faculty outstanding students to be granted degrees *cum laude, magna cum laude,* or *summa cum laude.*

Information for New Students

Admission of Undergraduates

Regular Decision

In selecting members of the Freshman class from the large number of well-qualified candidates who apply for admission, Rice University undertakes to identify and to admit, irrespective of race or creed, those with exceptional ability and potential who appear best prepared to grow toward intellectual maturity.

The criteria used in the prediction of such development are of four basic types: 1) scholastic record as reflected by courses chosen and the quality of performance; 2) scores made on the Scholastic Aptitude and Achievement Tests administered by the College Entrance Examination Board; 3) the evaluation made by teachers, counselors, and interviewers; and 4) performance on the College Entrance Examination Board Writing Sample. Scholastic performance provides a reasonable indication of the applicant's study habits, and self-discipline. College Entrance Examination Board scores furnish a credible basis to compare one individual with a very large number of other persons of similar background (when set to a specific scholastic assignment). Interview reports and ratings obtained from high school teachers and counselors give some insight into extracurricular areas of development and such currently unmeasurable factors as motivation, family background, and emotional stability, which must also be considered.

The experience of Rice University indicates that those most likely to succeed are the applicants who have, in addition to the obvious desirable personal traits, scholastic standing in the upper 10 per cent of their graduating classes and very high College Entrance Examination Board scores. Not all students with high scholastic standing in high school and good College Entrance Examination Board scores become outstanding Rice students; however, nearly all well-adjusted, well-motivated students of high intellectual capacity and intellectual curiosity have good chances of success.

Students are selected on a competitive basis in accordance with admission quotas in the Architecture, Humanities (Academic), and Science-Engineering programs of the University.

For further information, or application forms, candidates for admission as undergraduates should communicate with the Director of Admissions. When requesting application forms, the candidate should clearly indicate whether he is a prospective high school graduate or a

prospective transfer from another college. Freshman application forms should be requested and filed between October 1 and February 1 for entrance the following September, except for the Early Decision candidates.

1. The High School Record. Graduation from an approved public or private high school with not less than sixteen acceptable units is required. The record must include the following units:

English	4	Laboratory science	2
Social studies	2	(Biology, chemistry,	
Algebra	2	physics)	
Plane geometry	1	Additional credits	
Trigonometry	½	in above-listed solid	
Foreign language	2	subjects	2½
		Total	16

Both physics and chemistry are required of applicants for the Science-Engineering Division. A course in high school chemistry is prerequisite to the first-year course in chemistry.

2. Entrance Examinations. The entrance examinations and the writing sample are administered by the College Entrance Examination Board. The C.E.E.B. publishes a "Bulletin of Information" which contains an application blank and gives full details regarding the procedures for taking the entrance examination and the writing sample, and also a schedule showing the time and place of administration. Applicants should write to the C.E.E.B. and request a copy of this bulletin. Interested persons in the Southwest and other areas east of the Rocky Mountain states should address the College Entrance Examination Board, Box 592, Princeton, New Jersey. Applicants attending schools in New Mexico, Colorado, and points west should address the College Entrance Examination Board, Box 1025, Berkeley 1, California. A supply of C.E.E.B. bulletins is available on the Rice campus for those individuals who find it convenient to call for them. These examinations may be taken no later than December and January of the Senior year.

The following examinations are specified, according to the curriculum involved:

Academic and Architecture

(1) Scholastic Aptitude Test
(2) Three Achievement Tests as follows:
  (a) English composition
  (b) Any two of the following:
    A foreign language
    American History and Social Studies

Science-Engineering

(1) Scholastic Aptitude Test
(2) Three Achievement Tests as follows:
  (a) English composition
  (b) Mathematics (Level I or Level II)
  (c) Chemistry or physics
(3) The Writing Sample

European History and
World Affairs
Mathematics
A science

(3) The Writing Sample

(4) For Architecture candidates only: Architectural School Aptitude Test

A list of the courses of study and majors offered may be found on pages 46-55.

3. Personal Interviews. Interviews are an integral part of the admission procedure. They enable the Admissions Committee to reach a decision based on nonacademic, as well as academic, aspects of the candidate's development. The candidate should arrange for an interview before February. Campus interviews will be held at 109 Lovett Hall between the hours of 9 A.M. and 4 P.M., Tuesday through Friday, and until 11:30 on Saturday mornings. Applicants who cannot visit the University or who are unable to meet with a traveling member of the Admissions Committee may be interviewed by alumni interviewers located throughout the United States and in several foreign countries. If an applicant cannot be interviewed by one of these methods, the interview will be waived without prejudice.

4. Evaluations from High School Counselors and Teachers. Confidential rating sheets submitted by the applicant's high school teachers and counselors are considered in connection with every application.

The Committee on Admissions cannot give final consideration to applications until the results of the College Board tests are available. Notices regarding the action taken by the committee are sent to applicants during the early part of April.

A student who has been admitted to the University is required within two weeks after the date on the notice of his acceptance to submit a written statement of his intention to enroll, accompanied by a payment of $25 which will be credited to his account as part payment of the fees required at the opening of the session. The payment will be returned if the student changes his plans and serves notice before June 1. After that date, it will be refunded only in cases of hardship, such as illness. Should a student fail to register without giving notice of his intention prior to June 1, the $25 payment will be forfeited.

Room application forms and detailed information about residence in the colleges will be sent when admission is granted.

Early Decision Plan

Students who have completed the required College Board tests and who agree to wait for a decision from Rice before applying to another college, may file applications as early as July 1 after the Junior year

in high school. *Their applications must be complete by October 15.* Early Decision applicants will be notified of the Admissions Committee's decisions by November 15.

Requirements for admission will not be altered by an early decision. Those accepted will be expected to complete all of their high school work with suitable grades.

A candidate admitted under the Early Decision Plan will be required to make a deposit of $100 at the time of notification of admission. An additional deposit of $50 must be made by one who wishes to reserve space in one of the residential colleges.

An unsuccessful candidate for early decision may reapply for regular admission when additional criteria are available. The candidate's opportunity for admission under regular decision will not have been jeopardized by his unsuccessful Early Decision application. He would, of course, be released from his pledge to file an application exclusively at Rice.

A candidate applying under the Early Decision Plan who wishes to be considered for scholarship must file the Parents' Confidential Statement with the College Scholarship Service by October 1. Those accepted will be notified of the scholarship decision at the time admission is assured. *Applications for financial aid filed by Early Decision candidates after the October 1 deadline cannot generally be acted upon before the time of regular admission in April.*

Advanced Placement

Entering Freshman students who have done work well beyond the usual high school courses in certain subjects and who make superior scores on the Advanced Placement examinations offered by the Educational Testing Service may be given recognition for their achievements. Degree credit and advanced standing may be given in the following subject-matter fields: biology, English, French, German, history, physics, and Spanish. Students who make superior scores on the examination in chemistry may earn degree credit in chemistry by completing certain required laboratory work in quantitative analysis during their Freshman year.

Placement examinations in mathematics are given on the campus in the fall. A satisfactory grade permits the student to enroll in Mathematics 220 but does not give him credit for Mathematics 100.

Admission of Transfer Students

The number of candidates who may be accepted as transfers from other colleges and universities is limited by the capacity of the University to absorb them. In order to be considered for admission as a transfer student, the applicant must have completed ten semester-courses which are applicable to the degree he will seek at Rice.

Candidates for transfer should communicate with the Director of

Admissions before March 1. When requesting application forms, the applicant should indicate clearly the courses he will have completed in his present college by the following June. The transfer applicant who has never taken the C.E.E.B. tests will improve his chances by securing high scores on the Scholastic Aptitude Tests.

Decisions regarding transfer applications are usually made during May.

Student Housing

A prospective student should indicate on his application for admission whether or not, if admitted as a student, he desires to reside on the campus. Detailed information about residence in the colleges and room application forms will accompany the notice of admission sent to each new undergraduate. To reserve rooms it is essential that applications be submitted as directed. New undergraduate women students who do not live with their families in metropolitan Houston are required to live in one of the women's colleges. All other undergraduate women must secure permission from the Dean of Women if they wish to live off campus. Undergraduate women students are not permitted to live either alone or with other undergraduate women students in apartments, unless chaperoned by a responsible adult.

Correspondence from new students regarding housing in the residential colleges for men should be addressed to the Office of the Masters. Similarly, correspondence from new students regarding residence in the women's colleges should be addressed to the Dean of Women.

Scholarships and Loans Available to New Students

Rice University recognizes its continuing responsibility to provide the highest quality instruction for a limited number of exceptional students. To this end the University provides a program of financial assistance based on the applicant's need in order that no qualified student will be denied admission because of an inability to pay tuition. The program combines the use of scholarship funds with loan funds in an attempt to provide students with sufficient aid to meet educational expenses beyond the resources of the student and his parents.

It must be realized, however, that financing higher education is primarily the responsibility of the student and parent and, since available University scholarship and loan funds are limited, each applicant is urged to take advantage of any opportunity to seek other scholarship aid.

Applicants for financial aid must file the Parents' Confidential Statement with the College Scholarship Service before February 1. Candidates applying for admission under the Early Decision Plan must obtain the Parents' Confidential Statement forms from the

Office of Admissions at Rice and must file them with the College Scholarship Service by October 1.

The Parents' Confidential Statement forms for regular decision may be obtained from high school counselors or directly from the College Scholarship Service, Box 176, Princeton, New Jersey. Request for additional information about financial assistance should be addressed to the Financial Aid Officer, Rice University, Houston, Texas 77001.

Notifications of offers of financial aid will accompany notices of admission to Rice.

Admission of Graduate Students

An applicant for admission to graduate study should address all communications to the chairman of the department in which he wishes to study. The chairman will provide the relevant information about the graduate program and the appropriate application form. The completed form, with the transcript and photograph, should be returned to the chairman of the department. After the members of the staff have made a preliminary evaluation, the application form with the letters of recommendation will be transmitted by the chairman to the Graduate Council for final action.

In addition to any specific requirements of the department, the applicant will be expected to have at least a "B" average in his undergraduate work. Preference will be given to applicants who earn high scores on the Graduate Record Examination. Arrangements to take this examination may be made directly with the Educational Testing Service, 20 Nassau Street, Princeton, New Jersey. Applicants in the Houston area may also apply in person to the Graduate Office at Rice for the necessary forms.

Fees and Expenses

Tuition and Fees

Undergraduate

The tuition and fees charged to all undergraduate students who entered Rice in 1965, or will enter in 1966, are as set forth below. Students who entered prior to 1965 will continue to be charged as described in the *General Announcements* for 1964-65 so long as they continue without interruption to the completion of the baccalaureate sought.

An undergraduate who withdraws from the University and returns at a later date will be charged the same tuition as is being paid by the members of the class he enters upon his return.

A student who has not completed the requirements for his bachelor's degree after four full years of study (or after five years if a candidate for a five-year bachelor's degree) will be charged full tuition unless a reduced tuition rate has been specifically approved for him as the result of a petition submitted to the Committee on Financial Aid.

Tuition

The tuition for all undergraduate students who entered Rice University in September, 1965, or will enter in September, 1966, is $1,200 per year, payable $600 at the beginning of each semester. Rising costs of education may well require an increase in tuition charges in the near future.

Fees

Each student entering in 1966 is charged the following annual fees, which are paid at the beginning of the term in the fall.

Subsidies to students' activities	$11.50
Tickets to athletic events	4.00
College fee	15.00
Health Service	12.00
Total fees charged to new undergraduate students in 1966-67	$42.50

In addition, each student pays a laboratory fee of $10.00 per semester for each of the laboratory courses in which he is registered.

Special Charges

Freshman Week	$20.00
Late Registration	15.00
Late Change of Registration, each course	10.00
Diploma	6.00
Army R.O.T.C. (Deposit)	10.00

Graduate

Tuition and Fees

Tuition for full-time students enrolled in the Graduate Division is $1,500 per year, payable $750 at the beginning of each semester. In addition, each graduate student pays an annual Health Service fee of $12.

The graduate programs at Rice University are designed for full-time study, but, in special circumstances, students are admitted to graduate study on a part-time basis. Such application must be marked "Part-Time" on the face of the application. For such students, the tuition is $60 per semester hour plus a $50 registration fee for each semester or summer period. All other fees are applicable except that part-time students are not required to join the Student Health Service.

All foreign students are required to carry health insurance; the annual cost is approximately $26 for an individual, $65 for a couple, or $95 for a family. This expense is not included in the tuition or fees.

Graduate students who have completed all the course and residence requirements for an advanced degree and have only the thesis requirements to fulfill may do so *off campus*. In such cases, registration and payment of the $50 registration fee is required in the year the degree is to be received.

A graduate student may purchase a Student Athletic Card, at a cost of four dollars, which will entitle him to admittance to all regularly scheduled athletic events. If married, he may purchase a season ticket for his wife at a reduced rate of one half the regular price, provided the season ticket is purchased at the beginning of the fall term. The same privilege is extended to married undergraduate students.

Refund of Tuition

If a student withdraws from the University before the beginning of the second week of classes, 90 per cent of the tuition paid will be refunded. Thereafter, the amount of the refund will be reduced by 10 per cent of the total tuition charge each week that the student remains enrolled. There is no refund of fees or special charges after a student once attends classes.

Student Teaching Internship Fees

Regular students who have just completed a bachelor's degree and go immediately into the summer program and internship will be required to pay only the present course fee of $62.50 each summer or term of internship until the summer of 1969. After that such students will also be charged the summer registration fee of $50.

Former students admitted for the purpose of completing teacher certification will pay the $50 registration fee in addition to the course fee of $62.50 each summer or term of internship, this charge to begin with the summer of 1966.

Guaranty Bond

Every undergraduate student is required to provide a $300.00 guaranty signed by himself and a parent, guardian, or other responsible adult, excluding a spouse or another student.

Delinquent Accounts

No student in arrears in any financial obligation to Rice University as of September 1 of any year will be registered. All accounts must be paid or satisfactory arrangements for payment made before a student will be issued any certificate of attendance, diploma, or transcript of credit.

Transcripts

Transcripts are issued on requests made to the Office of the Registrar. No transcript is issued without consent of the individual whose record is concerned. Each student is entitled to two free transcripts. There is a charge of $1.00 for each additional copy, payable in advance. Those requesting transcripts by mail should include payment with the request.

Living Expenses

Undergraduates

Residence fees to cover costs of dining halls, operation of residences, and the Health Service are established from year to year as requirements dictate. For 1966-67, the yearly fee for residence in the men's colleges will be $1,006.20, in the women's college $1,056.20. This charge provides for room and three meals per day excluding the evening meals on Saturdays and Sundays. Meals are not served during the Thanksgiving, Christmas, mid-term, and Easter recesses. The women's colleges are closed to all residents during the two-week Christmas recess. A room

deposit of $50 is required of each student by June 1 in order to secure his assignment for the academic year to follow. New students are required to make a similar deposit upon notification of room assignments during the summer. These deposits are returnable only upon individual application and for good and sufficient cause. The balance of the residence fee is payable in two approximately equal installments. The exact amounts and due dates are stated in the Residential College Agreement which each resident is required to sign.

All items included, the young man or woman entering Rice University in September, 1966, who will live on campus will need to have available about $2,950 for the first year. For a student living at home the cost will be about $1,700 to $1,800.

Graduate Students

At present the University has no housing on the campus for graduate students. However, within walking distance of the campus there are many rooms and apartments for rent at reasonable prices. For the convenience of new students, the Dean of Students keeps a record of rooms and apartments about which he has been notified, and the daily newspapers list still others. Incoming graduate students are advised to arrive in Houston a day or two early in order to find lodging.

Occasionally room and board for a graduate student may be available in one of the undergraduate residential colleges for men ($1,006.20 per year) or in one of the women's colleges ($1,056.20 per year). A graduate student wishing to be considered for such a room may write to the Dean of Students or to the Dean of Women asking to be put on the waiting list. It will be advisable, however, to assume that lodging must be found off campus, since obtaining an accommodation on the campus is unlikely and since the deans may not know before the term begins about vacancies in the colleges.

Scholarships, Fellowships, Grants, Loans, and Employment

Undergraduate Scholarships and Grants

To encourage students in devotion to learning and in striving to develop creative capacity in productive scholarship many friends of Rice University have established undergraduate scholarships and grants-in-aid. These are reserved principally for students who have been in residence at least one year, although a few are designated for entering Freshmen with exceptional records. Honorary scholarships without stipend are also awarded to students who have demonstrated outstanding ability and promise of future development.

The Board of Governors has established a program of tuition scholarships extensive enough to assure that no student will be denied admission because of inability to pay tuition. The total amount of these scholarships is the equivalent of 175 four-year, full-tuition awards and 75 four-year, partial-tuition awards. In addition, the Board has established ten four-year, full-tuition Prize Scholarships to entering Freshmen with very exceptional records, awarded without regard to financial need of the recipients.

Alcoa Foundation Scholarship. Awarded to a student of engineering who is in either the Junior, Senior, or fifth year of study.

American Institute of Chemical Engineers, South Texas Section. Provides a scholarship for a student of chemical engineering who is a resident of the area served by the Section.

Amyx Memorial Scholarship. Established in 1964 by the Gulf Coast Section, Society of Petroleum Engineers of the American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., as a memorial to James W. Amyx. Awarded annually to a Sophomore in an engineering program related to the mineral industry.

Achievement Rewards for College Scientists Foundation Scholarships. Established by the Houston chapter in 1965 to assist students of science and technology who excel in these fields and who need monetary assistance to pursue their educations.

Samuel S. Ashe Scholarship. Awarded annually to the student having highest standing at the end of the Freshman year.

Associated General Contractors of America Scholarships. Established by the Houston chapter in 1965 to assist students in civil engineering and awarded on the basis of scholarship and promise for future professional achievement.

Max Autrey Memorial Scholarships. Established under the will of the late Mrs. Nettie S. Autrey in memory of her son. First awarded in 1942, they are open annually to all current students.

Axson Club's Ellen Axson Wilson Scholarship. Established in 1922 in memory of Mrs. Woodrow Wilson for a young woman student of Junior or Senior standing.

Axson Club's Katie B. Howard Scholarship. For young women of Junior or Senior standing, in memory of Mrs. A. R. Howard; has been awarded annually since 1937.

Graham Baker Studentship. The first undergraduate scholarship established at the Rice Institute. It is awarded annually to the student in the three lower classes earning the highest scholastic standing for the academic year.

James A. and Alice Graham Baker Scholarship. Established by the will of James A. Baker in 1941 to encourage and assist needy and worthy students.

R. C. Baker Foundation Scholarships. Four scholarships in mechanical engineering honoring the founder of Baker Oil Tools, Inc.

Mr. and Mrs. Val T. Billups Scholarship. Established by the named donors in 1953 for students of engineering above Freshman standing.

Black-Brollier Scholarship. Established in 1956 for students in architecture above Sophomore standing. Awards are made annually during the first semester.

Borden Freshman Prize. Given to the student having the highest grades for all work of the Freshman year.

Brochstein Foundation Scholarships. Established in 1965 to assist and encourage worthy undergraduate students.

Cabot Engineering Scholarships. Two-year award made available by the Cabot Foundation for a Senior male student in chemical or mechanical engineering.

Chapman-Bryan Memorial Scholarship. Created in 1937 by the bequest of Miss Johnelle Bryan on behalf of her sister, Mrs. Bryan Chapman, and the donor.

College Women's Club Scholarship. Established in 1942 to provide

a scholarship to assist a young lady in her first year of graduate study. The scholarship is awarded annually to a graduating Senior.

Continental Air Lines Foundation Scholarships. Established in 1964 to assist and encourage a worthy undergraduate student.

Continental Oil Company Scholarship. Awarded to a student with high standing in chemical engineering.

Millie Tutt Cook Scholarship. For the benefit of a Junior or Senior student preparing for a career in teaching.

Thomas A. and Pauline M. Dickson Scholarships. Established in 1932 to assist young men and women students who are largely self-supporting.

Distinguished Student in Architecture Scholarship. A fund contributed by Mr. Gus S. Wortham in 1962 makes possible awards to architecture students of outstanding ability.

E.B.L.S.-E.B.L.S. Alumnae Scholarship. Established in 1926 to assist a young woman student of the University.

Engineering Alumni Scholarship. Awarded to a student who is a candidate for a Bachelor of Science degree in one of the four branches of engineering.

Ray C. Fish Foundation Scholarships. Established in 1965 to aid and encourage a deserving young man and young woman of the entering class.

Thomas Flaxman Scholarship. Established in 1962 by Mr. Thomas Flaxman in honor of Dr. Lindsay Blayney to assist in providing educational opportunities for deserving students.

Walter W. Fondren, Jr., Memorial Scholarship. Established in 1961 by Mr. and Mrs. W. B. Trammell in memory of Walter W. Fondren, Jr., to assist men or women students.

Thomas R. and Julia H. Franklin Scholarships. Established in 1937 for annual scholarships to well-qualified, necessitous students.

General Motors Scholarship. A scholarship for an entering Freshman, renewable through four years contingent on satisfactory work.

Gibraltar Savings Association Scholarship. Established in 1959 for a male member of the entering Freshman class whose intention is to concentrate in the field of economics or business administration.

Mary Parker Gieseke Scholarship. Awarded annually to a student who has been in residence at least one year.

Blanche Randall Haden Scholarship. Awarded annually to a deserving undergraduate specializing in economics.

William D. and Lucy L. Haden Scholarships. Founded by Mr. Cecil R. Haden for entering students in architecture.

Haskins and Sells Foundation Scholarship in Accounting. Awarded to a Senior student having high academic standing in accounting, and planning to enter the fifth year of the accounting program.

William Clifford Hogg Fund. Established by the will of William Clifford Hogg in 1936. From this fund two scholarships are awarded annually, the *Will Hogg Memorial Distinguished Studentship* and the *Will Hogg Memorial Scholarship.*

Hohenthal Scholarships. Awarded to students of high scholastic standing who are earning a substantial part of their expenses.

Houston Engineering and Scientific Society Scholarship. Awarded to a Senior or fifth-year engineering student who is recommended to the Society by a committee of the University faculty.

William V. Houston Scholarship. An award to an incoming male Freshman student established in 1961 by Dr. George Robert Kolodny.

M. M. Feld and J. P. Hamblen Interfaith Charity Scholarship. Provided by the Interfaith Charity Bowl, Inc., to assist a student active in interfaith pursuits.

Louis F. Israel Premedical Scholarship. Donated by Dr. Israel in 1962 to assist a needy and worthy premedical student.

John McKnitt Alexander Chapter of the Daughters of the American Revolution Scholarship. An endowed undergraduate scholarship for a young woman student of Rice University.

Joint Organization for Business Survival Scholarships. Established in 1965 to assist students in the general area of marine biology and oceanography.

Jones College Scholarship. Made available by the Mary Gibbs Jones College Cabinet for a member of the college who has maintained high academic standing and has contributed significantly to the college life.

Jesse H. Jones Naval Scholarships. Given in honor of Fleet Admiral William F. Halsey, Jr., and General Alexander Archer Vandegrift. All members of the N.R.O.T.C. unit, including entering students are eligible.

Grant William Jordan and Cora Jordan Memorial Fund. Available

in trust to assist young men and women in obtaining an education at Rice University.

Louise S. Koehler Scholarship. Established in 1965 by the will of Louise S. Koehler for the assistance of young women in securing an education at Rice University.

Lady Washington Texas Centennial Award. Made annually to a young woman student from funds donated by the Lady Washington Chapter of the Daughters of the American Revolution.

Patrons of E. L. Lester and Company Scholarship. An annual award provided by E. L. Lester and Company in honor of its employees and customers, for an entering male student in engineering, physical science, or related fields.

Lubrizol Scholarship. Provided by the Lubrizol Foundation for a third-, fourth-, or fifth-year student in chemical engineering.

Margaret Brokaw McCann Scholarship. Established by her husband, the late S. G. McCann, first Rice Registrar, by their son, Dr. S. M. (Donald) McCann, and by many friends, it is awarded to a high-ranking, deserving young woman of one of the three upper classes, who plans advanced work in nursing, medicine, or other welfare fields. It was first awarded for the 1963-64 academic year.

John T. McCants Prize in Accounting. Established by friends in 1965 in honor of Mr. John T. McCants, first Bursar of Rice University. Awarded to a deserving Senior planning to enter the fifth year of the accounting program.

Emma S. McGree Scholarships. Established by the will of Mrs. Emma S. McGree in 1964 in honor of Miss Katie Scherffius and Mr. John T. Scherffius; for entering Freshmen men and women.

T. S. Martino Scholarship. The will of T. S. (Tony) Martino, longtime head gardener of the campus, bequeathed a generous fund which will provide scholarship assistance for undergraduate students.

Leonard S. Mewhinney Scholarship. Established in 1952 by the Brown Foundation, is awarded to a Naval R.O.T.C. engineering student enrolled in his fifth year at Rice University who has attained high academic standing and demonstrated aptitude for the naval service.

Achille and Malline Meyer Memorial Scholarship. Awarded annually to a fully or partially self-sustained student of the University.

Fannie Bess Emery Montgomery Scholarship. Established in 1963

by the John McKnitt Alexander Chapter of the Daughters of the American Revolution to assist a worthy young woman.

Ida R. and Hannah E. Nussbaum Scholarship. Provides an undergraduate scholarship in memory of the late Miss Ida R. Nussbaum and her sister.

Rebecca Raphael and Lilly G. Nussbaum Scholarship. Established under the will of the late Miss Ida R. Nussbaum in memory of her mother and sister.

Prize Scholarships. Established by the Board of Governors of Rice University in 1965. Tuition scholarships awarded without regard to financial need to very exceptional students admitted to the Freshman class.

Procter and Gamble Scholarships. A four-year scholarship established by the Procter and Gamble Company for one or more entering Freshmen who plan to study in the field of engineering or science. The first award was made in the fall of 1963.

Emanuel and Mose Raphael Scholarship. Established by bequest of Miss Ida R. Nussbaum in memory of her uncles.

William Marsh Rice Scholarships. Established by the Board of Governors of Rice University in 1965. Tuition scholarships awarded to students from Texas having financial need.

Richardson Fund. Bequeathed in trust by Mrs. Libbie A. Richardson, widow of Alfred S. Richardson, who was a charter member of the Board of Trustees of Rice University.

Daniel Ripley Scholarship. Established in 1927 by the late Mrs. Edith Ripley in memory of her husband. Awarded to a self-supporting young man or woman completing the Freshman year with outstanding scholarship.

Edith Ripley Scholarships. Established in 1928 by the late Mrs. Edith Ripley to be awarded annually to three young women students.

James M. and Sarah Wade Rockwell Scholarships. Established by a fund donated in 1958 in memory of the founders of the Rockwell Fund, Inc.

Catherine Withers Roper and Benjamin E. Roper Memorial Scholarships. Established through the will of their daughter, Miss Mary Withers Roper, to assist worthy students of the University.

Schlumberger Collegiate Award. Given by the Schlumberger Foundation for an advanced student with high standing in physics, geology, or electrical or mechanical engineering.

Standard Oil Company of California Scholarship. Awarded to an undergraduate student of good academic standing and on the recommendation of the A.I.Ch.E. Student Chapter.

Sara Stratford Scholarship. For women students of Rice University commemorating the late Mrs. Sara Stratford, first Adviser to Women.

Superior Oil Company Scholarships. Provided through a gift from the Superior Oil Company to assist worthy entering students who are planning to study physics.

Tau Beta Pi Scholarship. Awarded to a Sophomore or Junior engineering student with high standing from funds of the Gamma Chapter.

Texaco Scholarships. Made possible by Texaco, Inc. Awarded to Junior and Senior students of proven scholastic ability who have demonstrated qualities of leadership.

University Scholarships. Established by the Board of Governors of Rice University in 1965. Tuition scholarships awarded to students having financial need regardless of residence.

Abe and Rae Weingarten Scholarships. Established by the named donors in 1963 to assist needy and qualified students to continue their education.

Harris Weingarten Scholarship. Established by Abe and Joe Weingarten in memory of their father. First awarded in 1957.

Western Electric Fund Scholarship. Maintained by the Western Electric Fund for a student in engineering who has demonstrated exceptional promise and ability in his chosen field.

Blanche White Honor Scholarships. Awarded solely on academic excellence to students earning exceptionally high scholastic standing.

Graduate Fellowships and Scholarships

Fellowships

Provision is made for a variety of fellowships available to graduates of this and other universities. There are several memorial fellowships that have been founded and endowed by gift or bequest on the part of friends of Rice University. These provide a stipend designed to enable the holder to devote his time to study and research in his chosen field. There are also several industrial fellowships maintained by companies interested in the development of technical fields and the training of competent scientists and engineers.

Persons desiring to be considered for appointment as fellows should consult with the department in which they desire to work.

M. D. Anderson Fellowships in physics.

Ora N. Arnold Fellowship Fund. Graduates of Rice University or of Mexico may be appointed. An incumbent from Rice may study in Mexico, the South American states, the West Indies, or the Philippine Islands; an incumbent from the University of Mexico is expected to study at Rice University.

Atlantic Refining Company Fellowship in chemical engineering.

Samuel Fain Carter Fellowship for graduate study in economics.

Celanese Corporation Fellowship in chemical engineering.

Continental Oil Company Fellowship in chemical engineering.

M. N. Davidson Fellowship in architecture. Awarded to a fifth-year student.

Camille-Henry Dreyfuss Fellowship in chemical engineering.

Dow Chemical Company Fellowship in chemical engineering.

Ethyl Corporation Fellowship in chemical or mechanical engineering.

Ideal Cement Company Fellowship in civil engineering.

Edgar Odell Lovett Fellowship in mathematics.

Mrs. L. F. McCollum Fellowship.

National Aeronautics and Space Administration Traineeships.

National Defense Education Act Fellowships.

National Institute of Health Traineeships.

National Science Foundation Traineeships.

Petroleum Research Fund of the American Chemical Society. Fellowship in chemistry.

Phillips Petroleum Company Fellowship in mathematics.

Schlumberger Foundation Fellowship in mathematics.

Shell Oil Company Fellowships. One fellowship is available for study in physics and another for study in mechanical engineering.

Sun Oil Company Fellowship in chemical engineering.

Texas Company Fellowship in electrical engineering.

Union Carbide Fellowship in Chemistry.

United States Public Health Service Traineeship Awards in environmental engineering and biology.

William Ward Watkin Memorial Traveling Fellowship in architecture. Provision for a Rice University traveling fellowship in architecture has been made by the alumni of the Department of Architecture and the Rice Architectural Society. The award is based on a competition open to fifth-year and graduate students, and also to alumni under thirty years of age holding a professional degree in architecture.

Robert A. Welch Foundation Fellowships.

Rice Graduate Fellowships

Graduate students with high academic records and outstanding qualifications may receive assistance through awards of Rice University Fellowships. The stipend for these appointments range up to $3,200 for a twelve-month tenure or three-fourths of the stated amount for nine-month tenures. Rice University Fellowships provide an additional grant of $1,500 for the tuition.

In some departments, Rice Teaching Assistants may be awarded to advanced (third- or fourth-year) students. If exceptional teaching ability has been demonstrated, appointments known as Teaching Associates are available.

Graduate Tuition Scholarships

Students whose previous records show marked promise but for whom no graduate assistantships are available may, especially in their first year of graduate study at Rice University, be awarded graduate tuition scholarships without stipend. Graduate scholars may carry a full schedule of graduate work.

Other Graduate Fellowships

In addition to the above fellowships, students may also pursue advanced studies througn Woodrow Wilson Fellowships and National Science Foundation Fellowships as well as by awards made from grants to the University through such agencies as the Atomic Energy Commission, the National Institutes of Health, and the National Aeronautics and Space Administration.

The Committee on Graduate Instruction processes applications for fellowships submitted by graduate students of Rice University for research in other institutions and in other countries. Among available fellowships of this nature are the Rotary International Fellowship, the Rhodes Scholarships, the Frank B. Jewett Fellowships awarded by the Bell Telephone Laboratories, and the National Science Foundation Fellowships.

Rice is one of the sponsoring universities of the Oak Ridge Institute of Nuclear Studies. The Oak Ridge Institute provides a number of fellowships to doctoral candidates who have completed their residence requirements and who want to work on a thesis problem at Oak Ridge because of the special facilities which are available.

Student Loans

Students who find themselves in need of financial assistance to help defray academic expenses, such as fees, books, and room and board charges, should address inquiries to the Financial Aid Officer, Lovett Hall. Two types of loan funds are administered by this office, the National Defense Student Loans and loans provided through the generosity of a number of friends of the University.

Karl Bailey-William Carroll Memorial Loan Fund. Established in 1956 by friends of Karl B. Bailey and William Carroll.

Frank McFadden Caldwell Loan Fund. Established in 1953 by Mr. and Mrs. L. C. Caldwell in memory of their son, Frank McFadden Caldwell.

Louise Adele Drenkle Loan Fund. Established in 1965 by Mrs. Camille W. Brown in memory of Louise Adele Drenkle, widow of Colonel James Wood Nichols.

Mary Alice Elliott Loan Fund. Established in 1931 in memory of Mary Alice Elliott by her parents, Mr. and Mrs. Card G. Elliott. Awarded to a fifth-year student or alumnus of the Department of Architecture under thirty years of age for foreign travel and study.

Houston Bridge League Loan Fund. Established in 1962 by the Houston Bridge League.

Leo M. Levy Memorial Loan Fund. Established in 1947 by the Jewish Family Service.

Lora B. Peck Loan Fund. Established by the College Women's Club of Houston in 1951.

President's Loan Fund. Established by various friends of the University in 1915.

Rice University Students Loan Fund. Established in 1923 by a group of friends of the University.

Students Memorial Loan Fund. Established in 1936 by the will of William Clifford Hogg in memory of his father and mother.

Owen Wister Literary Society Alumnæ Loan Fund. Established in 1940 by the Owen Wister Literary Society Alumnæ.

Student Employment

It is strongly recommended that students in their first year do not plan part-time employment unless absolutely necessary to meet expenses. A college course of study is a full-time job requiring fifty to sixty hours per week to do justice to the educational opportunities presented through course work. In addition, every student should take advantage of the many other opportunities for growth and development that come through participation in the social, political, and cultural activities of the colleges and the student government. New students who must supplement their income are advised to consult the Financial Aid Officer.

There are on the campus and in the city opportunities in considerable variety for worthy and deserving students to earn a part of their expenses. Interested students should visit the Placement Office in the Memorial Center as early as possible.

Academic Honors and Prizes

Honor Societies

The *Phi Beta Kappa Society.* The Senate of the United Chapters of Phi Beta Kappa at its meeting in December, 1927, voted to recommend the establishment of a chapter at the University and at a meeting of the National Council held in September, 1928, the institution of the Rice, or Beta of Texas, chapter was duly authorized. The chapter was formally installed on March 1, 1929, by the secretary of the United Chapters.

The *Society of the Sigma Xi,* for the promotion of research in science, on the occasion of its thirty-eighth annual convention in December, 1937, acting upon the recommendation of the Executive Committee, duly authorized the establishment of a chapter of the Society at the University. The formal installation of the Rice chapter by the president of the national organization took place on March 23, 1938.

The *Tau Beta Pi Association,* organized to interest engineering students in competing for high standing in scholarship, authorized at its annual convention in October, 1940, the establishment of a chapter of the Association at the University. The Rice chapter, the Gamma of Texas, was formally installed on December 18, 1940, by the national secretary of the Association.

Delta Phi Alpha, German national honorary society, was founded to promote among university students an interest in the German language and literature. The National Council in April, 1949, authorized the organization of the Gamma Xi Chapter at Rice.

Phi Lambda Upsilon, an honorary chemical society, has as its purpose "the promotion of high scholarship and original investigation in all branches of pure and applied chemistry." The Alpha Alpha Chapter was installed at the University in 1927.

The *Pi Delta Phi Society,* organized to interest students of French in competing for high standing in scholarship, authorized in May, 1930, the formation of a chapter of the Society at Rice. The Theta Chapter was formally installed in that year by a delegate of the national organization.

Sigma Delta Pi, Spanish national honorary society, was founded to promote among university students an interest in the Spanish language and literature. The chapter at the University was installed on May 14, 1953.

Sigma Gamma Epsilon is a college honor society in the earth sci-

ences. The Beta Sigma Chapter was established in the Geology Department of the University on March 31, 1958.

The Alpha Zeta Chapter of *Sigma Tau,* an engineering society devoted to scholarship, practicality, and sociability, was installed at the University on May 20, 1953.

Tau Sigma Delta, a National Honor Society in Architecture and Applied Arts. The Tau Chapter was established at the University on May 7, 1961.

Prizes and Awards

Several prizes and awards are presented annually in recognition of accomplishment in various endeavors. They are made possible by individuals and organizations who wish to encourage students in certain activities and honor the name of a friend or relative. These prizes constitute a signal honor to the recipient.

The American Institute of Architects Award is presented to a fifth-year architectural student on the basis of undergraduate scholastic achievement, character, and promise of professional ability.

The American Institute of Architects Henry Adams Award is granted to the alternate of the American Institute of Architects Award.

The Alpha Rho Chi Medal is awarded to a fifth-year architectural student on the basis of leadership, service, and sign of promise in the profession of architecture.

The *Hubert E. Bray Award* is presented to the outstanding Freshman student of Jones College.

The *Ralph Budd Award* is a medal given for the best thesis in engineering.

The *James H. Chillman, Jr., Award* is given by the Rice Architectural Alumni Association and is awarded to any student of the University for the outstanding exhibit in the annual spring art show.

The *William Dunlap Darden Memorial Award* is granted on the basis of achievements and contributions as demonstrated by the master's thesis in architecture.

The *Engineering Alumni Watch Award* is presented to the fifth-year engineering student adjudged by the faculty to have achieved the outstanding scholastic record during his undergraduate work at Rice.

The *Featherlite Corporation Award* is offered by the Featherlite Corporation to a fourth-year architectural student on the basis of an architectural design competition.

The *Meador Dean Francis Award* is offered each year by Tau Beta Pi to the outstanding Junior engineering student.

The *Max Freund Prize* was established in 1954 by former students of Professor Emeritus Max Freund for a student of high academic standing who is pursuing a course of study in German language or literature.

The *John W. Gardner Award* is a medal given to a student presenting outstanding achievement in research in the humanities or social sciences.

The *Lady Geddes Prize in Writing* is awarded annually on the basis of a competition which is open to all Freshman and Sophomore students of Rice University.

The *Hamilton Watch Award* is provided by the Hamilton Watch Company for the fifth-year engineering student who has most successfully combined proficiency in his major field with notable work in the humanities.

The *Claude W. Heaps Prize in Physics* has been awarded annually since 1960 to an outstanding undergraduate student in physics. The prize, provided by students and friends of the late Professor Heaps, serves to honor his memory.

The *Robert Pilcher Quinn Award* is presented annually to a student who has demonstrated outstanding qualities in athletics, leadership, scholarship, and sportsmanship.

The *Sigma Xi Awards* are given annually by the Rice University Chapter of the Society of the Sigma Xi for proficiency in research. Candidates for degrees at both the master's and doctor's level are eligible.

The *H. A. Wilson Memorial Award* provides a substantial prize for the best research in physics done by a graduate student.

The *Eloise Szabo Witte Studentship* in history is awarded to the member of the Freshman class who has demonstrated the greatest promise in that subject and his indicated a desire for further study of history, preferably Biblical or ancient history.

Student Life

Student Responsibility

Rice University encourages student self-government and self-discipline within the framework of its general objectives. It is the responsibility of the University to examine continuously its presuppositions and practices. Students are encouraged to participate through appropriate examination, questioning, and criticism. Each member of the community, however, is expected to govern his conduct by standards of good taste and ethical judgment and to exercise his responsibility even when these standards are disregarded by others. It is assumed that students, having voluntarily enrolled, are in accord with the objectives and philosophy of the University and will abide by its regulations and accepted practices.

An individual or collective enterprise using the name of the University or its colleges is required to have the approval of University authorities. Rice University has a proper concern with any behavior on or off campus which may bring discredit or harm to an individual or to the University.

The University reserves the right to require the withdrawal of any student who fails to accept his responsibility, as evidenced by conduct or scholastic achievement considered detrimental to his own or the University's best interests. Such action is required only after careful consideration by appropriate agencies of the student government and/or officials of the faculty and administration.

The Honor System

One of the oldest and proudest of the Rice traditions is its honor system, which was adopted by a vote of the student body in 1916. All examinations are conducted under this honor code, which is administered by the Honor Council, whose members are elected by the student body annually. The Honor Council is responsible to the faculty, through the Dean of Students, for the validity of all examinations and for the investigation and prosecution of cases of violation of the system.

The Residential Colleges

On entering Rice, every undergraduate student becomes and thereafter remains a member of one of six colleges: Baker, Hanszen, Wiess,

and Will Rice for men, and Mary Gibbs Jones and Margarett Root Brown colleges for women. Each of the colleges is a self-governing community of students, whose elected officers and representatives have powers commensurate with their responsibilities for maintaining not only an orderly routine of daily life, but also broad social, cultural, and athletic programs. Among the colleges, the memberships are approximately equal, with all the academic disciplines proportionately represented. While uniformity has not been sought and practices differ from college to college, all are alike in seeking to foster in their members the intellectual awareness and the sense of individual honor and group responsibility that distinguish educated persons. Each college has a Master who, with his family, occupies the Master's House adjacent to the College. The Masters of the colleges have direct responsibility for all aspects of student life in their respective colleges. They are particularly responsible for stimulating intellectual and cultural interests, for encouraging student self-discipline and good behavior, and for the development of effective student government within the colleges. In the women's colleges the Dean of Women, assisted by the Resident Supervisors, has a primary role in personal counseling and discipline. Other members of the faculty are selected by the Masters, with the advice of the members of the colleges, as resident and nonresident Associates to assist the Masters in carrying out their responsibilities.

Upon acceptance by the University, each undergraduate student will be designated a member of one or another of the colleges. Two students who are entering Rice for the first time may ask to be assigned to the same college, but may not designate which college. A new student may request membership in the same college as a close relative. No other choice of college can be allowed.

The buildings of each college include a dining hall and common rooms, available to resident and nonresident alike, as well as quarters for an average of about 215 students of all classes. Rooms in the men's colleges are completely furnished except for linens, window drapes, and rugs. Rooms in the women's colleges are completely furnished except for linens and rugs.

Student Government and Activities

Student Government

All undergraduates are members of the Rice Student Association. This organization of the student body is governed through the Student Senate, made up of the five elected officers of the Student Association, the college presidents, the president of the Freshman class, two senators from each college, and an off-campus senator elected from the student body at large. Except for those student functions under the colleges, all student activities are directly or indirectly un-

der the jurisdiction of the Student Senate. In addition, each of the five classes—Freshman, Sophomore, Junior, Senior, and Class II Graduate—has its elected officers.

Most disciplinary offenses are tried in student courts. The Honor Council, as noted above, administers the honor system and conducts hearings and trials for offenses against it. Each college has a court which enforces college and University regulations among its members. An Inter-College Court has authority over offenses by student organizations and may act upon request in matters of an all-school nature involving members of more than one college. The University administration retains ultimate authority and responsibility in all matters of discipline.

Student Activities

In addition to the many activities of the residential colleges, there is a variety of campus-wide student activities. The official publications include the *Thresher,* the weekly campus newspaper, and the *Campanile,* the University annual. A student literary magazine, *Janus,* is published from two to three times a year. Rice engineering students publish the quarterly *Rice Engineer.* A Student Forum Committee sponsors a series of speakers on issues of current interest.

Student organizations are numerous. Many are associated with special academic and professional disciplines. These include the foreign language clubs, the Architectural Society, the Prelaw Society, the Premedical Society, the Engineering Society, the student affiliate of the American Chemical Society, and student branches of the American Institute of Aeronautics and Astronautics, the American Institute of Chemical Engineers, the American Institute of Physics, the American Society of Civil Engineers, the American Society of Mechanical Engineers, the Association for Computing Machinery, and the Institute of Electrical and Electronic Engineers, and the International Association of Students in Economics and Commerce. The Army and Navy R.O.T.C. students have the Chevron and the Sextant, respectively, to represent their special interests. A Film Guild, a Forensic Society, and a Sports Car Club exist for those interested in these matters. The Rice Players is a dramatic group sponsored by members of the faculty. For the musically inclined there are the Rice Band and other musical and choral groups. Students with active political interests may affiliate with the Young Democrats or the Young Republicans.

Women students may affiliate with one of the three literary societies —the Chaille Rice, the Elizabeth Baldwin, or the Owen Wister. The Rally Club is a special service organization for men.

Rice students are affiliated with a number of denominational religious organizations. These include the Baptist Student Union, the Canterbury Association, the Christian Science Organization, the Hillel

Society, the Lutheran Student Association, the Newman Club, the United Campus Christian Fellowship, and the Wesley Foundation. These organizations are represented on the Student Interfaith Council, a group chartered by the Student Association.

Through the generosity of the late Mrs. James L. Autry, as a memorial to the late James L. Autry of Houston, the Diocese of Texas of the Protestant Episcopal Church maintains Autry House in the immediate vicinity of Rice University as a social and religious center. The cornerstone of Autry House was laid during the commencement ceremonies of the Class of 1921. To this community group of the Episcopal church, the late Mrs. E. L. Neville of Houston, in memory of her brother, contributed the beautiful Edward Albert Palmer Memorial Chapel, which was dedicated November 27, 1927. All the opportunities of these establishments are available to the students of Rice University irrespective of religious affiliation.

Student Association Service Award

In memory of Hugh Scott Cameron, first Dean of Students at the University, the Student Association annually presents the Rice Service Award, in the form of a bronze medallion, to those currently enrolled or former students who have been most exemplary in rendering distinguished service to the school and to the student body. This coveted honor is sparingly bestowed after careful consideration of possible recipients by a committee of faculty and students appointed by the Association.

The Student Health Service

A Health Service located in Hanszen College is maintained for students. This service includes dispensary and infirmary care. The school physician makes scheduled sick calls and can be called in case of emergency. A registered nurse is on duty during school hours; qualified attendants are available at all hours. Information about the facilities and care, and about insurance, can be secured at the office of the Student Health Service.

Hospitalization and accident insurance coverage may be obtained through the University for those students who desire such coverage. Foreign students are required to have such insurance, but they need not make use of the coverage provided through the University.

Memorial Center Facilities

The Rice Memorial Center was built through the generosity of friends and alumni. Ground was broken for this building on Novem-

ber 9, 1957, and it was dedicated on Homecoming weekend in the fall of 1958. The center and chapel comprise a memorial to those Rice alumni who have died in the service of their country, and provision was made in the plans for commemorative inscriptions.

The center includes a chapel with associated offices. The chapel is utilized for regular nondenominational religious services, directed by a faculty committee with the assistance of a student chapel committee.

The center provides offices for the Dean of Students, the Association of Rice Alumni, the Student Association, the Honor Council, and various student publications. It also contains the Campus Store and Sammy's, the snack bar, as well as lounge and ballroom facilities.

Athletics

Rice is a charter member of the Southwest Athletic Conference and participates in the intercollegiate athletic contests sponsored by the conference. Football games are played in the 70,000-seat Rice Stadium and basketball in the Autry Court in the Rice Gymnasium.

There is a very active program of intramural athletics in both team and individual sports. Facilities include an indoor swimming pool, tennis, handball, and squash courts, gymnastic rooms, and playing fields.

Student Automobiles

All students at Rice currently enjoy the privilege of bringing automobiles on the campus. All such automobiles, however, must be registered with the Office of the Dean of Students at the beginning of the school year or whenever first brought on the campus. Desirable parking spaces are at a premium, and any student operating an automobile on the campus may park only in the areas assigned. Off-campus students have two options. They may park without payment of fee in the Stadium lot, or they may pay a nominal annual fee entitling them to park in special Commuting Student lots. Any automobiles parked or operated on the campus are there solely at the owner's risk. Failure to abide by the regulations will result in monetary fines for specific offenses and the withdrawal of driving privileges in the case of flagrant abuses. Copies of the *University Traffic and Parking Regulations* may be obtained from the Office of the Dean of Students.

Part Three

Courses of Instruction

Courses of Instruction

Course descriptions are listed alphabetically by departments of instruction. For most of the departments these descriptions are preceded by statements of specific requirements for students majoring in the department both at the undergraduate and the graduate levels. These statements are supplemental to the general degree requirements described on pages 46-58.

Courses numbers below 200 designate courses designed primarily for Freshmen; courses numbered from 200 to 299 are considered second-year courses and are open to Freshmen only with permission. Numbers from 300-499 are designated as advanced courses. They are open to students of the lower classes with permission and to graduate students on approval of the individual student's adviser.

Courses designed for graduate students are numbered 500 and above. The methods of presentation and quality of work expected make them generally unsuited to undergraduate participation. Hence an undergraduate is permitted to enroll in a graduate-level course only after consultation with his adviser and with the instructor of the course.

The letters "a" and "b" following the course numbers indicate first-semester and second-semester courses respectively. Thus, History 200a is taught only the first semester and History 201b only the second semester. Courses for which the number is not followed by a letter "a" or "b" may be taught either semester. When consecutive courses are shown with a single listing, as Biology 100a,b or Anthropology 370a, 371b, the first-semester course is prerequisite to the second.

Figures entered in parentheses following the title of each course signify the number of class hours per week, the number of laboratory hours per week, and the semester-hours credit for the completed course, in that order. Thus, the entry (3-3-4) in Biology 360a means that the course meets three hours per week, has three hours of laboratory work per week and is evaluated at four semester-hours credit upon completion of the semester's work.

Anthropology and Sociology

Professors Goodman, McCord, Norbeck, *Chairman,* and Wheeler
Associate Professor Hole

The *Undergraduate Major in Anthropology.* Students majoring in anthropology are required to take a total of ten semester-courses of anthropology, eight of which must be on the Junior and Senior level,

courses numbered 300 or higher. Anthropology 200a and 201b are ordinarily required for all majors. Not more than twelve semester-courses in the major, including courses in the 200 series, are permitted. With the approval of the departmental adviser, a maximum of two semester-courses numbered 300 or higher in related subjects, including certain courses in biology, history, psychology, and sociology, may be substituted for courses in anthropology. Linguistics 401a and 402b are acceptable for credit toward the major in anthropology.

ANTHROPOLOGY COURSES

Anthropology 200a. Physical Anthropology (3-0-3).

Human evolution, fossil man, human genetics, races of man and problems of race; the beginnings of culture. *Mr. Norbeck*

Anthropology 201b. Introductory Cultural Anthropology (3-0-3).

Major aspects of culture (social organization, economics, religion); cultural patterns and sociocultural change; late prehistory of man and the evolution of culture. *Mr. Norbeck*

Anthropology 300a. The Evolution of Culture (3-0-3).

A consideration of theories and supporting data concerning the evolution of culture. Special attention is given to the manner of growth and change of technology, economic systems, social structure, and religion, and to interrelationships of these elements of culture. *Mr. Norbeck*

Anthropology 301b. Primitive Religion (3-0-3).

Comparative survey of religion and magic; the relation of religion and magic to other aspects of culture, and their roles with respect to society and the individual. *Mr. Norbeck*

Anthropology 304a. 305b. Independent Study (0-0-6).

Directed reading and preparation of written papers on anthropological subjects not offered in the curriculum and advanced study of subjects on which courses are offered. Conducted as tutorial courses with no formal class meetings. Students seeking admission must secure approval of the department. *Staff*

Anthropology 310a. World Ethnology (3-0-3).

A survey of selected non-Western societies which illustrate varying modes of adaptation to geographical and cultural environments. *Mr. Hole*

Anthropology 311b. North American Ethnology (3-0-3).

A general survey of native cultures north of Mexico. Intensive study of selected peoples in light of the processes of culture. *Mr. Hole*

Anthropology 320a. Old World Prehistory (3-0-3).

The origin and development of human culture during the Pleistocene period; man's achievement of food production and the beginnings of literate civilizations in the Near East. *Mr. Hole*

Anthropology 321b. New World Prehistory (3-0-3).

Man's entry into the Americas; his dispersal with varied ecological adaptations over the continent; and the attainment of civilized societies in Meso-America and Peru. *Mr. Hole*

Anthropology 330a. Early Civilizations (3-0-3).

The growth and characteristics of civilization in Mesopotamia, Egypt, India, Meso-America, and Peru are examined historically and comparatively. *Mr. Hole*

Anthropology 331b. Culture Contact (3-0-3).

Descriptions of intercultural contact are examined to determine conditions under which cultural change, assimilation, integration, interdependence, or exclusion may occur. *Mr. Hole*

Anthropology 360a. Culture and Personality (3-0-3).

A consideration of theories, methods, and findings in the cross-cultural study of the relationships between personality and culture; mental health in cross-cultural perspective. *Mrs. Goodman*

Anthropology 370a. 371b. The Individual and Culture (3-0-3 each sem.)

Study of social and cultural forces acting upon the individual, and of the individual's responses and potentials for self-determination, in a variety of sociocultural contexts ranging from simple to complex. *Mrs. Goodman*

Anthropology 380a. Peoples and Cultures of Asia (3-0-3).

Survey of the Far East, emphasizing traditional cultures of Siberia, China, Japan, Tibet, and Southeast Asia, and their relationships. *Mrs. Goodman*

Anthropology 381b. The Study of Cities (3-0-3).

Comparative study of cities in widely separated areas of the world, identifying constants and major variables of urban culture, ancient, recent, and modern. *Mrs. Goodman*

Anthropology 390b. Value Systems (3-0-3).

Study of value categories; comparative study of systems of values, and their implications for behavior, in selected folk and sophisticated cultures. *Mrs. Goodman*

Anthropology 400a. Ethnological Theory (3-0-3).

A seminar presenting a survey and appraisal of major developments and trends of ethnological theory since the beginnings of anthropology as a systematic branch of study. Approval of instructor required for enrollment. *Mr. Norbeck*

Anthropology 401b. Kinship and Social Structure (3-0-3).

A seminar presenting an historical, analytic, and interpretive treatment of ethnological data and concepts concerned with kinship and the social structure of human societies. Approval of instructor required for enrollment. *Mr. Norbeck*

Anthropology 404a, 405b. Independent Study (0-0-3, each sem.).

Directed reading and preparation of written papers on anthropological subjects not offered in the curriculum and advanced study of subjects on which courses are offered. Conducted for graduate students as tutorial courses with no formal class meetings. Students seeking admission must secure approval of the department. *Staff*

SOCIOLOGY COURSES

Sociology 200a. Introduction to Sociology (3-0-3).

An introduction to the scientific study of society. The course will examine basic theories concerning the nature of society and the individual's relationship to his social world. *Mr. McCord*

Sociology 201b. American Social Problems (3-0-3).

An examination of the causes and treatment of certain American social problems: crime, alcoholism, mental disorder, and ethnic conflict. *Mr. McCord*

Sociology 300a. Social Stratification (3-0-3).

A study of the division of societies into classes, estates, and castes. Social mobility, the distribution of social power, and he relation of ethnic groups to class structure. Prestige and esteem. The methods of research into stratification. Analysis of studies of the American class system. *Mr. Wheeler*

Sociology 301b. American Ethnic Groups (3-0-3).

Survey of major ethnic groups of which the population of the U.S. is composed. Social, cultural, and religious factors. The processes of cooperation, conflict, and assimilation as they relate to nationality groups. Immigration as a factor in American society. *Mr. Wheeler*

Sociology 304a, 305b. Independent Study (0-0-3, each sem.).

Directed reading and preparation of written papers on sociological subjects not offered in the regular curriculum and advanced study of subjects on which courses are offered. Conducted as tutorial courses with no formal class meetings. Students seeking admission must secure approval of the department. *Staff*

Sociology 310a. Social Change (3-0-3).

A study of the processes of social change from the perspectives of leading theorists. Patterns and differential rates of change. Human motivations, political factors, policy making and planning in social development. Social change as a local and world phenomenon. *Mr. Wheeler*

Sociology 311b. Collective Behavior (3-0-3).

A study of the nature, origin, and development of the more temporary social groups: crowds, mobs, publics, cults and sects; conditions of social unrest, collective excitement, and panic; public opinion, reform movements, fashions and fads; the origin and reorganization of institutions, values, and societies. *Mr. Wheeler*

Sociology 330b. Social Philosophy (3-0-3).

A seminar concerned with the major theories about the nature and future course of modern society. Such writers as Marx, Mannheim, Toynbee, and Sorokin will be considered. Primary attention will be devoted to the question of freedom and authority in the modern world. *Mr. McCord*

Sociology 400b. Seminar on the Foundations of Social Thinking (3-0-3).

The development of sociological thought through the integration of contributions from biology, philosophy, anthropology, and other social sciences. Special emphasis is given to the culture concept, social values and social institutions, and the social process in relation to problems of social disorganization and adjustment. *Mr. Giles*

Sociology 404a, 405b. Independent Study (0-0-3, each sem.).

Directed reading and preparation of written papers on sociological subjects not offered in the regular curriculum and advanced study of subjects on which courses are offered. Conducted for graduate students as tutorial courses with no formal class meetings. Students seeking admission must secure approval of the department. *Staff*

Sociology 410a. Social Change in Developing Areas (3-0-3).

A seminar devoted to a consideration of the relation between social, political, and economic change in such nations as India, Egypt, Nigeria, and Indonesia. A critical review of basic theories. Approval of instructor required for enrollment. *Mr. McCord*

Sociology 419a. Communities (3-0-3).

An analysis of the structure, processes, and organization of contemporary towns and cities. The nature and varieties of community. Consideration is given to the phenomena or urbanism and of community cohesion. Methods and cases of community research. *Mr. Wheeler*

Sociology 420b. Field Methods (3-0-3).

Research projects in sociology undertaken by advanced students, singly or in teams, will serve as a focus for discussion of research methods. Approval of instructor required for enrollment. *Mr. Wheeler*

Architecture

Professors Caudill, *Director,* and Morehead
Associate Professors Evans, Kennon, Krahl, Mitchell, Ransom, and Todd
Assistant Professors Cannady, *Assistant to the Director,* Kendrick, Leifeste, Schorre, Sobel, and Wingfield
Lecturers Dunaway and Dyess
Visiting Lecturer Thomsen

Preceptors
Richard L. Aeck, F.A.I.A., of Aeck Associates, Atlanta, Georgia
O'Neil Ford, F.A.I.A., of O'Neil Ford and Associates, San Antonio, Texas
David G. Murray, A.I.A., of Murray, Jones & Murray, Tulsa, Oklahoma
Lawrence B. Perkins, F.A.I.A., of Perkins & Will, Chicago, Illinois
George F. Pierce, Jr., F.A.I.A., of Pierce & Pierce, Houston, Texas
John M. Rowlett, A.I.A., of Caudill, Rowlett & Scott, Houston, Texas
Henry L. Wright, F.A.I.A., of Kistner, Wright & Wright, Los Angeles, California

The profession of architecture is concerned with the physical environment of man. Each civilization, by its buildings and spaces, leaves a tangible record of its aims and beliefs through the expression of architecture. As contemporary society becomes increasingly urban, the architect's role in society is also becoming oriented toward urban problems in addition to the more traditional practice. The School of Architecture is fortunate to be located in metropolitan Houston, the South's largest city. The city offers students a wide range of professional associations and cultural activities. The Houston area is characterized by rapidly expanding population and accelerated building activity. The school uses the city as a teaching laboratory and its great variety of architectural examples—past, present, and under construction—as case studies.

Three degrees are offered: Bachelor of Arts, Bachelor of Architecture, and Master in Architecture. The undergraduate curriculum for the study of architecture is an accredited five-year program. After successful completion of the first four years of this program, the Bachelor of Arts degree is awarded. At this time the candidate's work is evaluated before he is admitted to the fifth year, which leads to the

professional degree of Bachelor of Architecture. The Master in Architecture degree is offered for graduate study by candidates already holding a professional degree in architecture.

All work at each class level is offered in a single course dealing with the three areas of knowledge requisite to the practice of architecture: *Design, Technology,* and *Management.* At each level a professor of architecture directs the integrated program for the year and coordinates the instruction of a team of specialists in these three areas. The student body, selected on a highly competitive basis, is small. Because of this, it is possible to give special attention to each student in small studio groups. Through the flexibility inherent in an integrated program, each student is allowed the freedom to develop his own capabilities and talents. Special programs are devised to encourage the student to progress at a rate commensurate with his abilities and interests.

In addition to the basic requirements of the University, students supplement their work in architectural studies through required and elective courses in various departments of the Division of Humanities, particularly in Fine Arts, for the history of art and for studio art courses in drawing, painting, and sculpture.

Supplementing the regular academic instruction are several auxiliary programs designed to span the gap between school and practice: the Rice Design Fetes, the Preceptorship Program, the Chilean Community Facilities Program, and the visiting lecturer and visiting critic series. The Rice Design Fete is a research program in which outstanding practicing architects return to a university atmosphere and students are involved in professional design responsibilities during a two-week work session on the campus with the purpose of completing program analyses and architectural solutions for a specific building type selected by a research sponsor. The Preceptorship provides a two-to-three-week professional indoctrination for outstanding students by some of the leading architects of the South, Southwest, and West Coast in the architect's office and home. The Chilean Community Facilities Program, sponsored by the Ford Foundation, provides for a class-in-residence for selected Rice students and involvement in design and community planning in Chile as well as research conducted on the Rice campus. The school maintains a close association with the profession and schedules short internships in offices during the school year and during the summers. The school also publishes a series of reports on investigations and thoughts from the School of Architecture. It is published in the belief that the education of architects can best be advanced if teachers, students, practitioners, and interested laymen share in what they are thinking and doing. In essence, the school offers a broad course in architecture tied closely to the profession and based on an intense liberal arts background.

Graduate Program in Architecture. The program leading to the Master in Architecture degree is concerned with the design of the total

physical environment. The scope of investigation, study, and design involves the broadest aspects of regional and urban design as well as the more particular design of specialized building types, technology, artifacts, and furniture. The emphasis is upon the development of the individual with each candidate's program specifically geared to his background and abilities, his rate of progress, and his professional orientation. The method is by guidance through comparative analysis of different architectural solutions to develop in the candidate self-criticism and self-direction. The graduate program is carried as Architecture 600a,b and consists of three phases:

1. An educational program to clarify architectural ideas and to achieve an assimilation of architectural principles by means of a series of problems on a class basis.
2. The selection of an area for research toward a proposed thesis.
3. The clarification of the thesis and the development of a demonstration in the nature of a creative design.

Each candidate for the master's degree must take Architecture 600a,b and one advanced course outside the School of Architecture in addition to fulfilling the University's requirements for a foreign language. Each candidate is assigned a faculty member as a thesis director, and the final presentation is made before a jury of faculty and visiting specialists.

COURSES

Architecture 100a, b. Principles of Architecture (0-12-4, each sem.).

a. Design: Communicative skill in various media; introduction to principles of design and their application to architecture; elementary architectural problem-solving; selected readings and essay composition; tours of museums and galleries.
b. Technology: Introduction to the characteristics of materials; principles of elementary structures; field trips to buildings under construction; awareness of mechanical equipment in buildings; architectural nomenclature.
c. Management: Introduction to the profession and the place of the professional in society; introduction to allied professions; visits to architectural offices; review of current office organization and operation of professional practice.

Laboratory fee required. *Staff*

Architecture 200a, b. Principles of Architecture (1½-14-6, each sem.).

a. Design: Application of basic architectural principles to single buildings—one- and two-story; short problems in interior design, landscape planning, and product design; house and neighborhood planning; study of environmental design determinants—physical and social.
b. Technology: Design of simple structures in wood and masonry; basic principles in applications of plumbing, electrical, and mechanical systems; strength of materials; introduction to structural and design potential of basic building materials.
c. Management: Organization of time; client relations; study of cost controls; professional responsibilities.

Laboratory fee required. *Staff*

Architecture 300a, b. Principles of Architecture (6-18-12, each sem.).

a. Design: Variety of architectural design problems with one project completely developed in detail; housing and community planning.

b. Technology: Structural theory in wood, steel and concrete; application of plumbing, electrical, and mechanical systems to design problems; performance, standards and selection of materials; strength of materials; inspection trips of illustrative construction.
c. Management: Study of professional ethics; visits to architectural offices; discussions with prime consultants in architectural practice.
Laboratory fee required. *Staff*

Architecture 400a, b. Principles of Architecture (6-18-12, each sem.).

a. Design: Advanced design problems of complex nature—multistory buildings and groups of buildings; philosophy and theory of design; development of personal technique and expression in communicative media.
b. Technology: Further study of capabilities and limitations of building materials; shop testing of experimental structures; principles of special-purpose structural shapes; full integration of construction methods, systems, and services; principles of specifications.
c. Management: Legal aspects of practice; management and supervision of construction; client interviews and programming; project presentation techniques; professional internships.
Laboratory fee required. *Staff*

Architecture 500a, b. Principles of Architecture (7-20-13, each sem.).

a. Design: Institutional and urban planning problems, high-rise buildings, landscape planning; design-theory seminars; basic design studies.
b. Technology: Comparative structural systems; basic methods of research; independent experimentation in materials and structures; seminars with allied consultants—estimators, appraisers, contractors, insurance specialists, special equipment consultants.
c. Management: Office management and operation; purpose of professional organizations; registration laws and procedures; professional ethics; place of advanced study and travel in the development of the architect.
Laboratory fee required. *Staff*

Architecture 600a, b. (8-15-13, each sem.).

Independent investigations in architecture culminating in preparation and presentation of a master's thesis. Laboratory fee required.
Staff Specialists, University Staff

Art

(*See* pages 160-162)

Biology

PROFESSORS AWAPARA, DAVIES, READ, *Chairman,* TALMAGE, AND J. B. WALKER
ASSOCIATE PROFESSORS CAMPBELL, J. HUDSON, WARD, AND WOODWARD
ASSISTANT PROFESSORS EISENBURG, ELBEIN, F. FISHER, AND PHILPOTT
VISITING ASSISTANT PROFESSOR SIMMONS
LECTURERS ANSEVIN AND PULLEY

Undergraduate Program. A major in biology may be taken in the humanities (academic) or the science-engineering program (*see* pages 47-50). The science-engineering program is strongly recommended. All majors are required to take introductory courses in physics and mathe-

matics, Chemistry 120a,b Biology 201a,b, and organic chemistry. It is recommended that majors who plan to enter graduate school take at least two years of German. In addition to Biology 201a,b, the department requires satisfactory completion of Biology 301a,b, Biology 303a,b, and at least four semesters of additional advanced work in biology.

Biochemistry Major. An interdepartmental major in biochemistry is offered in conjunction with the Department of Chemistry. The program of students wishing to elect this major must be approved by both departments.

Special Projects in Biology: Qualified biology majors are encouraged to undertake a research problem under the supervision of a faculty adviser. Such students may substitute Biology 400a,b for two advanced semester-courses during the Senior year. Funds are also available to support summer research by qualified undergraduate students. For more complete information concerning these programs, consult with members of the department staff.

Graduate Program. Open to qualified applicants who hold a bachelor's degree or equivalent in one of the natural sciences or engineering. Prospective graduate students are advised to take the Graduate Record Examination before applying, or as soon thereafter as practicable.

The following areas of specialization are currently offered in biology: biochemistry, cell biology, general physiology, genetics, invertebrate and vertebrate physiology, microbiology, symbiosis and parasitism, and environmental physiology.

Program for the Degree of Doctor of Philosophy:

(a) Usually four or more years of graduate study with at least the last two years at Rice University.
(b) At least thirty-six semester-hours of graduate courses in biological and related sciences other than thesis work, of which at least three must be taken at Rice University.
(c) Completion of an original investigation worthy of publication in a recognized scientific journal, and the submission of a doctoral thesis as described on pages 57-58.
(d) Completion of language requirements as described on page 57.
(e) Each student must pass three written examinations by October 15 of the academic year in which the Ph.D. degree is awarded. These are given in his major and two minor fields as selected by the student and approved by his advisory committee.
(f) An oral examination in defense of the thesis during the last year of residence.

The Degree of Master of Arts. The degree of Master of Arts may be obtained after two years of graduate study upon the successful com-

pletion of the language requirements, twenty-four semester-hours of graduate courses, satisfactory work in a written examination, and the acceptance of a thesis embodying the results of original investigation, in defense of which an oral examination is taken. The taking of this degree is not required as a prerequisite for the degree of Doctor of Philosophy and may be omitted with the approval of the departmental staff.

Assistantships. Financial assistance in the form of graduate fellowships, predoctoral fellowships, research assistantships, and scholarships is available. All graduate students in biology are expected to engage in laboratory instruction regardless of appointment. Graduate students are assigned to different courses from year to year to obtain the maximum benefit from this phase of training.

COURSES

A. Courses for Students Not Concentrating in Biology

The following course is offered for those students needing a preliminary course in the field. This course is applicable to a major in biology.

Biology 100a, b. General Biology (3-3-4, each sem.).

In this terminal course emphasis will be placed on the methods of science, the mechanisms of growth, metabolism, and heredity, and the concept of organic evolution. The laboratory work will include demonstrations and selected experimentation. *Staff*

B. Biology Courses for Those Concentrating in Biology

Biology 201a, b. Introduction to Biology (3-3-4, each sem.).

A general introductory course dealing with the basic principles of biology. The first semester will be devoted mainly to subcellular phenomena, followed by consideration of cell organization, differentiation, organ and organismal function, population phenomena, and evolution. This course is a prerequisite for advanced courses in biology. Concurrent registration in Chemistry 200a,b is recommended. Prerequisite: Chemistry 120a,b or equivalent. *Messrs. Read and Woodward*

Biology 301a, b. Organismal Biology (3-3-4, each sem.).

The evolution, systematics, and zoogeography of the invertebrates and vertebrates, with a consideration of their comparative morphology, physiology, and behavior as related to adaptation for aquatic, terrestrial, and aerial habitats. This course is required for biology majors. Prerequisite: Biology 201a,b. Laboratory fee required. *Messrs. Fisher and Hudson*

Biology 303a, b. Biochemistry and Cell Physiology (3-3-4, each sem.).

The first semester is concerned with the chemistry, biodegradation, and biosynthesis of cell constituents. The second semester is concerned with cell structure and function. This course is required for biology majors. Prerequisite: Chemistry 200a,b or equivalent. Laboratory fee required. *Messrs. Awapara and Campbell*

Biology 360a. Marine Biology (3-3-4).

A study of the marine and estuarine environments with particular attention to the local fauna. Laboratory will include weekend field trips. Class is limited to fifteen students. Prerequisite: A course in invertebrate zoology or invertebrate paleontology. Laboratory fee required. *Mr. Pulley*

Biology 400a, b. Special Problems and Honors Work (2-6-4, each sem.).

Open only to Senior biology majors and with permission of the chairman of the department. For use primarily in honors programs. *Staff*

Biology 410. Genetics (3-3-4).

A study of the gene from the points of view of genetic recombination, mutation, function, and chemical composition. Prerequisite: Biology 303a,b Laboratory fee required. *Mr. Woodward*

Biology 415b. Botany (3-3-4).

A comparative study of plants as viewed through physiology and evolution. Prerequisite: Biology 201a,b. Laboratory fee required. *Mr. Pulley*

Biology 420a. Parasitism and Symbiosis (3-3-4).

An introduction to the biology of symbiosis, with special emphasis on the physicochemical relationships between organisms. Illustrative examples demonstrating principles are drawn from the plant or animal kingdoms. Prerequisite: Biology 301a,b and 303a,b. Laboratory fee required. *Mr. Read*

Biology 430b. Population Ecology (3-3-4).

A theoretical and experimental approach to the study of populations. Stress will be placed on quantitative approaches to current concepts and problems. Topics to be considered include intra- and interspecific relationships and community structure. Prerequisites: Biology 301a,b and 303a,b. *Mr. Eisenberg*

Biology 440a. Comparative Biochemistry and Physiology (3-3-4).

A consideration of the concept of biochemical unity as it relates to the origin of life and the establishment of metabolism and information transfer. Subsequent evolution and biological diversity are considered as logical extensions of this concept. Weekly student seminars are held on current and/or pertinent literature. Laboratory consists of special projects designed to illustrate techniques used in the study of invertebrate biochemistry. Prerequisite: Biology 303a,b. Laboratory fee required. *Mr. Campbell*

Biology 445a. Vertebrate Physiology (3-3-4).

Studies of the physiology of organ systems. Homeostatic capacities of individual organ systems with their comparative function in various vertebrate groups will be emphasized. Prerequisite: Biology 301a,b and 303a,b. Laboratory fee required. *Mr. Hudson*

Biology 450b. Developmental Biology (3-3-4).

An analysis of developmental processes in the animal organism from fertilization to the elaboration of its final form. Emphasis will be placed on induction and cell differentiation. Organogenesis, metamorphosis, regeneration, and other developmental phenomena will be discussed. The laboratory work will concern observation and experimental analysis of development in amphibian and avian embryos. *Mrs. Ansevin*

Biology 460b. Advanced Biochemistry (3-0-3).

A study of recent advances in the mechanism of enzyme action, biosynthesis of essential cellular constituents, and intracellular metabolic control processes. Prerequisite: Biology 303a. *Mr. Walker*

Biology 465b. Advanced Biochemistry Laboratory (0-8-2).

A laboratory course emphasizing procedures involved in answering certain biochemical questions. Students will proceed under their own initiative on assigned projects. Prerequisite: Registration for Biology 460b and consent of instructor. Laboratory fee required. *Mr. Walker*

Biology 470b. General Microbiology (3-3-4).

A study of microorganisms, including Protozoa, algae, fungi, bacteria, and viruses. Special attention will be given to the bacteria. Lectures will be concerned with evolution, classification, growth, nutrition, and metabolism. Prerequisites: Biology 301a,b and 303a,b. Laboratory fee required. *Mr. Elbein*

Biology 475a. Cells and Tissues (3-3-4).

Study of the morphology and function of cell components, cells, and tissues, as revealed by light and electron microscopy and associated histo- and cytochemical methods. Laboratory work in histology and histochemistry. Prerequisite: Biology 303a,b or its equivalent. Laboratory fee required. *Mr. Philpott*

Biology 480a. Endocrinology (3-3-4).

Study of the primary endocrine glands of mammals and their relationships to the physiological homeostasis of the mammal. While emphasis is placed on the function, morphology, and interrelationships of the glands of internal secretion of mammals, the comparative anatomy and evolution of these glands in the vertebrates is discussed. Laboratory work is restricted primarily to histological study of the glands, surgical procedures, and simple experiments demonstrating hyposecretion. Prerequisite: Biology 303a,b. Laboratory fee required. *Mr. Talmage*

Biology 490b. Radioisotopes in Biology (3-4-4).

An introductory study of the applications of nuclear radiation to biological problems. The student is acquainted with characteristics of nuclear emissions, problems of health physics, and introduction to radiochemistry, study of radiation effects, and the use of isotopes as biological tracers. Prerequisites: At least one previous course in biology, chemistry, mathematics, and physics. Laboratory fee required. *Mr. Talmage*

Biology 500. Biology Seminar (1-0-2).

Held weekly to hear papers on current research by members of the staff, visiting investigators, and advanced graduate students. Attendance by graduate students in biology is required. Visitors and undergraduates are invited. *Staff*

Biology 508. Advanced Vertebrate Physiology (3-0-3).

Review of current literature on comparative physiology of vertebrates. Prerequisite: Consent of instructor. *Mr. Hudson*

Biology 510a, b. Topics in Biochemistry (3-0-3).

Messrs. Awapara and Walker

Biology 514a. Biosynthesis of Natural Products (3-0-3).

A study of mechanisms of biosynthesis of naturally occurring substances of current interest in biology. Prerequisite: Biology 460b. *Mr. Walker*

Biology 516b. Proteins and Amino Acids (3-0-3).

A study of the metabolism of proteins and amino acids. Some attention will be given to methods of protein isolation and characterization. Prerequisite: Biology 460b. *Mr. Awapara*

Biology 520. Advanced Cell Physiology (3-0-3).

Offered in 1966-67. A seminar on current literature and research in cell physiology. Prerequisite: Consent of instructor. *Mr. Campbell*

Biology 521. Advanced Comparative Biochemistry and Physiology (3-0-3).

Offered in alternate years with Biology 520 (not given in 1966-67). A seminar on current literature and research in comparative biochemistry and biochemical evolution. Prerequisite: Consent of instructor. *Mr. Campbell*

Biology 540. Cell Biology (2-6-4).

Instruction in methods for studying cells and cell phenomena and in interpretation of observations. Laboratory work will involve the practice and application of techniques to cell biology. Seminar work will focus on recent work on morphology, function, and biochemistry of cells. Prerequisite: Biology 303a,b (or equivalent) and Biology 475a. *Mr. Philpott*

Biology 541. Topics in Cell Biology (3-0-3).

Mr. Philpott

Biology 545. Tissue-Culture Technique (2-6-4).

The course will offer practical experience with several tissue-culture techniques in current use, together with seminars reviewing significant contributions of tissue-culture methods to biological and medical research. *Mrs. Ansevin*

Biology 550. Topics in Microbiology (3-0-3).

Mr. Elbein

Biology 560. Physiology of Parasitism (3-0-3).

Conferences, student reports, and laboratory work on the physiology of parasites and the functional relationships of hosts and parasites. Attention will be given to growth, metabolism, nutrition, and physiological evolution of parasites, with emphasis on comparative aspects. The basis of pathology and disease will be treated as a series of physiochemical problems, with examples drawn from the animal or plant kingdom. *Mr. Read*

Biology 561. Topics in Symbiotics (3-0-3).

Mr. Read

Biology 570. Arthropod Physiology (3-0-3).

Readings, conferences, and student reports on current literature concerned with the physiology of arthropods. Especial emphasis will be placed on the insects. *Mr. Fisher*

Biology 571. Invertebrate Endocrinology (3-0-3).

Offered on alternate years with Biology 570. Consideration of current literature dealing with endocrine mechanisms in invertebrates. *Mr. Fisher*

Biology 580. Seminar in Endocrinology I (3-0-3).

The thyroid, pancreas, adrenals, and the relationships of hormones to carbohydrate metabolism are studied. Reading seminar on current literature in endocrinology. *Mr. Talmage*

Biology 581. Seminar in Endocrinology II (3-0-3).

The parathyroids, the pituitary, and the physiology of reproduction. Readings, conferences, and laboratory work. Includes also a weekly seminar on current literature in endocrinology. *Mr. Talmage*

Biology 599. Topics in Genetics (3-0-3).

Study of current literature in the broad areas of chemical genetics, microbial genetics, protein synthesis, differentiation, and mutation. It is held in collaboration with geneticists from other universities in Houston. *Mr. Woodward*

Biology 600. Graduate Research.

Staff

Business Administration

(*See* pages 120-126)

Chemical Engineering

(*See* pages 132-136)

Chemistry

PROFESSORS FRANKLIN, KILPATRICK, E. S. LEWIS, *Chairman,* MARGRAVE, PITZER, RICHTER, SALSBURG, AND TURNER
ASSOCIATE PROFESSORS CURL AND SASS
ASSISTANT PROFESSORS BROOKS, CANTRELL, AND MAGID

The Undergraduate Program. Undergraduates electing chemistry as a major are expected to satisfy the requirements of the science-engineering program set forth on pages 49-50. In general they will take Chemistry 200a,b in the Sophomore year in place of one of the specified electives. It is desirable for chemistry majors who seek admission to graduate school, but who do not possess advanced high school language credits, to take two years of German and one year of either French or Russian. The department further requires satisfactory completion of the following courses:

Junior Year

Chemistry 310a,b
Chemistry 400a and Chemistry 401a
Chemistry 470b
Mathematics 300a,b

Senior Year

Chemistry 460b

Three semesters of approved advanced course work in chemistry. Superior students may substitute undergraduate research (Chemistry 490a, b) for one or two semesters of classroom instruction.

Interdepartmental Majors. Interdepartmental majors are offered in biochemistry and chemical physics by the Department of Chemistry in conjunction with the Department of Biology and the Department of Physics, respectively. Students wishing to elect either of these majors must be approved both by the Department of Chemistry and the other department concerned.

The Graduate Program. A student who has completed work for the bachelor's degree in chemistry equivalent to that offered at Rice University may be admitted to graduate standing. Preference is normally given to applicants who earn high scores on the Graduate Record Examination, including the advanced test in chemistry (*see* page 71). A minimum of one year of graduate study is required for the degree

of Master of Arts and at least two years for the degree of Doctor of Philosophy.

A candidate for the degree of Master of Arts is required to demonstrate a reading knowledge of scientific German, French, or Russian. He must complete six semesters of course work, present in a thesis the results of a program of research approved by the department, and pass a final oral examination.

To be recommended for the degree of Doctor of Philosophy, the student must complete for publication a thesis which represents a distinctly original and significant contribution to the field of chemistry. He must possess a reading knowledge of scientific German and of scientific French or Russian as a second language. The candidate must further have acquired through course work and independent study a broad fundamental knowledge of chemistry in addition to those areas of the subject encompassed by his own research interests. Cumulative examinations for the Ph.D. degree are given periodically beginning in the second year, and a final oral examination on the thesis is required for all candidates.

COURSES

Chemistry 120a, b. Introductory and Analytical Chemistry (3-3-4, each sem.).

A general introductory course dealing with the basic phenomena and principles of chemistry. The laboratory work in the first semester includes volumetric and gravimetric methods of quantitative analysis. The second deals with the fundamentals and methods of qualitative analysis. The course is required of science-engineering students, and is also open to academic majors. Prerequisite: High school chemistry. Laboratory fee required. *Staff*

Chemistry 200a, b. Organic Chemistry (3-4-4, each sem.).

The course is designed to give a thorough survey of aliphatic and aromatic chemistry with an introduction to the heterocyclic compounds, and to present the theories relating to their structure and reactions. A special laboratory section in which the work is devoted chiefly to the synthesis of substances of medicinal interest is arranged for premedical students. Prerequisite: Chemistry 120a,b. Laboratory fee required. *Messrs. Cantrell and Richter*

Chemistry 310a, b. Physical Chemistry (3-4-4, each sem.).

A quantitative study of theoretical and physical chemistry with emphasis on the principles of thermodynamics, statistical mechanics, and quantum mechanics. Among the topics included are atomic and molecular structure, equilibria, electrochemistry, kinetics, and theory of solutions. The laboratory work consists of one four-hour period a week. Prerequisites: Mathematics 200a,b and Physics 200a,b. *Messrs. Brooks and Margrave*

Chemistry 400a. Advanced Organic Chemistry (3-0-3).

An introduction to theoretical organic chemistry emphasizing reactions of general synthetic importance. Chemistry majors normally take this course in the Junior year. Prerequisite: Chemistry 200a,b. *Mr. Magid*

Chemistry 401a. Modern Organic Laboratory (0-8-2).

A laboratory course covering the techniques of modern organic chemistry. This course is designed to accompany Chemistry 400a. Prerequisite: Chemistry 200a,b. Laboratory fee required. *Messrs. Lewis and Turner*

Chemistry 420b. Statistical Thermodynamics (3-0-3).

A development of the equilibrium theory of statistical mechanics. Applications to imperfect gas theory and the calculation of thermodynamic properties of molecules are given special attention. Prerequisites: Chemistry 450a, Mathematics 300a,b, and Physics 200a,b. *Mr. Salsburg*

Chemistry 430a. Quantum Chemistry (3-0-3).

This course is devoted to a discussion of valence theory and to a consideration of structure and reactivity based upon simple quantum mechanical considerations. *Mr. Sass*

Chemistry 445b. Physical-Organic Chemistry (3-0-3).

A study of the mechanisms of various important organic reactions. Prerequisite: Chemistry 310a,b, Chemistry 400a. *Mr. Lewis*

Chemistry 450a. Advanced Thermodynamics (3-0-3).

Relation of heat and work to chemical and physical systems. A consideration of free energy, entropy, and other thermodynamic functions as applied to equilibria. Special attention to the treatment of solutions. *Mr. Kilpatrick*

Chemistry 460b. Special Topics in Inorganic Chemistry (3-0-3).

This course will normally be taken by chemistry majors in the Senior year. Prerequisite: Chemistry 310a. *Mr. Margrave or Mr. Pitzer*

Chemistry 470b. Instrumental Methods (3-8-5).

A required course for Junior chemistry majors. Special emphasis is given to the principles and applications of modern instrumental methods in the areas of inorganic, organic, and physical chemistry. Laboratory fee required. Prerequisite: Chemistry 310a. *Mr. Curl*

Chemistry 480a. Chemistry of Natural Products (3-0-3).

A study of important types of naturally occurring substances of current interest in chemistry and biology. Prerequisite: Chemistry 400a. *Mr. Turner*

Chemistry 490a, b. Special Study and Research for Undergraduates (Credit to be determined).

Open only to chemistry majors with superior records, and with the permission of the chairman of the department. Laboratory fee required. *Staff*

Chemistry 500a, b. Graduate Research (Credit to be determined). *Staff*

Chemistry 505a, b. Advanced Physical Chemistry (4-0-4, each sem.).

An intensive review of general physical chemistry with emphasis on independent work by the student. A course designed primarily for first-year graduate students. *Staff*

Chemistry 510a, b. Chemistry of the Steroids (3-0-3, each sem.).

A consideration of the reactions and stereochemistry of the steroids, including a discussion of the physiological importance of these compounds. Not offered in 1966-67. *Mr. Turner*

Chemistry 520a, b. Kinetics of Reactions of Gases (3-0-3, each sem.).

A treatment from both theoretical and empirical considerations of chemical reactions in gases, including some studies of fast reactions catalyzed by solids. Prerequisite: Chemistry 505a,b or equivalent. *Mr. Franklin*

Chemistry 530a. Chemistry of Gaseous Ions (2-0-2).

Prerequisite: Chemistry 505a,b. Not offered in 1966-67. *Mr. Franklin*

Chemistry 540b. Special Topics in Organic Chemistry (3-0-3).

Chemistry 550a. Reaction Kinetics and Mechanisms in Solutions (3-0-3).

A consideration of the rates of reactions with emphasis on homogeneous kinetics as a tool in the study of reaction mechanisms. Prerequisite: Chemistry 400a. Not offered in 1966-67. *Mr. Lewis*

Chemistry 570b. Spectral Methods in Organic Chemistry (3-0-3).

The application of infrared, ultraviolet, and nuclear magnetic resonance spectroscopy to organic chemistry. Prerequisite: Chemistry 400a. *Mr. Magid*

Chemistry 580a. Special Topics in Alkaloid Chemistry (3-0-3).

A consideration of the chemistry of selected groups of alkaloids. Not offered in 1966-67. *Mr. Turner*

Chemistry 590a. Advanced Topics in Theoretical Chemistry.

Mr. Salsburg

Chemistry 610a. High-Temperature Chemistry (3-0-3).

A study of the techniques for generation and measurement of high temperatures and of the nature of high-temperature phenomena utilizing the principles of thermodynamics and quantum mechanics and modern experimental tools. Special attention is devoted to the characterization of high-temperature vapors, to gas-solid interactions, and to plasma phenomena. Not offered in 1966-67. *Mr. Margrave*

Chemistry 640a. Chemistry of the Terpenes (3-0-3).

Mr. Turner

Chemistry 650a, b. Quantum Mechanics (3-0-3, each sem.).

A study of simple mechanical systems from the point of view of wave mechanics with application of these concepts to the chemical bond. Consideration of the energy states of polyatomic molecules. Prerequisite: Mathematics 300a,b or 310a,b. *Mr. Kilpatrick*

Chemistry 660a. X-ray Crystal Structure Analysis (3-0-3).

A course in X-ray analysis including experimental methods, symmetry and space groups, dynamic theory of X-ray diffraction, Fourier and Patterson methods, modification functions, and order-disorder phenomena. Prerequisite: Chemistry 505a,b. Not offered in 1966-67.

Mr. Sass

Chemistry 690a. Special Topics in Organic Reaction Mechanisms (3-0-3).

Mr. Lewis

Chemistry 700. Summer Graduate Research

Staff

Civil Engineering

(*See* pages 136-142)

Classics, Italian, Portuguese, Russian, and Spanish

Associate Professors Castañeda, *Chairman,* Jitkoff
Leal de Martínez, and Levin
Assistant Professors Heath, Lendínez, and Skarginsky
Lecturers Lauderdale, Moore, and Muñoz

Work is offered in Greek, Latin, Italian, Portuguese, Russian, and Spanish. Undergraduate majors are presently offered in Classical Studies and Spanish.

A fully equipped language laboratory is now in operation, and laboratory work is required of students in the beginning classes in all the modern languages.

Qualified upperclassmen may engage in independent work at the discretion of the department.

CLASSICS

Associate Professor Levin
Assistant Professor Heath
Lecturer Moore

Requirements for an Undergraduate Major in Classical Studies. A major in Classical Studies is presently offered with the cooperation of the Departments of History and Fine Arts. The overall major requirement is distributed between classical languages and literatures (at least thirty semester-hours, equal to five year-courses, of which twenty-four hours, equal to four year-courses, must be at the 300 level or above) and relevant courses in fine arts, history, humanities, and philosophy. Preparation to insure an adequate reading and speaking knowledge of at least one modern foreign language is very strongly urged. All prospective programs for individuals majoring in Classical Studies are to be drawn up in consultation with the members of the Classics staff.

COURSES

Greek 100a, b. First-Year Greek (3-0-3, each sem.).

A course designed to develop as rapidly as possible an ability to read simple Greek prose: study of grammar, forms, and vocabulary is combined with practice in reading. *Mr. Levin*

Greek 200a, b. Intermediate Greek (3-0-3, each sem.).

The course is designed to broaden the skills acquired in Greek 100 through a close study of readings which may include a dialogue of Plato, a tragedy, or selections from Homer. *Mr. Heath*

Greek 300a. Greek poetry (3-0-3, each sem.).

A selection will be made from the writings of two or more Greek poets, exclusive of Homer. Prerequisite: Greek 200a,b or equivalent. *Staff*

Greek 300b. Greek Prose (3-0-3, each sem.).

Readings will be selected from the work of prose authors not already encountered in lower-level courses. Prerequisite: same as for Greek 300a. *Staff*

Latin 100a, b. First-Year Latin (3-0-3, each sem.).

Designed for students who have had no previous acquaintance with the Latin language. The first semester will be given over to grammatical and syntactic study. Selections from Caesar's *Commentaries* will be read during the second semester. *Mrs. Moore*

Latin 200a, b. Intermediate Latin (3-0-3, each sem.).

A course designed for students who enter with two or three years of high school Latin as well as for those who have successfully completed Latin 100a,b. Rapid review of forms and syntax will be followed by reading of representative selections from Latin prose and poetry. *Staff*

Latin 300a. Cicero (3-0-3).

Several works of Cicero will be read. There will be discussion also of related literary and historical topics. Prerequisite: Latin 200a,b or three or four years of high school Latin. *Mr. Levin*

Latin 300b. Catullus and Horace (3-0-3).

A study of the development of Latin lyric poetry in Catullus and the *Odes* and *Epodes* of Horace. Consideration will be given to their Greek predecessors, to the Roman age that they mirror, and to the standards by which their work may be criticized. *Mr. Heath*

Latin 410a. Tacitus (3-0-3).

Readings in the *Annals* of Tacitus and discussion of some of the historical problems of the region of Tiberius. Offered in alternate years: will be given in 1967-68. Prerequisite: Latin 300 a and b or equivalent. *Mr. Heath*

Latin 410b. Lucretius (3-0-3).

Readings in the *De Rerum Natura* and discussion of literary and philosophical topics. Offered in alternate years: will be given in 1967-68. Prerequisite: Latin 300 a and b or equivalent. *Mr. Levin*

Latin 420a. Elegiac Poetry (3-0-3).

Readings and discussion of a representative selection of poems by Catullus, Tibullus, Propertius, and Ovid. Offered in alternate years: will be given in 1966-67. Prerequisite: Latin 300 a and b or equivalent. *Mr. Heath*

Latin 420b. Satire (3-0-3).

Readings and discussion of a representative selection of the work of the Roman satirists, both in prose and in verse. Offered in alternate years: will be given in 1966-67. Prerequisite: Latin 300 a and b or equivalent. *Mr. Levin*

Latin 490a, b. Special Topics in Roman Literature (0-0-3, each sem.).

Independent work for qualified upperclassmen in genres or authors not presented in other upper-level courses: may be repeated for credit. *Staff*

Classics 315a. Greek Literature in Translation (3-0-3).

A study of the Greek creative achievement in epic and lyric poetry and in drama. Open to Sophomores with permission of the instructor. Offered in alternate years: will be given in 1967-68. *Mr. Levin*

Classics 315b. Greek Literature in Translation (3-0-3).

A continuation of the foregoing: Greek historians, orators, philosophers. Open to Sophomores with permission of the instructor. Offered in alternate years: will be given in 1967-68. *Mr. Heath*

Classics 316a. Roman Literature in Translation (3-0-3).

Major achievements in dramatic, lyric, and epic poetry will be studied, with due attention given both to Greek influence and to Roman originality. No prerequisite, although the sequence of 315a, b and 316a, b is strongly recommended. Open to Sophomores with permission of the instructor. Offered in alternate years: will be given in 1966-67. *Mr. Levin*

Classics 316b. Roman Literature in Translation (3-0-3).

A continuation of the foregoing: readings in Roman oratory, historical writing, and philosophy. No prerequisite; but note the recommendation made above regarding Classics 316a. Open to Sophomores with permission of the instructor. Offered in alternate years: will be given in 1966-67. *Mr. Heath*

Classics 320a, b. Trends in European Culture during Antiquity and the Middle Ages (3-0-3, each sem.).

This course traces selected aspects of European thought from Periclean Athens to the later Middle Ages, with special reference to Hellenistic and Greco-Roman influences. Religious, philosophical, and scientific implications are examined in some detail. Offered in alternate years: given in 1966-67. Prerequisite: History 200a, 201b. Also offered as History 320a,b. *Mr. Lear*

Classics 430a, b. Topics in Ancient and Medieval Intellectual History (3-0-3, each sem.).

This course deals with selective phases of classical and medieval thought based on the cultural monuments of antiquity and the Middle Ages. Intensive reading and reports on special aspects of the field. Offered in alternate years: given in 1967-68. Prerequisite: History 200a, 201b. Also offered as History 430a, b. *Mr. Lear*

ITALIAN

Italian 100a, b. Elementary Italian (3-1-3, each sem.).

Introduction to the study of the Italian language, with emphasis on the development of audio-lingual skills. Graded readings will be used to introduce the student to the basic elements of Italian culture and civilization. Language laboratory work required. *Staff*

Italian 200a, b. Intermediate Italian (3-0-3, each sem.).

Emphasis on intensified oral and written practice. Review of grammar. An introduction to the culture and civilization of Italy. Readings of contemporary short stories and plays. *Staff*

PORTUGUESE

Associate Professor Leal de Martínez

Portuguese 100a, b. First-Year Portuguese (3-1-3, each sem.).

Introduction to the study of the Portuguese languese, with emphasis on the development of audio-lingual skills. Language laboratory work required. *Mrs. Leal de Martínez*

Portuguese 200a, b. Second-Year Portuguese (3-0-3, each sem.).

The first part of this course is devoted to a comprehensive review of grammar which will gradually lead the student to engage in natural conversation. Contemporary short stories will provide current linguistic models and serve as the point of departure for class conversation and discussion. The second part of the course is intended to introduce the student to the main currents of Portuguese literature. *Mrs. Leal de Martínez*

RUSSIAN

Associate Professor Jitkoff
Assistant Professor Skarginsky

Russian 100a, b. Elementary Russian (3-1-3, each sem.).

Pronunciation, grammar, introduction to conversation, graded reading, and practice in translation. Language laboratory work required. *Staff*

Russian 110a. Russian for Graduate Students (3-0-0).

A noncredit course in Russian, restricted to graduate students preparing for the graduate language examination. *Mr. Jitkoff*

Russian 200a. Intermediate Russian (3-0-3).

Designed to provide practice in reading, composition, and comprehension. Prerequisite: Russian 100b. *Mr. Skarginsky*

Russian 200b. Intermediate Russian: Literary (3-0-3).

Introduction to Russian literature with emphasis on composition. Outside reading required. Prerequisite: Russian 200a. *Mr. Skarginsky*

Russian 201b. Intermediate Russian: Scientific (3-0-3).

Reading and translation in field of major study. Prerequisite: Russian 200a. *Mr. Jitkoff*

Russian 300a. Russian Culture and Civilization (3-0-3).

Reading and discussion on topics related to the development of Russian civilization. Oral and written reports on assigned topics. The course will be conducted in Russian. Prerequisite: Russian 200b or 201b. Offered in alternate years: will be given in 1967-68. *Mr. Jitkoff*

Russian 300b. Reading in Russian Classics (3-0-3).

Reading in Russian literature. Oral and written reports on assigned topics. The course will be conducted in Russian. Prerequisite: Russian 300a. Offered in alternate years: will be given in 1967-68. *Mr. Jitkoff*

Russian 330a, b. History of Russian Literature (3-0-3, each sem.).

A comprehensive survey of Russian literature from its beginning to the twentieth century. Prerequisite: Russian 200b. Offered in alternate years: will be given in 1966-67. *Mr. Skarginsky*

Russian 450a, b. Independent Work: Special Topics in Russian Literature. (0-0-3, each sem.).

Research for qualified upperclassmen. *Staff*

SPANISH

Associate Professors Castañeda, Leal de Martínez
Assistant Professor Lendínez
Lecturers Lauderdale and Muñoz

Requirements for an Undergraduate Major in Spanish. Ten of the semester-courses offered in fulfillment of major requirements must be Spanish courses numbered 300 or higher. Qualified upperclassmen are offered an opportunity to earn up to six hours of credit in independent work. All departmental majors must have their programs approved by the department.

COURSES

Spanish 100a, b. First-Year Spanish (3-1-3, each sem.).

Introduction to the study of the Spanish language, with emphasis on the development of audio-lingual skills. Graded readings will be used to introduce the student to Hispanic culture and civilization. Language laboratory work required. *Staff*

Spanish 110b. First-year Spanish (3-1-3).

A presentation of the fundamentals of Spanish grammar. Language laboratory work required. *Miss Lauderdale*

Spanish 200a, b. Second-Year Spanish (3-0-3, each sem.).

The first part of this course is devoted to a comprehensive review of grammar which will gradually lead the student to engage in natural conversation. Contemporary short stories will provide current linguistic models and serve as the point of departure for class conversation and discussion. The second part of the course is intended to introduce the student to the main currents of Hispanic literature. *Staff*

Spanish 210a, b. Second-Year Spanish (3-0-3, each sem.).

Designed for students who have successfully completed Spanish 110. Review of grammatical patterns and selected readings of cultural interest. *Miss Lauderdale*

Spanish 300a, b. Hispanic Culture and Civilization (3-0-3, each sem.).

Topics relating to the development of social, political, and economic institutions of Spain will form the basis for extensive conversation, discussion, and composition. Thus, while further developing his language skills, the student will also be introduced to the cultural reality of the Hispanic world. Will be given in 1967-68. *Mr. Lendínez*

Spanish 320a, b. Survey of Spanish-American Literature (3-0-3, each sem.).

A study of the main trends and outstanding writers of Spanish America. Offered in alternate years: will be given in 1966-67. *Mrs. Leal de Martínez*

Spanish 340a, b. Spanish Literature from 1800 to the Present (3-0-3, each sem.).

Particular emphasis on Romantic drama, Galdós, the generation of '98, García Lorca, and contemporary novel and theater. Offered in alternate years: will be given in 1967-68. *Mrs. Leal de Martínez*

Spanish 350a, b. History of the Spanish Language (3-0-3, each sem.).

The development of Spanish from the Romanization of Spain to our times. Linguistic, cultural, social, and regional factors which have led to modern Spanish. Required for students majoring in Spanish. Prerequisite: Spanish 200a,b or its equivalent. Offered in alternate years: will be given in 1966-67. *Staff*

Spanish 360a, b. Golden Age Drama (3-0-3, each sem.).

The development of the "comedia" as illustrated by selected works of Lope de Vega, Tirso de Molina, Ruiz de Alarcón, Calderón de la Barca, and other seventeenth-century playwrights. Offered in alternate years: will be given in 1967-68. *Mr. Castañeda*

Spanish 380a, b. Prose and Lyric Poetry of the Golden Age (3-0-3, each sem.).

Intensive and detailed analysis of selected texts in poetry and prose, emphasizing mysticism, the development of lyric poetry from Garcilaso to Góngora, the picaresque novel, and Cervantes. Offered in alternate years: will be given in 1966-67. *Mr. Castañeda*

Spanish 400a, b. Survey of Spanish Literature (3-0-3, each sem.).

Representative readings from the medieval period to the present, while providing a panoramic view of the history of Spanish literature, will also be used to develop the student's ability in literary study and stylistic analysis. Offered in alternate years: will be given in 1966-67. *Mr. Lendínez*

Spanish 420a, b. Independent Work: Special Topics in Spanish Literature (0-0-3, each sem.).

Reserved for qualified upperclassmen who are particularly interested in an author or period not covered in other courses. Permission of the department required. *Staff*

Commerce

LECTURERS HALE, JOHNSTON, *Chairman*, AND MARKEY

COURSES

Commerce 100a, b. Introduction to Business (3-0-3, each sem.).

Historical, economic, and social setting of business enterprise; descriptive analysis of business activity.

Commerce 110a, b. Business Mathematics (3-0-3, each sem.).

Linear equations; exponents and radicals; quadratic equations; binomial theorem; logarithms; curve plotting. Compound interest and annuities; sinking funds; permutations and combinations; introduction to probability.

Commerce 200a, b. Financial Control (3-0-3, each sem.).

Introduction to the methods of accounting for partnerships and corporations; concepts of costs, income, and profit; financial analysis; problems in valuation, depreciation, and surplus accounting.

Commerce 310a. Business Statistics (3-2-3).

Collection, classification, and presentation of data; use of graphic methods; frequency distributions; sampling; time series; index numbers; correlation.

Commerce 315b. Finance and Banking (3-0-3).

Functions and theory of money and credit; principles of commercial banking; the Federal Reserve System.

Commerce 410a. Marketing (3-0-3).

Marketing functions and institutions; role of commodity characteristics and the choice of distribution channels; financing marketing activities; management and control of marketing risks.

Commerce 415b. Business Finance (3-0-3).

Short- and long-term financing of assets; investment banking; tools of financial analysis; budgets and financial planning.

Commerce 420a. Business Organization I (3-0-3).

Personnel management and employee relations; personnel policies; job evaluation; wage and salary administration; employee services; labor legislation.

Commerce 425b. Business Organization II (3-0-3).

Principles of internal organization and control; selected topics in business policy.

Economics and Business Administration

Professors Brothers, Edwards, and Rimlinger, *Chairman*
Visiting Professor Ness
Associate Professors Krzyzaniak, Levy,
Simons, and Young
Assistant Professors Besen, Conlisk, Huddle, McLure
Steele, and Summers
Lecturers Farb and Giles
Visiting Lecturer Bannister

The Undergraduate Program in Economics. Undergraduate majors are required to take ten semesters of approved departmental courses. These must include Economics 200a and b, Economics 250a, Business Administration 200b, and one 300 numbered course. Furthermore, in lieu of three semesters of course work, the department offers an independent work program, admission to which is granted on a selective basis.

The Five-Year Program in Accounting. Students primarily interested in accounting may, with departmental approval, extend their training into a fifth year. To be eligible for this program students must have successfully completed a Bachelor's degree, whether with a major in economics or some other field. Students who are interested in the five-year program are advised to enroll in Business Administration 200b in their Sophomore year, Business Administration 300a,b in their Junior year, and Business Administration 400a in their Senior year. In the fifth year, students are required to enroll in three full-year advanced accounting courses and two additional upper-class courses outside the department. Upon the successful completion of these requirements a student is awarded the degree of Bachelor of Science in Accounting. This program is designed for those who wish to prepare themselves for careers in public accounting as well as for positions of managerial responsibility in business.

The Graduate Program in Economics. Admission to graduate study in economics is granted each year to a limited number of students who hold an undergraduate degree (or the equivalent), whether in economics or another field. The graduate program is designed primarily for students qualified to pursue a course of study leading to the Ph.D. degree. Some training in mathematics at the undergraduate level is advisable but is not a prerequisite of admission. The Economics Department also offers graduate work leading to the M.A. degree.

Candidates for the Ph.D. degree who have good undergraduate preparation in economics should expect to devote two years to full-time study (or the equivalent) before taking the general examination which must be passed before the submission of the doctoral disserta-

tion. A minimum of one additional year is usually necessary for completion of the dissertation. Applicants are required to take the Graduate Record Examination.

The aim of the graduate program is to provide thorough training in economic theory and in the use of quantitative methods of analysis, and also to afford an understanding of modern economic institutions and policy problems. Those successfully completing the Ph.D. program will be prepared for careers as professional economists in teaching, business, and government.

Instruction is carried on in small classes, seminars, and tutorials in which student participation is emphasized. Close contact with the faculty is encouraged as a means of stimulating and sustaining student interest in research problems.

Supplemental facilities and opportunities include:

(1) Participation in the Economics Seminar which meets at least once a month to hear visiting economists, departmental faculty, and graduate students present results of current research.
(2) Use of a large-scale digital computer in connection with advanced research and courses.
(3) Enrollment in graduate courses in such related subject areas as history, mathematics, philosophy, and engineering.

Candidates for the doctor's degree will be expected to:

(1) Pass reading examinations in French and German, one by the end of the first and the other by the end of the second year of residence. Another language may be substituted for one of these, with approval of the Graduate Committee of the department.
(2) Demonstrate proficiency in statistics, elementary mathematical economics, and economic history or history of economic thought.
(3) Complete an approved program of graduate courses.
(4) Pass a general examination (written and oral) on three approved fields of economics, one of which must be economic theory. The fields offered are:
    1. Economic Theory
    2. Mathematical Economics and Econometrics
    3. Business, Labor, and Industrial Behavior
    4. Monetary and Fiscal Theory and Policy
    5. Growth, Development, and International Economics

    Students may substitute an outside field for one of these, other than economic theory, with the approval of the departmental Graduate Committee.

    The Economics Department participates in the University's Interdisciplinary Program in Systems Theory. Candidates for the doctor's degree in economics may also be enrolled in this program, in which case their fields will be:

1, 2 or Applied Mathematics, Systems Theory, and 3, 4, or 5.

(5) Submit (with the approval of the advisory committee) and successfully defend in an oral examination a doctoral dissertation setting forth in publishable form the results of original research.

Candidates for the master's degree in economics are expected to fulfill the following requirements:

(1) Complete successfully an approved program of graduate courses.
(2) Demonstrate proficiency in the use of statistics.
(3) Pass a reading examination in French or German. Another language may be approved as a substitute for one of these.)
(4) Make a successful oral defense of a thesis presenting in prescribed form the results of original research.

ECONOMICS COURSES

Economics 200a, b. Principles of Economics (3-0-3, each sem.).

The principles of modern economics and the history of economic thought and controversy. The first part of the course is concerned with the theory of national income determination, price and distribution theory, and the theory of trade. In the second part of the course the great economic ideas and issues of the past and present are studied, with emphasis on those ideas and policy issues of continuing influence in national and international economic affairs.

Economics 250a. Elements of Statistical Method (3-2-3).

Basic concepts of probability and sampling theory. Elementary techniques of estimation, hypothesis testing, correlation, and regression.

Economics 304b. Junior Independent Work (0-0-3).

Each student is required to undertake research and to write (and rewrite) a short paper on a topic approved by his adviser. Only a limited number of students are permitted to enroll in this course, selection being based on interviews with those who apply. Preference is given to Juniors who are contemplating enrolling in Economics 404 as Seniors. Prerequisite: Economics 200a,b and one advanced course.

Economics 355a. Money and Banking (3-0-3).

Determinants of the demand for money; the relationship between money and national income; American financial institutions; instability and prices and income and the role of monetary policy; conflicts between internal and external stability. Prerequisite: Economics 200a.

Economics 370a. Economic Analysis I (3-0-3).

A course in intermediate theory devoted to the study of economic equilibrium and market relationships; the theories of the firm and the household, of income distribution, and of general equilibrium. Prerequisite: Economics 200a.

Economics 375b. Economic Analysis II (3-0-3).

The theory of national income determination and economic growth; a critical consideration of selected theories of income fluctuations; some application of theory to policy questions. Prerequisite: Economics 200a.

Economics 404. Senior Independent Work (0-0-6).

A course for Seniors in which each student is required to undertake intensive research on a subject approved at the end of his Junior year. The results of this

research are to be incorporated in a thesis submitted in the spring of the Senior year. Prerequisite: Economics 304b.

Economics 410b. Economics of Labor Relations (3-0-3).

A survey of the history and current status of the labor movement in the United States; organization and structure of labor unions; trends in labor legislation; collective bargaining and the settlement of labor disputes; wage and employment theory; social insurance; current labor problems and issues. Prerequisite: Economics 200a or approval of the instructor.

Economics 420a. International Economics (3-0-3).

A study of the economic relationships between separate countries in the international economy; trade theory; balance of payments analysis; international finance; tariffs and other trade restrictions; current policy issues. Prerequisite: Economics 200a.

Economics 430b. Comparative Economic Systems (3-0-3).

Theoretical models of various economic systems are presented as a basis for analyzing the operation and the institutional characteristics of several economies, including the U.S., the U.S.S.R., Great Britain, India, and China. Prerequisite: Economics 200a.

Economics 435b. Government Regulation of Industry (3-0-3).

The nature, enforcement, and economic impact of the federal statute laws regulating monopoly and competition in the United States; the development and legal interpretation of the antitrust laws through precedents established in important cases. Prerequisite: Economics 200a or approval of the instructor.

Economics 445a. Mathematical Methods in Management (3-0-3).

An introduction to analytical and mathematical methods useful in managerial decisions. Primary emphasis is placed on mathematical programming formulations and solutions of management problems. Prerequisite: Economics 200a.

Economics 446b. Managerial Economics (3-0-3).

The use of economic and operations-research methods in the planning and controlling of business operations. Prerequisite: Economics 445a or permission of the instructor.

Economics 450b. Economic Growth and Development (3-0-3).

An analysis of the mechanics of economic growth in general and specific investigations of economic development of underdeveloped areas, including problems of capital formation, manpower mobilization, population pressures, and economic and social organizations. Prerequisite: Economics 200a.

Economics 475a. Taxation and Fiscal Policy (3-0-3).

An analysis of the financial operations of governmental units at the national, state, and local level, but particularly at the federal level; analysis of monetary and fiscal policies to promote economic stability; economic appraisal of the United States tax structure and of its effects on incentives and on the prospects for long-run economic growth and development. Prerequisite: Economics 200a.

Economics 490a. Development of Economic Institutions (3-0-3).

A seminar devoted to analysis of the impact of technological change and political and social developments upon the evolution of economic institutions. Economic forces which lie beyond supply-and-demand factors in the market economy are investigated. The course surveys the works of leading institutional economists and social anthropologists as a point of departure for research and discussion.

Economics 495a, b. Senior Research Seminar (1-0-1, each sem.).

Reading and Discussion related to selected research topics. Open to Seniors with special approval.

Economics 500. Economic Research.

Research on an approved topic in partial fulfillment of the requirements for the master's degree.

Economics 501. Price Theory (3-6-5).

Microeconomic theory. Topics studied include the theory of the firm, the theory of consumer behavior, duopoly, bilateral monopoly, imperfect competition, capital theory, and the theory of income distribution.

Economics 502. Income and Employment Theory (3-6-5).

Macroeconomic theory of employment, interest, and income. Considers the work of Keynes and subsequent developments including growth models.

Economics 503. Topics in Economic Theory (3-6-5).

Selected theoretical issues in the areas of capital, welfare economics, uncertainty, growth, and income.

Economics 504. Theory of Public Finance (3-6-5).

Analysis of government revenue and expenditure, function of the budget, principles of taxation, tax incidence and effects, national debt, and compensatory finance.

Economics 505. Monetary Theory (3-6-5).

Modern monetary theory. The economics of money, banking, and finance.

Economics 506. Monetary and Fiscal Policy (3-6-5).

Selected theories of monetary and fiscal policy and their application. Analysis of contemporary policy issues.

Economics 507. Elementary Mathematical Economics (3-6-5).

Introduction to mathematical theories of economics. Theory of choice, preference and utility. Survey of simple models of exchange, production and consumption, and market equilibrium. Elements of programming, games, operational analysis.

Economics 508. Advanced Mathematical Economics (3-6-5).

The mathematical framework and the analytical investigation of fundamental models in economics.

Economics 509. Advanced Statistics (3-6-5).

Statistical inference and the testing of hypotheses; multiple and partial correlation analysis; selected topics in time-series analysis and index-number construction.

Economics 510. Econometrics (3-6-5).

Mathematical models of economic behavior and their numerical evaluation by statistical methods.

Economics 511. Topics in Policy and Applied Economics (3-6-5).

Selected research problems in economic development, economic planning, national income accounting, and industrial organization.

Economics 512. International Trade Theory (3-6-5).

Classical, neoclassical, and modern trade theory; balance of payments equilibrium; some welfare aspects of trade. Offered in alternate years.

Economics 513. Topics in Managerial Economics (3-6-5).

Theory of investment of the firm; organization theory; problems in applying theory in decision-making.

Economics 514. Industrial Organization and Control (3-6-5).

Industrial markets and public policy. Examines the determinants and implications of price and production policies and also considers the adequacy of the antitrust laws in relation to the problems of industrial organization.

Economics 515. Labor Economics (3-6-5).

The economics of the labor market and the economic implication of trade unions. Attention is given to major public policy issues.

Economics 516. Economic History and Development (3-6-5).

An historical analysis of the economic growth and industrialization of the U. S., Western Europe, and Russia in the last 150 years. Stresses the conditions which favored or retarded growth in different times and places.

Economics 517. History of Economic Thought and Methodology (3-6-5).

The development of economic thought and methodology from the seventeenth century to the present. Emphasis is given to classical and neoclassical doctrines reflected in modern economic theory and analytical techniques.

Economics 518. International Finance (3-6-5).

Analysis of international monetary problems; foreign-exchange theory; international investment. Offered in alternate years.

Economics 519. Economic Growth and Development (3-6-5).

An analysis of theory and policy questions relating to the level and rate of economic development. An examination of development problems, plans, and planning techniques in selected countries.

Economics 600. Economic Research.

Research on an approved topic in partial fulfillment of the requirements for the doctor's degree.

BUSINESS ADMINISTRATION COURSES

Business Administration 200a, b. Introduction to Business Administration (3-0-3).

Basic accounting principles; financial statements; interpretation of financial and operating reports.

Business Administration 300a. Principles of Accounting I (3-0-3).

Study of accounting procedures and principles at the intermediate level; financial statements; net income concepts; capital stock, retained earnings, and dividends; generally accepted accounting principles; accounting for current assets and investments. Prerequisite: Business Administration 200a or 200b.

Business Administration 300b. Principles of Accounting II (3-0-3).

Study of accounting for fixed assets, liabilities, and reserves; analysis and interpretation of statements and operations; combination and reorganizations; fund flows; allocation of income taxes; price-level impact on financial statements. Prerequisite: Business Administration 300a or permission of the instructor.

Business Administration 400a. Advanced Accounting (3-0-3).

Partnership; statement of affairs; receiverships; actuarial science; estates and trusts; parent and subsidiary accounting; consolidated statements; foreign ex-

change and public accounts. Prerequisite: Business Administration 300a and 300b or permission of instructor.

Business Administration 500a. Managerial Accounting (3-0-3).

An intensive study of the accumulation, analysis, reporting, and use of accounting data for business planning, control, and operations.

Business Administration 510a, b. Federal Taxes (3-0-3, each sem.).

A study of Federal taxation of individuals, trusts, estates, partnerships, and corporations, with required research and writing on tax problems.

Business Administration 515b. Auditing (3-0-3).

An intensive study of financial examination theory, organizational control, and operations auditing.

Business Administration 520a. Theory of Accounting (3-0-3).

Topics of current interest arising from the search for generally acceptable accounting principles. Study of inconsistencies between current theory and practice. Applications of economic analysis to accounting concepts.

Business Administration 530b. Quantitative Methods (3-0-3).

A study of the usefulness of modern techniques of data processing in financial analysis and reporting.

Education

Associate Professor Wood, *Chairman*
Lecturers Baum and Bolling

Teacher Education and Certification. Rice University seeks to contribute graduates to society able to think and to question, educated to comprehend and to cope with a rapidly changing world. Although professional instruction is not the primary ingredient of undergraduate education, the University's role in preparing students for their future life work cannot be ignored. While maintaining complete institutional integrity, Rice University supports the intention as well as the letter of regulations promulgated by the state governing the development and presentation of teacher preparation and certification programs.

To this end Rice University has a Department of Education which closely cooperates with departments offering work in subject-matter fields. It is the function of this department to provide rigorous professional courses and to administer the established teacher education programs.

The Rice University teacher education program strives to fit the prospective teacher to perform all the roles which may be expected of him. To accomplish this objective, it gives sustained close attention to the following vitally interrelated components:

A. a sound liberal or general education
B. an extended knowledge of the subject(s) or areas(s) to be taught
C. professional knowledge, as distinguished from professional skills

(i.e., relevant historical, philosophical, social, and psychological material)

D. skills in managing a classroom, in working with children and people, and in the supervision of the learning process.

Admission to the Teacher Education Program. Students who have satisfied the following requirements may apply to the Education Council for admission to the teacher education program:

1. Junior standing at Rice University
2. Satisfactory completion of History 110a,b: American History
3. A grade average of 3 or better in at least 75 per cent of all semester hours attempted in teaching field offered for approval
4. Passing grades in Freshman and Sophomore English courses
5. Given evidence of satisfactory speech patterns
6. Provided evidence of adequate physical vigor and strength and absence of obvious physical conditions which might interfere materially with performance in a classroom as a teacher
7. Approval of a completed Teacher Certification Program form by the appropriate departmental representatives and the Education Council prior to registration for the Junior year
8. Approval of the completed form "Application for Admission to the Teacher Education Program" by the Education Council prior to registration for the Junior year

Texas State Requirements for Secondary Provisional Certificate

(Grades 7-12)

A Provisional Teacher's Certificate is based upon a bachelor's degree, satisfactory completion of an approved teacher-preparatory program, and the recommendation of the University. Rice University is approved to offer the following teacher-preparatory programs: biology, chemistry, English, French, German, health and physical education, history, Latin, mathematics, physics, Spanish, general science, and social studies.

The approved program shall consist of the following:

1. *Foundations in Arts and Sciences:* Approximately two years including:

A. English	12 semester hours
American History	6 semester hours
Government	6 semester hours
From two of the following:	12 semester hours
Science	
Mathematics	
Foreign Language	
B. Other institutional degree requirements	

2. *Academic Specialization:*

   Plan I. Preparation to Teach Two Fields:
   24 semester hours in each area including 12 semester hours of advanced work in each, with approval of the Rice Education Council.

   Plan II. Preparation to Teach Related Fields:
   48 semester hours in a composite field (general science or social studies) with at least 18 semester hours of advanced work and with approval of the Rice Education Council.

3. *Professional Education:* 18 semester hours of which 6 semester hours shall be in student teaching.

4. *Elective courses.*

Requirements for Completion of the Teacher Education Program

To be recommended to the Texas Education Agency for certification, a student must satisfy all institutional requirements for a bachelor's degree which will include:

1. Completion of History 110a,b and Political Science 210a,b before the Junior year
2. Twenty-four semester hours of credit in each of two teaching fields or forty-eight semester hours of credit in a composite field.
3. Completion of the required professional education courses. Education 310a,b is to be taken in the Junior year and Education 410a,b in the Senior year
4. Satisfaction of the supervised student teaching requirement (Education 420) as outlined below.

COURSES

Education 310a. The Historical and Philosophical Foundations of Education (3-0-3).

A study of secondary education's historic function in the United States; intellectual foundations of modern educational thought and practice; philosophic analysis of contemporary and recent theories useful in planning the educative activities of the secondary school. Prerequisite: History 110 or consent of the instructor and filing of Teacher Certification Plan.

Education 310b. Human Development: The Psychology of Human Learning (3-0-3).

Introductory survey of theoretical systems in the field of human learning together with a consideration of their implications for education; motivation; personality development in adolescence; statistics; tests and measurement; evaluation.

Education 410a. Fundamentals of Secondary Education (3-0-3).

Background and purposes of the secondary school; trends in modern secondary education; curriculum of the secondary school; current trends in school administration; essentials of educational research.

Education 410b. Seminar in Teaching (3-0-3).

Problems that face the beginning teacher; current trends in effective teaching materials and procedures; comprehensive study of materials and procedures for teaching the student's subject-matter field of specialization in preparation for actual teaching; observation of, and orientation to, public school teaching.

Education 420. Principles of Teaching: Introduction to Teaching in the Secondary School and Supervised Teaching. (Credit: 6 semester hours.)

NOTE: *Either of two distinct plans may be followed by teacher education candidates. The main difference is the type of supervised teaching experience provided.*

The Apprenticeship Plan (Plan A):

Prerequisite: Education 310a,b.

Apprenticeship is designed for students who wish to complete preparation for their teaching careers in four years and two six-week summer sessions. Candidates will enroll for the summer session following their Junior year. The Apprentice will observe teaching, act as a helping teacher, and perhaps teach as may be appropriate in the Rice Summer School for High School Students.

Education 410a,b is to be completed during the Senior year.

Following graduation from Rice the Apprentice will attend the summer session for full-time teaching in the Rice Summer School for High School Students under the supervision and guidance of a Master Teacher and the University staff. While the Apprentice spends somewhat less time in student teaching than under the Internship Plan, he is not remunerated for his teaching service. The Apprentice is to be recommended for a Texas Provisional Teacher's Certificate following successful completion of his second summer session.

The Internship Plan (Plan B):

Prerequisites: Education 310a,b and Education 410a,b.

Under this plan students are expected to attend a six-week summer session immediately following their graduation from Rice. Each Intern will observe and teach classes under the supervision of a Master Teacher and a University staff member in the Rice Summer School for High School Students. During the following fall semester Interns will be assigned to classrooms in neighboring school systems for full-time duty. Two Interns will be employed as a pair to take the place of a normally employed teacher. Each Intern is to teach three periods per day under supervision and guidance of a teacher at his assigned school and a staff member from the University. During the half-year of their service Interns will be paid a salary commensurate with the salary being paid to substitute teachers by cooperating school systems for

their employment as classroom teachers. Interns successfully completing their teaching assignment will be offered a regular contract to teach the spring semester and will be recommended for a Texas Provisional Teacher's Certificate.

Electrical Engineering

(*See* pages 143-148)

Engineering and Applied Science

General Undergraduate Information. Curricula in engineering at Rice University lead to degrees in the fields of chemical engineering, civil engineering, electrical enginering, and mechanical engineering.

The first two years of the science-engineering program taken by all engineers are described generally on pages 51-52. Sophomore students contemplating a major in engineering should pay particular attention to the electives recommended under the special engineering departments.

The following undergraduate courses listed as "Engineering" are offered for the preparation of students majoring in all branches. For requirements of each department, reference should be made to the appropriate section.

COURSES

Engineering 201. Engineering Graphics I (1-5-3).

An engineering course which develops graphics as a method of exchanging ideas. Included are orthogonal projection, sketching, dimensioning, ASA and SAE standards, pictorial projection, and lettering. Staff approval of all drawing instruments is required. Laboratory fee required.

Engineering 202. Engineering Graphics II (1-5-3).

Emphasis on the graphical method of solving technical problems. Included are graphical arithmetic, graphical calculus, nomography, and relationships of algebraic and graphical solutions of problems in space. Prerequisites: Engineering 201 and completion of or registration in Mathematics 200a,b or 210a,b.

Engineering 211. Engineering Mechanics I (3-0-3).

Vector methods, equilibrium of static systems, kinematics of motion, dynamics of a particle, vibrating systems. Prerequisites: Physics 100a,b, Mathematics 100a,b.

Engineering 212. Engineering Mechanics II (3-0-3).

Dynamics of systems of particles, moments and products of inertia, dynamics of rigid bodies, Lagrange's equations, introduction to Hamiltonian methods. Prerequisite: Engineering 211.

Engineering 251. Electronic Computation Laboratory (0-3-1).

Programming and operation of automatic computers. Programming for digital computers in problem-oriented languages, particularly Fortran. Introduction to numerical analysis. Prerequisite: Mathematics 100a,b.

Engineering 471. Applied Mathematics I: Lumped-Parameter Systems (3-0-3).

Discussion of lumped-parameter problems including the writing of equations for electromechanical systems. The mathematical methods which will be presented include matrix theory and linear vector spaces, frequency-response concepts, Green's function and superposition in linear systems, Fourier and Laplace transformations, and Floquet theory in periodic systems.

Engineering 472. Applied Mathematics II: Complex Variables; Distributed-Parameter Problems (3-0-3).

Complex variable theory will be presented with applications to conformal mapping potential theory, stability theory, and Fourier and Laplace transformations. Physical examples of distributed-parameter problems will be presented and solutions developed in terms of an expansion in a complete set of appropriate eigenfunctions.

Engineering 475. Sets; Probability; Random Processes (3-0-3).

Sets, events, and switching theory. Fundamental probability theory, random variables, mathematical expectation, and limit theorems. Introduction to random processes. A careful formulation of the mathematical model with relations to important physical problems.

Engineering 571. Applied Mathematics III: Distributed-Parameter Problems; Perturbation Theory (3-0-3).

Distributed-parameter problems will be discussed with physical examples from fluid flow, electromagnetic field theory, elasticity, heat conduction, transport phenomena, etc. Mathematical methods for solution will include separation of variables, transform techniques, and the method of characteristics. The course will also contain an introduction to perturbation theory in ordinary differential equations and variational methods.

Engineering 671. Applied Mathematics IV: Approximation Methods; Ordinary and Partial Differential Equations (3-0-3).

Approximation methods in ordinary and partial differential equations will be discussed including saddle-point integration, boundary-layer theory, and general asymptotic methods.

Engineering 672. Applied Mathematics V: Advanced Topics (3-0-3).

Mathematical topics will include integral equations, the Wiener-Hopf method in integral and partial differential equations, and variational methods.

Engineering 673. Applied Mathematics VI: Applied Functional Analysis (3-0-3).

A detailed study of motion in Banach and Hilbert spaces, which includes fixed-point theorems and the Leray-Schauder degree. Application in systems theory to classes of problems formulated by nonlinear integral equations, functional equations, and partial differential equations. These classes of problems may include nonlinear programming, nonlinear optimization, and periodicity, bifurcation, and stability in systems exhibiting hereditary behavior.

Chemical Engineering

Professors Akers, Busch, Horn, Kobayashi, and Leland, *Chairman*
Associate Professors S. Davis, Deans, and Hellums
Assistant Professor G. Fisher
Instructor Norman

Undergraduate Program. A general outline of the undergraduate engineering program is given on pages 51-52. Chemistry 200a,b is required for chemical engineering majors and is normally taken during the Sophomore year.

The undergraduate curriculum in chemical engineering is designed to provide a sound scientific and technical basis for further professional development. At the same time, the curriculum affords each student an opportunity to specialize in one of a number of technical areas. At the beginning of his fourth year, the student selects an integrated sequence of technical electives for his last two years. This group of courses, chosen with the counsel of a faculty adviser, is intended to give the student greater depth in an area of particular interest to him. Examples of such areas are applied mathematics, nuclear technology, environmental science and engineering, chemical process kinetics, engineering economics, process dynamics, and molecular or continuum mechanics.

After completing four years of his curriculum, the student receives a Bachelor of Arts degree, with a chemical engineering major. If his achievement is satisfactory, he then qualifies for a fifth year of study leading to the professional degree, Bachelor of Science in Chemical Engineering.

Students with special interest in research may, upon recommendation of the department and approval of the Graduate Council, enter a program leading directly to the Master of Science degree after completing the Bachelor of Arts degree.

Graduate Program. Graduate study in chemical engineering can lead to either the Master of Science or the Doctor of Philosophy degree. University requirements for these degrees are outlined on pages 55-58.

A candidate for the Master of Science degree is required to complete a minimum of eight approved one-semester courses with high standing. He must also submit, and defend in an oral examination, a thesis indicating his research ability.

A candidate for the Doctor of Philosophy degree must demonstrate his competence in the areas of applied mathematics, thermodynamics, and transport processes, as well as in his chosen field of interest. He must also pass a qualifying examination, normally during his second year of residence. His thesis must be defensible evidence of his ability to carry out meaningful research in a specialized area of chemical engineering.

In addition to the normal program in chemical engineering, the department participates in three interdisciplinary graduate programs. These programs are particularly designed for students who received their previous degree(s) in mathematics, physics, chemistry, or biology, but who have become interested in the engineering applications appropriate to a particular field of interest. In these programs, a graduate student is not expected to be responsible for the broad background in chemical engineering expected in a regular program but, instead, substitutes his background in his own particular field and is responsible for only that part of chemical engineering appropriate to his program. The three programs are:

1. Environmental Science and Engineering, in cooperation with the Biology Department;
2. Nuclear Engineering, in cooperation with the Physics Department;
3. Systems Theory, Information Theory, and Process Control, in cooperation with the Electrical Engineering Department.

COURSES

Chemical Engineering 301a. Chemical Engineering Fundamentals (3-0-3).

A first course in the application of chemical engineering principles; the use of basic mathematical concepts, physical laws, stoichiometry, and the thermodynamic properties of matter to obtain material and energy balances for systems undergoing both steady and unsteady state changes.

Chemical Engineering 302b. Separation Processes I (3-0-3).

A systematic treatment of single and multistage contacting operations involving binary and mulicomponent systems. The systems are studied using finite difference calculus when appropriate. The operations discussed include distillation, absorption, leaching, and extraction.

Chemical Engineering 401a. Introduction to Transport Phenomena (3-0-3)

The fundamental principles of heat, mass, and momentum transport applied to the continuum; the analysis of macroscopic physical systems based on the continuum equations.

Chemical Engineering 402b. Special Topics in Transport Phenomena (3-0-3).

A detailed treatment of special topics in transport phenomena. Topics include flow of ideal fluids, boundary-layer theory, macroscopic balances of momentum, heat, and mass transfer.

Chemical Engineering 443a, b. Chemical Engineering Laboratory (0-3-1, each sem.).

Laboratory investigation of chemical engineering principles. Use of digital and analog computational devices is illustrated where needed.

Chemical Engineering 471a. Applied Mathematics I: Lumped-Parameter Systems (3-0-3).

Discussion of lumped-parameter problems including the writing of equations for electromechanical systems. The mathematical methods which will be presented in-

clude matrix theory and linear vector spaces, frequency-response concepts, Green's function and superposition in linear systems, Fourier and Laplace transformations, and Floquet theory in periodic systems. This is offered jointly as Engineering 471.

Chemical Engineering 472b. Applied Mathematics II: Complex Variables; Distributed-Parameter Problems (3-0-3).

Complex variable theory will be presented with application to conformal mapping and potential theory, stability theory, and Fourier and Laplace transformations. Physical examples of distributed-parameter problems will be presented and solutions developed in terms of an expansion in a complete set of appropriate eigenfunctions. This is offered jointly as Engineering 472.

Chemical Engineering 473a or b. Numerical Analysis for Chemical Engineers (3-0-3).

The analysis of numerical procedures used in optimization of chemical systems, interpretation of experimental data, and numerical integration of differential equations. Digital computers used in solution of example problems.

Chemical Engineering 501a. Rate Processes (3-0-3).

The derivation of the equations of change for a continuum fluid; analysis of velocity distribution, heat conduction, and diffusion in laminar and turbulent fluid systems; macroscopic relations for integrated process units.

Chemical Engineering 502b. Advanced Rate Processes (3-0-3).

A study of recent advances in the theory of transport processes; the application of current techniques to the solution of engineering transport problems.

Chemical Engineering 503a, b. Applications of the Theory of Transport Phenomena (3-0-3)a, (3-3-4)b.

A synthesis course applying the principles of transport phenomena and chemical kinetics to the simulation, optimal design, and optimal operation of equipment and processes. The second semester includes a computation laboratory.

Chemical Engineering 511a. Thermodynamics I (3-0-3).

An advanced treatment of the laws of thermodynamics. Thermodynamic behavior of pure and multicomponent fluids. Chemical and physical equilibrium in multicomponent systems.

Chemical Engineering 512b. Thermodynamics II (3-0-3).

Special applications of the equilibrium concept to systems involving gravitational, surface, or electrical effects. A detailed study of nonideal solutions. Selected problems and topics in thermodynamics.

Chemical Engineering 531a. Nuclear Engineering (3-0-3).

An introductory course in nuclear properties, nuclear reactions, radioactive decay, and fission reactions; theory and design of nuclear reactions using the one-group model, the Fermi age treatment, and neutron diffusion; nuclear processing, waste disposal, and health physics.

Chemical Engineering 532b. Nuclear Engineering (3-0-3).

A continuation of Chemical Engineering 531 with a more advanced treatment of nuclear reactor theory using the two-group and multigroup methods and neutron transport theory; calculations for time-dependent reactor operations, temperature and heat transfer effects in a reactor, reactors with reflectors and breeder reactors; a more detailed consideration of the related topics of fuel cycles, isotope separation, and shielding.

Chemical Engineering 536a, b. Environmental Engineering I and II (3-0-3, each sem.).

The theory of the operations and processes used in water and waste-water treat-

ment and the synthesis of systems for accomplishment of a specified water-quality objective.

Chemical Engineering 543a, b. Advanced Projects Laboratory (0-3-1, each sem.).

Individual and group projects under the direction of various members of the staff. A comprehensive report is required at the end of each semester.

Chemical Engineering 551a or b. Separation Process II (3-0-3).

A quantitative study of multistage calculations for multicomponent systems; analog and digital computer solutions of separation problems; the development of mathematical models for real stages.

Chemical Engineering 560a or b. Heterogeneous Equilibrium and the Phase Rule (3-0-3).

Heterogeneous equilibrium in pure, binary, and multicomponent systems is studied from the standpoint of the phase rule of Gibbs over extreme ranges of pressures and temperatures. General thermodynamic principles are introduced whenever possible.

Chemical Engineering 571a or b. Statistics and Experimental Design (3-0-3).

Application of statistical techniques to the design of experiments and analysis of data for multivariable systems. Includes fractional factorial methods, rotatable designs, and search procedures for optimization of processes with several variables.

Chemical Engineering 575a or b. Process Dynamics (3-0-3).

The dynamic equations for discrete (lumped-parameter) chemical systems are developed. Linear systems analysis is used to determine the local behavior of chemical systems. Simulation techniques, phase-plane analysis, and stability analysis are applied to the study of models of several chemical systems.

Chemical Engineering 590a or b. Chemical Reaction Kinetics (3-0-3).

Study of rates of elementary reaction; the kinetics of complex reaction systems; interactions between chemical rates and transport phenomena; theory of chemical reactors.

Chemical Engineering 641a. Experimental Processes I (2-6-4).

The concept of experimental design presented as an integral part of studies of new problems in process definition and the kinetics affecting process environment.

Chemical Engineering 641b. Experimental Processes II (2-6-4).

A continuation of Chemical Engineering 641a.

Chemical Engineering 662a, b. Graduate Seminar (1-0-1, each sem.).

Chemical Engineering 670a, b. Special Topics in Applied Mathematics (3-0-3, each sem.).

Topics in linear algebra, matrix theory, tensor analysis, the calculus of variations, and functions of a complex variable applied to engineering problems.

Chemical Engineering 672b. Mathematical Foundations of Systems Theory (3-0-3).

A development and organization of the mathematical theory necessary to describe, analyze, and synthesize large systems. Also offered as Electrical Engineering 613b.

Chemical Engineering 673a. Models in Systems Theory (3-0-3).

Specific abstract models of physical systems. These may be categorized as (1) linear and nonlinear, (2) lumped and distributed, (3) time-variant and time-invariant, (4) deterministic and stochastic, (5) discrete-time and continuous-time, and (6) single-variable and multiple-variable systems. The mathematical formulations of the control problem and the identification problem are discussed in detail. The various abstract models are related to specific engineering systems. Also offered as Electrical Engineering 610.

Chemical Engineering 674a. Stability Theory (3-0-3).

Modern stability theory is applied to various abstract models of physical systems. The various methods of stability analysis are discussed and compared. The method of Lyapunov is discussed in detail. Also offered as Electrical Engineering 611.

Chemical Engineering 675b. Optimization Theory (3-0-3).

Optimization methods are introduced, compared, and applied to various abstract models of physical systems. The relationships of various methods are studied in detail. Topics include Pontryagin's maximum principle, Hamilton-Bellman-Jacobi theory, state space techniques, game theory, dynamic programming, statistical decision theory, and linear programming. Also offered as Electrical Engineering 612.

Chemical Engineering 683a, b. M.S. Research and Thesis.

Chemical Engineering 685a or b. Molecular Transport and the Molecular Flow of Gases (3-0-3).

The flow of gases is treated from a molecular standpoint. The solutions to the Boltzmann transport equation and the resulting transport coefficients are discussed. The notion of slip and free molecular flow are also explored.

Chemical Engineering 690a or b. Kinetics and Catalysis (3-0-3).

Chemical reaction rates, reaction mechanisms, theories of catalysis, diffusion in porous solids.

Chemical Engineering 691a or b. Chemical Reaction Engineering (3-0-3).

Mathematical simulation of applied chemical systems such as chemical reactors; analysis of stability, parametric sensitivity, and control; optimal design and operation.

Chemical Engineering 720a or b. Advanced Topics in Chemical Engineering.

Chemical Engineering 783a, b. Ph.D. Research and Thesis.

Civil Engineering

PROFESSORS W. J. AUSTIN, SIMS, AND VELETSOS, *Chairman*
ASSOCIATE PROFESSORS HOLT, KRAHL, MCDONALD, AND THIBODEAUX
ASSISTANT PROFESSORS JIRSA, MERWIN, ORAN AND THOMPSON

Undergraduate Program. The general requirements for the Bachelor of Science degree in civil engineering and the contents of the first two years of the common core science-engineering program are described on pages 51-52. Students contemplating a major in civil engineering should take Engineering 211, 212, and 251 as part of their electives in

the Sophomore year. However, should they fail to do so, they may rectify this omission without penalty during the Junior year.

The undergraduate curriculum is designed to provide a sound basis for future professional growth. The emphasis during the first four years is on mathematics and the engineering sciences, especially solid mechanics, fluid mechanics, and materials. The fifth year of study is devoted primarily to specialized civil engineering subjects. However, through the provision of numerous electives in the fifth year, the student may also specialize in one of the following technical areas: applied mathematics, structural engineering and mechanics, soil mechanics and foundation engineering, or environmental engineering. The course requirements for each year of study may be obtained from the departmental office. The detailed program of a student is formulated in consultation with his adviser.

After successful completion of the first four years of study, a student receives a Bachelor of Arts degree with a civil engineering major. He may then qualify for a fifth year of study leading to the professional degree of Bachelor of Science in Civil Engineering. Students with special interest in research may, upon recommendation of the department and approval of the Graduate Council, enter a program leading to the Master of Science degree directly after completing the Bachelor of Arts degree.

Graduate Program. The primary strength of the graduate program in civil engineering is in the fields of structural engineering and applied mechanics and of soil mechanics and foundation engineering. The program emphasizes the scientific fundamentals of these disciplines; it is designed to develop strength in depth and the ability to keep abreast of the technical developments that may be expected in the years ahead. Special attention is given to promoting the student's interest in and ability for independent study and research. The programs of study offered can lead to the degrees of Master of Science and Doctor of Philosophy. University requirements for these degrees are outlined on pages 55-58.

A candidate for the Master of Science degree is required to complete the equivalent of eight one-semester courses. In addition, he is required to complete an acceptable thesis, participate in a departmental graduate seminar, and meet the University language requirements.

In addition to the above requirements for the Master of Science degree, candidates for the degree of Doctor of Philosophy must satisfy the following requirements: complete eight one-semester courses with high standing; fulfill the University language requirements; pass a comprehensive oral qualifying examination designed to test the candidate's knowledge of his field and his ability to think in a creative manner; complete a thesis which shall constitute an original contribution to knowledge; and pass a final oral examination on the thesis and related topics.

The research interests of the members of the civil engineering faculty fall in the following five categories: (1) structural mechanics, (2) plasticity and material properties, (3) soil mechanics and foundation engineering, (4) structural testing, including structural models, and (5) hydromechanics and marine structures. The research activity in structural mechanics is concentrated in the areas of structural dynamics, plate and shell structures, instability, numerical analysis, and computer utilization.

The recently completed Ryon Engineering Laboratory provides a modern facility for research in the above areas. Furthermore, the computer facilities are ample for undergraduate and graduate instruction and research. They include an IBM 1620, the Rice computer, and an IBM 7040.

COURSES

Civil Engineering 321. Structural Analysis I (3-0-3).

Analysis of statically determinate beams, frames, trusses, and funicular structures, including space structures. Influence lines. Approximate analysis of statically indeterminate structures. Prerequisite: Engineering 211.

Civil Engineering 356. Engineering Measurements (2-3-3).

A study of theory of measurements, experimental errors, distribution of errors, propagation of errors, curve fitting, dimensional analysis, and least squares is made with application to various types of engineering measurements. Application of these concepts to elementary surveying is made in the laboratory. Laboratory fee required.

Civil Engineering 400. Senior Civil Engineering Laboratory (0-3-2).

A single laboratory course to provide the laboratory instruction necessary for several disciplines of interest to Senior civil engineering students. Selected experiments in the fields of thermodynamics, fluid mechanics, strength of materials, and material science are performed. Two semesters. Laboratory fee required. This course is offered jointly as Mechanical Engineering 406 and 407.

Civil Engineering 401. Mechanics of Materials (3-0-3).

Stresses and deformations due to tensile, compressive, and shearing forces, bending moments, and torque. Consideration of beams, columns, shafts, pressure vessels, axially-loaded members, members with combined loadings, determinate and indeterminate structural systems. Study of engineering properties of materials and failure theories. Prerequisite: Engineering 211 or equivalent.

Civil Engineering 402. Mechanics of Fluids (3-0-3).

The emphasis is on the fundamentals of fluid mechanics, including properties, fluid statics, flow concepts, viscous effects, dimensional analysis, dynamic similitude, and two-dimensional ideal fluid flow. Engineering applications of fluid mechanics are presented.

Civil Engineering 421. Route Surveying and Highway Design (3-3-4).

Simple and compound horizontal and vertical curves for highway and railway use. Problems in earthwork. Leveling. Application of error theory. Geometrical and structural design of highways. Laboratory fee required.

Civil Engineering 422. Structural Analysis II (3-3-4).

Basic theorems of structural analysis. Deflections of beams and trusses. Classical methods of analysis of statically indeterminate trusses, beams, and framed structures.

Influence lines for statically indeterminate structures. Prerequisites: Civil Engineering 321 and Civil Engineering 401.

Civil Engineering 441. Civil Engineering Analysis (3-0-3).

A study of certain mathematical methods useful in the field of engineering. Formulation of problems of interest to civil engineers, mathematical methods of solution, interpretation of results. Application of electronic computers to civil engineering problems.

Civil Engineering 442. Special Topics in Civil Engineering Analysis (3-0-3).

A continuation of Civil Engineering 441. Mathematical methods of analysis applied to such topics as theory of elasticity, elastic stability, static and dynamic analysis of structures.

Civil Engineering 490. Civil Engineering Professional Practice (3-0-3).

A course to acquaint the students with the professional aspects of engineering works-project financing, elements of contracts and specifications, discussion of A.I.A., A.S.C.E., and A.G.C. agreement forms, manuals of professional practice.

Civil Engineering 503. Experimental Problems in Civil Engineering (0-3-2).

Direct and indirect methods of model stress analysis. Strain measurement and stress determination. Photoelastic stress analysis.

Civil Engineering 521. Advanced Engineering Hydraulics (3-3-4).

Principles and design of water collection, transmission, and distribution systems, including hydrology, reservoirs and dams, open-channel and conduit transmission systems, and associated hydraulic machinery. Prerequisite: Civil Engineering 402 or equivalent.

Civil Engineering 522. Water Resources Engineering (3-3-4).

The application of engineering principles to the control and use of water resources, including irrigation, municipal and industrial water supply, hydroelectric power, river navigation, drainage, sewage disposal, water quality control, and flood prevention. Importance of a water resources program to regional development; evaluation of water resources and a water-resource plan as applied to an actual river basin. Prerequisite: Civil Engineering 521 or equivalent.

Civil Engineering 541. Theory of Concrete Structures (3-3-4).

Properties of concrete. Theory of reinforced concrete. An analytical study of behavior of concrete members in relation to present design codes. Laboratory fee required.

Civil Engineering 542. Design of Reinforced Concrete Structures (3-3-4).

Design of structural members and frameworks of reinforced concrete. Elastic and ultimate strength design. Prestressed concrete. Design of typical parts of buildings, bridges, and foundations. Laboratory fee required.

Civil Engineering 561. Advanced Mechanics of Materials (3-3-4).

Advanced topics in stress analysis. Three-dimensional states of stress and strain; theories of failure of elastic action; shear center; unsymmetrical bending; curved beams; beams on elastic supports; flat plates; torsion of noncircular sections; column theory; local buckling; lateral buckling; stress concentration; plastic analysis. Properties of metals.

Civil Engineering 562. Design of Steel, Aluminum, and Timber Structures (3-3-4).

Design of tension members, compression members, beams, and connections. Design of plate girders, roof trusses, simple bridge trusses, and building frames. Work-

ing drawings, estimates of weight and cost. Introduction to plastic design of steel. Laboratory fee required.

Civil Engineering 581. Structural Analysis III (3-3-4).

Matrix methods of structural analysis. Flexibility and stiffness of structural elements. Equations of compatibility and equilibrium. Force and displacement methods of analysis. Nonlinear structures; arches and suspension bridges. Prerequisite: Civil Engineering 422.

Civil Engineering 582. Soil Mechanics and Foundation Engineering I (3-3-4).

A comprehensive introductory course. Geological origins and classification of soils and their hydraulic, strength, and compressibility characteristics. Stress distribution in soils, bearing capacity of shallow and pile foundations, lateral earth pressure, slope stability. Field exploration procedures. All the standard tests are performed in the laboratory. Laboratory fee required.

Civil Engineering 583. Soil Mechanics and Foundation Engineering II (3-0-3).

Review of fundamentals. Design of shallow and pile foundations. Analysis of earth slopes and design of earth dams. Design of retaining walls and rigid and flexible pavements.

Civil Engineering 610. Numerical Engineering Analysis (3-0-3).

Study of the nature of complex problems in structural mechanics and of the means of obtaining practical solutions. Methods of formulating exact and approximate governing equations for physical situations involving discrete (lumped-parameter) and continuous systems. Numerical methods for the solution of systems of linear and nonlinear equations, eigenvalue problems, and ordinary and partial differential equations. Applications to problems in solid mechanics and structural analysis, including equilibrium, buckling, dynamic, and vibration problems.

Civil Engineering 620. Advanced Statically Indeterminate Structures (3-0-3).

Classical and modern methods of analysis applied to a study of stresses and deflections in structures such as rigid frames, trusses, continuous beams and arches. Methods to be applied include real work, virtual work, Castigliano's theorem, and least work. Slope deflection and column analogy.

Civil Engineering 622. Numerical Methods of Structural Analysis (3-0-3).

Numerical methods for the solution of complex structural engineering problems with applications to bridges, buildings, aircraft, and other structures. Moments and deflections of elastic and inelastic beams with axial and transverse loading, buckling strength of columns, moments and deflections of beams resting on elastic or plastic supports, vibration of beams, analysis of arches. Finite difference method for the solution of ordinary and partial differential equations with applications to the bending of plates and floor slabs, and other problems.

Civil Engineering 624. Computer Methods in Structural Analysis (3-0-3).

Matrix methods of structural analysis. Flexibility and stiffness of structural elements, fixed-end forces, equations of compatibility and equilibrium, force and displacement methods of analysis, mass matrices for systems with discrete and continuous mass distributions, matrix solution of dynamics problems, tearing methods.

Civil Engineering 630. Structural Dynamics I (3-0-3).

Free vibration, forced vibration, and transient response of structures and structural components having from one to an infinite number of degrees of freedom; response spectra for undamped and damped systems subjected to exciting forces,

ground shock and earthquake motions; formulation of problems in matrix form; modal analysis; approximate methods of computation of natural frequencies and modes; wind-induced vibrations; introduction to problems of wave propagation.

Civil Engineering 631. Structural Dynamics II (3-0-3).

Free and forced vibration of nonlinear elastic systems. Approximate methods of analysis, criteria for stability, subharmonic and superharmonic vibrations. Statistical concepts in vibration analysis. Characterization of random excitations and response of systems to such inputs. Propagation of waves in elastic solids, with special reference to effects of blast and earthquakes. Characteristics of recorded earthquake motions and response of structures to such inputs. Response spectra for elastic and inelastic systems subjected to ground shock, earthquakes, and other random inputs. Earthquake-resistant design of structures, and discussion of building codes. Introduction to vibration of plates, gridworks, and cylindrical shells. Prerequisite: Civil Engineering 630 or equivalent.

Civil Engineering 632. Buckling of Structures (3-0-3).

Behavior of axially and eccentrically loaded columns, effect of residual stresses, inelastic buckling. Torsional buckling of columns. Lateral buckling of beams. Stability of frameworks. Buckling of plates due to compression and shear.

Civil Engineering 634. Analysis of Plates and Shells I (3-0-3).

Bending theory of medium-thick plates with applications to the analysis of plates of rectangular, circular, and other shapes. Discussion of various methods of solution. Orthotropic plates and gridworks. Plates on elastic foundations. Bending of circular cylindrical shells and shells of revolution loaded symmetrically with respect to their axes. Membrane analysis of shells of revolution and translational shells.

Civil Engineering 635. Analysis of Plates and Shells II (3-0-3).

Refined theories of plates, effects of in-plane forces, large deflections. Limit analysis of plates. Bending theory of thin cylindrical shells with applications to the analysis of roof shells, tanks, and pipes. Discussion of approximate theories. Analysis of folded plate structures. Approximate bending theory of shallow shells with applications. Prerequisite: Civil Engineering 634 or equivalent.

Civil Engineering 636. General Theory of Shells (3-0-3).

Differential geometry of surfaces. General linear theory of shells of arbitrary shape. General discussion of significance of membrane theory. Exact and approximate methods of solution. Applications to practical problems. Introduction to large deformations and buckling of shells. Prerequisite: Civil Engineering 634 or equivalent.

Civil Engineering 638. Energy Methods in Applied Mechanics (3-0-3).

Fundamental principles and direct methods of variational calculus. General discussion of basic concepts of mechanics of deformable solid bodies. Principle of virtual work with applications to problems of equilibrium and stability. Derivation of variational principles of mechanics, including stationary potential energy, complementary energy, and Reissner's variational theorem. Applications to equilibrium problems in both small and large deformation theories, and to problems of stability. Variational principles of dynamics with applications.

Civil Engineering 640. Introduction to the Mathematical Theory of Elasticity. (3-0-3).

A study of the mechanics of elastic deformable bodies, based upon the fundamental concepts of equilibrium, compatibility of strains, and properties of materials. Exact relations between stresses, strains, and displacements are studied in some detail with special consideration given to their significance in structural engineering problems. Failure theories. Theoretical bases for common experimental methods, such as photoelasticity, membrane analogy, etc. Bending and torsion of prismatic bars. Propagation of waves in elastic media. Bending of plates. Elastic stability of plates. Membrane theory of shells. General theory of shells.

Civil Engineering 642. Theory of Plasticity (3-0-3).

A study of the mechanics of inelastically deformed bodies; mathematical formulation of plastic stress-strain laws; flexure and torsion of prismatic members; application of limit design and shakedown theorems to structures; mixed elastic-plastic problems.

Civil Engineering 650. Steel Design (3-0-3).

Elastic and plastic design of steel members; codes and specifications for buildings; riveted, bolted, and welded construction; evolution of bridge specifications; loads and working stresses; economic proportions.

Civil Engineering 652. Design of Lightweight Structures (3-0-3).

Analysis and design of structures and structural members of minimum weight.

Civil Engineering 660. Behavior of Reinforced Concrete Members (3-0-3).

Behavior of reinforced concrete members under various loadings from first application of load to ultimate strength. Study of sections subjected to pure flexural and axial loads, combined bending and axial load, combined shear and flexure. Bond and anchorage problems and effects of torsion. Evaluation of design specifications according to results of research and engineering practice.

Civil Engineering 662. Behavior of Reinforced Concrete Structures (3-0-3).

Behavior of reinforced concrete structures under various loadings, with emphasis on ultimate strength. Consideration of statically indeterminate beams and frames. Design and analysis of floor slabs including yield-line theories. Evaluation of building code specifications and discussion of research in reinforced concrete structures.

Civil Engineering 670. Advanced Soil Mechanics (3-0-3).

Detailed consideration of compressibility and shear characteristics of cohesive and granular soils. Lateral earth pressures. Advanced theories of stress distribution in soils and bearing capacity of shallow and pile foundations. Seepage. Behavior of soils under dynamic loads. Brief consideration of deformational behavior of rock masses.

Civil Engineering 671. Theoretical Soil Mechanics (3-0-3).

Consideration of stress and strain and the relations of elasticity, viscosity, plasticity, and combinations thereof. Rheology of cohesive and granular soils. Review of recent theories of soil deformation. Solution of complex soil mechanics problems, including use of approximation techniques.

Civil Engineering 699. Special Problems. (Variable credit).

Study of selected topics including individual investigations under the direction of a member of the Civil Engineering faculty.

Civil Enginering 700. Research and Thesis.

An original research investigation carried out by the individual student under the direction of a member of the Civil Engineering faculty.

Electrical Engineering

Professors Bourne, *Chairman,* Gordon, Graham, McEnany, Pfeiffer, and Wischmeyer
Associate Professors de Figueiredo, Jain, Pearson, and Rabson
Assistant Professors Burrus, L. E. Davis, Goldwyn, and Leeds
Lecturer MacPhail

The first two years of the science-engineering program are described on pages 51-52 of the catalog. Sophomore students contemplating a major in electrical engineering should elect Engineering 211, 212, and 251 and a full year of Physics 200a,b or 210a,b. However, provisions are made in the Electrical Engineering curriculum so that students who fail to take Engineering 211, 212, and 251 in the Sophomore year may rectify this omission without penalty in the Junior year.

Representative programs showing the normal registration in courses for each year leading to the degree of Bachelor of Science in Electrical Engineering are available from the department. Under suitable conditions, appropriate course substitutions may be made in some areas. Departmental approval is required for any such changes.

Requirements of a general nature for advanced degrees are outlined on pages 55-58. Students should consult the department advisers for specific courses of study.

After completing four years of his curriculum, the student receives a Bachelor of Arts degree, with an electrical engineering major. If his achievement is satisfactory, he then qualifies for a fifth year of study leading to the professional degree, Bachelor of Science in Electrical Engineering.

Qualified students may, upon recommendation of the department and approval of the Graduate Council, enter a program leading directly to the Master of Science degree after completing the Bachelor of Arts degree.

A candidate for the Master of Science degree in the Electrical Engineering Department is required to complete an approved course of study. Usual practice calls for a level of attainment indicated by satisfactory grades in at least two related 600-level semester-courses. In addition, he is required to complete an acceptable thesis and meet the University language requirements.

The granting of the degree of Doctor of Philosophy presupposes high quality academic work and demonstrated ability to do independent and creative research. To be admitted to candidacy, the student must show promise of realizing these goals by obtaining high standing in graduate courses and by performing satisfactorily on qualifying examinations designed to test his grasp of fundamentals as well as his ability to think independently. Considerable emphasis is placed on

the research leading to a satisfactory dissertation. Each candidate takes a final oral examination, as described on page 58. The doctoral candidate should expect to devote, as a minimum, the equivalent of three full academic years of Class I graduate study.

Regular graduate programs in electrical engineering include the general areas of systems and control theory, communications and information theory, active and passive networks, computers, solid-state and physical electronics, electromagnetic theory, and biomedical engineering. In addition to the regular graduate programs, there are four special graduate programs particularly designed for those who received their previous degree (s) in mathematics, physics, chemistry, or the other sciences, including undergraduate engineering science programs, but who have become interested in the engineering applications appropriate to a particular field of science. These programs exist in the areas of system and information theory, solid-state electronics and materials science, computer science, and biomedical engineering.

COURSES

Electrical Engineering 301. Fundamentals of Network Analysis (3-4-4).

Formulation of network descriptions, natural modes, and forced solutions. Use of matrices, linear graphs, and the transformation calculus. Time-domain and frequency-domain techniques. System functions and introduction of signal analysis. Prerequisites: Electrical Engineering 341 and Mathematics 300a.

Electrical Engineering 341. Introduction to Electronics and Circuit Analysis (3-4-4).

Fundamental concepts of circuit analysis and their immediate application to simple electronic circuits. Linear circuit elements, fundamental circuit laws, waveforms, network theorems. Models of diodes, transistors, and vacuum tubes. Amplifiers, logic circuits. Introduction to microwave and photon interaction devices. Prerequisites: Mathematics 200a,b or 210a,b and Physics 200a,b or 210a,b. Laboratory fee required.

Electrical Engineering 342. Electronic Circuits (3-4-4).

Low-pass, band-pass, and compensated amplifier stages. Power amplifiers, multistage amplifiers. Biasing of transistors. Feedback amplifiers and oscillators. Linear wave-shaping and elementary pulse circuits. Electronic instrumentation. Prerequisites: Electrical Engineering 301 and Mathematics 300a. Laboratory fee required.

Electrical Engineering 405. Electromagnetic Field Theory (3-0-3).

Review of vector analysis. Electrostatics. Magnetostatics. Boundary-value problems. Electromagnetic induction. Maxwell's equations and plane waves. Prerequisites: Physics 200a,b or 210a,b.

Electrical Engineering 406. Electromagnetic Wave Propagation (3-0-3).

Transmission lines. Plane waves. Plane interfaces. Guided waves. Rectangular and circular waveguides. Microwave resonant cavities. Radiation. Linear antennas and simple arrays. Prerequisite: Electrical Engineering 405.

Electrical Engineering 445. Advanced Electronic Circuits (3-4-4).

Modulation and frequency translation. Feedback amplifiers. Pulse circuits, timing, and counting circuits. Bistable, monostable, and astable configurations. Nonlinear oscillators. Parametric amplification. Prerequisites: Electrical Engineering 342. Laboratory fee required.

Electrical Engineering 460. Introduction to Quantum Mechanics (3-4-4).

Experimental foundations of quantum mechanics; solutions of Schroedinger's equation for the harmonic oscillator and the hydrogen atom; the exclusion principle; the hydrogen molecule; metallic binding; behavior of an electron in a periodic potential; the band theory of solids; quantum statistics. Prerequisite: Electrical Engineering 405. Laboratory fee required.

Electrical Engineering 501. Network Analysis and Synthesis (3-0-3).

Advanced linear network theory, n-port networks, distributed-parameter and time-varying networks. Introduction to the synthesis of driving-point and transfer functions. Filter design. Prerequisites: Electrical Engineering 301 and Engineering 472.

Electrical Enginering 504. Electrical Engineering Laboratory (0-4-2).

Selected experiments from network analysis and synthesis, energy conversion and control, communication theory, and solid-state electronics. Prerequisite: fifth-year standing. Laboratory fee required.

Electrical Engineering 513. Electromechanical Energy Conversion Devices (3-0-3).

Energy in singly and multiply excited magnetic and dielectric systems; linear magnetic circuits and transformers; nonlinear magnetic circuits and magnetic amplifiers; principles of electromechanical energy conversion, rotating machinery, and transducers.

Electrical Engineering 514. Direct-Energy Conversion Devices (3-0-3).

Review of modern physics, thermodynamics, and transport theory; thermoelectric and thermomagnetic engines, thermionic converters; radiant energy converters; magneto-hydrodynamic converters; fuel cells; ferroelectric energy conversion.

Electrical Engineering 530. Introduction to Statistical Communication Theory (3-0-3).

Harmonic analysis of stationary random processes. Simple filtering of stationary random processes by time-invariant linear systems. Introduction to information theory and coding for simple, discrete systems. Prerequisite: an introduction to random processes; considerable familiarity with the theory of the Laplace transformation and with properties of the transfer or system function in time-invariant linear systems.

Electrical Engineering 560. Electrical Engineering Materials (3-0-3).

Atomic and crystal theory of electrical engineering materials. Properties and parameters of magnetic, dielectric, conducting, and semiconducting materials important in the understanding of device characteristics. Prerequisite: Electrical Engineering 460.

The following one-semester elective courses will be offered according to demand and availability of faculty.

Electrical Engineering 507. Nonlinear Analysis (3-0-3).

An introductory study of nonlinear systems and the various methods of analysis. Problems described by first and second order, driven and undriven equations giving rise to nonlinear oscillations and vibrations are covered. The basic topics of analysis are: basic numerical methods, phase-plane methods, stability, exact analytical solutions, approximate analytical methods, perturbations, describing functions, and certain time-varying linear problems. Also offered as Mechanical Engineering 507.

Electrical Engineering 515. Linear Control Systems (3-4-4).

Theoretical and laboratory study of linear-feedback control systems. Class topics include analysis of typical components, general feedback theory, time response of

linear-feedback control systems, frequency-response methods, the Nyquist criterion, root locus, system compensation, and sampled-data systems. The laboratory includes typical electrical components, instrument servos, and the electronic differential simulator. Prerequisite: Engineering 471. Laboratory fee required.

Electrical Enginering 520. Digital Computers (3-0-3).

Study of the organization of digital computers, including such topics as number systems, arithmetic and control units, and input-output equipment. Prerequisite: Electrical Engineering 445.

Electrical Engineering 531. Communications Systems (3-0-3).

Study of important types of communications systems with respect to propagation media, frequency requirements, information-handling ability, reliability, and noise. Prerequisite: Electrical Engineering 530.

Electrical Enginering 561. Solid-State Devices (3-4-4).

A study of some of the important solid-state electronic devices, particularly semiconductor and ferromagnetic devices. Prerequisite: Electrical Engineering 560. Laboratory fee required.

Electrical Engineering 562. Microwave Devices (3-4-4).

Review of waveguides and resonant cavities. The scattering matrix and applications to 2-, 3- and 4-port devices. Principles of broadband transformers, couplers, and filters. Microwave generation. Tensor susceptibility and nonreciprocal devices. Prerequisite: Electrical Engineering 406. Laboratory fee required.

Electrical Engineering 593a, b. Electrical Engineering Projects (Credit to be arranged).

Theoretical and experimental investigations under staff direction.

The following courses are normally open only to students engaged in a program leading to an advanced degree.

Electrical Engineering 601. Network Synthesis (3-0-3).

A study of both the theoretical and practical aspects of network synthesis. Emphasis will be on linear, passive electrical networks. Topics covered include: realizability, one-port synthesis, approximation methods, two-port synthesis and filter design, n-port theory, and selected topics of current interests.

Electrical Engineering 605. Advanced Electromagnetic Field Theory (3-0-3).

The mathematical techniques involved in field theoretical calculations: Green's functions, variational methods, integral transforms, wave propagation through periodic structures, interaction of fields with charged particles.

Electrical Engineering 606. Applications of Electromagnetic Field Theory (3-0-3).

Applications of electromagnetic theory to plasma physics, microwave techniques, antennas and radiation of electromagnetic waves, ferrites, and quantum electronics.

Electrical Engineering 607. Nonlinear Circuit Analysis (3-0-3).

Consideration of various electronic circuits whose performance depends on nonlinear phenomena. Physical circuits are examined and the pertinent approximate equations are formulated. This is followed by an analytical treatment of these equations.

Electrical Engineering 610. Models in Systems Theory (3-0-3).

The art of developing appropriate mathematical models for systems is introduced by the study of examples selected from a wide variety of fields. Both deter-

ministic and stochastic models are considered. The special assumptions, parameters, and empirical data required for each model are discussed. Factors influencing the choice of a model for any specific problem are identified and illustrated. Some attention is given to the types of mathematical problems posed by various models, but primary attention is directed to the formulation of problems through the development of suitable models. Also offered as Chemical Engineering 673a.

Electrical Engineering 611. Stability Theory (3-0-3).

Modern stability theory is applied to various mathematical models for systems. The various methods of stability analysis are discussed and compared. The method of Lyapunov is discussed in detail. Also offered as Chemical Engineering 674a.

Electrical Engineering 612. Optimization Theory (3-0-3).

Optimization methods are introduced, compared, and applied to various mathematical models for systems. The relationships of various methods are studied in detail. Attention is given to such topics as Pontryagin's maximum principle, Hamilton-Beltman-Jacobi theory, calculus of variations, statistical decision theory, and mathematical programming. Also offered as Chemical Engineering 675b.

Electrical Engineering 613. Introduction to Statistical Aspects of Systems Theory (3-0-3).

Fundamental statistical concepts and strategies important for system theory are developed. Attention is given to such topics as reliability theory, statistical decision theory, game theory, queuing theory, and dynamic programming. Also offered as Chemical Engineering 672b.

Electrical Engineering 615. Seminar in Systems Theory (3-0-3).

A seminar on advanced topics in systems engineering.

Electrical Engineering 616. Modern Control Theory (3-0-3).

Designed for students preparing for advanced work and/or research in control system design. Topics include state-variable formulation of control problems, stability of linear systems, multivariable systems, optimal control of linear systems, and an introduction to stochastic optimization and filtering. The emphasis is on linear systems represented by ordinary differential or finite difference equations. Prerequisite: Electrical Engineering 515.

Electrical Engineering 621. Digital Computer Design (3-0-3).

Arithmetical and logical operations are considered and the techniques for implementation worked out. The interconnection of the various sections of the computer are examined and typical machine organizations are worked out in detail.

Electrical Engineering 622. Advanced Digital Computer Design (3-0-3).

Advanced features used in modern computers are considered, such as floating-point arithmetic, index registers, and concurrent operations.

Electrical Engineering 624. Integrated Instrumentation—Computer Systems (3-0-3).

Instrument-system design aspects of experimental research. Philosophy of design, theoretical limitations, and practical examples are included. Effect of on-line digital computer usage is stressed.

Electrical Engineering 626. Algorithm Theory (3-0-3).

Algorithmic processes—recursive-function theory, Turing machines, A. A. Markov's theory of algorithms, the formalisms of E. L. Post. Abstract automata—their characterization, properties, and capabilities. A general study of the concepts and methods of algorithmic programming. Given fall semester of odd-numbered years. Also given as Philosophy 563a.

Electrical Engineering 627. Artificial Intelligence (3-0-3).

A study of heuristic problem-solving concepts and techniques. Construction and

analysis of game-playing programs, learning devices, theorem-proving processes. Investigation of the problem of producing intelligent behavior in artifacts. Given spring semester of even-numbered years. Also given as Philosophy 564b.

Electrical Engineering 631. Information Theory (3-0-3).

A careful development of the ideas of information theory in discrete systems, a brief introduction to information in continuous systems, and an introduction to algebraic coding theory.

Electrical Engineering 632. Seminar in Information Theory (3-0-3).

Selected topics in the field of information theory.

Electrical Engineering 635. Seminar in Communications Engineering (3-0-3).

Topics in communications engineering selected according to the interest of the class and instructor.

Electrical Engineering 645. Electronic Circuit Synthesis (3-0-3).

It is assumed that the student is familiar with the analysis of electronic circuits. Performance specifications are considered and circuits are synthesized to meet these requirements. Certain of these are constructed and tested. Particular attention is given to second-order effects on the operation of these circuits.

Electrical Engineering 661. Semiconductor Electronics (3-0-3).

Fundamental theory of semiconductor devices. The material of an introductory course in solid-state theory is assumed. Also offered as Mechanical Engineering 648.

Electrical Engineering 662. Ferromagnetic Theory and Devices (3-0-3).

Theory of magnetism. Magnetostatics. Dynamic behavior of magnetic materials. Magnetic thin films. Magnetic tape cores. Device characteristics. The material of an introductory course in solid-state theory is assumed. Also offered as Mechanical Engineering 649.

Electrical Engineering 663. Electron Theory of Solids (3-0-3).

Electron theory of solids, starting with the free-electron model and leading to Brillouin zones and band theory. One semester. Also offered as Mechanical Engineering 646.

Electrical Engineering 664. Physical Properties of Solids (3-0-3).

Based on the electron theory of solids, the electrical and thermal conductivities are studied. The origin and behavior of diamagnetic, paramagnetic, and ferromagnetic materials are considered. A discussion of semiconductors is included Prerequisite: Electrical Engineering 663 or equivalent. One semester. Also offered as Mechanical Engineering 647.

Electrical Engineering 665. Seminar in Solid-State and Physical Electronics (3-0-3).

A seminar on advanced topics in electrophysics.

Electrical Engineering 666. Quantum Electronics (3-0-3).

The development of the quantum mechanical techniques necessary to explain such devices as the laser and maser. Energy levels of ions and atoms. Interaction of electromagnetic fields with ions and atoms. Microwave masers. Solid state, gaseous, and semiconductor laser operation. Prerequisites: Electrical Engineering 560 and 605.

Electrical Engineering 690. Research and Thesis (Credit to be arranged).

Mechanical and Aerospace Engineering and Materials Science

Professors Beckmann, Brotzen, Chapman, *Chairman,* and Miele
Associate Professors Cheatham, Plapp, Roberts, and Wilhoit
Assistant Professors Ingram, McLellan, Rudee, W. F. Walker and Wierum

Lecturer Nordgren

Requirements for the degree of Bachelor of Science in Mechanical Engineering are summarized on pages 51-52. Representative courses and normal sequence of registration in courses during the undergraduate years are available from the department.

It is recommended that students contemplating a major in mechanical engineering take Engineering 211 and Engineering 212 as one of their electives in their Sophomore year. However, schedule adjustments may be made in the Junior year to permit those students who do not take these courses as Sophomores to major in mechanical engineering without suffering the penalty of taking an additional course.

After completing four years of his curriculum, the student receives a Bachelor of Arts degree with a mechanical engineering major. If his achievement is satisfactory, he then qualifies for a fifth year of study leading to the professional degree, Bachelor of Science in Mechanical Engineering.

Candidates for the degree of Master of Science in Mechanical Engineering must complete eight semester-courses and attend a graduate seminar each year.

Students with special interest in research may, upon recommendation of the department and approval of the Graduate Council, enter a program leading directly to the Master of Science degree after completing the Bachelor of Arts degree.

In addition to the above requirements for the Master of Science degree, candidates for the degree of Doctor of Philosophy must complete not less than eight approved semester-courses and pass written and oral comprehensive examinations.

The research interests of the mechanical engineering faculty and the laboratory research equipment available provide the following areas of specialization in the field of mechanical engineering: (1) Engineering Mechanics, (2) Materials Science, Physical Metallurgy; (3) Fluid Dynamics, Gas Dynamics, Heat Transfer; (4) Aero-astronautics.

COURSES

Mechanical Engineering 313. Advanced Engineering Mechanics (3-0-3).

Continuation of Engineering 211 and 212 with emphasis on applications of energy methods in dynamics. Variational methods are used in the study of particle

and rigid-body dynamics, electric circuits, electromechanical systems, and continuous dynamic systems. *Mr. Cheatham*

Mechanical Engineering 380. Industrial Processes (3-3-4).

The statistical and economic bases for industrial decision-making are developed. Topics discussed include basic probability theory and distributions, statistical decision-making and significance tests, regression techniques, analysis of variance, quality control, and engineering economics. The laboratory provides practical experience and observation of selected industrial techniques. Laboratory fee required. *Mr. Rudee*

Mechanical Engineering 390. Production Metallurgy (3-3-4).

Class and laboratory instruction in the processes utilized in the production of metals. A study is made of the chemistry and thermodynamics of the reactions involved in ore concentration and in the extraction, refining, and alloying of metals. Laboratory fee required.

Mechanical Engineering 395. Materials Science (3-3-4).

An introductory course in the science of solid materials, covering not only metals, but also ceramics, plastics, and semiconductors. The basic understanding of the nature of solid materials will be stressed. The subject matter is approached from both the atomic and macroscopic points of view. Prerequisites: Physics 100a,b, 200a,b, Chemistry 120a,b. Laboratory fee required. *Mr. Roberts*

Mechanical Engineering 401. Thermodynamics (3-0-3).

A fundamental and rigorous exposition of the laws of classical thermodynamics. The various deductions that may be made from these laws are discussed and their physical significance is emphasized. Applications of these principles to systems of physical significance in various disciplines are made. Particular attention is directed to the applications of these principles to pure substances and the interrelations between their thermodynamic properties. *Mr. Chapman*

Mechanical Engineering 404. Applications of Thermodynamics (3-0-3).

A course which stresses the applications of classical thermodynamics to systems of particular interest in mechanical and aerospace engineering. Energy conversion systems, refrigeration systems, psychometric principles, and thermodynamic applications in compressible flow are treated. *Mr. Walker*

Mechanical Engineering 405. Dynamics *and* Thermodynamics of High Velocity Fluid Flow (3-0-3).

An introductory course which deals with the fundamentals of compressible fluid dynamics. A thorough treatment is given to one-dimensional flows with area change, normal shocks, friction, and heat addition. An introduction is made to multidimensional flows with special emphasis on perturbation theory, Prandtl-Meyer flow, and oblique shock waves. *Mr. Walker*

Mechanical Engineering 406. Senior Laboratory I (0-3-1).

A single course to provide the laboratory instruction necessary for the several disciplines of interest to Senior mechanical engineering students. Selected experiments are performed in the field of thermodynamics, fluid mechanics, strength of materials, and materials science. Laboratory fee required. *Mr. Plapp*

Mechanical Engineering 407. Senior Laboratory II (0-3-1).

A continuation of Mechanical Engineering 406. Laboratory fee required. *Mr. Plapp*

Mechanical Engineering 483. Mechanical Design (3-0-3).

The application of energy methods, buckling theory, and failure theories to problems of mechanical design. Considered are torsion theory, design of shafts

and springs, shrink fits, flywheel problems, and power transmission elements such as cams and gears. Lubrication theory is also included. *Mr. Cheatham*

Mechanical Engineering 501. Seminar I (1-0-1).

A course devoted to the purpose of training engineering students in collecting and presenting orally formal papers on topics of engineering interest. The papers are given by the students, using materials secured from technical periodicals. The course meets weekly and is conducted in the form of a professional society meeting. Required of all mechanical engineering students in the year they are candidates for the bachelor's degree in mechanical engineering. *Staff*

Mechanical Engineering 502. Seminar II (1-0-1).

A continuation of Mechanical Engineering 501.

Mechanical Engineering 507. Nonlinear Analysis (3-0-3).

An introductory study of nonlinear systems and the various methods of analysis. Problems described by first and second order, driven and undriven equations giving rise to nonlinear oscillations and vibrations are covered. The basic topics of analysis are: basic numerical methods, phase-plane method, stability, exact analytical solutions, approximate analytical methods, perturbations, describing function, and certain time-varying linear problems. Also offered as Electrical Engineering 507.

Mechanical Engineering 511. Elements of Continuum Mechanics I (3-0-3).

An introduction to advanced topics in the mechanics of deformable media. Topics include tensor analysis, strain, stress, elasticity, plasticity, and fluid flow. *Mr. Ingram*

Mechanical Engineering 512. Elements of Continuum Mechanics II (3-0-3).

A continuation of Mechanical Engineering 511. Topics include variational and energy methods, thermoelasticity, viscoelasticity, irreversible thermodynamics, and finite deformation. *Mr. Ingram*

Mechanical Engineering 521. Energy Conversion Systems (3-0-3).

Applications of thermodynamics to the study of energy conversion systems of various forms, including reciprocating engines, gas turbines, ram jets, liquid- and solid-fuel rocket engines. A detailed treatment of thermochemical equilibrium as applied to the combustion process is given. *Mr. Wierum*

Mechanical Engineering 522. Applied Fluid Mechanics and Fluid Machinery (3-0-3).

Applications of fluid mechanics in mechanical engineering. Drag and lift forces in two- and three-dimensional flows are analyzed. Particular emphasis is placed on steady and nonsteady flow in pipes, gravity wave theories, and fluid machinery. *Mr. Beckmann*

Mechanical Engineering 526. Advanced Thermodynamics and Heat Power Laboratory I (0-3-1).

Advanced laboratory work in thermodynamics, heat transfer, and fluid mechanics, consisting of at least one small research project in addition to a number of tests of common items of equipment. Laboratory fee required. *Mr. Plapp*

Mechanical Engineering 527. Advanced Thermodynamics and Heat Power Laboratory II (0-3-1).

A continuation of Mechanical Engineering 526. Laboratory fee required.

Mechanical Engineering 536. Introduction to X-ray Diffraction (3-3-4).

An introduction to the study of crystals by the diffraction of X rays. The theory of diffraction from a lattice is developed and applications to commonly encountered

experimental techniques are discussed. In addition, chemical analysis by fluorescence and direct observation of lattice defects by electiron microscopy are presented. Laboratory fee required. *Mr. Rudee*

Mechanical Engineering 541. Physical Metallurgy (3-3-4).

A study of the fundamentals of solidification, alloying, and heat treatment. The mechanical and nonmechanical properties of metallic systems are discussed from atomic and electronic theory. Structural changes in metals accompanying various basic forming processes are described. An introduction to the oxidation and corrosion of metals. Laboratory experiments will complement the course work and include experiments for example on X-ray diffraction and resistivity. Laboratory fee required. *Mr. Roberts*

Mechanical Engineering 542. Nonmetallic Materials (3-3-4).

The mechanical and physical properties of nonmetallic materials. Laboratory work usually consists of a semester project in one particular phase of the study of nonmetallic materials or physical metallurgy. Laboratory fee required. *Mr. McLellan*

Mechanical Engineering 561. Advanced Metallurgical Laboratory I (0-4-1).

Students whose interest lies primarily in the fields of materials and metallurgy are given the opportunity for research in these fields. The students will be able to work on problems of a basic nature. Laboratory fee required. *Staff*

Mechanical Engineering 562. Advanced Metallurgical Laboratory II (0-4-1).

A continuation of Mechanical Engineering 561. Laboratory fee required.

Mechanical Engineering 570. Mechanical Vibrations (3-0-3).

Linear vibrations theory beginning with a one-degree-of-freedom system and continuing to a multi-degree-of-freedom system. Applications include vibration isolation and motion-measuring instruments. Methods of determining natural frequencies of multi-degree-of-freedom systems are also treated. *Mr. Wilhoit*

Mechanical Engineering 590. Heat Transfer (3-0-3).

A general course of lectures and recitations from text covering a basic study of the laws of heat transfer by conduction, convection, and radiation. *Mr. Chapman*

Mechanical Engineering 593. Mechanical Engineering Problems.

If conditions are favorable, mechanical engineering students may elect at least nine hours a week in approved investigations or designs under the direction of a member of the staff. *Staff*

Mechanical Engineering 600. Research and Thesis.

Mechanical Engineering 603. Special Topics in Mechanical and Aerospace Engineering and Materials Science (Variable credit).

Mechanical Engineering 605. Graduate Seminar.

Mechanical Engineering 607. Advanced Engineering Analysis (3-0-3).

An introduction to the theory of the complex variable and a review of vector analysis with particular emphasis on engineering applications in the field of fluid dynamics, heat conduction, and elasticity. *Mr. Plapp*

Mechanical Engineering 615. Advanced Dynamics (3-0-3).

Dynamics of a particle, dynamics of a system of particles, Hamilton's principle, and Lagrange's equations. Applications to advanced engineering problems. *Mr. Wilhoit*

Mechanical Engineering 617. Continuum Mechanics I (3-0-3).

A study of the principles of continuum mechanics which are applicable to general types of materials. Tensor analysis, strain, motion, and stress. Thermodynamics of continuous media with application to constitutive equations of specific materials. Nonlinear elasticity and fluid mechanics. Prerequisites: Mechanical Engineering 511 and 512. *Mr. Ingram*

Mechanical Engineering 618. Continuum Mechanics II (3-0-3).

A continuation of the topics of Mechanical Engineering 617. The principles available for the formulation of nonlinear constitutive equations are developed and applied to viscoelasticity, plasticity, electromagnetic media, and mixtures of fluids and solids. *Mr. Ingram*

Mechanical Engineering 619. Wave Propagation I (3-0-3).

A survey of the basic problems and solutions for acoustic, elastic, and electromagnetic wave propagation. Topics include reflection and refraction at plane surfaces. Cagniard's method, the response of systems to localize sources, surface waves, and wave propagation in anistropic media are also considered. *Mr. Ingram*

Mechanical Engineering 620. Wave Propagation II (3-0-3).

Harmonic and generalized functional analysis. Application is made of transform techniques to the solution of problems concerning wave propagation in stratified media, plates, and cylinders. Diffraction and scattering are considered. A brief survey is made of wave propagation in plasmas. *Mr. Ingram*

Mechanical Engineering 625. Theory of Elasticity I (3-0-3).

General analysis of stress and strain (in three dimensions) and stress-strain relation for an elastic continuum. The formulation of boundary-value problems, general theorems, and minimum principles are presented. Application is made to torsion and flexure of cylinders and to plane strain, plane stress, and generalized plane stress. *Mr. Nordgren*

Mechanical Engineering 626. Theory of Elasticity II (3-0-3).

Muskhelishvili's method and conformal mapping for two-dimensional elastostatic problems. Special formulation of three-dimensional problems, solutions by Green's function and transform techniques are presented. Thermoelasticity, variational theorems, and related approximate methods are included. Prerequisite: Mechanical Engineering 625. *Mr. Nordgren*

Mechanical Engineering 627. Theory of Elasticity III (3-0-3).

General linear theory of bending of elastic shells. Various approximate theories are also presented. Applications are made to static and dynamic problems of cylindrical shells, shells of revolution, and shallow shells. Non-linear theories and stability problems are considered. Prerequisites: Mechanical Engineering 625 and 626. *Mr. Nordgren*

Mechanical Engineering 628. Plasticity Theory I (3-0-3).

The basic laws of plastic flow are formulated. Yield and loading surfaces, normality and convexity requirements, and hardening rules are introduced. Solution of elastic-plastic problems are presented. *Mr. Cheatham*

Mechanical Engineering 629. Plasticity Theory II (3-0-3).

A continuation of the topics considered in Mechanical Engineering 628. Methods of plastic limit analysis are applied to beams, structures, and continuous media. Plane plastic flow and the theory of the slip-line field are studied. *Mr. Cheatham*

Mechanical Engineering 634. Thermodynamics of Alloys (3-0-3).

A discussion of classical thermodynamics, the thermodynamic parameters characterizing liquid and solid solutions. Review of quantum and classical statistical mechanics, statistics of lattice interactions, magnetic systems, and vapors. Statistical mechanical treatment of phase equilibria. *Mr. McLellan*

Mechanical Engineering 635. Transformations in Alloys (3-0-3).

Diffusion theory and the calculation of correlation coefficients for simple lattices. Thermal, self, and solute diffusion through metallic and ionic lattices. Diffusion-controlled transformations. Precipitation from supersaturated solid and liquid solutions. Order-disorder transformations. Shear transformations. Transformations occurring in the heat treatment of iron alloys. *Mr. McLellan*

Mechanical Engineering 636. Diffraction in Nonideal Crystals (2-3-3).

A course describing some of the techniques available for the study of defects in crystals by diffraction methods. Topics covered include diffraction contrast in electron microscopy, the analysis of the structure of deformed metals, and the detection of departures from randomness in solid solutions. Prerequisite: Mechanical Engineering 536. *Mr. Rudee*

Mechanical Engineering 644. Lattice-Imperfection Theory (3-0-3).

Dislocations in otherwise perfect media: the geometry of dislocations in a continuum, their stress fields, and interactions. Dislocations in real crystals (dislocation reactions, dislocation interaction with other crystal imperfections) and theories concerning the origin of dislocations. The presence and behavior of lattice vacancies and interstitials in solids. Production of these defects by different methods including irradiation. *Mr. Roberts*

Mechanical Engineering 645. Mechanical Metallurgy (3-0-3).

Elastic, plastic, and viscous behavior of metallic solids. The interpretation of mechanical behavior in terms of lattice-imperfection theory. Discussion of fracture, fatigue, creep, and damping in metals. Prerequisite: Mechanical Engineering 644. *Mr. Roberts*

Mechanical Engineering 646. Electron Theory of Solids. (3-0-3).

Electron theory of solids, starting with the free-electron model and leading to Brillouin zones and band theory. Also offered as Electrical Engineering 663. *Mr. McLellan*

Mechanical Engineering 647. Physical Properties of Solids (3-0-3).

Based on the electron theory of solids, the electrical and thermal conductivities are studied. The origin and behavior of diamagnetic, paramagnetic, and ferromagnetic materials are considered. A discussion of semiconductors is included. Prerequisite: Mechanical Engineering 646 or equivalent. Also offered as Electrical Engineering 664. *Mr. Rudee*

Mechanical Engineering 648. Semiconductor Electronics (3-0-3).

Fundamental theory of semiconductor devices. The material of an introductory course in solid-state theory is assumed. Also offered as Electrical Engineering 661.

Mechanical Engineering 649. Ferromagnetic Theory and Devices (3-0-3).

Theory of magnetism. Magnetostatics. Dynamic behavior of magnetic materials. Magnetic thin films. Magnetic tape cores. Device characteristics. The material of an introductory course in solid-state theory is assumed. Also offered as Electrical Engineering 662.

Mechanical Engineering 654. Theory of Optimum Flight Paths (3-0-3).

Ordinary theory of maxima and minima, extremization of linear integrals by Green's theorem, calculus of variations in one independent variable. Applications to optimum flight paths of aircraft, missiles, satellites, and spaceships. *Mr. Miele*

Mechanical Engineering 655. Theory of Optimum Aerodynamic Shapes (3-0-3).

Calculus of variations in one and two independent variables. Applications to optimum wings, fuselages, wing-fuselage combinations, and rocket nozzles at supersonic, hypersonic, and free-molecular flow velocities. *Mr. Miele*

Mechanical Engineering 670. Advanced Thermodynamics (3-0-3).

A continuation of the study of the principles of thermodynamics, including a thorough review of the fundamental concepts and laws, a detailed consideration of energy and its transformations and of equilibrium, and introduction to chemical thermodynamics and statistical mechanics. *Mr. Plapp*

Mechanical Engineering 673. Advanced Fluid Dynamics I (3-0-3).

Potential flow and other topics of classical fluid dynamics are extended to airfoil theory, ducted flow and free jets, and open-channel flow. *Mr. Beckmann*

Mechanical Engineering 674. Advanced Fluid Dynamics II (3-0-3).

This course emphasizes flow of viscous fluids. Primary attention is given to boundary-layer flow and to turbulent flow. *Mr. Beckmann*

Mechanical Engineering 675. Special Applications of Fluid Dynamics I (3-0-3).

Geostropic flows in meterology and oceanography are investigated and applied to secondary flow phenomena of laminar and turbulent character. Additional topics of greater interest include ocean wave spectra and their application to the statistics of turbulence. *Mr. Beckmann*

Mechanical Engineering 676. Special Applications of Fluid Dynamics II (3-0-3).

The theory of lubrication and wear, cavitation flow through porous media, transport of solids and gases in fluids, and other phenomena are emphasized. *Mr. Beckmann*

Mechanical Engineering 682. Theory of Convective Heat Transfer (3-0-3).

A thorough investigation of the processes of forced and free convection in laminar and turbulent flow, including a development of the basic equations describing these processes and a presentation of the principal cases for which they have been solved. *Mr. Plapp*

Mechanical Engineering 691. Advanced Gas Dynamics I (3-0-3).

Analysis of the general equations of fluid flow. Properties of compressible fluids. Subsonic and supersonic flow in the steady and nonsteady states and in one, two, and three dimensions. Shock waves and other phenomena connected with high-velocity flow. *Mr. Chapman*

Mechanical Engineering 692. Advanced Gas Dynamics II (3-0-3).

A continuation of Mechanical Engineering 691. *Mr. Chapman*

Mechanical Engineering 696. Viscous Hypersonic Flow (3-0-3).

This course develops the modern theories for laminar and turbulent boundary layers of reactive gas mixtures flowing at hypersonic speeds. *Mr. Wierum*

Mechanical Engineering 697. Hypersonic Gas Dynamics (3-0-3).

The gas dynamic effects which occur in flight at high Mach numbers are studied. Detailed consideration is given to the theoretical techniques for analyzing hypersonic flows past slender, blunt, and blunt-nosed slender bodies. *Mr. Wierum*

Mechanical Engineering 698. Physical Gas Dynamics (3-0-3).

Both equilibrium and nonequilibrium phenomena in the dynamics of high temperature gases are studied. Emphasis is placed upon the influence of atomic and molecular structure on the dynamical behavior of gaseous systems. *Mr. Wierum*

Mechanical Engineering 699. Gas Dynamics of Radiant Media (3-0-3).

The application of radiative transport theory to the physical problems of gas dynamics is studied. Detailed consideration is given to radiation energy transfer,

the interaction of radiant energy with homogeneous matter, and the conservation equations of the gas dynamics of radiant media. *Mr. Wierum*

English

Professors Camden, Dowden, *Chairman,* McKillop, Paulson, Spears, George Williams, and Kathleen Williams
Visiting Professors Super and McManaway
Associate Professors Gallegly, Grob, Parish, Thomas, and Ward
Assistant Professors Baker, Cox, Doughtie, Isle, O'Grady, and Velz
Instructor Reedy
Lecturers Bartholomew, Lowe, and McMurtry

Requirements for a Major in English: Thirty-six hours (twelve semesters) in English, two semesters preferably to be English 250a and b, eight to be advanced; at least one semester each of Shakespeare, English literature before 1700 (in addition to Shakespeare), English literature from 1700 to 1900, American literature, and modern literature; two semesters of advanced courses in French, German, or Latin; four semesters of approved collateral advanced courses in history, history of art, or philosophy.

Requirements for the Degree of Master of Arts. Eight advanced semester-courses in English; the passing of a reading examination in French, German, or Latin; the satisfactory completion of a thesis; the passing of an oral examination. Two years are usually required to complete the work for this degrere.

Requirements for the Degree of Doctor of Philosophy. Prospective students are urged to take the Graduate Record Examination at the earliest opportunity and to consult the department well in advance of registration with regard to their qualifications and to the feasibility of their plans for advanced studies in English. The awarding of the doctor's degree is not based on an accumulation of credits; the candidate is expected to show a comprehensive knowledge of the field and to prove his command of the processes and results of scholarship. The following requirements are minimal: sixteen advanced semester-courses in English, including those required for the degree of Master of Arts; a course in Old English or the history of the English language; the passing of a reading examination in two foreign languages, usually French and German, before taking the preliminary examination; the passing of a preliminary examination, both written and oral, on the general field of English studies; the completion of a thesis which shall constitute an original contribution to knowledge and demonstrate the candidate's power of independent work; the passing of a final oral examination on the thesis and related fields. A graduate student is not admitted to candidacy for this degree until he has passed the preliminary examination.

COURSES

English 100a, b. Introduction to Critical Reading, Thinking, and Writing (3-0-3, each sem.).

Special attention will be given to expository writing and to the study of literary forms. *Staff*

English 210a, b. Argumentation and Public Speaking (3-0-3, each sem.).

Practical training in the fundamentals of effective speech, written argument, and debate. Designed to prepare the students for the ordinary demands of business life. Platform speaking, themes, conferences. This course is planned for students of physical education and commerce. *Mr. Gallegly*

English 240a. Modern and Ancient Narrative in Prose, Verse, and Drama (3-0-3).

Classical and medieval Literature in translation (Homer to Dante). *Mr. Thomas*

English 240b. Modern and Ancient Narrative in Prose, Verse, and Drama (3-0-3).

World narrative (Cervantes to the present, including English and non-English drama, fiction, and verse.) Prerequisite: English 240a. *Mr. Thomas*

English 250a, b. Masters of English Literature (3-0-3, each sem.).

Readings in the major authors representative of the various periods. The backgrounds and a chronological history of English literature will be provided through lectures and supplementary reading. Recommended for all prospective majors in English. *Mr. Grob*

English 260a, b. American Literature (3-0-3, each sem.).

A survey of major American writers and literary movements. *Mrs. Lowe*

English 300a. English Drama from the Beginning to Marlowe (3-0-3).

The development of dramatic genres from the "quem quaeritis" to the 1590's in the light of medieval and classical traditions. *Mr. Velz*

English 300b. English Drama from Ben Jonson to the Closing of the Theaters (3-0-3).

A survey of the Jacobean and Caroline dramatists with special emphasis on themes and conventions. *Mr. Velz*

English 310a, b. Modern British Poetry (3-0-3, each sem.).

A survey of British poetry from 1890 to date, with special emphasis on major intellectual developments of the period as they have been reflected in the poetry. *Mr. Williams*

English 320a, b. Approaches to Modern Drama (3-0-3, each sem.).

Representative English, Continental, and American plays. *Mr. Thomas*

English 323a. Auden, Eliot, and Pound (3-0-3). *Mr. Spears*

English 325a. Conrad and His Contemporaries (3-0-3).

Works by Conrad will be compared with those of other novelists of the period and examined in the light of current critical opinion. *Mr. Dowden*

English 325b. Twentieth-Century British Novel (3-0-3). *Mr. Spears*

English 330a, b. Advanced Writing (3-0-3, each sem.).

The writing of essays, stories, plays, and novels. Time is given also to problems of marketing manuscripts. Stories are read and analyzed, and critical theories are discussed. Frequent conferences. *Mr. McMurty and Mr. Williams*

English 340a, b. The English Novel (3-0-3, each sem.).

Major novelists of the eighteenth and nineteenth centuries. (May be taken in either or both semesters.) *Mr. McKillop*

English 350a, b. The Romantic Period (3-0-3, each sem.).

The course will stress the important themes and techniques of literature in the early nineteenth century. Wordsworth and Coleridge will be read in the first semester; Byron, Shelley, and Keats in the second. Representative novels will also be studied. *Mr. Dowden*

English 355a. Early Victorian Literature (3-0-3).

Poetry and expository prose of the early Victorian period. Special attention will be given to Carlyle, Tennyson, and Browning. *Mr. Grob*

English 355b. Middle and Late Victorian Literature (3-0-3).

Poetry and expository prose of the middle and the late Victorian period. Special attention will be given to Newman, Mill, Ruskin, Arnold, and Hopkins. *Mr. Grob*

English 360a, b. English Drama from 1660 to 1900 (3-0-3, each sem.). *Mr. Camden*

English 365a. The Restoration (3-0-3).

Poetry, prose, drama, and criticism from 1660-1700 *Mr. Paulson*

English 366a, b. Eighteenth-Century Literature (3-0-3).

First semester: Swift, Pope, and Fielding. Second semester: the age of Johnson. *Mr. Paulson*

English 370a. Sixteenth-Century Literature (3-0-3).

Sixteenth-century survey: early Tudors, Humanism and the Reformation, pastoral poetry and Spenser. *Mr. Doughtie*

English 370b. Sixteenth-Century Literature (3-0-3).

Prose fiction, Ovidian poetry, and the sonnet (with emphasis on Sidney and Shakespeare). Prerequisite: 370a or permission of the instructor. *Mr. Doughtie*

English 375a, b. Late Nineteenth-Century and Early Twentieth-Century English Literature (3-0-3, each sem.).

Aestheticism; "strenuous" writers; developments of Edwardian and Georgian literature; impact of World War I. *Mr. Thomas*

English 380a. Literature of the Renaissance (3-0-3).

Mr. Parish and Mr. Baker

English 380b. Milton and the Classical Tradition (3-0-3).

Mr. Parish and Mr. Baker

English 385a. Chaucer (3-0-3). *Mr. O'Grady*

English 385b. Medieval Vision-Allegory (3-0-3). *Mr. O'Grady*

English 390a. American Literature to 1850 (3-0-3).

Special attention is given to Hawthorne, Emerson, Melville, and Thoreau. *Mr. Ward*

English 390b. American Literature 1850-1900 (3-0-3).

Special attention is given to Whitman, Dickinson, Clemens, and James. *Mr. Ward*

English 393a. Modern American Fiction (3-0-3).

A survey of main figures from 1900 to the present. *Mr. Isle*

English 393b. Modern American Poetry (3-0-3).
A general survey of poetry in America from 1900 to the present. *Mr. Isle*

English 395a, b. Life and Literature of the West and Southwest (3-0-3, each sem.). *Mr. Gallegly*

English 400a, b. Shakespeare (3-0-3, each sem.).
A close study of certain of the comedies, histories, and tragedies, with lectures on the interpretation of these plays in the light of the Elizabethan mind. (May be taken in either or both semesters.) *Mr. Camden*

English 404a, b. Directed Reading and Independent Work in English and American Literature (3-0-3, each sem.).
Open to students of high standing having a principal interest in English or other modern literatures. Opportunity for independent reading and research will be provided for a selected group who wish to develop individual abilities and significant interests. Papers embodying the results of research will be written. *Staff*

English 440a, b. History of the English Language (3-0-3, each sem.).
Study of a growing language in Old, Middle, and Modern English texts. *Mr. Cox*

English 500. Topics in English and American Literary History.
Graduate research and thesis for the degree of Master of Arts. *Staff*

English 505a, b. Chaucer (3-0-3, each sem.). *Mr. O'Grady*

English 510a, b. Old English (3-0-3, each sem.).
Introduction to the historical study of the English language; phonology, morphology, and syntax of Old English; *Beowulf* and other selected literary texts. *Staff*

English 515a, b. Seminar in Sixteenth-Century Literature (3-0-3, each sem.). *Miss Williams*

English 520a. Seminar in the Romantic Period: Wordsworth, Coleridge (3-0-3). *Mr. Grob*

English 520b. Seminar in the Romantic Period: Byron, Shelley, and Keats (3-0-3). *Mr. Dowden*

English 530a. Bibliography and Methodology (3-0-3).
The course is designed to acquaint students with the bibliographical guides and aids to literary research. Attention will also be given to methods of preparing papers, theses, and dissertations. *Mr. Thomas*

English 535b. Literary Criticism (3-0-3).
A study of the principles of classical, romantic, and realistic literature as formulated by the major critics from Plato to the present day. *Mr. Dowden*

English 545a. Victorian Literature (3-0-3). *Mr. Grob*

English 545b. Victorian Literature (3-0-3). *Mr. Grob*

English 550a, b. Shakespeare Seminar (3-0-3, each sem.). *Mr. Camden*

English 555a, b. Seminar in Elizabethan and Jacobean Drama (3-0-3, each sem.). *Mr. Camden*

English 560a, b. Eighteenth-Century Prose and Poetry (3-0-3, each sem.). *Mr. McKillop*

English 565a, b. The Eighteenth-Century Novel (3-0-3, each sem.). *Mr. Paulson*

English 566a, b. The Nineteenth-Century Novel (3-0-3, each sem.). *Mr. Paulson*

English 570a. Seminar in Seventeenth-Century Literature (3-0-3). *Mr. Baker and Mr. Parish*

English 570b. Milton Seminar (3-0-3). *Mr. Baker and Mr. Parish*

English 575a. Seminar in American Literature (3-0-3). *Mr. Ward*

English 575b. Seminar in American Literature (3-0-3). *Mr. Ward*

English 580a, b. Directed Reading in English and American Literature (3-0-3, each sem.). *Staff*

English 585a, b. Modern British Poetry (3-0-3, each sem.). *Mr. Spears*

English 590a. Seminar on Comparative Literature (English-French) (3-0-3).
Same as French 590a.

English 590b. Comparative Study of Style (3-0-3).
Same as French 590b.

English 595a, b. Medieval English Literature (3-0-3, each sem.). *Mr. O'Grady*

English 600. Topics in English and American Literary History.
Graduate research and thesis for the degree of Doctor of Philosophy. *Staff*

English 700. Summer Graduate Research.
Open only to graduate students already admitted to study for an advanced degree. At least forty hours of library study and research per week. *Staff*

Ethnopsychology

(*See* pages 211-212)

Fine Arts

Professors Chillman and O'Neil, *Acting Chairman*
Associate Professor Parsons
Instructor Kane
Lecturers Brown, Havens, and Mears

Requirements for a Major in Fine Arts: Students are required to take at least six semester-courses in the history of art; eight are recom-

mended. In addition, two semesters of art studio courses at the 300 or 400 level are a requirement; two semesters each of courses in either art studio or history of art are recommended.

COURSES

Art 201a, 202 b. Design (1-6-3, each sem.).

The fundamentals of visual design; point, line, plane, value, color, shape, form, texture, and light. Open only to students intending to major in Fine Arts, with permission. *Miss Evans*

Art 225a, 226b. Drawing I (1-6-3, each sem.).

An introduction to the problems of drawing, using various media: pencil, charcoal, pen-and-ink, brush-and-ink. Primarily intended for architecture students but open to others with permission. *Mr. Parsons*

Art 325a, 326b. Drawing II (1-6-3, each sem.).

Continued study of drawing, with additional work in wash and other water media. Open to all students. *Mr. Mears*

Art 425a, 426b. Painting I (1-6-3, each sem.).

Problems of painting, both traditional and experimental, in oil and other opaque media. Open to all students. Prerequisite: Art 201a, 202b. *Mr. O'Neil*

Art 430a, 431b. Painting II (1-6-3, each sem.).

Advanced painting problems, with individual instruction and criticism. Prerequisite: Art 425a. *Mr. O'Neil*

Art 435a, 436b. Sculpture I (1-6-3, each sem.).

Sculpture in clay, ceramics, metal, direct metal welding, and other sculptural media. Open to all students. 435a is prerequisite for 436b. *Mr. Parsons*

Art 440a, 441b. Sculpture II (1-6-3, each sem.).

Sculpture in clay, ceramics, metal, direct metal welding, and other sculptural media. Prerequisite: Art 436b. *Mr. Parsons*

History of Art 205a, 206b. Introduction to the History of Art (3-0-3, each sem.).

A survey of painting, sculpture, and architecture from the Paleolithic period to the twentieth century. Open to all students. *Mrs. Brown*

History of Art 215a, 216b. Ancient Art (3-0-3, each sem.).

Egypt, the Middle East, Greece, and Rome. Prerequisite: History of Art 205a, 206b, or permission of instructor. *Mr. Chillman*

History of Art 315a, 316b. Medieval Art (3-0-3, each sem.).

Changing concepts of form and space illustrated by the development of the medieval church and the arts related to it. Fall semester: Early Christian, Byzantine and Romanesque Art. Spring semester: Gothic Art. Prerequisite: 205a or 215a, 216b or permission. *Mrs. Brown*

History of Art 345a. Modern Architecture (3-0-3).

Traces the evolution of modern architecture from the period of Romantic Classicism to the present. Particular emphasis upon developments after 1850, especially in America. Prerequisite: Permission of instructor. *Mr. Kane*

History of Art 365b. Pre-Columbian Art (3-0-3).

Survey of principal developments in architecture, sculpture, and painting in ancient Mexico, Central and South America. Prerequisite: Permission of instructor. *Mr. Kane*

History of Art 415a, 416b. Renaissance and Baroque Art (3-0-3, each sem.).

The artistic expression of new perspectives and energies. Fall semester: Renaissance Art. Spring semester: Baroque and Rococo Art. Prerequisite: Permission of instructor. *Mrs. Brown*

History of Art 450a, 451b. Key Monuments (3-0-3, each sem.).

Masterpieces of architecture, sculpture, and painting. Examples are the Acropolis at Athens and the cathedral at Chartres. Lectures, discussion, and papers. Not primarily for Fine Arts majors, but open to Juniors, Seniors, and graduate students in other areas. *Mr. Chillman*

History of Art 460a, 461b. The Nineteenth Century (3-0-3, each sem.).

Survey of art in Europe and America from the late eighteenth century through Impressionism. Prerequisite: Permission of instructor. *Mr. Kane*

History of Art 475a, 476b. Twentieth-Century Painting and Sculpture (3-0-3, each sem.).

Selective survey and discussion of principal phases of modern expression in Europe and America, from Post-Impressionism to the present. Prerequisite: Permission of instructor. *Mr. Kane*

Theater 300a, 301b. Introduction to Theater (3-0-3, each sem.).

A study of the form and structure of drama from Greek to modern. Special emphasis on the analysis of plays from the viewpoints of the various theater artists: director, actor, and designer. *Mr. Havens*

French

Professors Bourgeois, Topazio, *Chairman,* and Wadsworth
Visiting Professor Landré
Associate Professors L. Hodges, Lecuyer, Raaphorst, and Shelton
Assistant Professor Tappan
Lecturer Courtine

Undergraduates may major in French, and there is a graduate program in French leading to the degrees of Master of Arts and Doctor of Philosophy. A fully equipped language laboratory is in operation, and laboratory work is an important part of the elementary courses in French.

Undergraduate Majors. Students who intend to major in French should consult the section of this catalogue dealing with curricula and degrees to familiarize themselves with the University requirements; they should also consult with one of the senior members of the department. At least eight of the courses offered in fulfillment of major requirements must be numbered 300 or higher; ten are recommended. Qualified upperclassmen are offered an opportunity to engage in independent work. All departmental majors and prospective majors must have their programs approved by a representative of the department.

Graduate Programs. Admission to graduate study in French will be

granted to a limited number of qualified students. Evidence of qualification is a solid and distinguished undergraduate record in the study of French literature, and a capacity for independent work is also considered essential. The award of advanced degrees is not based solely on accumulation of credits or compliances with formal requirements. Candidates are expected to attain a wide general knowledge of the appropriate history and literature and to demonstrate their command of the French language. In most cases two years will be required for the completion of work for the degree of Master of Arts.

Requirements for the Degree of Master of Arts in French.

(a) Completion with high standing of a program approved by the department; normally this will include 18 semester hours in advanced courses.
(b) Passing a reading examination in one language other than French approved by the department.
(c) Passing a preliminary oral examination in French on the French authors indicated in a reading list provided.
(d) Completion of an acceptable thesis.
(e) Passing a final oral examination.

Requirements for the Degree of Doctor of Philosophy in French.

(a) Completion with high standing of a program approved by the department; normally this will include 42 semester hours in advanced courses, including those required for the degree of Master of Arts.
(b) Passing a reading examination in two languages other than that of the candidate's specialization and approved by the department.
(c) Passing a preliminary written and oral examination on the authors indicated in a reading list provided, and on the literature, culture, and civilization of France. The oral examination may be taken only after the successful completion of the preliminary written examination. Knowledge of a second literature is required, and appropriate reading lists will be available.
NOTE: Requirements (b) and (c) must be met at least a year before the submission of a dissertation.
(d) Completion of a dissertation approved by the department: the dissertation is expected to represent an original contribution to knowledge.
(e) Passing a final oral examination of the dissertation and related fields.

Note: Regardless of the type of appointment held by the graduate student, he or she may be required to undertake research or teaching assignments, depending upon the background of the graduate student and the needs of the Department.

COURSES

French 101a, 102b. Elementary French (3-1-3, each sem.).

A close study of the fundamentals of French grammar and pronunciation. Exercises in written French. Oral practice, dictations, and translation of suitable texts. Language laboratory work required. *Mr. Tappan and Staff*

French 110. French for Graduate Students (3-0-0).

A rapid study of French grammar with special emphasis on syntactical difficulties encountered in the comprehension of the written language. (Noncredit course restricted to graduate students preparing for the graduate language examination.) *Staff*

French 201a, 202b. Intermediate French (3-0-3, each sem.).

Emphasis on intensified oral, written, and translation practice. An introduction to the main currents in French literature. Readings of significant texts. composition, dictation, and conversation. *Mr. Hodges and Staff*

French 301a, 302b. French Civilization and Advanced Composition (3-0-3, each sem.).

A thorough study of French manners as reflected in literature and in the arts. Phonetics. Oral and written reports in French. *Mr. Shelton and Staff*

French 311a. Survey of French Literature (3-0-3).

A comprehensive survey of the main currents in French literature from its beginning to the 18th century. Recommended for French majors. *Mrs. Raaphorst*

French 312b. Survey of French Literature (3-0-3).

A comprehensive survey of the main current in French literature from the 18th century to the present. Recommended for French majors. *Mrs. Raaphorst*

French 318. The Renaissance (3-0-3).

A careful examination of the main intellectual and esthetic currents of the French renaissance with particular attention to Rabelais' *Gargantua* and *Pantagruel* and Montaigne's *Essais*. *Mr. Lecuyer*

French 321a. The Seventeenth Century (3-0-3).

French poets, novelists, and moralists of the early seventeenth century, notably Malherbe, Corneille, Descartes, and Pascal. *Mr. Wadsworth*

French 322b. The Seventeenth Century (3-0-3).

French writers of the classical period, notably Molière, La Fontaine, La Rochefoucauld, Racine, Boileau, La Bruyère, and Mme. de La Fayette. *Mr. Tappan*

French 331a. The Eighteenth Century (3-0-3).

The age of Enlightment and its precursors: Bayle, Fontenelle, Montesquieu, Voltaire, Lesage, Marivaux, Diderot, and Abbé Prévost. *Mr. Topazio*

French 332b. The Eighteenth Century (3-0-3).

The works and influence of Voltaire, Diderot, Rousseau, Sedaine, Choderlos de Laclos, Bernardin de St. Pierre, Beaumarchais, and Chénier. *Mr. Topazio*

French 351a. French Romantic Poetry and Novel (3-0-3).

This course traces the development of the romantic movement through the novels of Chateaubriand, Mme. de Stael, Constant, and George Sand, and the poetic works by Lamartine, Hugo, Vigny, and Musset. Class analysis of texts and essays in French. *Mr. Bourgeois*

French 352b. The Romantic Drama (3-0-3).

This course traces the development of the romantic movement through the novels of Chateaubriand, Mme. de Stael, Constant, and George Sand, and the poetic

works by Lamartine, Hugo, Vigny, and Musset. Class analysis of texts and essays in French. *Mr. Bourgeois*

French 391a. French Stylistics (3-0-3).

A study of present-day French in the context of general linguistics. Some work in the laboratory may be required. *Mr. Lecuyer*

French 392b. French Phonetics and Diction (3-0-3).

Practical application of the study of phonetics to the methods of learning and teaching French. Some work in the laboratory may be required. *Mr. Lecuyer*

French 404. Directed Study and Senior Thesis (0-0-6).

Open only to Senior students selected after application to the department. An extensive program of research is undertaken, after consultation, with approval of the department. A paper embodying the results of the research must be submitted. At least four advanced courses in French are prerequisites.

French 411a. Introduction to Old French (3-0-3).

Rapid presentation of the phonology and syntax of Old French. Selected readings from the principal literary genres of the medieval period. *Mr. Tappan*

French 412b. Special Topics in Medieval Literature (3-0-3).

An intensive study of one genre, author, or work of the medieval period. Prerequisite: French 411a. *Mr. Tappan*

French 451a. French Realism and Naturalism (3-0-3).

A thorough study of major novels by Stendhal and Balzac. Discussions and essays in French. *Mr. Bourgeois*

French 452b. French Realism and Naturalism (3-0-3).

A study of significant novels by Flaubert, Maupassant, Zola, Daudet, and the de Goncourt brothers. Discussions and essays in French. *Mr. Bourgeois*

French 455. The Parnassian Movement in French Literature (3-0-3).

Mr. Landré

French 481a. Modern French Drama (3-0-3).

A study of significant plays of Giraudoux, Cocteau, Anouilh, Montherlant, Camus, and Sartre. Detailed study, discussion, and written analyses in French. *Mr. Lecuyer*

French 482b. Special Topics (3-0-3).

A study of major novels of Proust, Gide, Mauriac, Saint-Exupéry, Camus, and others. Detailed study, discussion, and written analyses in French. *Mr. Lecuyer*

French 491. Special Topics (3-0-3).

Qualified students may, on the recommendation of the Department, undertake a special research assignment. May be repeated for credit with the assignment of an additional topic. *Staff*

French 500. Graduate Research.

Graduate research and thesis in partial fulfillment of the requirements for the degree of Master of Arts.

French 524a. Corneille (3-0-3).

A study of the principal plays of Pierre Corneille. *Mr. Tappan*

French 527b. Seminar on Classical Drama (3-0-3).

A study of the principal plays of Molière and Racine. *Mr. Wadsworth*

French 531a. Voltaire (3-0-3).

An intensive study of the significant and representative works of Voltaire. (Omitted in 1966/67. To be given in 1967/68). *Mr. Topazio*

French 532b. Jean-Jacques Rousseau (3-0-3).

All the major works of Rousseau will be studied. (Omitted in 1966/67. To be given in 1967/68). *Mr. Topazio*

French 533a. Montesquieu and Diderot. (3-0-3).

Several of the most representative works of Montesquieu and Diderot will be studied. *Mr. Topazio*

French 534b. A Study of the novel in the Eighteenth Century. (3-0-3).

Le Sage, Marivaux, Prévost, Voltaire, Diderot, Rousseau, and Laclos. *Mr. Topazio*

French 551a. Nineteenth-Century French Drama (3-0-3).

The evolution of the dramatic conception from 1800 to 1885. *Mr. Bourgeois*

French 552b. Nineteenth-Century French Drama (3-0-3).

The evolution of the dramatic conception from 1885-1914. *Mr. Bourgeois*

French 561a. Balzac (3-0-3).

A study of Balzac's understanding of human nature based on the most representative novels in "Scènes de la vie privée" and "Scènes de la vie de Province". (To be given in 1967/68) *Mr. Bourgeois*

French 562b. Balzac (3-0-3).

A study of Balzac's understanding of human nature based on the most representative novels in "Scènes de la vie parisienne" and other parts of *La Comédie humaine*. (To be given in 1967/68) *Mr. Bourgeois*

French 570b. André Gide (3-0-3).

An intensive study of his works. *Mrs. Raaphorst*

French 572b. André Malraux (3-0-3).

A study of his principal works. (To be given in 1967/68) *Mrs. Raaphorst*

French 575b. Montherlant (3-0-3).

A study of the novels and plays of Henri de Montherlant. *Mr. Lecuyer*

French 576. The New Novel in France (3-0-3).

A study of the representative works of Robbe-Grillet, Michel Butor, Nathalie Sarraute, and Marguerite Duras. To be given in 1967-68. *Mr. Lecuyer*

French 574a. The Avant-garde theater in France (3-0-3).

A study of the representative plays of Adamov, Beckett, Genêt, Ionesco and others. *Mr. Lecuyer*

French 581. Special Topics in French Literature (3-0-3).

This course is designed to fill particular lacunae in a doctoral candidate's program. Subjects would therefore change according to specific needs of students. Can be repeated for credit since topics would change. *Staff*

French 591a. Seminar on Comparative Literature (English-French) (3-0-3). *Mr. Landré*

French 592b. Comparative Study of Style (3-0-3).

Close analyses of British, American, and French writers, showing analogies and differences and stressing the common nature of problems in form. To be given in 1967-68. *Mr. Lecuyer*

French 600. Graduate Research.

Graduate research and dissertation in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

Geology

PROFESSORS J. A. S. ADAMS, *Chairman*
CRONEIS, DEBREMAECKER, ROGERS, AND J. L. WILSON
ASSISTANT PROFESSORS BURCHFIEL, CLARK AND LANKFORD
VISITING LECTURERS NETTLETON AND STENZEL

In January, 1952, Mrs. Olga Wiess provided an endowment fund to establish the Harry Carothers Wiess Chair of Geology as a memorial to her husband. As a result, the Department of Geology was created, and a full program of courses in the subject is being offered. The first Senior class in geology was graduated in June, 1955, and the first doctorate was awarded in June, 1958. A geology laboratory, completed in June, 1958, provides ample space and facilities for undergraduate and graduate instruction and research.

Until June, 1964, all geology majors were in the science-engineering program; beginning in the 1964-65 academic year, however, it has been possible for students to major in geology in either the science-engineering or the academic programs.

Undergraduate Requirements. In addition to satisfaction of the general requirements of the science-engineering program, or academic program, undergraduate majors in geology are expected to complete the following courses:

Geology 200a, 201b ordinarily taken in the Sophomore year, but may be delayed to the Junior year
Geology 310a, 310b taken in the Junior year
Geology 330a, 331b taken in the Junior year
Geology 400a, 401b taken in the Senior year
One to two year-courses (two to four semester-courses) of approved geology electives
Geology 390 or other approved summer field course; ordinarily taken in the summer between the Junior and Senior years.

Graduate Requirements. Students with a bachelor's degree in geology or related sciences from Rice University, or an equivalent degree from another institution of similar standing, are considered for admission to graduate work.

Graduate work is conducted in those specialties that are compatible with the equipment available and with the interests of the staff. At present, the Department of Geology is prepared to offer advanced work in geochemistry, geophysics, igneous and metamorphic petrol-

ogy, marine geology, stratigraphy, sedimentation, sedimentary petrology, structural geology, and paleontology, micropaleontology, and paleoecology. Graduate work in geology is oriented toward the theoretical and fundamental aspects of the subject rather than directly toward its many applied aspects.

Candidates for advanced degrees in geology will be expected to:

(1) Pass a reading examination in one foreign language for the master's degree; German is ordinarily required, but the Geology Department may permit the substitution of French in some cases. Candidates for the Ph.D. degree must pass reading examinations in two languages, one of which must be German.

(2) Complete at a high level an approved program of graduate courses in geology and related subjects. This program may include an advanced field course and undergraduate courses in certain supporting sciences, such as mathematics (calculus), chemistry, physics, and biology. Prospective students with deficiencies in such supporting sciences will find their graduate program greatly accelerated by removing those deficiencies prior to enrolling for graduate work.

(3) Pass a set of basic examinations in geology. These examinations are ordinarily given early in a student's graduate career and may at the discretion of the department, be repeated one or more times in whole or in part. Ph.D. candidates are expected to achieve higher scores than master's candidates. In some cases, specific examinations may be waived in lieu of high grades in related courses.

(4) Complete for publication a thesis which represents an original contribution to the science.

(5) Pass an oral examination covering the candidate's research work and related phases of geology.

(6) Engage in some laboratory instruction regardless of the type of appointment. This experience is considered an important and valuable part of graduate training, and every effort is made to give as great a variety of assignments as possible.

Most graduate students can expect to spend two years beyond the bachelor's degree in order to complete requirements for the master's degree and an additional two years for the Ph.D. degree. Some students of very high ability may be allowed to bypass the master's degree and work directly for the Ph.D.

COURSES

Geology 200a. Physical Geology (3-3-4).

An introduction to the study of the physical, chemical, and geological processes that produce rocks, economic deposits, and landforms. The laboratory includes exercises with advanced instrumentation, map and structure interpretation, and the identification of hand specimens of rocks and minerals. Prospective majors in

geology are expected to have had Chemistry 120a,b, Physics 100a,b, and Mathematics 100a,b. Laboratory fee required. *Messrs. Adams and Rogers*

Geology 201b. Historical Geology (3-3-4).

An introduction to the study of the physical events of the ancient past from the birth of the earth through the most recent ice age, together with a synopsis of the concurrent changing patterns of life. The laboratory includes the analysis of geological maps with emphasis on the structure of the stratified rocks and their organic remains. Prerequisite: Geology 200a or consent of the department. Laboratory fee required. *Mr. Lankford*

Geology 310a. Mineralogy (3-4-4).

Basic introduction to the following topics: crystallography, crystal structure, crystal chemistry, X-ray diffraction, and occurrence of minerals, with emphasis on the more common rock-forming minerals. Laboratory fee required. *Staff*

Geology 310b. Petrology (3-6-5).

A survey of optical properties of crystals, identification of minerals by oil-immersion methods and in thin sections, description and interpretation of igneous and metamorphic rocks. Laboratory fee required. *Messrs. Burchfiel and Rogers*

Geology 321b. Mineral Resources (3-0-3).

An introduction to the study of the geology, origin, and general economics of mineral and fuel deposits. Topics for study include the analysis of significant occurrences and methods of exploration. Prerequisite: Consent of the department. *Mr. Adams*

Geology 330a. Structural Geology (3-4-4).

Introduction to structural geology and field methods. Topics covered include description of faults, folds, and other structural features, field methods for recognizing and interpreting structures, mechanics of rock deformation, and elementary tectonics. Laboratory work involves descriptive geometry, plane table surveying, aerial photograph interpretation, and preparation of geologic maps. Laboratory fee required. *Mr. Burchfiel*

Geology 331b. Sedimentation (3-3-4).

Introduction to the study of sedimentary rocks, Emphasis is placed on the processes of weathering, transportation, and deposition and on the petrographic attributes of the more important types of sedimentary rocks. Laboratory work is concerned largely with sedimentation analyses and the description of hand specimens and thin sections. Prerequisite: Geology 310a. Laboratory fee required. *Mr. Lankford*

Geology 390. Field Geology.

In addition to the various shorter field trips conducted in connection with a number of the geology courses taken in residence, a summer field course of not less than six weeks is required of all majors. The work may be taken at any one of several approved university field stations during the summer prior to the Senior year. Credit variable. Laboratory fee required.

Geology 400a. Invertebrate Paleontology (3-4-4).

An introduction to the morphology and geological record of the major invertebrate groups characterized by significant fossil representation. Laboratory fee required. *Mr. Wilson*

Geology 401b. Stratigraphy and Index Fossils (3-4-4).

The principles of stratigraphy and stratigraphic analysis. Problems of correlation, standard sections, and paleogeography. Prerequisite: Geology 400a. Laboratory fee required. *Mr. Stenzel*

Geology 405a. Micropaleontology (2-6-4).

A microscopic study of the plant and animal remains commonly recoverable from drill cuttings. Principles underlying the use of such fossils in local and world-wide correlations. Prerequisite: Geology 401b or consent of the department. Laboratory fee required. *Mr. Lankford*

Geology 411b. Igneous and Metamorphic Petrology (3-4-4).

Study of the origin and mode of formation of igneous and metamorphic rocks. Emphasis is placed on the application of experimental petrology to field and petrographic evidence concerning major petrologic problems. Laboratory work involves petrographic study of selected suites of important rocks. Prerequisite: Geology 310a,b. Laboratory fee required. *Staff*

Geology 418a. Marine Geology (3-3-4).

A study of the major components of modern ocean basins and margins including their sediments, sedimentary environments, marine processes, and interpretations of bathymetry, structure, and history. The course will include field trips along the Gulf Coast and in the Gulf of Mexico. Prerequisites: Geology 330a and 331b. Laboratory fee required. *Mr. Lankford*

Geology 455a. Geochemistry (3-4-4).

A study of the geological and chemical processes that produced the observed distribution and abundances of the elements. The age, formation, and heat balance of the earth are some of the topics discussed from a geochemical viewpoint. Laboratory work includes both wet chemical and modern instrumental determinations of major and trace elements in rocks and minerals. Prerequisites: Geology 310a and consent of the department. Laboratory fee required. *Mr. Adams*

Geology 455b. Geochemistry (3-4-4).

A continuation of Geology 455a, which is a prerequisite. *Mr. Adams*

Geology 460a. Geophysics (3-4-4).

Gravity, magnetism, potential theory, elasticity, and elastic waves theory. Emphasis is on the principles and the mathematical physics. Laboratory work is concerned with applications of the methods. Prerequisite: Consent of the department. Laboratory fee required. *Mr. DeBremaecker*

Geology 460b. Geophysics (3-3-4).

A continuation of Geology 460a, which is a prerequisite. *Mr. DeBremaecker*

Geology 480. Research in Geology.

Advanced work adapted to the needs of the individual student. Credit variable. Laboratory fee required.

Geology 490. Recent Advances in Geology.

A study of recent research in specific fields under the guidance of a member of the staff. Credit variable. Laboratory fee required.

Geology 500. Special Studies.

Advanced work in certain phases of geology, adapted to the needs of individual graduate students. Registration permitted only with consent of the department. Credit variable.

Geology 505a. Principles of Paleontology (3-3-4).

A consideration of the genetical, ecological, and biogeographical factors which account for the temporal and geographic distribution of fossil organisms. Emphasis is placed on the reconstruction of the life relationships and habitats of fossil invertebrates. Prerequisite: Geology 400a and 540b (may be taken concurrently). *Staff*

Geology 506b. Evolution of the Invertebrates (3-3-4).

A study of the major features of invertebrate evolution as exemplified by the fossil record. Topics considered include rates of evolution, adaptation, and extinction. Prerequisite: Geology 505a. *Staff*

Geology 510-518. Seminars in Geology.

Courses covering the subjects listed in sequence under geology research courses numbered 590 to 598. Individual seminars may cover different topics in different years and may be taken more than once. All seminars three units per semester.

Geology 530a. Advanced Sedimentary Petrology (3-4-4).

A survey of sedimentary processes (weathering, transportation, deposition, and diagenesis) and sedimentary rocks. Selected topics will be studied in the fields of sedimentary mineralogy, lithofacies analysis and environmental interpretation, and tectonic sedimentation. Laboratory work includes sedimentation analysis and thin-section study of sedimentary rocks. *Mr. Rogers*

Geology 531b. Advanced Topics in Petrology (3-0-3).

A study of major problems of igneous and metamorphic petrology. Topics include origin of magmas, the granite problem, basalts, and volatiles in silicate systems. Topics will vary from year to year. *Mr. Rogers*

Geology 535a. Advanced Mineralogy (3-6-5).

This course is devoted largely to the techniques of making precise determinations of chemical and physical properties of minerals. Rock-forming minerals are studied by universal stage, X-ray powder-diffraction, and wet chemical techniques. *Staff*

Geology 540b. Statistical Geology (3-3-4).

Fundamentals of statistical analysis and their application to geologic problems. Topics covered include sampling distributions, comparison of means and variances, correlation and regression, chi-square analysis, variance analysis, and handling of multiple sets of data. *Mr. Rogers*

Geology 550a. Chemical Geology (3-3-4).

Survey of physical chemistry and its applications to geologic studies. Topics covered include basic thermodynamics, phase equilibria and solution chemistry, reaction kinetics, crystal chemistry, and crystal growth. *Mr. Rogers*

Geology 550b. Chemical Geology (3-3-4).

A continuation of Geology 550a, which is a prerequisite. *Mr. Rogers*

Geology 555a. Advanced Topics in Geochemistry (3-3-4).

A study of selected topics, particularly radiometry, isotope and trace element analysis and interpretation. *Mr. Adams*

Geology 555b. Radiogeology (3-4-4).

The detection and quantitative determination of natural and artificial radioactive nuclides with particular emphasis on the geologic mechanisms of mobilization, transportation, and fixation in the lithosphere, hydrosphere, atmosphere, and biota. Alpha, beta, and gamma detection in the field and laboratory, as well as alpha and gamma pulse-height analysis in the laboratory, are considered in both theory and practice. Gamma spectrometry in the field is also included. The biological and health aspects of the radiation environment are discussed. *Mr. Adams and others*

Geology 560a, b. Advanced Topics in Geophysics (3-3-4, each sem.).

Study of selected topics in geophysics, including seismology, gravitation, and geomagnetism. *Mr. DeBremaecker*

Geology 566a. Advanced Tectonics (3-3-4).
Mechanics of rock deformation and its relation to field observations and an understanding of faulting, folding, and minor structures. Study of selected structural problems and regional tectonics. *Mr. Burchfiel*

Geology 566b. Advanced Tectonics (3-3-4).
A continuation of Geology 566a, which is a prerequisite. *Mr. Burchfiel*

Geology 590. Research in Physical and Structural Geology (1-9-3).
Messrs. Burchfiel and DeBremaecker

Geology 591. Research in Mineralogy (0-9-3).
Mr. Adams

Geology 592. Research in Petrography and Petrology (0-9-3).
Mr. Rogers

Geology 593. Research in Geochemistry (0-9-3).
Messrs. Adams and Rogers

Geology 594. Research in Geophysics (0-9-3).
Mr. DeBremaecker

Geology 595. Research in Invertebrate Paleontology and Stratigraphy (0-9-3).
Messrs. Croneis and Lankford

Geology 596. Research in Economic and Petroleum Geology (0-9-3).
Staff

Geology 597. Research in Regional Geology (0-9-3). *Staff*

Geology 598. Research in Marine Geology (0-9-3). *Mr. Lankford*

Germanics

Professors Kahn, *Chairman*, and Louis
Associate Professors Dvoretzky, Lehnert, and Wilson
Visiting Associate Professor Kreuzer
Assistant Professors Copeland, Milburn, Puppe, Schubert, and Stavenhagen
Instructors Ewton and Van Houten

Requirements for an Undergraduate Major in German.

(a) Completion of a program approved by the department.
(b) The equivalent of at least eight semester-courses in German numbered 300 or higher.
(c) It is recommended that German majors take collateral courses in other literatures, history, and philosophy.

Requirements for the Degree of Master of Arts in German.

(a) Completion with high standing of a program approved by the department; normally this will include eight graduate semester-courses.
(b) Passing a reading examination in one foreign language other than German approved by the department.
(c) Completion of an acceptable thesis.
(d) Passing a written and oral examination based in part on a reading list provided by the department.

Requirements for the Degree of Doctor of Philosophy in German.

(a) Completion with high standing of a program approved by the department; normally this will include sixteen graduate semester-courses, including those required for the degree of Master of Arts.
(b) Passing a reading examination in two foreign languages other than German approved by the department.
(c) Passing a preliminary written and oral examination on the general field of Germanic studies: this examination will be based in part on a reading list provided by the department.
NOTE: Requirements (b) and (c) must be met at least a year befor the submission of a dissertation.
(d) Completion of a dissertation approved by the department; the dissertation is expected to represent an original contribution to knowledge.
(e) Passing a final oral examination on the dissertation and related fields.

As part of their training graduate students, regardless of the type of appointment, will be required to perform some duties, such as assisting in classes, the language laboratory, research, and other activities suggested by the department.

COURSES

German 101a. Elementary German (3-2-3).

Grammar, conversation, and extensive reading. Language laboratory work required. *Staff*

German 102b. Elementary German (3-2-3).

Grammar, conversation, and extensive reading. Language laboratory work required. Prerequisite: 101a. *Staff*

German 111a. German for Graduate Students (3-0-0).

A noncredit course in German, restricted to graduate students preparing for the graduate language examination. The course stresses grammar. *Mr. Stavenhagen*

German 112b. German for Graduate Students (3-0-0).

The continuation of the above. The course is devoted to readings in the students' fields of interest. *Mr. Stavenhagen*

German 201a. Intermediate German (3-1-3).
Grammar, conversation, and extensive reading. Language laboratory work required. *Staff*

German 202b. Intermediate German: Scientific (3-0-3).
The course emphasizes readings in scientific German. Prerequisite: 201a. *Staff*

German 204b. Intermediate German (3-0-3).
The course stresses readings in literature. Prerequisite: 201a. *Staff*

German 207a. Intermediate German: Literary (3-0-3).
The course will be conducted in German, will stress the interpretation of literary texts, and will introduce the student to critical methods. *Mr. Lehnert*

German 208b. Intermediate German: Literary (3-0-3).
The continuation of the above. Prerequisite: 207a or permission. *Mr. Lehnert*

German 301a. Advanced Scientific German (3-0-3).
The course will be conducted in German. *Mr. Wilson*

German 302b. Advanced Scientific German (3-0-3).
The continuation of the above. Prerequisite: 301a or permission. *Mr. Wilson*

German 305a. Composition and Conversation (3-0-3).
The work will be based on literary texts. *Staff*

German 306b. Composition and Conversation (3-0-3).
The continuation of the above. Prerequisite: 305a. *Staff*

German 311a. Storm and Stress (3-0-3).
The course deals with the theories and literature of Preromanticism. Offered in alternate years: given in 1966-67. *Mr. Kahn*

German 312b. Schiller (3-0-3).
Offered in alternate years: given in 1966-67. *Mr. Kahn*

German 321a. Nineteenth-Century Dramatists (3-0-3).
The course emphasizes the works of Grillparzer, Büchner, and Hebbel. Offered in alternate years: given in 1966-67. *Mr. Milburn*

German 322b. Twentieth-Century Dramatists (3-0-3).
The course emphasizes the works of Wedekind, Brecht, and Dürrenmatt. Offered in alternate years: given in 1966-67. *Mr. Milburn*

German 331a. Survey of German Literature (3-0-3).
From the beginnings until the mid-eighteenth century. Offered in alternate years: given in 1967-68. *Mr. Dvoretzky*

German 332b. Survey of German Literature (3-0-3).
From the mid-eighteenth century to the present. Offered in alternate years: given in 1967-68. *Mr. Dvoretzky*

German 341a. Romanticism (3-0-3).
Offered in alternate years: given in 1966-67. *Mr. Lehnert*

German 342b. From Romanticism to Realism (3-0-3).
The course includes the study of Hölderlin, Heine, and Mörike. Offered in alternate years: given in 1966-67. *Mr. Lehnert*

German 351a. German Literature, 1850-1900 (3-0-3).

The course includes the study of Stifter, Keller, Meyer, Storm, and Fontane. Offered in alternate years: given in 1967-68. *Mr. Milburn*

German 352b. German Literature, 1850-1900 (3-0-3).

The course includes the study of Marx, Nietzsche, Hauptmann, Freud, and naturalism. Offered in alternate years: given in 1967-68. *Mr. Milburn*

German 361a. Literature of the Enlightenment (3-0-3).

The course emphasizes the first half of the eighteenth century. Offered in alternate years: given in 1966-67. *Mr. Dvoretzky*

German 362b. Literature of the Enlightenment (3-0-3).

The course emphasizes Lessing. Offered in alternate years: given in 1966-67. *Mr. Dvoretzky*

German 371a. Hofmannsthal (3-0-3).

Offered in alternate years: given in 1967-68. *Mr. Lehnert*

German 372b. Thomas Mann (3-0-3).

Offered in alternate years: given in 1967-68. *Mr. Lehnert*

German 381a. German Literature since 1900 (3-0-3).

The course deals chiefly with the poetry of Rilke, George, and Benn. Offered in alternate years: given in 1966-67. *Mr. Puppe*

German 382b. German Literature since 1900 (3-0-3).

The course treats primarily the prose writings of Kafka, Broch, and Döblin. Offered in alternate years: given in 1966-67. *Mr. Puppe*

German 391a. Goethe: 1749-1788 (3-0-3).

Offered in alternate years: given in 1967-68. *Mr. Kahn*

German 392b. Goethe: 1788-1832 (3-0-3).

Offered in alternate years: given in 1967-68. *Mr. Kahn*

German 401a. Independent Work: Special Topics in German Literature or Philology (0-0-3).

Independent work for qualified students: may be repeated for credit. *Staff*

German 402b. Independent Work: Special Topics in German Literature or Philology (0-0-3).

The same as the above: may be repeated for credit. *Staff*

German 411a. German Literature of the Renaissance and Reformation (3-0-3).

Offered in alternate years: given in 1967-68. *Mr. Stavenhagen*

German 412b. German Literature of the Baroque (3-0-3).

Offered in alternate years: given in 1967-68. *Mr. Schubert*

German 500a, b. Graduate Research.

Graduate research and thesis in partial fulfillment of the requirements for the degree of Master of Arts.

German 501a. Seminar in the Literature of the Nineteenth and Twentieth Centuries (3-0-3).

The topics will change from year to year: may be repeated for credit. The topic in 1966-67 will be the concept of structure in lyrical poetry, drama, and prose. *Mr. Lehnert*

German 502b. Seminar in the Literature of the Nineteenth and Twentieth Centuries (3-0-3).

The topics will change from year to year: may be repeated for credit. The topic in 1966-67 will be problems of structure in Thomas Mann's *Joseph* novels. Prerequisite: 501a or permission. *Mr. Lehnert*

German 503a. Special Topics in Germanic Philology (3-0-3).

The topics will change from year to year: may be repeated for credit. The topic in 1966-67 will be the medieval court epic. Prerequisite: one semester of Middle High German or permission. *Mr. Stavenhagen*

German 504b. Special Topics in Germanic Philology (3-0-3).

The topics will change from year to year: may be repeated for credit. The topic in 1966-67 will be the linguistic structure of German. *Mr. Copeland*

German 505a. Seminar in Enlightenment, Classicism, and Romanticism (3-0-3).

The topics will change from year to year: may be repeated for credit. The topic in 1966-67 will be Goethe, 1749 to 1788. *Mr. Kahn*

German 506b. Seminar in Enlightenment, Classicism, and Romanticism (3-0-3).

The topics will change from year to year: may be repeated for credit. The topic in 1966-67 will be Goethe, 1788-1832. *Mr. Kahn*

German 509a. Seminar in Bibliography, Research Problems, and Literary Theory (3-0-3).

The course treats problems in bibliography and literary research. *Mr. Dvoretzky*

German 510b. Seminar in Bibliography, Research Problems, and Literary Theory (3-0-3).

The course treats chiefly problems of literary theory and criticism. *Mr. Dvoretzky*

German 521a. Germanic Philology (3-0-3).

An introduction to the study of Gothic. Offered in alternate years: given in 1966-67. *Mr. Wilson*

German 522b. Germanic Philology (3-0-3).

An introduction to the study of Old High German, Old Norse, and Old Saxon. Offered in alternate years: given in 1966-67. *Mr. Wilson*

German 531a. Middle High German (3-0-3).

An introduction to the study of Middle High German. The *Nibelungenlied* will be read. Offered in alternate years: given in 1967-68. *Mr. Louis*

German 532b. Middle High German (3-0-3).

Emphasis will be placed on the Middle High German lyric. Offered in alternate years: given in 1967-68. *Mr. Louis*

German 551a. Seminar in Expressionism (3-0-3).

Literary problems of the early twentieth century. Offered in alternate years: given in 1967-68. *Mr. Puppe*

German 552b. Seminar in Expressionism (3-0-3).

The course will deal with specific problems in prose and poetry, chiefly the work of Kafka and Benn. Offered in alternate years: given in 1967-68. *Mr. Puppe*

German 575a. Special Topics in German Literature (3-0-3).

The topics will change from year to year: may be repeated for credit. *Staff*

German 576b. Special Topics in German Literature (3-0-3).
The topics will change from year to year: may be repeated for credit. *Staff*

German 600a, b. Graduate Research.
Graduate research and dissertation in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

Greek

(*See* pages 114-115)

Health and Physical Education

PROFESSOR HERMANCE
ASSOCIATE PROFESSORS BEARDEN, *Chairman,* AND POINDEXTER
ASSISTANT PROFESSORS BARKER, BLAND, HAHAMIS, AND SPENCE
LECTURERS WOJECKI AND CHARLTON

Basic Health and Physical Education (102-3 Women) (104-5 Men) (106 Athletics) (0-4-0).
A course to discuss the place and importance of health and physical education in our modern society, to teach the skills and knowledge of physical education activities, and to familiarize the students with the physical education facilities and equipment available to them at Rice University. Two-hour periods each week. Required of all freshmen. *Staff*

Health and Physical Education 100a. Foundations of Physical Education (3-0-3).
This course investigates the underlying factors that structure the physical education discipline. A study is made of the nature and scope of physical education, philosophy of physical education as part of general education, history of physical education, and the biological, psychological, and sociological interpretations of physical education. *Mr. Bearden*

Health and Physical Education 110b. Foundations of Health Education (3-0-3).
An introduction to the nature of growth and development of health education. A study is made of the underlying principles and contributions of health education to physical education and to education. Emphasis is placed on educational concepts and practices of health problems in America as influenced by economic and social factors. *Mr. Bland*

Health and Physical Education 125. Laboratory (0-3-2).
The following physical education athletic activities are included in this course: tennis, soccer, tumbling, swimming, diving, and Senior Red Cross Life Saving and Water Safety. Laboratory fee required. *Mr. Bland and Miss Hahamis*

Physical Science 110. The Fundamentals of the Physical Sciences. (3-0-6).
A study of the basic principles of chemistry, physics, geology, astronomy, and meteorology with special emphasis upon the impact of science and technology on society. *Mr. Hermance*

Health and Physical Education 200a. Principles and Philosophy of Physical Education in the United States (3-0-3).

A study of physical education, recreational sports, and athletics in education and society. Emphasis is placed upon the biological basis of life, the unity of mind and body, the structure and function of the human organism in relation to social values, human behavior, and physical efficiency, and physical education in an age of automation and leisure. A study will be made of the American Association for Health, Physical Education, and Recreation, the Olympic Games, the National Collegiate Athletic Association, the Amateur Athletic Union, interscholastic and intercollegiate conferences, Little Leagues, and the camping movement.

Mrs. Poindexter

Health and Physical Education 210b. Intramural Sports, School-Community Recreation Programs, and Safety Education (3-0-3).

A study is made of the educational values of intramural sports and recreation including leadership, organization and administration, units of competition, scoring plans and tournaments, facilities and equipment, publicity, and public relations. Safety education includes a survey of the safety movement in business, industry, and education, the program of safety education, professional liability, and safety standards. *Mr. Barker*

Health and Physical Education 225. Laboratory (0-3-2).

The following physical education activities are included: archery, handball, squash, volleyball, badminton, fencing, and apparatus. For each activity a study is made of the history, educational values, court and field construction, activity skills and game formations, methods of teaching and coaching, officiating, and audiovisual aids. Laboratory fee required. *Mr. Barker*

Health and Physical Education 300a. Kinesiology (3-0-3).

This course investigates basic kinesiology and includes an analysis of selected physical education activities. An investigation is made of the physical principles of equilibrium, motion, and force underlying bodily movement. *Mr. Spence*

Health and Physical Education 310b. Methods, Materials, and Curriculum Construction in Physical Education and Interscholastic Athletics, Grades 7-12 (3-0-3).

This course of study includes a study of methods of teaching physical education, materials of the program, and curriculum construction in physical education and interscholastic athletics. Special emphasis is placed upon teaching techniques and the learning process, class management, testing and grading, units of instruction, audiovisual and material aids, and curriculum construction based upon sports and games, recreational and lead-up activities, aquatics, social and rhythmic activities, self-testing activities, and the fundamental skills of movement. *Mr. Hermance*

Health and Physical Education 320a. Tests and Measurements and Adaptive Physical Education (3-0-3).

This course includes anthropometric measurements, cardiac function tests, athletic achievement tests, classification tests, motor ability and capacity, motor fitness tests, and statistical methods. Adaptive physical education includes a study of society of the disabled, adjustment problems of the handicapped, and the program of physical education for the handicapped. *Mr. Bearden*

Health and Physical Education 321b. Physiology of Muscular Activity (3-0-3).

This course investigates the specific effects of exercise upon the body. *Mr. Spence*

Health and Physical Education 325. Laboratory (0-3-2).

The following physical education, recreation, and athletic activities are included: golf, weight training, wrestling, basic rhythms, recreational and lead-up games, and

softball. For each activity a study is made of the history, educational values, court and field construction, activity skills and game formations, methods of teaching and coaching, officiating, and audiovisual aids. Laboratory fee required.
Miss Hahamis and Mr. Charlton

Health and Physical Education 400a. Organization and Administration of Health and Physical Education (Including Interscholastic Athletics), Grades 7-12 (3-0-3).

This course is based upon a study of the organization and administration of programs of health, physical education, and interscholastic athletics, including administrative policies and procedures, staff, budget, facilities and equipment, office management, schedules, public relations, and publicity. *Mr. Hermance*

Health and Physical Education 410b. Methods, Materials, and Curriculum Construction in Health Education, Grades 7-12 (3-0-3).

This course is based upon a study of methods of teaching health education, materials of the program, and curriculum construction in school health education including student health service, school health environment, health instruction, resources for health education, appraisal of physical and mental health, the medical examination, school health council, audiovisual and material aids, and demonstrations. *Mrs. Poindexter*

Health and Physical Education 425. Laboratory (0-3-2).

The following physical education and athletic activities are included: football, basketball, baseball, track and field, first aid, and the care and prevention of athletic injuries. A study of First Aid leads to the standard Certification in First Aid by the American Red Cross. For each activity a study is made of the history, educational values, court and field construction, activity skills and game formations, audiovisual aids, and the psychology and techniques of teaching and coaching interscholastic athletics. The care and prevention of athletic injuries includes a study of weight-control programs in athletics, drugs, massage, strains, sprains, contusions, dislocations, fractures, taping, impact force in athletics, basic conditioning, and training-room design, equipment, and operation. *Messrs. Bland and Wojecki*

History and Political Science

Professors Craig, Drew, *Associate Chairman,* Higginbotham, Lear, Masterson, Muir, Rath, *Chairman,* Vandiver
Visiting Professor Wright
Associate Professor Loewenheim
Assistant Professors Ambler, Cuthbertson, Fedyshyn, Galambos, Hitchins, Matusow, Neu, and Straka
Visiting Assistant Professors Frank and Raucher
Lecturer Hudspeth
Visiting Instructor Low

HISTORY

Undergraduate Majors. Undergraduates majoring in history are normally expected to take the equivalent of six year-courses in history approved by the department, including two of the following: History 100a,b, History 110a,b, and History 200a,b. With the permission of the department, advanced work in the history of art or in political

science may be substituted for not more than two advanced semester-courses in history. French or German is recommended as the foreign language for history majors; other languages may be accepted when special circumstances justify their substitution.

Graduate Work in History. Graduate students in history are accepted for study leading to either the M.A. or Ph.D. degree. Holders of the B.A. degree (or its equivalent) from an acceptable institution are eligible to apply. Since the graduate program is designed to train a limited number of carefully selected students, emphasis is on quality rather than quantity. Both the M.A. and the Ph.D. degrees are offered in limited areas of American history and in several areas of medieval and modern European history, further information about which may be obtained on request from the department.

Assistantship-fellowships as well as graduate scholarships are awarded on application to qualified students of demonstrated ability. Assistant-fellows are expected to render limited services to the department, although these services are not intended to be so heavy as to prevent the student's carrying a full study load. A number of assistant-fellows are given the opportunity to gain experience in helping to edit either the *Journal of Southern History* or the *Austrian History Yearbook,* both of which are sponsored by Rice University. The department also is usually allowed to recommend a number of graduate students for NDEA fellowships.

Requirements for the M.A. Candidates for the M.A. are expected to complete a certain amount of formal class or seminar work, usually the equivalent of eight semester-courses, in addition to passing a reading examination in one foreign language (usually French or German) and writing a thesis under the direction of an advisory committee of the department headed by a professor having special competence in the subject area of the thesis. An oral defense of the thesis is also required. Completion of these requirements usually takes two years, although a special accelerated program is designed to award the M.A. after the completion of the work of one summer and one school year beyond the B.A. degree.

Requirements for the Ph.D. Candidates for the Ph.D. degree are expected to prepare themselves for a preliminary examination in two fields in their area of major concentration and in one minor field. Such preparation will normally include course work, seminars, directed reading, and a substantial amount of independent reading by the student. The comprehensive examination, which will include an oral and may include a written examination, is given only after the student has completed his course and seminar work and passed a reading examination in two foreign languages (usually French and German). In addition to the two foreign language examinations and the comprehensive examination, the Ph.D. candidate must present and defend a thesis embodying the results of original research.

COURSES

History 100a, b. Europe since 1500 (3-0-3, each sem.).

An examination of the development of European civilization since the Renaissance. *Mrs. Drew, Mr. Straka, and others*

History 110a, b. American History (3-0-3, each sem.).

A survey of the growth of the American nation, with considerable attention to its European background. Recommended as fulfilling the state requirement for prelegal and premedical students as well as for students seeking a teaching certificate. *Messrs. Vandiver, Matusow, and others*

History 200a. Ancient History (3-0-3).

This course, together with History 201b, is intended to provide an historical background for the various humanistic branches of study. The work of the first semester is largely devoted to the history of the ancient Near East, Greece, and the Roman Republic. *Mrs. Drew*

History 201b. Medieval History (3-0-3).

This course is designed to be a continuation of History 200a. Its work is largely devoted to a study of the Roman Empire and the Middle Ages. *Mrs. Drew*

History 300a. American Social Thought I (3-0-3).

A study of ideas about social relations in the context of economic-material developments and philosophic-scientific thought since the colonial settlements. The course will examine Puritanism, the Great Awakening, the Enlightenment, and nineteenth-century controversies about political theory, national mission, moral-social reform, and slavery. Not offered 1966-67. *Mr. Raucher*

History 301b. American Social Thought II (3-0-3).

A continuation of History 300a. This course will examine debates about business supremacy, poverty, ethnic heterogeneity, and national mission since industrialization and the Darwinian upheaval. Not offered 1966-67. *Mr. Raucher*

History 304a, b. Independent Reading (3-0-3, each sem.).

Independent reading under the supervision of a member of the department. Open to Juniors in the accelerated M.A. program and occasionally to others with special permission. *Staff*

History 310a. Jeffersonian and Jacksonian Democracy (3-0-3).

A study of the development of the United States from 1800 to 1848 with particular emphasis on political ideas and practices. *Mr. Higginbotham*

History 315a. America since the Civil War I (3-0-3).

This is a discussion course dealing with the major intellectual, social, and political trends in the life of the American people since the Civil War. This portion of the course begins with Reconstruction and ends with the Spanish-American War. Open only to Juniors and Seniors with the consent of the instructor. *Mr. Matusow*

History 316b. America since the Civil War II (3-0-3).

A continuation of History 315a. This portion of the course covers the period from the Progressive era through the Kennedy administration. Open only to Juniors and Seniors with the consent of the instructor. *Mr. Matusow*

History 320a, b. Trends in European Culture during Antiquity and the Middle Ages (3-0-3, each sem.).

This course traces selected aspects of European thought from Periclean Athens to the later Middle Ages, with special reference to Hellenistic and Greco-Roman influences. Religious, philosophical, and scientific implications are examined in

some detail. Prerequisite: History 200a and 201b or consent of instructor. Also offered as Classics 320a,b. *Mr. Lear*

History 330a. Europe, 1300-1500 (3-0-3).

A survey of selected aspects of European history during the time period frequently called the Renaissance. Not offered 1966-67. *Mrs. Drew*

History 331b. Europe, 1500-1715 (3-0-3).

A survey of selected aspects of European history during the Reformation and the period immediately following. Not offered 1966-67. *Mrs. Drew*

History 340a. History of American Foreign Policy, 1775-1900 (3-0-3).

American foreign policy and its relation to the foreign policies of other nations, with emphasis on the domestic political forces shaping governmental decisions. Among the topics considered are the diplomacy of the American Revolution, the perils of independence, the origins of the War of 1812, continental expansion, and the crisis of the 1890's Prerequisite: Consent of the instructor. Not offered 1966-67. *Mr. Neu*

History 341b. History of American Foreign Policy, 1900 to the Present (3-0-3).

A continuation of History 340a. This portion of the course covers the rise of America to world power during the era of Theodore Roosevelt, World War I and American intervention, World War II, and the growth of rival Western and Communist blocs. Prerequisite: Consent of the instructor. Not offered 1966-67. *Mr. Neu*

History 345a. History of Russia before the Twentieth Century (3-0-3).

A survey of main developments in Russian history from earliest times to 1905. *Mr. Hitchins*

History 346b. History of Russia in the Twentieth Century (3-0-3).

Continuation of History 345a. A survey of main developments in Russian history from 1905 to the present. *Mr. Hitchins*

History 350a. Europe, 1763-1814 (3-0-3).

This course deals with political, intellectual, religious, economic, and social movements during the Age of Enlightened Despotism. This is followed by a detailed examination of the French Revolutionary and Napoleonic eras. Not offered in 1966-67. *Mr. Low*

History 351b. Europe, 1814-1870 (3-0-3).

Continuation of History 350a. In the first part of the course the intellectual, religious, economic, social, diplomatic, and political trends of the period between 1814 and 1847 are examined. Then the revolutionary movement of 1848-49, the reign of Napoleon III, the unification of Italy, the unification of Germany, and the Franco-Prussian war will be studied. Not offered in 1966-67. *Mr. Low*

History 355a, b. History of American Foreign Policy since 1890 (3-0-3, each sem.).

Largely a discussion course focusing on major problems in American foreign policy. Among topics considered the first semester are the rise of America to world power, World War I and American intervention, and the diplomacy of the 1920's. The second semester covers American isolationism in the 1930's, World War II, the China tangle, and the growth of rival Western and Communist blocs. Open to students who have not taken History 340a and 341b only with the consent of the instructor. *Mr. Neu*

History 360a. The History of England and British Expansion to 1714 (3-0-3).

This course considers the period of Roman rule in Britain, the Saxon and Danish invasions, the establishment of Norman and Angevin order, the evolution of late

medieval political and social institutions, and concludes with the Tudor and Stuart revolutions in government and society. The emphasis is on the evolution of Britain as a society and as a culture. *Mr. Straka*

History 361b. The History of England and British Expansion since 1714 (3-0-3).

A continuation of History 360a. This section of the course starts with the Hanoverian monarchs, analyzes the arrival of industrial production in England and the effects of this change on society and politics, the age of reform in the nineteenth century, the appearance and development of the empire and commonwealth, and Britain's role in the world politics of the twentieth century. *Mr. Straka*

History 370a. Intellectual History of Modern Europe I (3-0-3).

A history of scientific ideas and ethical systems. Readings will be drawn from the works of Bacon, Descartes, Hobbes, Locke, Newton, Fontenelle, Voltaire, Diderot, Hume, Kant, and Rousseau. Not offered 1966-67.

History 371b. Intellectual History of Modern Europe II (3-0-3).

Continuation of History 370a. Readings will be taken from the works of Hegel, J. S. Mill, Marx, Darwin, Zola, Nietzsche, James, Freud, Koestler, Sartre, and Camus. Not offered 1966-67.

History 375a. History of Modern Germany to 1918 (3-0-3).

A survey of the history of modern Germany from the Reformation to 1918. Not offered in 1966-67. *Mr. Frank*

History 376b. History of Modern Germany, 1918-1945 (3-0-3).

Continuation of History 375a. A survey of the history of modern Germany from 1918 to 1945. Not offered in 1966-67. *Mr. Frank*

History 380a, b. American Economic History (3-0-3, each sem.).

A study of the economic history of the United States from the colonial period through the Second World War. Examination of principal economic trends will be supplemented by histories of individual firms and business leaders. Open to qualified students after consultation with the instructor. *Mr. Galambos*

History 390b. History of the American West (3-0-3).

This course traces the westward movement from its beginning on the Atlantic seaboard to its culmination on the Pacific. Most attention is given to the history, institutions, and problems of the Trans-Mississippi West, with special emphasis on Texas and the Great Plains. Prerequisite: History 110a,b. *Mr. Muir*

History 395a, b. A History of the South (3-0-3, each sem.).

A study of life and economy of the Southern people from the colonial period. Primary emphasis is placed on the period to 1877. Prerequisite: History 110a,b. *Mr. Vandiver*

History 400a, b. A History of France 1610-1799: The Old Regime and the Enlightenment, and the French Revolution (3-0-3, each sem.).

A study of the political and economic institutions and the chief literary, philosophical, and scientific currents in the great age of France. Not offered in 1966-67.

History 404a, b. Senior Thesis (0-0-3, each sem.).

A limited number of Seniors majoring in the department are allowed to write a thesis of fifteen to twenty-five thousand words on a subject to be approved in advance by their departmental advisers. Open to students in the accelerated M.A. program and to other well-qualified students with special permission. Students must take both History 404a and 404b in order to gain credit. *Staff*

History 410b. Reading and Research in the Jeffersonian and Jacksonian Periods (3-0-3).

A weekly seminar stressing written reports on reading and including a term paper based on the use of primary materials. *Mr. Higginbotham*

History 420a, b. Medieval Sources (3-0-3, each sem.).

Survey and translation of typical medieval Latin sources. The selections are studied from the point of view of historical significance and of literary appreciation. This course is intended for students of history and the modern languages who desire some familiarity with ordinary medieval Latin texts. Prerequisite: Latin 300 or three or four years of high school Latin. Not offered 1966-67. *Mr. Lear*

History 430a, b. Topics in Ancient and Medieval Intellectual History (3-0-3, each sem.).

This course deals with selective phases of classical and medieval thought based on the cultural monuments of antiquity and the Middle Ages. Intensive reading and reports on special aspects of the field. Prerequisite: History 200a and 201b. Also offered as Classics 430a,b. Not offered in 1966-67. *Mr. Lear*

History 440a, b. Social and Economic History of Europe in the Middle Ages (3-0-3, each sem.).

A seminar covering selected problems in the social and economic history of Europe from the period of the late Roman Empire to the close of the Middle Ages. Open only to advanced students after consultation with the instructor. *Mrs. Drew*

History 445b. Military and Naval History (3-0-3).

A survey of wars and the causes of wars from ancient times to the present, with emphasis on basic military principles and on the importance of sea power in history. Not offered in 1966-67. *Mr. Craig*

History 450a. Contemporary History (3-0-3).

A survey of current world affairs, with lectures and readings on the background of present-day policies and events. Not offered in 1966-67. *Mr. Craig*

History 455a. Modern Europe, 1871-1914 (3-0-3).

The subject of this course is the political, diplomatic, and cultural history of Europe from the proclamation of the German Empire to 1914. Prerequisite: History 100a,b. Not offered in 1966-67. *Mr. Loewenheim*

History 456b. Modern Europe, 1914 to the Present (3-0-3).

Continuation of History 455a. This portion of the course covers the political, diplomatic, and cultural history of Europe from 1914 to the present. Prerequisite: History 100a,b. Not offered in 1966-67. *Mr. Loewenheim*

History 460a. Tudor England (3-0-3).

The course will be a topical approach to the sixteenth century, with emphasis given to the nature of "Tudor absolutism," the Reformation, the English renaissance, Elizabethan politics, exploration, and war. Prerequisite: History 200a, 201b, 360a, and 361b, or consent of the instructor. Not offered in 1966-67. *Mr. Straka*

History 461b. Stuart England (3-0-3).

The course will be arranged topically and will focus on the century's two major revolutions, the Great Rebellion and the Glorious Revolution, their causes and influences. Other topics will include Puritanism and Parliament, the origin of parties, the Popish Plot, the political views of Hobbes, Filmer, and Locke. Prerequisite: History 200a, 201b, 360a, and 361b, or consent of instructor. Not offered in 1966-67. *Mr. Straka*

History 465a, b. American Colonial History (3-0-3, each sem.).

A study of early American society, culture, and political thought, with emphasis on the eighteenth century.

History 470b. American Political Leaders (3-0-3).

This proseminar deals with the nature of American political leadership by an examination of the personalities and careers of political figures at both the local and national levels. Attention is given to the relationship of the leader to the intellectual and social circumstances of his time as well as to his political principles and techniques. Prerequisite: History 110a,b or consent of instructor. Also offered as Political Science 470b. Not offered in 1966-67.

History 475a. The History of Central Europe (3-0-3).

A brief summary of the main phases of the history of Central Europe from ancient times to the present. *Mr. Rath*

History 476b. Colloquium in Central European History (3-0-3).

A critical examination of the main literature in the field. Prerequisite: History 475a. *Mr. Rath*

History 480a, b. American Politics (3-0-3, each sem.).

An advanced survey of American political history. Emphasis is placed on the relationship of politics to economic and social events. Prerequisite: History 110a,b. Also offered as Political Science 480.

History 485a. God, Nature, and Man: Seventeenth-Century English Political and Social Thought (3-0-3).

This course will include consideration of major and minor theories of social origin and development—the state of nature, divine right, contractarianism—and those who formulated them: James I, Bacon, Filmer, Hobbes, Harrington, Locke and others. Prerequisite: History 360a and 361b or consent of instructor. Not offered 1966-67. *Mr. Straka*

History 495a, b. Civil War and Reconstruction (3-0-3, each sem.).

A study of the rise of sectionalism, the secession crisis, United States versus Confederate States, and economic and social consequences of the war. Emphasis is placed on the years 1861-1865. Prerequisite: History 110a,b. Not offered in 1966-67. *Mr. Vandiver*

History 500a, b. Historical Research (0-0-3, each sem.).

Master's thesis. Students must take both History 500a and 500b in order to gain credit. *Staff*

History 510a. Directed Reading in American History (0-0-3).

For graduate students only. *Staff*

History 511b. Directed Reading in American History (0-0-3).

Continuation of History 510a. *Staff*

History 515a. General Reading in American History (0-0-3).

An independent reading course designed to give students of graduate level a knowledge of the most significant works in the general field of American history as distinct from those in any specialized area.

History 516b. General Reading in American History (0-0-3).

Continuation of History 515a.

History 520a. Directed Reading in Medieval History (0-0-3).

For graduate students only. *Staff*

History 521b. Directed Reading in Medieval History (0-0-3).

Continuation of History 520a. *Staff*

History 525a, b. Topics in Legal History and Political Theory (3-0-3, each sem.).

Much attention is given to methods, materials, and the recent literature in this field. Instruction is based on the translation of several primary sources in Roman and Germanic law as well as reports on such topics as sovereignty and allegiance. Open to properly qualified students after consultation with the instructor. Not offered 1966-67. *Mr. Lear*

History 530a. Directed Reading in Modern European History (0-0-3).

For graduate students only. *Staff*

History 531b. Directed Reading in Modern European History (0-0-3).

Continuation of History 530a. *Staff*

History 535b. Bibliographical Guides in United States History (3-0-3).

A seminar for graduate students in the construction and use of bibliographies for research in United States history. *Mr. Muir*

History 545a, b. Historiography (3-0-6).

Seminar in historiography and the philosophy of history for graduate students.

History 550a, b. Studies in the History of the Atlantic Community (3-0-3, each sem.).

A seminar on the origins, character, and development of the Atlantic Community, with special emphasis on its political, diplomatic, and cultural history since 1898. Prerequisite: History 455a and 456b or equivalent. Open to graduate students and to qualified Seniors with special permission. Not offered 1966-67.
Mr. Loewenheim

History 555a, b. Seminar in German History (3-0-3, each sem.).

Frederick the Great, Bismarck, and Hitler. Studies in the history of the German political tradition. Prerequisite: History 455a and 455b or the equivalent. Qualified undergraduates may be admitted by special permission. Not offered 1966-67.
Mr. Loewenheim

History 560a, b. Selected Problems in Intellectual History (3-0-3, each sem.).

A seminar devoted to the European Enlightenment. Papers will be written and read in seminar. Proficiency in one foreign language required. Open to properly qualified Seniors and graduate students after consultation with the instructor.

History 565a, b. Seminar in Austrian History (3-0-3, each sem.).

Selected topics in nineteenth- and twentieth-century Austrian history. Prerequisite: History 350a and 351b or 455a and 455b or the equivalent. Qualified undergraduates may be admitted by special permission. *Mr. Rath*

History 570a, b. Seminar in the First World War (3-0-3, each sem.).

Studies in the causes of World War I and the course of the war itself. Open to properly qualified graduate students after consultation with the instructor.
Mr. Vandiver

History 575b. The Great Tradition in European Historical Writing from the Age of Gibbon to the Present (3-0-3).

A seminar-research course examining the main currents of European historical writing since the eighteenth century. Special attention will be devoted to such seminal figures as Gibbon, Ranke, Macaulay, Treitschke, Burckhardt, Acton, Croce, Meinecke, Namier, and Lefebvre, and to a number of leading contemporary historians. For graduate students and qualified undergraduate students by permission.

Graduate students are expected to have a reading knowledge of French or German. Not offered 1966-67. *Mr. Loewenheim*

History 580b. Seminar in American Colonial History (3-0-3).

Research in selected fields of Colonial history, especially in the social and intellectual background of the American Revolution. Open to properly qualified graduate students and Seniors after consultation. Not offered in 1966-67.

History 590b. Seminar in Western American History (3-0-3).

This course includes a study of the leading authorities in Western American history, training in the critical examination of source material, and original research in selected topics of Western history. Open to graduate students and to Seniors who show a proficiency in history, after consultation with the instructor. *Mr. Muir*

History 595a, b. Topics in Confederate History (3-0-3, each sem.).

This seminar is devoted to original research in various phases of the history of the Southern Confederacy, 1861-1865. Open to properly qualified students after consultation with the instructor. Not offered 1966-67. *Mr. Vandiver*

History 600a, b. Historical Research (3-0-3, each sem.).

Doctoral dissertation. *Staff*

POLITICAL SCIENCE

Majors in Political Science. Students majoring in political science are required to take the equivalent of five two-semester courses in the field. These must include Political Science 210a,b in addition to courses selected from at least three of the following areas:

1. American Politics.
2. Comparative Government.
3. Constitutional Law.
4. International Relations.
5. Political Theory.

Six hours of advanced work, selected upon the advice of the department, should also be completed in any of the following fields: anthropology, economics, history, humanities, philosophy, or sociology.

COURSES

Political Science 210a, b. Introduction to Political Science and American Government (3-0-3, each sem.).

This course studies the nature of political science, the origin of the state, and major ideologies. An examination of British parliamentary democracy provides a background to American institutions. The course then examines the history and operation of the federal government and American politics. Planned for any student interested in political science, the course is also designed to meet state professional requirements for prospective lawyers, physicians, and teachers. *Mr. Cuthbertson and others*

Political Science 305a. Directed Reading I (0-0-3).

Independent reading under the supervision of a member of the department. Open only to Junior majors with the consent of the department. *Staff*

Political Science 306b. Directed Reading II (0-0-3).

Continuation of Political Science 305a. Independent reading under the supervision of a member of the department. Open only to Junior and Senior majors with the consent of the department. *Staff*

Political Science 310a, b. Law and Society (3-0-3, each sem.).

The study of law as a social science. Approximately one-third of the course deals with such concepts as the meaning of justice, the development of the English common law, equity, and statutory law, and their adoption in the United States; the meaning of jurisdiction and our state and federal court system. The remaining two-thirds of the course deals with the substantive law of contracts, agency, bailments, sales, partnerships, and corporations. The casebook method is employed for the latter part of the course. *Mr. Hudspeth*

Political Science 320a. American Constitutional Law (3-0-3).

This course deals with the interpretation of the Constitution by the Supreme Court. The treatment is largely historical and deals primarily with problems of federalism, the commerce clause, protection of property, taxation, the separation of powers, and civil rights. The casebook method is used, supplemented by assigned readings. Not offered 1966-67. *Mr. Hudspeth*

Political Science 330a. American Parties, Politics, and Pressure Groups (3-0-3).

The nature and functions of contemporary American political parties and pressure groups. The course will include a study of American elections and voting behavior, party composition and organization, and the relation of parties and pressure groups to legislation and administration.

Political Science 340a. Ancient and Medieval Political Theory (3-0-3).

This course introduces the sources of ancient and medieval political thought. Special emphasis will be given to the historical analysis of political philosophy and mythology and to the influence of Plato and Aristotle. *Mr. Cuthbertson*

Political Science 341b. Modern Political Theory (3-0-3).

This course examines the problems and concepts of contemporary political theory: democracy and totalitarianism; state and individual; power and scientific politics; liberalism and conservatism; "the lunatic fringe"; and the "decline" of modern political thought. It compares the theoretical origins of modern governments and studies the theory of nationalism. *Mr. Cuthbertson*

Political Science 360a. Comparative Government: Western European Democracies (3-0-3).

A survey of government and politics in Western European democracies, with primary emphasis on Great Britain, France, and Germany. *Mr. Ambler*

Political Science 361b. Comparative Government: Totalitarian Systems and the Politics of Modernization (3-0-3).

The first half of the semester will be devoted to a study of totalitarian political systems, notably Nazi Germany, the U.S.S.R., and Communist China. The last half of the course will deal with selected political systems in underdeveloped areas, focusing upon problems of political modernization. *Mr. Ambler*

Political Science 365a. Soviet Government and Politics under Lenin and Stalin (3-0-3).

A study of modern Communism with special emphasis upon Russian revolutionary theory and practice. The course will also treat the Russian Revolution and the establishment of the Soviet regime, the development of the Soviet system of government, its planned economy and regimented society under Stalin's leadership, the rise and fall of the Third International, and the Soviet role in world affairs up to the outbreak of the Second World War. Not offered in 1966-67. *Mr. Fedyshyn*

Political Science 366b. The Soviet Union and International Communism in the Post-World War II Period (3-0-3.).

The Soviet Union in World War II. The emergence of the U.S.S.R. as a superpower. The take-over of East-Central Europe and the establishment of Communist

regimes in the Far East. The Cominform and the end of the Stalin era. The rise and fall of Khrushchev and the disintegration of the Communist Bloc. Soviet government and politics in the post-Khrushchevian period. *Mr. Fedyshyn*

Political Science 370a. International Relations (3-0-3).

An analysis of basic factors in world politics and examination of various systems of international relations—from the balance of power to nuclear multipolarity. The course will also deal with the changing nature of world politics by analysing new factors and forces in international relations and the new meaning of war and peace in a greatly enlarged international community of the mid-twentieth century. Not offered in 1966-67. *Mr. Fedyshyn*

Political Science 375b. International Law and Organization (3-0-3).

An introduction to international law and the nineteenth-century international agencies and practices. A study of the establishment, structure, and functions of the League of Nations and the United Nations Organizations. An examination of the "new" United Nations and its problems, and a review of the prospects for closer international cooperation on the basis of a strengthened U.N. Charter, general and universal disarmament, and the establishment of world law. *Mr. Fedyshyn*

Political Science 405a, b. Senior Thesis (0-0-6).

Open only to Senior majors upon invitation by the department. Students must complete both Political Science 405a and 405b in order to obtain credit. *Staff*

Political Science 410a, b. Ancient and Medieval Political Theory (3-0-3, each sem.).

A survey of the main trends in politics and law from antiquity into the later Middle Ages. Open only to advanced students after consultation with the instructor. Not offered 1966-67. *Mr. Lear*

Political Science 460b. Comparative Politics (3-0-3).

With a primary focus on informal political processes, this course deals with selected topics such as political culture, social structure and politics, oligarchy and democracy, political parties, electoral systems, pressure groups, civil-military relations, and political change. These and other topics will be examined in a comparative context with material to be drawn primarily from Western democracies and from underdeveloped areas. Prerequisite: Consent of instructor. *Mr. Ambler*

Political Science 465a. Government and Politics in France (3-0-3).

This seminar will deal with French political institutions, political parties, political culture, and other selected topics. Prerequisite: Consent of instructor. *Mr. Ambler*

Political Science 470b. American Political Leaders (3-0-3).

This proseminar deals with the nature of American political leadership by an examination of the personalities and careers of political figures at both the local and national levels. Attention is given to the relationship of the leader to the intellectual and social circumstances of his time as well as to his political principles and techniques. Also offered as History 470b. Prerequisite: History 110a,b or consent of instructor. Not offered in 1966-67.

Political Science 475b. The Study of International Relations (3-0-3).

This course deals with the various approaches to the study of international relations—political, legal, economic, and psychological—and indicates current problems and the way in which solution is sought by these different approaches. *Mr. Wright*

Political Science 480a, b. American Politics (3-0-3, each sem.).

An advanced survey of American political history. Emphasis is placed on the relationship of politics to economic and social events. Prerequisite: History 110a,b. Also offered as History 480a,b. Not offered in 1966-67.

Political Science 490a, b. Research Seminar in Modern Political Theory and Interdisciplinary Fields (3-0-3, each sem.).

Open only to qualified Seniors after consultation with the instructor. Not offered 1966-67. *Mr. Cuthbertson*

History of Art

(*See* pages 160-162)

Humanities

Humanities 100a, b. Leading Minds in Western Civilization (3-0-3, each sem.).

A course in intellectual history. It is a study of the most important ideas in Western European and American civilization studied through the lives and works of understanding people from antiquity to the modern world. *Mr. Tsanoff*

Humanities 101a, b. The Classical Foundations of Political Thought (3-0-3, each sem.).

An examination of the historical and philosophical influences underlying the political theory and institutions of the classical world. The first semester is devoted primarily to the political and constitutional history of ancient Greece and Rome with the purpose of analyzing the governing systems and structures. The second semester deals with basic political ideas and problems of the ancient world such as natural law, justice, citizen and subject, republic, god-kingship, slavery, equality, and sovereignty. *Mr. Lear*

Humanities 300a. The Beginnings of Modern Thought in the Renaissance (3-0-3).

A historical and critical outline of the transition from medieval to modern thought: an examination of the main representative minds of Renaissance culture in its many aspects: philosophical, scientific, literary, social-political. Not offered 1966-67. *Mr. Tsanoff*

Humanities 300b. The Idea of Progress in History (3-0-3).

A historical and systematic inquiry into the growing vitality of social values. In the first part of the course the idea of progress is traced in its historical development since classical antiquity. The second part of the term is devoted to an appraisal of the belief in social progress by an examination of the reasons for and against it provided by the evidence in the various social institutions. Not offered 1966-67. *Mr. Tsanoff*

Humanities 310a, b. Autobiography: Its Personal and Social-Historical Aspects (3-0-3, each sem.).

A study of the self-recorded lives of great men and women as intimate expressions of personal character and achievements and as individual reflections of various societies and ages from antiquity to modern times. *Mr. Tsanoff*

Italian

(*See* pages 114-116)

Latin

(*See* pages 114-115)

Linguistics

Linguistics 401a. Introduction to Descriptive Linguistics (3-0-3).

An introduction to language and linguistics giving consideration to basic linguistic concepts and techniques. *Mr. Lowe*

Linguistics 402b. Special Topics in Linguistics (3-0-3).

Topics will be drawn from the areas of historical linguistics, phonetics, phonemics, morphology, syntax, and semantics. *Mr. Lowe*

Mathematics

Professors Bray, Curtis, *Chairman,* Douglas, Dyer, Rachford, and Ulrich
Associate Professors Connell, Durst, Johnson, and Jones
Assistant Professors Fabes, Gersten, Glaser, Hempel, O'Neill, Tierney, and Wells

Requirements for an Undergraduate Major. It is permissible to major in mathematics in either the science-engineering program or the humanities (academic) program. In either case, twelve courses in mathematics are required. Three choices of courses are permissible. The first is Mathematics 100a,b, 200a,b or 210a,b, 300a, 340a, 370a,b, and two of Mathematics 400a and 410b, 415a,b, 435a,b, 465a,b, and 470a,b. The second is Mathematics 220a,b, 310a,b, 340a,b, 371a,b, 415a,b, or 525a,b, 445a,b, or 465a,b. The third is Mathematics 220a,b, 340a,b, 371a,b, 445a,b, 465a,b and one course at the 500 level. An outstanding student in Mathematics 100a,b, or 200a,b may, upon recommendation from his professor, be admitted into an honors section such as Mathematics 310a,b. In the case of a double major (physics and mathematics, for example) ten courses in mathematics are acceptable to the department.

Admission to graduate study in mathematics will be granted to a limited number of students who have indicated ability for advanced and original work. It normally takes one or two years after the bachelor's degree to obtain an M.A. degree and three or four years to obtain a Ph.D. An M.A. is not a prerequisite for the Ph.D.

A number of graduate assistantships and fellowships are available and will be awarded on the basis of merit. The recipients of such aid are expected to devote about six hours a week to duties in the department.

Requirements for the Master's Degree.

1. *To qualify as a candidate* for the Master of Arts degree, the prospective candidate must have:
   a. Done satisfactory work (2— or better) in at least eight courses acceptable to the department, exclusive of Mathematics 600.

This is to mean that the grades in those courses completed during previous years, and the grades in those courses taken during the year in which the petition for candidacy is filed are satisfactory (2— or better).

If a student's candidacy is approved under the above conditions, but his grades at the end of the year in which his candidacy is approved no longer meet these conditions, his candidacy for the master's degree is automatically revoked.

b. Passed at least one examination in an approved foreign language no later than the period scheduled by the language departments during the first week of the second semester of the year in which the candidate expects to receive the master's degree.

2. *The remaining requirements* for the master's degree are:
   a. The writing of an original thesis acceptable to the department while enrolled in Mathematics 600 (thesis).
   b. The passing of a final oral examination on the thesis.
   c. Any other conditions required by the general rules of the University.

N.B. For students who transfer to Rice while engaged in a program of graduate study, transfer of course credits will be allowed only when approved by both the department and the Graduate Council.

Requirements for the Doctor's Degree.

1. *To qualify as a candidate* for the doctorate, the prospective candidate must have:
   a. Completed satisfactorily (with a year grade of 2— or better) at least twelve courses numbered 400 or higher, exclusive of Mathematics 600 (thesis). The selection of these six courses must be satisfactory to the department. For students who transfer to the University in the middle of their graduate work, transfer of grades will be allowed only when approved by both the department and the Graduate Council.
   b. Passed a qualifying examination given by the department. This examination may be scheduled at any time convenient to the department and the candidate. Normally, the candidate will be expected to pass this examination at least one year before the degree is expected; without exception, this examination must be passed by the first of November of the academic year in which the degree is expected. In taking this examination, the candidate will be expected to know the material of Mathematics 400a, 410b, 415a,b or 525a,b, 445a,b, 465a,b, and 470a,b. Students in numerical analysis replace either Mathematics 445a,b or 470a,b by Mathematics 435a,b. A student who fails this examination on the first attempt may take it again at a later date; if a student fails on the second attempt, he must withdraw from the University.

c. Passed examinations in two approved foreign languages no later than the period scheduled by the language departments during the first week after registration at the beginning of the academic year in which the degree is expected.

2. *The remaining requirements* for the doctorate are:

a. Satisfactory work (2— or better) in at least fourteen semester-courses numbered 400 or higher, exclusive of Mathematics 600; these fourteen courses include twelve under the qualifying requirements.
b. The writing of an original thesis acceptable to the department while enrolled in Mathematics 600 (thesis).
c. The passing of a final oral examination on the thesis.
d. Any other conditions required by the general rules of the University.

COURSES

Mathematics 100a, b. Elementary Analysis (4-0-4, each sem.).

Limits, differentiation, and integration are introduced early in the year, and applications are discussed. Other topics include a careful definition of trigonometric and exponential functions, analytic geometry, partial differentiation, vector methods. The course is designed to give the student an introduction not only to the applications of the calculus but also to the techniques of mathematical reasoning; it (or Mathematics 220) is the basic course in mathematics and is required of all Freshmen enrolled in the science-engineering curriculum and may be elected by students in the humanities (academic) curriculum.

Mathematics 101a, b. Fundamental Concepts of Mathematics (3-0-3, each sem.).

Elementary logic, the real number system, introduction to differential and integral calculus. Emphasis is on the abstract nature of mathematical reasoning, and the purpose of the course is to indicate the place of mathematics among the several branches of knowledge. This course is open only to students in the humanities curriculum who do not plan to continue their study of mathematics beyond one year.

Mathematics 200a, b. Advanced Analysis (3-0-3, each sem.).

Least upper bounds, limits, definite integrals, improper integrals, infinite series, multiple integrals, line and surface integrals, divergence theorem and Stokes' theorem, with applications to physical problems. Required of all science-engineering majors who do not take Mathematics 210 or 220. Students with considerable facility in mathematical reasoning should enroll in Mathematics 210. Prerequisite: Credit for Mathematics 100 or permission of the department.

Mathematics 210a, b. Advanced Analysis (3-0-3, each sem.).

The course has the same scope as Mathematics 200 but is more complete and rigorous. Prerequisite: Written permission of the department.

Mathematics 220a, b. Analysis (4-0-4, each sem.).

An honors course for Freshmen covering the same material as Mathematics 100 and 210. Registration by permission of the department. Selection is made on the basis of either the CEEB Advanced Placement Examination on analytic geometry and calculus or a qualifying examination given by the Mathematics Department at the beginning of the school year. The students are expected to know the techniques of differentiation, integration, areas, volumes, max-min problems, etc., in advance so that emphasis can be placed on the theoretical aspects.

Mathematics 300a, b. Differential Equations (3-0-3, each sem.).

Integration of differential equations of first order by elementary methods, geometry of integral curves, existence and uniqueness theorems for differential equations, properties of linear equations, oscillation and separation theorems, theory of regular singular points, special functions of mathematical physics, Fourier analysis, orthogonal systems, expansion theorems, boundary-value problems. Prerequisite: Mathematics 200a,b, 210a,b, 220a,b.

Mathematics 310a, b. Functions of Several Variables (3-0-3, each sem.).

An honors course following Mathematics 220. Linear algebra is developed as needed. Differentiation of functions from open subsets of Euclidean space to Euclidean space is studied; max-min problems, Lagrange's multiplier rule, etc. are considered in this setting. Differential forms on Euclidean spaces and on manifolds are considered. Lebesgue integration for such forms is developed. Vector calculus is considered as a special case and applications to problems of dynamics are made. Prerequisite: Mathematics 220a,b.

Mathematics 340a, b. Topology (3-0-3, each sem.).

General topological spaces, compactness, paracompactness, metric spaces, completeness, uniform continuity, simplicial complexes, CW complexes, mapping cylinders, the well-ordering principle, function spaces, the compact-open topology, covering spaces, fiber spaces, the fundamental group, and an introduction to homology and homotopy groups. Some mathematical maturity will be necessary. Prerequisite: One of Mathematics 200a,b, 220a,b, 310a,b, or consent of instructor.

Mathematics 360a, b. Probability and Statistics (3-0-3, each sem.).

Conditional probability, Bernoulli's theorem, law of large numbers, distributions, central-limit theorem, correlation, large and small sample theory, goodness of fit, testing statistical hypotheses, design of experiments. Prerequisite: Mathematics 200a,b, 210a,b, or 220a,b.

Mathematics 370a, b. Algebra (3-0-3, each sem.).

An introduction to the basic structures of algebraic systems: groups, rings, fields, and their morphisms. Vector spaces are studied extensively, including matrices, determinants, characteristic values, canonical forms, multilinear algebra. Basis theorem of abelian groups and modules is established. Prerequisite: Mathematics 200a,b or 210a,b.

Mathematics 371a, b. Algebra (3-0-3, each sem.).

An honors course in algebra including the material of Mathematics 370a,b, finite group theory, and Galois theory. Prerequisite: Mathematics 310a,b.

Mathematics 400a. Complex Variable Theory (3-0-3).

Linear transformations, holomorphic functions, power series, complex integration and the Cauchy integral, residue calculus.

Mathematics 400b. Complex Variable Theory (3-0-3).

An assortment of topics such as normal families, the Riemann mapping theorem, boundary correspondence, univalent functions, entire functions, and meromorphic functions.

Mathematics 401b. Applied Complex Variable Theory (3-0-3).

A selection of topics such as ordinary differential equations in the complex domain, special functions of mathematical physics, conformal mapping, the Laplace transform, and a more extensive treatment of the calculus of residues.

Mathematics 410b. Real Variable Theory (3-0-3).

Lebesgue and Daniell theory of measure and integration.

Mathematics 415a, b. Partial Differential Equations (3-0-3, each sem.).

Cauchy-Kovalevskaya theorem, classification of partial differential equations, first-order hyperbolic systems, harmonic functions and potential theory, Dirichlet and Neumann problems, the Dirichlet principle, integral equations and the Fredholm alternative, hyperbolic equations, energy estimates, parabolic equations. Properties of solutions of elliptic and parabolic equations.

Mathematics 435a, b. Numerical Analysis (3-0-3, each sem.).

Approximate integration and differentiation by finite differences, interpolation, functional approximation, linear and nonlinear algebraic equations, eigenvalues, approximate solution of ordinary and partial differential equations. Prerequisite: Mathematics 300a,b.

Mathematics 445a, b. Algebraic Topology (3-0-3, each sem.).

This course develops homotopy theory, theory of fiber spaces, singular homology and cohomology. Theorems of Hurewicz and Whitehead are established. Spectral sequences are studied and used to analyze fiber spaces. Serre C-theory is developed. Geometrical applications are made in studying fixed-point theory, imbedding problems, and vector field problems. Prerequisites: Mathematics 340a,b and one of Mathematics 220a,b, 310a,b, 370a,b, or 371a,b.

Mathematics 465a, b. Differential Geometry (3-0-3, each sem.).

Differentiable manifolds. Stokes' theorem and deRham's theorem, Fundamental theorem of local Riemannian geometry, manifolds in Euclidean spaces, Lie groups, vector space bundles, theory of affine connections.

Mathematics 470a, b. Algebra II (3-0-3, each sem.).

Finite groups, Galois theory, and representation theory are developed. Special topics are included according to the instructor's interest. Prerequisite: Mathematics 370a,b.

NOTE: *It will be observed that the numbers on the following courses come in groups of five. Each group represents one field in mathematics. If two courses in one group are given in the same year, then two of the five possible numbers will be used. If a student takes several courses in one group, they will be recorded with different numbers from the group.*

Mathematics 500-504. Advanced Complex Variable Theory (3-0-3, each sem.).

Special studies in complex variable theory; typical topics are normal family theory, conformal mapping of multiply-connected domains, univalent functions, Nevanlinna theory of distribution of values for entire and meromorphic functions, boundary behavior of holomorphic and meromorphic functions, Riemann surfaces, uniformization, Banach spaces of holomorphic functions, several complex variables.

Mathematics 505-509. Topics in Analysis (3-0-3, each sem.).

Typical topics include Dirichlet series, singularities of Taylor series, approximation theory, constructive theory of functions, harmonic analysis, analytic number theory, infinitely differentiable functions, asymptotic representations, theory of composition, Tauberian theorems, moment problems, and closure theorems.

Mathematics 510-514. Topics in Real Variable Theory (3-0-3, each sem.).

Typical topics are trigonometric series, Fourier integrals, the use of Banach spaces in classical and functional analysis, Orlicz spaces, and fractional integration.

Mathematics 515-519. Topics in Partial Differential Equations (3-0-3, each sem.).

Typical topics include singular integral operators, Hörmander's theory of linear differential operators, abstract Cauchy problems, elliptic equations of higher order, parabolic equations, not-well-posed problems, and *a priori* estimates for hyperbolic equations.

Mathematics 520-524. Topics in Probability Theory (3-0-3, each sem.).

Discrete and continuous parameter stochastic process, Markov processes, martingales, stochastic potential theory.

Mathematics 525a, b. Functional Analysis (3-0-3, each sem.).

Topological linear spaces, theory of distributions, Banach algebras, harmonic analysis.

Mathematics 526-529. Topics in Functional Analysis (3-0-3, each sem.).

Generalized functions in sense of Gelfand and Shilov, semigroups, Banach spaces of analytic functions and invariant subspaces, singular integral operators, and interpolation of operators.

Mathematics 530-534. Topics in Applied Mathematics (3-0-3, each sem.).

Typical topics include the Laplace transform and its application to problems in differential equations and complex variable theory, special functions of mathematical physics, methods of mathematical physics, calculus of variations, numerical analysis.

Mathematics 535-539. Topics in Potential Theory (3-0-3, each sem.).

Potential theory in n-dimensional Euclidean space, harmonic and superharmonic functions, Poisson integral, polar sets and capacity, Dirichlet problem, Green's function, Martin boundary.

Mathematics 540-544. Topics in Point-Set Topology (3-0-3, each sem.).

Typical topics include general point-theoretic topology, topology of 3-space, imbedding problems, topology of manifolds, decomposition spaces and mappings, knot theory, dimension theory, and theory of retracts.

Mathematics 545-549. Topics in Algebraic Topology (3-0-3, each sem.).

Material studied will include topics such as extraordinary homology and cohomology theories, Lie Groups, Bott periodicity, the Steenrod algebra, higher order cohomology operations, characteristic classes, sheaf theory, homotopy theory, vector fields on manifolds, imbedding problems.

Mathematics 550-554. Topics in Combinatorial Topology (3-0-3, each sem.).

Whitehead's theory of regular neighborhoods, simple homotopy type and torsion, generalized Poincaré conjecture, combinatorial imbeddings of manifolds, triangulated manifolds and the Hauptvermutung, study of combinatorial manifolds of dimensions three and four.

Mathematics 555-559. Topics in Differential Topology (3-0-3, each sem.).

Topology of differential manifolds, fiber bundles, tubular neighborhood theorem, Whitney imbedding theorem, transverse regularity theorem, diffeotopy extension theorem. Special topics: structure of manifolds and manifold pairs, s-cobordism theorem, Novikov's theorem, differential structures on spheres, cobordism theories, theory of immersions, characteristic classes, handle-bodies, smoothing theory, Cairns-Hirsch theorem, obstruction theory, Morse theory, infinite dimensional manifolds, and the calculus of variations, Atiyah-Singer theorem, Nash theory.

Mathematics 600. Thesis.

Mathematics Colloquium.

The colloquium usually meets one afternoon each week to allow the exposition of original investigations by visitors, faculty members, or students.

Mechanical Engineering

(*See* pages 149-155)

Military Science

PROFESSOR LANPHIER, *Chairman*
ASSISTANT PROFESSORS BRAMLETT AND VAN WOERKOM

Military Science 101a. Organization of the Army; Individual Weapons and Marksmanship (1-1-1).

Organization of the squad, platoon, and company of the infantry battalion emphasizing specific duties and responsibilities of key personnel. The integration of small units into larger teams and general design of military organization to fit missions to be performed. Functioning, care, and maintenance of the caliber .30 rifle with stress on marksmanship training and good shooting habits.

Military Science 102b. U. S. Army and National Security (1-1-1).

A brief presentation of national defense policy and world-wide commitments that require support of the armed forces. The mission and capabilities of the U. S. Army Reserve and National Guard; the missions, capabilities, and interdependence of the U. S. Air Force, U. S. Navy, and U. S. Army. The role of the U. S. Army in conceivable types of warfare.

Military Science 201a. American Military History (2-1-2).

Survey of American military history from the origin of the U. S. Army to the present with emphasis on the factors which led to the organizational, tactical, logistical, operational, strategical, and social patterns found in the present-day army.

Military Science 202b. Map and Aerial-Photograph Reading; Introduction to Basic Tactics (2-1-2).

Application of basic principles of map and aerial-photograph reading to military science. Organization, composition, and mission of basic military teams to include rifle squad, patrols, and small infantry-tank teams. Combat orders and formations, cover and concealment, patrolling, field fortifications, and camouflage.

Military Science 301a. Military Teaching Principles and Branches of the Army (2-1-2).

Educational psychology as it pertains to the five stages of instructional technique and the importance of each, including practical application to military instruction. The role of each of the combat arms and services of the Army. Conduct of guerrilla warfare and counterinsurgency operations.

Military Science 302b. Military Leadership: Small-Unit Tactics and Communications (3-1-3)

Responsibilities and basic qualities of a leader, objectives of leadership, leadership principles and techniques, functional role of the leader, and special problems of military leadership. Principles of offensive and defensive combat and their ap-

plication to the units of the infantry division. Familiarization with the means and principles of Army communications.

Military Science 401a. Military Operations: Logistics and Administration. (3-1-3).

Organization and functions of a military staff, using the infantry division staff as a model, relationship between commanders and the staff and the relationship between subordinate units and the staff; the army logistics system, including supply, maintenance, evacuation, and troop movement; the role of the officer in Army administration, to include familiarization with Department of Army publications and forms.

Military Science 402b. Military Law; Role of the U. S. in World Affairs; and Service Orientation (2-1-2).

Brief history of military law, the articles of the Uniform Code of Military Justice, nonjudicial punishment, composition and jurisdiction of courts-martial, rules of evidence, and trial procedures; analysis of the major geographical areas of the world with regard to economic power, war potential, and inclination and aptitude for the conduct of war; customs of the service; conduct and code of an officer; responsibilities and obligations of an officer; the Army as a career.

Music

The Shepherd School of Music

ASSOCIATE PROFESSOR HALL
LECTURER BEDFORD

Oportunity for students to continue their music activity at Rice will be found in the Rice Chamber Orchestra and University and College choruses. They may also arrange for private study of their instrument through the Music office.

Music 300a, b. Orientation and Historical Survey (3-0-3, each sem.).

An investigation into the technical, psychological, and social aspects of music. Prerequisite: Junior standing. *Mr. Hall*

Music 315a, b. Harmony and Sight-Singing (3-0-3, each sem.).

Instruction in the theory and practice of traditional harmony, sight-singing and dictation. The translation of notation into rhythm and sound, and sound into notation. Includes all triads and seventh chords, with inversions and nonchord tones. *Mr. Hall*

Music 415a, b. Advanced Harmony (3-0-3, each sem.).

Advanced work in harmony including chromatic alteration and modulation, modern technics, and original work in small forms. Prerequisite: Music 315 or instructor's permission. *Mr. Hall*

Naval Science

PROFESSOR FRANCIS, *Chairman*
ASSOCIATE PROFESSOR JOHNSON
ASSISTANT PROFESSORS QUEEN, TATE, TAYLOR, AND WORRELL

Naval Science courses as described will be taken in succession as listed.

Naval Science 100a, b. Sea Power and Orientation (1-2-1, each sem.).

This course consists of a one-hour weekly classroom period plus a two-hour weekly laboratory in which fundamental concepts of sea power, traditions, customs, organization, seamanship, and missions of the Navy are presented. In addition, either History 100a,b (Europe since 1500) or History 110a,b (American History)—both taught by the History Department—is a course requirement for all Freshman N.R.O.T.C. students.

Naval Science 201a. Navigation (3-2-3).

Terrestrial and celestial navigation. Piloting problems, utilizing electronic and visual navigation aids, are studied. Motions of celestial bodies are determined. The celestial sphere concept is utilized in determining position by the employment of spherical trigonometry.

Naval Science 202b. Naval Weapons (3-2-3).

Introduction to naval weapons and space technology. Fire-control systems. Principles of sonar and radar. Guided missiles. Nuclear weapons and radiological defense. Antisubmarine warfare. Amphibious warfare.

Naval Science 301a. Naval Machinery (3-2-3).

Basic principles of and problems in thermodynamics are employed in the study of various power cycles of both main propulsion and auxiliary plants. Steam, internal combustion, and nuclear plants are studied and their energy transformations analyzed. With the emphasis on fundamental principles employed, the student is familiarized with the entire shipboard engineering plant, including electrical systems, refrigeration, compressed-air, and hydraulic systems. Principles of ship stability are studied, including evaluations of transverse and longitudinal stability after damage and weight change.

Naval Science 302b. Naval Operations (3-2-3).

The elements of shipboard operations, including the Rules of the Nautical Road, problems in relative motion, maneuvering ships in formation, and employment of the Striking Force. Fleet communications, with an introduction to electronics countermeasures. The effects of weather on naval operations.

Naval Science 401a. Naval Leadership (3-2-3).

This course consists of one of several appropriate psychology courses offered by the Psychology Department, together with the regularly scheduled Naval Science laboratory and drill period. Psychology may be taken any year.

Naval Science 402b. Principles and Problems of Leadership (3-2-3).
ership (3-2-3).

Application of the principles of naval management, naval administration, and leadership.

N.R.O.T.C. students who desire to be commissioned as second lieutenants in the U. S. Marine Corps or Marine Corps Reserve, and whose applications for transfer are accepted, will substitute the following courses during the final two years.

Naval Science 301Ma. Evolution of the Art of War (3-2-3). (3-2-3).

Significance of military power. Classic principles of war, analyzed as a foundation for further understanding of military operations by a study of famous battles.

Naval Science 302Mb. Modern Basic Strategy and Tactics (3-2-3).

Basic strategic concepts and principles of offensive and defensive tactics through the battalion level.

Naval Science 401Ma. Amphibious Warfare (3-2-3).

History of amphibious warfare. Development of amphibious tactics. Gunfire support. Planning. Logistics. Administration.

Naval Science 402Ma. Marine Corps Leadership and the Uniform Code of Military Justice (3-2-3).

Development of leadership techniques through a study of the basic psychology of leadership. Uniform Code of Military Justice.

Philosophy

PROFESSORS FULTON, *Chairman,* KOLENDA, MACKEY, NIELSEN, AND ROBINSON
ASSISTANT PROFESSOR WILKINS
INSTRUCTOR AUSTIN

Undergraduate Majors: Philosophy majors will normally be expected to take Philosophy 221a, 222b or 271a, 272b or equivalent, and eight semesters of upper-division courses. At least half of the upper-division courses are to be selected from one of the following areas of philosophical study and research.

History of Philosophy (301a, 302b, 303a, 304b, 305a, 442b)
Logic and Philosophy of Science (321a, 322b, 323a, 324b, 476b)
Aesthetics, Ethics, and Political Philosophy (307a, 331a, 332b, 361a, 362b)
Philosophy of Religion (302b, 311a, 312b, 476b)

Students who intend to major in philosophy should consult with members of the department in choice of specialization. With departmental approval, qualified upperclassmen may enroll for independent study in Philosophy 401a, 402b or both.

Graduate Study. College graduates who have shown ability in their undergraduate courses in philosophy may be admitted to graduate study. The beginning of advanced study presupposes the completion of undergraduate courses approximately equivalent to an undergraduate major in philosophy. The fulfillment of the requirements for the degree of Master of Arts ordinarily takes two years; for the degree of Doctor of Philosophy, three or more.

As an important feature of the graduate program, a philosophical colloquium is regularly held for the discussion of current work of graduate students, staff, and guests.

Requirements for the Master of Arts degree include:

(a) The completion with high standing of at least eight advanced semester-courses approved by the department.
(b) Ability to use French or German in his studies in accordance with the requirements on page 57.
(c) The completion of a written thesis on a subject approved by the department.
(d) The passing of satisfactory written and oral examinations in philosophy, not limited to the student's special field of study.
(e) Satisfactory performance of limited teaching duties assigned by the department.

Requirements for the degree of Doctor of Philosophy include:

(a) The completion with high standing of courses approved by the department.
(b) Ability to use French and German in his studies in accordance with the requirements on page 57.
(c) The passing of qualifying examinations in history of philosophy, metaphysics, value theory, and logic and epistemology.
(d) The completion of a written thesis on a subject approved by the department. At least one year of thesis research must be spent in residence.
(e) Satisfactory performance of limited teaching duties assigned by the department.
(f) The passing of a final oral examination, not limited to the student's special field of study.

COURSES

Philosophy 221a. The Classical Tradition (3-0-3).

Readings in ancient and medieval philosophy, usually Plato, Aristotle, St. Augustine, and St. Thomas Aquinas. Lectures, discussions, and papers aimed at developing proficiency in (a) the reading and interpretation of philosophical texts, and (b) the identification and critical consideration of problems in metaphysics, epistemology, and ethics. *Mr. Mackey*

Philosophy 222b. The Modern Temper (3-0-3).

Same as Philosophy 221a, except that the readings will be drawn from modern sources, such as Descartes, Hume, Kant, Kierkegaard, and Nietzsche. Prerequisite: Philosophy 221a. *Mr. Mackey*

Philosophy 271a. Introduction to Religious Thought, I (3-0-3).

Examination of classical religious texts, including portions of the Old and New Testaments, works of early Christian writers, and major writings of the Hindu tradition; accompanied by lectures and secondary readings and preceded by brief consideration of theories about the nature and origin of religion. *Mr. Austin*

Philosophy 272b. Introduction to Religious Thought, II (3-0-3).

Contemporary work on such issues as the sources and validity of religious knowledge and religious diagnoses and remedies for the "human predicament," considered against the background of the controversies of the Reformation and traditional arguments concerning the existence of God and the problem of evil. Prerequisite: Philosophy 271a or permission of instructor. *Mr. Austin*

Philosophy 301a. Thales to Plotinus (3-0-3).

Extensive reading and discussion of major texts of ancient philosophy in translation. Given fall semester of odd-numbered years. *Mr. Fulton*

Philosophy 302b. Medieval Philosophy (3-0-3).

Historical and critical study of some major medieval thinkers, with emphasis on their metaphysical and epistemological views. Philosophers studied include St. Augustine, St. Anselm, Peter Abelard, St. Bernard of Clairvaux, St. Bonaventura, St. Thomas Aquinas, Duns Scotus, William Ockham. Given spring semester of even-numbered years. *Mr. Mackey*

Philosophy 303a. Galileo to Hume (3-0-3).

Historical and critical study of major works of seventeenth- and eighteenth-century rationalism and empiricism. Given fall semester of even-numbered years. *Mr. Fulton*

Philosophy 304b. Kant and the Nineteenth Century (3-0-3).

Given spring semester of odd-numbered years. *Mr. Kolenda*

Philosophy 305a. The History of American Philosophy (3-0-3).

An introduction to the "golden age" of American philosophy: Royce, Pierce, James, Dewey, Mead, and Santayana. Given fall semester of even-numbered years. *Mr. Wilkins*

Philosophy 307a. Moral and Political Philosophy from Hobbes to Burke (3-0-3).

Study of Thomas Hobbes, John Locke, Francis Hutcheson, David Hume, Adam Smith, the Scottish "common sense" philosophers, and Edmund Burke. Attention is given to the question of how a philosopher's theory of knowledge and his picture of human nature affect his moral and political philosophy. Given fall semester of odd-numbered years. *Mr. Wilkins*

Philosophy 311a. History of Religion: The Far Eastern Tradition (3-0-3).

Reading in the holy books of India, China, and Japan. Study of Hinduism, Buddhism, Confucianism, Taoism, and Shinto. Critical biography of the founders and leading teachers of the major traditions. Examination of contemporary expressions of Eastern religions as "living faiths." *Mr. Nielsen*

Philosophy 312b. History of Religion: The Western Tradition (3-0-3).

Study of Judaism, Christianity, and Islam in their historical development. Attention to the basic themes of Western theism: God, immortality, history, evil, and redemption. Use of Biblical criticism in the study of the Old and New Testaments as well as the Koran. Prerequisite: Philosophy 311a or permission of instructor. *Mr. Nielsen*

Philosophy 321a. Logic (3-0-3).

A study of first-order logic with emphasis on the development of formal deductive techniques and on the semantic concept of logical consequence. *Mr. Robinson*

Philosophy 322b. Advanced Logic (3-0-3).

Higher-order logics; the formalization of mathematical concepts and theories. The decision problem and semialgorithmic proof procedures. *Mr. Robinson*

Philosophy 323a. Philosophy of Science (3-0-3).

Readings, lectures, and discussions concerning the internal structure and philosophical implications of theories in physical science. Topics discussed include the logical relations among hypotheses, models, laws, and observations; causality, chance, and probability; physical explanations of organic and mental phenomena.
Mr. Austin

Philosophy 324b. Problems in the Philosophy of Science (3-0-3).

Topics selected by class and instructor, primarily from among philosophical problems arising in such areas as contemporary cosmology, evolutionary theory, psychological and psychoanalytic theories, and the foundations of mathematics. Given spring semester of even-numbered years. Prerequisite: Philosophy 323a or permission of instructor. *Mr. Austin*

Philosophy 331a. History of Ethics (3-0-3).

Study of basic approaches to ethics from Plato to Kant: affirmation, consolation, Christianization, secularization, formalization. Given fall semester of even-numbered years. *Mr. Kolenda*

Philosophy 332b. Modern Ethics (3-0-3).

Developments in ethics during the last hundred years: utilitarianism, idealism, naturalism, intuitionism, emotivism, analysis, existentialism. Given spring semester of odd-numbered years. *Mr. Kolenda*

Philosophy 361a. Aesthetics (3-0-3).

Readings in ancient, medieval, and modern aesthetics, focused on problems in the metaphysics of art and beauty. Special attention will be given to the arts of language (rhetoric and poetry) by reading and discussion of selected writings in literary theory. Given fall semester of even-numbered years. *Mr. Mackey*

Philosophy 362b. Philosophical Ideas in Literature (3-0-3).

Reading and discussion of works presenting a philosophy of life: Goethe, Nietzsche, Dostoyevsky, Rilke, Conrad, Santayana, and Thomas Mann. Given spring semester of even-numbered years. *Mr. Kolenda*

Philosophy 401a. Independent Study and Senior Thesis (3-0-3).

Department permission required. *Staff*

Philosophy 402b. Independent Study and Senior Thesis (3-0-3).

Department permission required. *Staff*

Philosophy 442b. Bradley to Whitehead (3-0-3). *Mr. Fulton*

Philosophy 476b. Natural Science and Religion (3-0-3).

Historical and systematic studies in the relations (conflict, synthesis, mutual irrelevance) between Christian theology and the physical and biological sciences from Copernicus and Luther to the present. Given spring semester of odd-numbered years. *Mr. Austin*

Philosophy 501a. Research and Thesis (3-0-3). *Staff*

Philosophy 502b. Research and Thesis (3-0-3). *Staff*

Philosophy 511a. Wittgenstein and His Influence (3-0-3).

Study of Wittgenstein's *Philosophical Investigations* and of its influence on contemporary philosophy. Given fall semester of odd-numbered years. *Mr. Kolenda*

Philosophy 512b. Topics in Epistemology (3-0-3).

Investigation of the development of some key philosophical concepts. Given spring semester of even-numbered years. *Mr. Kolenda*

Philosophy 513a. Peirce and Pragmatism (3-0-3).

Study of the thought of C. S. Peirce and of its influence on other pragmatists, especially William James and John Dewey. Given fall semester of even-numbered years. *Mr. Kolenda*

Philosophy 521a. Readings in Non-Christian Religious Philosophy (3-0-3).

Critical examination of the major traditions of Indian and Chinese philosophy. Attention to both historical development and modern expressions of Hindu and Buddhist thought. Appraisal of contemporary interpretations as related to both idealism and existentialism. Given fall semester of even-numbered years. *Mr. Nielsen*

Philosophy 522b. Protestant Philosophy since the Reformation (3-0-3).

Critical appraisal of the relation of the Reformation to the philosophical tradition: Protestant scholasticism, nineteenth-century idealism and modern neo-orthodoxy. Readings in Luther, Calvin, Kant, Schleiermacher, Kierkegaard, Nietzsche, and Karl Barth. Given spring semester of odd-numbered years. *Mr. Nielsen*

Philosophy 524b. Hellenism and Christianity (3-0-3).

Given spring semester of even-numbered years. *Mr. Nielsen*

Philosophy 525a. The Problem of Religious Knowledge (3-0-3).

Given fall semester of odd-numbered years. *Mr. Nielsen*

Philosophy 542a. Symbolism (3-0-3).

The theory of symbols and their use in philosophy, literature, religion, etc. Readings in Cassirer, Whitehead, medieval theorists, and others. Given fall semester of odd-numbered years. *Mr. Mackey*

Philosophy 543a. Hegel (3-0-3).

Study of *Phenomenology of Mind* and *Encyclopaedic Logic,* with papers on special projects. Given fall semester of odd-numbered years. *Mr. Fulton*

Philosophy 544b. Metaphysics (3-0-3).

Systematic study of selected metaphysical problems, conducted by means of examination of classical and modern texts. Given spring semester of odd-numbered years. Topic for 1967: being and unity in scholastic thought. *Mr. Mackey*

Philosophy 545a. Kant (3-0-3).

Close study of the *Critique of Pure Reason.* Papers and projects of special problems in Kantian philosophy. Given fall semester of even-numbered years. *Mr. Fulton*

Philosophy 552b. Husserl (3-0-3).

Given spring semester of even-numbered years. *Mr. Fulton*

Philosophy 554b. Whitehead (3-0-3).

Given spring semester of odd-numbered years. *Mr. Fulton*

Philosophy 561a. Foundations of Mathematics (3-0-3).

Foundational problems and the various schools of thought concerning them; formalized axiomatic-set theory; the incompleteness results of Godel. Given fall semester of even-numbered years. *Mr. Robinson*

Philosophy 562b. Theory of Formal Systems (3-0-3).

Recursive-function theory; the fundamental limitations of formalisms. Given spring semester of odd-numbered years. *Mr. Robinson*

Philosophy 563a. Algorithm Theory (3-0-3).

Algorithmic processes—recursive-function theory, Turing machines, A. A. Markov's theory of algorithms, the formalisms of E. L. Post. Abstract automata—their characterization, properties, and capabilities. A general study of the concepts and methods of algorithmic programming. Given fall semester of odd-numbered years. *Mr. Robinson*

Philosophy 564b. Artificial Intelligence (3-0-3).

A study of heuristic problem-solving concepts and techniques. Construction and analysis of game-playing programs, learning devices, theorem-proving processes. Investigation of the problem of producing intelligent behavior in artifacts. Given spring semester of even-numbered years. *Mr. Robinson*

Philosophy 571a. Philosophy of History (3-0-3).

This course deals both with classical texts such as Vico, Kant, Hegel, and Toynbee and with contemporary treatments of the problem of historical explanation. In the latter connection Collingwood, Hempel, Popper, Berlin, Dray, and Danto will be read. Given fall semester of odd-numbered years. *Mr. Wilkins*

Philosophy 572b. Social and Political Philosophy (3-0-3).

A history and evaluation of classical texts in political philosophy from Aquinas through the eighteenth century. Supplemented by readings in analytic philosophy. Given spring semester of even-numbered years. *Mr. Wilkins*

Philosophy 573a. Philosophy of Mind (3-0-3).

The course is organized around Ryle's *Concept of Mind* and the critical literature it has engendered. Given fall semester of even-numbered years. *Mr. Wilkins*

Philosophy 574b. The Philosophy of Law (3-0-3).

A study of the concept of law, the obligation to obey the law, and the nature of judicial decision making. Given spring semester of odd-numbered years. *Mr. Wilkins*

Physical Education

(*See* pages 177-179)

Physics

Professors Class, Houston, Paul, Phillips, *Chairman,* Risser, Rorschach, Trammell, and Walters
Visiting Professor Lane
Associate Professor Donoho
Visiting Associate Professor Köhler
Assistant Professors Barnard, Duck, Jordan, and Legg
Lecturers S. D. Baker, Bryan, and Wildenthal

A minimum of one year of graduate study is required for the degree of Master of Arts and at least two years for the degree of Doctor of Philosophy. To be recommended for the degree of Doctor of Philosophy, a student must present an original thesis describing the results of experimental or theoretical research in a form suitable for publication. He must also attend a sufficient number of courses to acquire a broad

fundamental knowledge of physics in addition to his research specialization. His mastery in the field of physics will be tested by an oral examination given by the faculty. All full-time graduate students in the Department of Physics may be required to engage in some teaching.

Research done recently in the department has included work on the following subjects among others:

(1) Nuclear disintegrations produced by high-energy protons, deuterons, alpha particles, and helium 3 ions.
(2) Energies of beta and gamma rays, charged particles, and neutrons.
(3) Scattering of neutrons and disintegrations produced by neutrons.
(4) Theory of nuclear reactions.
(5) Nuclear and electron resonance.
(6) Magnetic properties of materials.
(7) Physics of the solid state.
(8) Low-temperature physics.
(9) Superconductivity.
(10) Nuclear spin polarization.
(11) Theory of solid state.
(12) Modern atomic physics.
(13) Atomic physics theory.

The physics laboratories are well equipped for modern research in the above areas, with ample auxiliary equipment available. A new building housing a 6 mev Van de Graaff accelerator ws completed in 1953 and a 12 mev Van de Graaff accelerator was installed in 1961.

Chemical Physics Major. An interdepartmental major in chemical physics is offered in conjunction with the Department of Chemistry. Students wishing to elect this major must be approved by both departments.

COURSES

Physics 100a, b. Mechanics, Heat, and Sound, (3-3-4, each sem.).

The first year of the two-year sequence in physics required of all science-engineering students. It consists of three hours of classroom work and three hours of laboratory work per week. This course also satisfies one of the laboratory-science requirements for humanities (academic) students. Topics of study include: kinematics; statics and dynamics of solids and liquids based on Newton's three laws of motion; thermal properties of materials and introductory thermodynamics based on the first and second laws of thermodynamics; wave motion and sound. The level of treatment is that of "Physics for Students of Science and Engineering" by Resnick and Halliday. Also included is a brief introduction to the history of science which traces the development of modern science from early Greek times to the period of Galileo and Newton. Students taking Physics 100a,b must have or be enrolled in Mathematics 100a,b or Mathematics 220a,b. Laboratory fee required.

Messrs. Bryan and Rorschach

Physics 101a, b. Introductory Survey of Physics (3-3-4, each sem.).

An introductory course consisting of two lecture hours, one problem hour, and three hours of laboratory work per week. This course provides a broad study of classical and modern physics and is designed as a terminal course to be open only to academic students and students of architecture. Students taking Physics 101

must have completed or be enrolled in Mathematics 100a,b or Mathematics 101a,b. This course is especially recommended for academic students in their Junior or Senior year. It may also be taken by academic and architecture students at the Freshman and Sophomore level. Laboratory fee required. *Mr. Legg*

Physics 200a, b. Electricity and Magnetism (3-3-4, each sem.).

A course of three lectures and three hours of laboratory work per week. This course with Physics 100a,b makes up a complete course of the principles of physics which is required of science-engineering students. In the first semester Maxwell's equations are reached through a study of the fundamentals of electricity and magnetism, including electrostatics, currents and circuits, magnetostatics, and electromagnetic induction. The second semester treats electromagnetic radiation and other wave motions, geometrical and physical optics, special relativity, and elementary atomic physics. Laboratory fee required. *Messrs. Duck and Wildenthal*

Physics 210a, b. Electricity and Magnetism (3-3-4, each sem.).

This course covers the material of Physics 200a,b but gives a more complete and rigorous treatment. It is open to students who have passed Physics 100a,b and Mathematics 100a,b with high standing. Laboratory fee required.
Messrs. Baker and Trammell

Physics 310a, b. Introduction to Modern Physics (3-0-3, each sem.)

Review of the successes of classical physics, including the extension of classical mechanics to high velocities. Breakdown of classical mechanics and electrodynamics, leading to the quantum theory of radiation and quantum mechanics. Elementary quantum mechanics, followed by an introductory study of atomic, molecular, and solid-state physics. Selected topics in nuclear and strong-interaction physics. Prerequisite: Physics 200a,b or preferably 210a,b, and enrollment in Mathematics 300a,b.
Mr. Barnard

Physics 330a. Junior Physics Laboratory (0-3-2).

Required of all Juniors majoring in physics. Fall Semester: Introduction to electronics. Basic properties of electron devices and their applications in physics research. Laboratory fee required. *Messrs. Donoho and Barnard*

Physics 330b. Junior Physics Laboratory (0-3-2).

Required of all Juniors majoring in physics. Spring Semester: Introductory experiments in atomic and nuclear physics. Physics 310a,b must be taken concurrently. Laboratory fee required. *Messrs. Donoho and Barnard*

Physics 400a, b. Introduction to Mathematical Physics (4-0-4, each sem.).

A systematic review of the principal subjects in mechanics and electrodynamics. Mathematical methods, including differential equations and vector analysis, will be applied to the solution of problems in particle dynamics, vibrating systems, dynamics of rigid bodies, electrostatics, magnetostatics, and electromagnetic field.
Mr. Legg and Staff

Physics 415a. Introduction to Optics (3-0-3).

Fall Semester: Electromagnetic theory of physical and geometrical optics; interference, diffraction, and quantum optics. Introduction to special relativity; covariant formulation of electromagnetic theory and electrodynamics. *Mr. Class*

Physics 415b. Introduction to Quantum Mechanics (3-0-3).

Spring Semester: Introduction to fundamental principles of quantum mechanics. Basic postulates and their significance are examined. Applications to the free particle, harmonic oscillator, and one-electron atom are studied. *Mr. Class*

Physics 425a, b. Statistical and Thermal Physics (3-0-3, each sem.).

An introduction to the behavior and properties of macroscopic systems. Topics included are: statistical derivation of the laws of thermodynamics; classical thermodynamics of simple systems; methods and results of statistical mechanics; quantum

statistics; systems of interacting particles; magnetism; transport processes; irreversible processes; and fluctuations. *Mr. Jordan*

Physics 430a. Senior Physics Laboratory (0-3-2).

Required of all Seniors majoring in physics. Experiments in geometrical, physical, polarization, and quantum optics; spectroscopy; resonance fluorescence in atoms and nuclei; and microwave spectroscopy. Laboratory fee required. *Mr. Jordan*

Physics 430b. Senior Physics Laboratory (0-3-2).

Required of all Seniors majoring in physics. Experiments in physics of current research interest: low-energy nuclear spectroscopy; electron-position annihilation; X-ray crystallography; electron paramagnetic resonance; the Meissner effect and other low-temperature phenomena; and optical pumping. Readings in the research literature are required. Laboratory fee required. *Mr. Jordan*

Physics 500a, b. Introduction to Solid-State Physics (3-0-3, each sem.).

This course gives an introductory treatment of the basic concepts in solid-state physics. Following a brief review of thermodynamics and statistical mechanics, the thermal, electrical, and magnetic properties of solids are discussed. Some of the topics include: crystal structure, lattice vibrations, the interaction of waves with crystals, electron theory, cohesive forces, paramagnetism, and magnetic ordering. The level of treatment is approximately that of the text "Wave Mechanics of Crystalline Solids" by R. A. Smith. Prerequisite: Physics 425a,b or equivalent. Students enrolled in Physics 500a,b should take Physics 520a,b concurrently. *Mr. Rorschach*

Physics 510a, b. Advanced Dynamics (3-0-3, each sem.).

The general principles of analytical dynamics. Orbit theory and the central force problem. The kinematics of rigid bodies, treated from the standpoint of matrix transformations, canonical transformations. Hamilton-Jacobi theory. *Mr. Class*

Physics 520a, b. Principles of Quantum Mechanics (3-0-3, each sem.).

A deductive presentation of the principles of quantum mechanics with applications to various problems in spectroscopy, collisions of atomic particles, molecular binding, etc. *Messrs. Houston and Phillips*

Physics 530a, b. Electromagnetic Theory (3-0-3, each sem.).

Electrostatics, magnetostatics, boundary-value problems, stress-energy relations; electromagnetic wave equations, Lienard-Wiechert potentials, multiple fields, radiation; special relativity, radiation from accelerated changes. *Mr. Duck*

Physics 540a, b. Nuclear Physics (3-0-3, each sem.).

Nuclear properties; interaction of radiation with matter and radiation detection; nuclear reaction and models of nuclear structure; nuclear forces; the fundamental particles and their interactions. *Mr. Paul*

Physics 560a, b. Structure of Solids (3-0-3, each sem.).

A review of the quantum mechanical theory of perfect crystals. Nuclear and electron motions will be studied as an explanation of thermal, electrical, and magnetic phenomena in solids. *Mr. Houston*

Physics 570a, b. Atomic Physics (3-0-3, each sem.).

Theory of atomic and molecular spectra, atomic collisions and reactions, basic processes in gaseous electronics. Nuclear and electronic paramagnetism, principles of magnetic resonance and relaxation, spin-system thermodynamics. Dynamic polarization, optimal pumping, topics in modern quantum electronics. *Mr. Walters*

Physics 580a, b. Physics Colloquium (1-0-1, each sem.).

One meeting a week at which results of researches in physics will be discussed. *Staff*

Physics 590. Research Work. *Staff*

Physics 600a, b. Special Topics in Solid-State Physics (2-0-2, each sem.). *Staff*

Physics 610a, b. Neutron and Reactor Physics (3-0-3, each sem.).

Fundamental properties of the neutron: mass, magnetic movement, interaction with the proton, etc. Interaction with nuclei. Sources and detectors. Interaction with matter in bulk; slowing down and diffusion. Nuclear chain reactions. Magnetic scattering and polarization. Neutron diffraction. *Mr. Risser*

Physics 620a, b. Theoretical Nuclear Physics (3-0-3, each sem.).

General nuclear properties, two-body problems, scattering, nuclear spectroscopy, nuclear reactions, interaction of nuclei with electromagnetic and electron-neutrino fields, nuclear shell theory. *Mr. Trammell*

Physics 630a, b. Advanced Quantum Mechanics (3-0-3, each sem.).

Relativistic quantum mechanics of the electron; field quantization for the electron-positron and electromagnetic fields; quantum electrodynamics; scattering matrix theory; radiative corrections. *Mr. Köhler*

Physics 640. Special Topics in Nuclear Physics. *Staff*

Physics 700. Summer Graduate Research.

Open only to students already admitted as candidates for an advanced degree. At least forty hours of laboratory work per week. *Staff*

Political Science

(*See* pages 187-190)

Psychology

Professors Hudson and Wann
Associate Professor Price-Williams, *Chairman*
Assistant Professor Willems

Students planning to major in psychology should take two courses during the Sophomore year, Psychology 200a, 205b. Majors are expected to take ten semester-courses in addition. Psychology 200a and 305b are open to nonmajors, and certain of the other courses may be taken without prerequisites by permission.

COURSES

Psychology 200a. Survey of Psychology (3-0-3).

A survey of the fields of psychology and an introduction to its main theoretical issues. *Mr. Price-Williams*

Psychology 205b. Social Aspects of General Psychology (3-0-3).

An advanced extension of the work covered in the introductory course. Individual and social aspects of psychological processes in motivation, learning, perception, thought, and language. *Mr. Price-Williams*

Psychology 305b. An Introduction to the Concepts and Techniques of Social Psychology (3-0-3).

Social processes and relations between individuals and groups. *Mr. Willems*

Psychology 325a. Statistics and Research Design (3-0-3).

An introduction to the theories and techniques of the statistical method as applied to problems in psychological research. The course will be concerned with means of describing distribution of scores and measures, the normal curve and probabilities, sampling and statistical inference, and correlation. *Mr. Willems*

Psychology 325b. Advanced Statistics and Research Design (3-0-3).

More advanced correlation techniques, frequency comparisions, small-sample methods, analysis of variance, and further consideration of sampling and statistical inference. *Mr. Willems*

Psychology 330a. Differential Psychology (3-0-3).

This course is designed to familiarize the student with the techniques for measuring individual differences. Critical reviews will be made of various theories of individual differences in intelligence and personality. *Mr. Wann*

Psychology 330b. Personality Theory (3-0-3).

An introduction to the concepts and techniques of personality study. A continuation of Psychology 330a, which is a prerequisite. *Mr. Wann*

Psychology 340a. Experimental Psychology (3-4-4).

An introduction to laboratory methods of research in the areas of sensation, perception, and learning. *Mr. Hudson*

Psychology 340b. Advanced Experimental Psychology (3-4-4).

An advanced course in psychological research using humans and animals with particular reference to psychological theory. Emphasis is placed upon the design and execution by the student of exploratory studies. *Mr. Hudson*

Psychology 400b. Advanced General Psychology (3-0-3).

An attempt to derive a set of basic principles of psychology as a unified discipline. Emphasis will be on the reconciliation of conflicting theoretical orientations. *Mr. Price-Williams*

Psychology 410a. Developmental Social Psychology (3-0-3).

The course presents three major topics: adolescence, comparative social psychology, and theories and problems of social psychology. The first semester is designed to acquaint the student, from the point of view of adolescence, with the physical, social, and emotional processes that go into the making of an adult. *Mr. Wann*

Psychology 410b. Developmental Social Psychology (3-0-3).

The second semester is a continuation of the above topics, giving greater emphasis to social processes. These are viewed from the vantage point of comparative social psychology and the wide varieties of behaviors possible for human beings and from the points of view provided by alternative theories. *Mr. Wann*

Psychology 415a. History and Theories of Psychology (3-0-3).

A review of the development of Western scientific psychology and the emergence of theoretical systems. *Mr. Willems*

Psychology 490a, b. Independent Study and Research (0-0-3, each sem.).

Staff

ETHNOPSYCHOLOGY GRADUATE PROGRAM

The Department of Psychology and the Department of Anthropology and Sociology have combined for an interdisciplinary graduate program for a doctorate in ethnopsychology. Graduate students will be able to emphasize one of the three major disciplines in the program, that is either psychology, anthropology, or sociology. In addition to the major emphasis on one of these disciplines, students will be expected to cover certain requirements in the other two disciplines. The alternatives are therefore: (1) emphasis on psychology, with minimal requirements in anthropology and sociology; (2) emphasis on anthropology, with minimal requirements in psychology and sociology; (3) emphasis on sociology, with minimal requirements in psychology and anthropology. The minimal duration of the program is three years. There will be a qualifying examination at the end of the first year. A comprehensive examination will be given later in the program prior to the student embarking on his doctoral thesis. An important part of the student's training is involvement in ongoing research studies by members of the faculty.

COURSES

Ethnopsychology 500a, b. Proseminar: Theories of Behavorial Science (3-0-3, each sem.).

An examination of the main concepts and principles that have shaped the emerging interdisciplinary field of the behavioral sciences. *Staff*

Ethnopsychology 505. Independent Study and Tutorial (0-0-3 to 9). *Staff*

Ethnopsychology 515b. Theory and Methods in Ethnopsychology (3-0-3).

The study of the "psychology of peoples." Theories of culture and personality relationships and the formation of characteristic psychological structures in cultural groups. Methodology of the psychological study of cultural and ethnic groups. Field research and analysis of personal materials from nonliterate peoples.
Mr. Price-Williams

Ethnopsychology 520a. Seminar in the Theory and Problems of Underdeveloped Societies (3-0-3).

A study of the psychological characteristics of traditional societies and the problems associated with rising expectations. *Mr. Hudson*

Ethnopsychology 525b. Interdisciplinary Research Seminar in Problems of Development of New Nations (3-0-3).

Using the case-history method, an examination will be made of the political, economic, sociological, and psychological problems associated with processes of development among nations and societies in transition.
Mr. Hudson and faculty of the Departments of History, Economics, and Anthropology

Ethnopsychology 530a. Social Aspects of Psychological Evaluation (3-0-3).

The influence of cultural processes on the study of personality and abilities through psychological tests. *Staff*

Ethnopsychology 540b. Seminar in Social Psychology (3-0-3).
A survey of research and theory in social psychology. *Staff*

Ethnopsychology 550b. Seminar in Urban Affairs (3-0-3).
Seminar devoted to research concerned with ecological and cultural influences in urban areas. *Mr. McCord and Staff*

The following undergraduate courses are also recommended:

Anthropology 400a.	Ethnological Theory
Sociology 410a.	Social Change in Developing Areas
Sociology 420b.	Field Methods
Sociology 400b.	Seminar on the Foundations of Social Thinking
Linguistics 401a.	Introduction to Descriptive Linguistics
Linguistics 402b.	Special Topics in Linguistics

Inter-University African Studies Program

By arrangement with the University of Houston, Texas Southern University, and St. Thomas University in the field of African studies, graduate students interested in Africa, may attend courses and obtain credit at these other universities. Information of the courses offered can be obtained from the chairman of the Psychology Department at Rice.

Russian

(*See* pages 114-117)

Sociology

(*See* pages 97-100)

Space Science

Professors Dessler, *Chairman,* Gordon, O'Brien, and Walters
Associate Professors Clayton and Michel
Assistant Professors Anderson, Freeman and Haymes
Lecturers Kovar and Shaw
Visiting Lecturer Cook

Research opportunities exist for graduate studies leading to degrees of Master of Science and Doctor of Philosophy in the Department of Space Science. To gain such a degree a student must be knowledgeable in many areas of space science and expert in at least one.

There is no bachelor's degree with a major in Space Science. However, Space Science 400a,b is offered as an elective course to acquaint

Rice undergraduates and graduates from other institutions with many of the concepts and research opportunities in space science.

Space science is an interdisciplinary field; undergraduates with bachelors' degrees in astronomy, chemistry, electrical engineering, geophysics, physics, or any of several other scientific and engineering disciplines may apply for admission to graduate work in the department.

GRADUATE PROGRAM

The requirements for M.S. and Ph.D. degrees are outlined below. A booklet giving more detailed and specific information is available from the department office.

Degree of Master of Science. A candidate for a master's degree shall have completed successfully at least four courses within the Department of Space Science, as well as other graduate-level courses deemed necessary by his advisory committee. A candidate must pass a reading examination in one foreign language to be approved by the advisory committee. He shall prepare a written thesis on an original research topic and defend his thesis orally.

Degree of Doctor of Philosophy. The basic requirement for a student to receive the Ph.D. is that he demonstrate the capacity for independent, original research. In addition, there are the following formal requirements:

A minimum of three years' graduate study is normally required. Candidates who hold a master's degree may complete requirements for the doctorate in two years. After one year in the department the student shall be required to pass a written and an oral candidacy examination. A student must also pass examinations in two foreign languages that have been approved by his advisory committee and complete successfully at least six courses within the Department of Space Science together with other graduate-level courses selected by the department before being admitted to candidacy. A candidate shall prepare a thesis on an original research topic and defend the thesis orally. The thesis must be of such quality that it would be acceptable for publication in a reputable scientific journal.

COURSES

Space Science 300b. General Astronomy (3-0-3).

An introduction to the changing realm of astronomy. This course will be essentially descriptive in nature. It will cover such topics as astronomical instruments, the solar system, stars, galaxies, quasars, etc. Cosmological theories concerning the origin and evolution of the universe will also be discussed. No prerequisites; open to Sophomores with permission. *Mr. Kovar*

Space Science 400a, b. Introduction to Space Science (3-0-3, each sem.).

An introduction to phenomena of current interest in space science, including: astronomy, solar-terrestrial relationships, properties of the interplanetary medium, cosmic radiation, the Van Allen and other radiation belts, auroras, and planetary atmospheres and ionospheres. Emphasis will be on qualitative descriptions rather than rigorous analyses. *Messrs. Haymes and O'Brien*

Space Science 500a, b. Particles and Fields (3-0-3, each sem.).

An introduction to the interactions on a cosmic scale between charged particles and magnetic and electric fields. Topics include principles of plasma physics, particle orbit theory, the solar wind, the effect of the solar wind on magnetic fields of the earth and sun, geomagnetic storms, cosmic radiation, and Van Allen radiation. The first semester will be devoted to a rigorous treatment of the behavior of the plasma state. Research applications of basic principles will be covered in the second semester. *Messrs. Dessler and Shaw*

Space Science 550a, b. Stellar Evolution and Nucleosynthesis (3-0-3, each sem.).

Analysis of the physical principles governing the structure and evolution of stars and the synthesis of elements in stellar interiors. Basic topics covered are (1) introduction to stars, (2) equation of state of ionized matter, (3) energy transport, (4) thermonuclear reaction rates, (5) calculation of stellar structure and evolution, and (6) correlation of observed abundances with mechanisms of nucleosynthesis. The course is mathematical, but the physical motivations for all discussions will be emphasized. Previous or concurrent enrollment in Physics 520a,b is prerequisite. *Mr. Clayton*

Space Science 560b. Gravitation and Relativity (3-0-3).

A study of the theories of gravitation with emphasis on the General Theory of Relativity. Applications, experimental tests, and cosmological implications are discussed. A familiarity with the Special Theory of Relativity such as is covered in Physics 530 or equivalent is prerequisite. *Mr. Michel*

Space Science 580. Graduate Research. Credit to be arranged. *Staff*

Space Science 590a, b. Space Science Colloquium(1-0-1, each sem.). *Staff*

Space Science 650a. Advanced Topics in Stellar Evolution (3-0-3).

The topics vary at the discretion of the instructor but may include: (1) computer programs in stellar evolution, (2) supernovae, (3) astrophysical sites of heavy-element synthesis, (4) nuclear chronology of the galaxy, (5) stellar pulsation, (6) stellar rotation, and (7) semiempirical approach to stellar evolution. Grades will normally be assigned on the basis of a written research paper. Space Science 550a,b is prerequisite. *Mr. Clayton*

Space Science 700. Summer Graduate Research.

Open only to students already admitted as candidates for an advanced degree. At least forty hours of laboratory work per week. *Staff*

Spanish

(*See* pages 114-119)

Theater

(*See* pages 160-162)

Index