RICE UNIVERSITY

GENERAL ANNOUNCEMENTS

SEPTEMBER, 1961 — JUNE, 1962

WILLIAM MARSH RICE UNIVERSITY

The Rice Institute prior to July 1, 1960

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These *Announcements* are the catalogue of William Marsh Rice University.

GENERAL ANNOUNCEMENTS

for

SEPTEMBER, 1961 — JUNE, 1962

of

WILLIAM MARSH RICE UNIVERSITY

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

CONTENTS

1961

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
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				

NOVEMBER

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		

DECEMBER

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						

1962

JANUARY

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			

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	19	20	21	22	23	24
25	26	27	28			

MARCH

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

APRIL

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					

MAY

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		

JUNE

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

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
	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			

NOVEMBER

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	

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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					

1963

JANUARY

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		

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	19	20	21	22	23
24	25	26	27	28		

MARCH

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						

APRIL

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				

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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	

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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						

ACADEMIC CALENDAR

1961-62

Friday, September 1	Last Day for Returning Registration Cards
Sunday, September 3	Arrival of Freshmen
Monday, September 4-8	Freshman Week
Monday, September 4	Matriculation Address, 5:00 P. M.
Monday, September 11	Opening of Courses
Wednesday, November 22	Beginning of Thanksgiving Recess, 6:00 P. M.
Monday, November 27	Resumption of Courses, 8:00 A. M.
Wednesday, December 20	Beginning of Christmas Recess, 6:00 P. M.
Wednesday, January 3	Resumption of Courses, 8:00 A. M.
Saturday, January 13	Last Day of First Term Classes
Tuesday, January 16	Beginning of Mid-Year Examinations
Monday, January 29	Resumption of Courses, 8:00 A. M.
Thursday, April 19	Beginning of Easter Recess, 6:00 P. M.
Friday, April 27	Resumption of Courses, 8:00 A. M.
Thursday, May 17	Last Day of Classes
Saturday, May 19	Beginning of Final Examinations
Friday, June 1	Baccalaureate Exercises
Saturday, June 2	Forty-ninth Commencement

1962-63

Saturday, September 1	Last Day for Returning Registration Cards
Sunday, September 2	Arrival of Freshmen
Monday, September 3-7	Freshman Week
Monday, September 3	Matriculation Address, 5:00 P. M.
Monday, September 10	Opening of Courses
Wednesday, November 21	Beginning of Thanksgiving Recess, 6:00 P. M.
Monday, November 26	Resumption of Courses, 8:00 A. M.
Thursday, December 20	Beginning of Christmas Recess, 6:00 P. M.
Thursday, January 3	Resumption of Courses, 8:00 A. M.
Saturday, January 12	Last Day of First Term Classes
Tuesday, January 15	Beginning of Mid-Year Examinations
Monday, January 28	Resumption of Courses, 8:00 A. M.
Tuesday, April 9	Beginning of Easter Recess, 6:00 P. M.
Tuesday, April 16	Resumption of Courses, 8:00 A. M.
Tuesday, May 14	Last Day of Classes
Thursday, May 16	Beginning of Final Examinations
Friday, May 31	Baccalaureate Exercises
Saturday, June 1	Fiftieth Commencement

OFFICERS OF ADMINISTRATION

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Chancellor

CAREY CRONEIS, PH.D., LL.D., D.SC., D.ENG.
President, Acting, 1960-61

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Assistant to the President

GEORGE HOLMES RICHTER, PH.D.
Dean of the University

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Dean of Humanities

LEVAN GRIFFIS, PH.D.
Dean of Engineering

JAMES REDDING SIMS, PH.D.
Adviser to Men

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Bursar

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Director of Development

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Mr. and Mrs. James M. Lykes, Jr.
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Mr. and Mrs. O. J. McCullough
Mr. and Mrs. R. Thomas McDermott
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Mr. and Mrs. Leopold L. Meyer
Mr. and Mrs. Frank W. Michaux
Mr. and Mrs. Alvin S. Moody
Mr. and Mrs. Dan M. Moody
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Mr. and Mrs. William A. Smith
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Mr. and Mrs. H. Gardiner Symonds
Mr. Ben Taub
Mr. and Mrs. Henry J. N. Taub
Mr. and Mrs. Howard T. Tellepsen
Mr. and Mrs. Russell Thorstenberg
Mr. and Mrs. Wash Bryan Trammell
Mr. and Mrs. P. E. Turner
Mr. and Mrs. Joe Weingarten
Mr. and Mrs. Wesley W. West
Mrs. Harry C. Wiess
Mr. and Mrs. I. M. Wilford
Mr. and Mrs. Wallace D. Wilson
Mr. and Mrs. Benjamin N. Woodson
Mr. and Mrs. Andrew Jackson Wray

INSTRUCTIONAL AND RESEARCH STAFF

EMERITUS FACULTY

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

BRAY, HUBERT EVELYN
B.A. (Tufts) 1910, M.A. (Harvard) 1916, Ph.D. (Rice) 1918
Trustee Professor of Mathematics and Non-Resident Associate of Jones College

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

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

MCCANN, SAMUEL GLENN
Ph.B. (Wooster) 1914, M.A. (Rice) 1917
Emeritus Director of Admissions and Honorary Associate of Wiess College

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

MORAUD, MARCEL
Agrégé de l'Université (Paris) 1919, Docteur és Lettres (Paris) 1933
Professor Emeritus of French

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

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

SLAUGHTER, JOHN WILLIS
A.B., B.D. (Lombard) 1898, Ph.D. (Michigan) 1901
Lecturer Emeritus in Civics and Philanthropy

TSANOFF, RADOSLAV ANDREA
B.A. (Oberlin) 1906, Ph.D. (Cornell) 1910
Trustee Professor of Humanities and Honorary Associate of Will Rice College

WHITING, GEORGE WESLEY
A.B. (West Virginia) 1908, A.M. (Harvard) 1913, Ph.D. (Chicago) 1926
Professor Emeritus of English

WILSON, HAROLD ALBERT
M.Sc. (Leeds) 1897, D.Sc. (London) 1900, M.A. (Cambridge) 1904, F.R.S.
Professor Emeritus of Physics and Honorary Associate of Hanszen College

FACULTY

ADAMS, JOHN A. S.
Ph.B. (Chicago) 1946, B.S. (Chicago) 1948, M.S. (Chicago) 1949, Ph.D. (Chicago) 1951
Professor of Geology

AKERS, WILLIAM WALTER
B.S. in Ch.E. (Texas Tech.) 1943, M.S. in Ch. E. (Texas) 1944, Ph.D. (Michigan) 1950
Professor of Chemical Engineering

ASIMOW, ROBERT MAX
B.S. (U.C.L.A.) 1953, M.S. (U.C.L.A.) 1955, Ph.D. (U.C.L.A.) 1958
Assistant Professor of Mechanical Engineering

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

AUTEN, JOHN H.
B.S. (Ohio State) 1947, Ph.D. (M.I.T.) 1954
Associate Professor of Economics

AWAPARA, JORGE
B.S. (Michigan State) 1941, M.S. (Michigan State) 1942, Ph.D. (Southern California) 1947
Associate Professor of Biology

BACKUS, KERBY DEWEL
B.S. (East Texas S. C.) 1956
Instructor in Engineering Drawing

BAKER, LEE EDWARD
B.S. in E. E. (Kansas) 1945
Assistant Professor of Electrical Engineering, Non-Resident Associate of Hanszen College

BARBER, WILLIAM DEARMOND
B.A. (Cincinnati) 1953, M.A. (Cincinnati) 1954, Ph.D. (Wisconsin) 1961
Assistant Professor of History

BARKER, J. R.
B.S. in Phy.Ed. (Rice) 1949, M.Ed. (Texas) 1954
Assistant Professor of Physical Education

BARNARD, ANTHONY CHARLES LANGRISH
B.Sc. (Birmingham) 1953, Ph.D. (Birmingham) 1957
Instructor in Physics

BARTHELME, DONALD
B. Arch. (Pennsylvania) 1930
William Ward Watkin Professor of Architecture

BATTISTA, JOSEPH LLOYD
Certificat d'Etudes française (Bordeaux) 1919, Diplome d'Etudes, supérieures (Bordeaux) 1919, B.A. (Michigan) 1920, M.A. (Washington Univ.) 1923, M.A. (Harvard) 1929
Associate Professor of Romance Languages

BEARDEN, FRANCIS W.
B.S. (Texas Tech.) 1947, M.A. (Columbia) 1949, Ed.D. (Columbia) 1954
Assistant Professor of Physical Education and Non-Resident Associate of Will Rice College

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

BLACK, HUGH CLEON
B.A. (Rice) 1941, M.Ed. (Texas) 1947, Ph.D. (Texas) 1949
Associate Professor of Philosophy and Education, Non-Resident Associate of Baker College

BLACK, JAMES OLIVER
B.A. (Arkansas) 1949, M.A. (Arkansas) 1950, Ph.D. (Arkansas) 1958
Visiting Lecturer in English

BLAND, ROBERT L.
B.A. (Central Washington) 1953, M.A. (Columbia) 1954
Assistant Professor of Physical Education, Non-Resident Associate of Hanszen College

BONNER, TOM WILKERSON
B.S. (Southern Methodist) 1931, M.A. (Rice) 1932, Ph.D. (Rice) 1934
Professor of Physics, Non-Resident Associate of Will Rice College

BOURGEOIS, ANDRÉ MARIE GEORGES
Bachelier és Lettres (Paris) 1921, Bachelier en Droit (Paris) 1923, Certifié d'Etudes supérieures de lettres (Paris) 1930, M.A. (Texas) 1934, Docteur d'Université (Paris) 1945, Officier de l'Instruction publique 1945
Professor of French

BRACKETT, THOMAS E.
B.S. (Maine) 1954, Ph.D. (California) 1958
Assistant Professor of Chemistry, Non-Resident Associate of Will Rice College

BROTHERS, DWIGHT STANLEY
B.A. (Colorado College) 1951, M.A. (Princeton) 1954, Ph.D. (Princeton) 1957
Associate Professor of Economics, Non-Resident Associate of Wiess College

BROTZEN, FRANZ RICHARD
B.S. (Case Institute) 1950, M.S. (Case Institute) 1953, Ph.D. (Case Institute) 1954
Professor of Mechanical Engineering, Non-Resident Associate of Jones College

BROWN, ARLEN
Ph.B. (Chicago) 1948, Ph.D. (Chicago) 1952
Associate Professor of Mathematics

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

BURGHARD, HERMAN C., JR.
B.S. in M. E. (Rice) 1950, M.S. (Rice) 1958
Assistant Professor of Mechanical Engineering

BUSCH, ARTHUR W.
B.S. (Texas Tech.) 1950, S.M. (M.I.T.) 1952
Assistant Professor of Civil Engineering

CAMDEN, CARROLL
A.B. (Centre) 1925, M.A. (Iowa) 1928, Ph.D. (Iowa) 1930
Professor of English and Non-Resident Associate of Hanszen College

CAMPBELL, JAMES WAYNE
B.S. (Southwest Missouri) 1953, M.S. (Illinois) 1955, Ph.D. (Oklahoma) 1958
Instructor in Biology

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

CHAPMAN, ALAN JESSE
B.S. in M. E. (Rice) 1945, M.S. (Colorado) 1949, Ph.D. (Illinois) 1953
Professor of Mechanical Engineering

CHILLMAN, JAMES
B.S. in Arch. (Pennsylvania) 1913, M.S. in Arch. (Pennsylvania) 1914, F.A.A.R. (Am. Acad. in Rome) 1922, Fellow A.I.A. 1950
Trustee Professor of Fine Arts and Non-Resident Associate of Jones College

CLASS, C. M.
A.B. (Johns Hopkins) 1943, Ph.D. (Johns Hopkins) 1951
Associate Professor of Physics and Master of Jones College

CONNER, JACK EDWARD
B.A. (Texas A. and I.) 1939, B.S. (Texas A. and I.) 1942, Ph.D. (Stanford) 1952
Associate Professor of English and Non-Resident Associate of Will Rice College

COPE, JACKSON I.
B.A. (Illinois) 1950, Ph.D. (Johns Hopkins) 1952
Associate Professor of English, Non-Resident Associate of Jones College

CRAIG, HARDIN, JR.
A.B. (Princeton) 1929, A.M. (Harvard) 1931, Ph.D. (Harvard) 1937
Professor of History, Librarian and Non-Resident Associate of Will Rice College

CRONEIS, CAREY
B.S. (Denison) 1922, M.S. (Kansas) 1923, Ph.D. (Harvard) 1928, D.Sc. (Denison) 1945, LL.D. (Lawrence College) 1944, D.Sc. (Ripon) 1945, D.Eng. (Colorado Mines) 1949, LL.D. (Beloit) 1954
Harry Carothers Wiess Professor of Geology and President, Acting, 1960-1961

CURL, ROBERT FLOYD, JR.
B.A. (Rice) 1954, Ph.D. (California) 1957
Assistant Professor of Chemistry

DAVIES, JOSEPH ILOTT
B.A. (Rice) 1928, M.A. (Rice) 1929, Ph.D. (Rice) 1937
Associate Professor of Biology and Non-Resident Associate of Hanszen College

DAVIS, SAM H., JR.
B.A. (Rice) 1952, B.S. in Ch.E. (Rice) 1953, Sc.D. (M.I.T.) 1957
Assistant Professor of Chemical Engineering

DEANS, HARRY ALEXANDER
B.A. (Rice) 1953, B.S. in Ch. E. (Rice) 1954, M.S. in Ch. E. (Rice) 1956
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DE BREMAECKER, JEAN-CLAUDE
Ingénieur Civil des Mines (Louvain) 1948, M.S. (Louisiana State) 1950, Ph.D. (California) 1952
Assistant Professor of Geology

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FACULTY IN MILITARY AND NAVAL SCIENCE

BAYLY, DONALD CLAY
B.S. (U. S. Naval Academy) 1945, M.S. (U. S. Naval Post Graduate School) 1952
Lieutenant Comamnder, U. S. N.
Assistant Professor of Naval Science

DEAN, ORVILLE OTIS
B.S. in B. A. (Oklahoma) 1936
Captain, U. S. N.
Professor of Naval Science

GRIFFIN, JOHN IRVING
B.A. (Dartmouth) 1957
Lieutenant (j. g.), U. S. N.
Assistant Professor of Naval Science

KOBS, ERNEST CHARLES, JR.
B.S. (Texas A & M) 1948, M.S. in C. E. (Missouri School of Mines and Metallurgy) 1957
Captain, C.E.
Assistant Professor of Military Science

ROSS, ROBERT MAIN
B.A. (Occidental) 1941
Commander, U. S. N.
Associate Professor of Naval Science

SCHLOER, ERIC GEORGE
B.S. (Utah) 1948, M.S. (Utah) 1950
Lieutenant Commander, U. S. N.
Assistant Professor of Naval Science

SEARS, REDFORD DAVIS
B.A. (Texas) 1947
Major, U. S. M. C.
Assistant Professor of Naval Science

SPACEK, FRANK J., JR.
B.S. (Texas A & M) 1947
Major, C. E.
Assistant Professor of Military Science

TANGEMAN, STEWART EDWARD
B.A. (Nebraska) 1948
Lieutenant Commander, U. S. N.
Assistant Professor of Naval Science

WILBY, LANGFITT B.
B.S. (U. S. Military Academy) 1935, M.S. in C. E. (University of Calif.) 1938
Colonel, C. E.
Professor of Military Science

STAFF OF THE LIBRARY

BISHOP, MARTHA
Ph.D. (University of Munich) 1947
Catalogue Librarian

BLAKE, RUTH
B.A. (Rice) 1950, M.A. (Rice) 1951
Catalogue Librarian

BRIANT, BARBARA
B.A. (Hendrix) 1956, M.A. (Peabody) 1957
Circulation Librarian

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

CARTER, CLAUDIA J.
B.A. (New Hampshire) 1950, M.S. in L. S. (Columbia) 1958
Assistant Order Librarian

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

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

HOOKER, LLOYD
B.S. (University of Houston) 1958, M.A. (Peabody) 1959
Circulation Librarian

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

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

LANE, SARAH LOUISE
B.A. (Rice) 1919, B.S. in L. S. (Columbia) 1932
Head of Circulation Department

O'KEEFFE, RICHARD L.
Ph.B. (Mount Carmel) 1949, M.S. in L. S. (Louisiana State) 1956
Assistant Librarian and Science Librarian

RODELL, ELIZABETH GOODSON
B.A. (Rice) 1931, B.S. in L. S. (Denver) 1940
Head of Catalogue Department

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

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

STAFF OF THE ATHLETIC DEPARTMENT

BALE, ALLEN MELBERT
Assistant Coach of Football

BEALL, WILLIAM E.
Assistant Coach of Football and Baseball

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

DAVIS, JOE WALLACE
Line Coach of Football

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

FRANKIE, JOHN
Coach of Basketball

GIAMMALVA, SAMUEL ANTONE
Coach of Tennis

GRIGG, CECIL BURKETT
Backfield Coach of Football and Assistant Coach of Track

HAGAN, HAROLD B.
Assistant Coach of Football

LANZA, NICK
Coach of Freshman Football

MOORE, CHARLES EDWARD, JR.
Assistant Coach of Football

MORGAN, JOHN O.
Assistant Coach of Football and Coach of Baseball

NEELY, JESS CLAIBORNE
Director of Athletics and Head Coach of Football

WHITMORE, WILLIAM ROGERS
Athletic Publicity Director

WOJECKI, EDWARD J.
Head Athletic Trainer and Assistant Instructor in Physical Education

WILLIAM MARSH RICE

UNIVERSITY

GENERAL STATEMENT

William Marsh Rice, a native of Massachusetts, founded the Rice Institute in Houston, where he had spent a great part of his life. The founder's ashes are contained in the base of a bronze statue by John Angel, at the center of the Academic Court.

The Rice Institute was incorporated in 1891 under a charter which allowed large freedom in the organization of an institution to be dedicated to the advancement of literature, science, and art. On December 28, 1907, the Board of Trustees appointed Dr. Edgar Odell Lovett, professor of mathematics and head of the astronomy department at Princeton University to be the first president of the Institute. The new university was opened in September, 1912, after careful and extended planning, to an entering class of seventy-seven students.

The enrollment expanded rapidly at the Institute during the early years. Since 1924, annual admission of undergraduate students has been limited to about 450. No restriction has so far been placed on the acceptance of qualified graduate students.

In 1946, Dr. Lovett retired as president and was succeeded by Dr. William V. Houston. Dr. Lovett became president emeritus; he died in 1957. In 1960, Dr. Houston retired as president and assumed the title of Chancellor of the University. The appointment of a new president will be announced.

During World War II, the Board of Trustees was actively planning the post-war development of the Institute. Based on a comprehensive survey undertaken early in 1945, a long-range development program was formulated, whose spirit is indicated by the first of its twelve points.

> It shall continue to be the objective of the Rice Institute to provide especially good training for a limited number of students. The Institute will provide a broad and sound basic program with a well-developed and strong curriculum in arts and letters and with the emphasis on science and research that is required to meet changing circumstances.

The development program has been carried forward very actively. The most visible evidence has been the number of new buildings erected in recent years. The M. D. Anderson Hall, a classroom and office building, was opened in 1947. The Fondren Library was opened for use in May, 1949. In rapid succession have come the Abercrombie Engineering Laboratory; Wiess Hall, a fourth residence hall for two hundred men; a nuclear research laboratory housing a six-million-volt Van de Graaff generator provided by the Atomic Energy Commission; a home for the President; a new football stadium which seats 70,000 persons; and a gymnasium containing a swimming pool and offices for the physical education department. In 1956-57, by enlarging the existing dormitories and erecting new dining halls, lounges, and homes for the masters, Rice created four residential colleges for men; Baker, Will Rice, Hanszen, and Wiess. The Mary Gibbs Jones College for Women was opened in September of 1957. A geology building, a biology building, and the Hamman Hall auditorium were all completed early in 1958, and the Rice Memorial Center, connected by a cloistered walk to the Rice Memorial Chapel, with associated offices and meeting rooms for various student religious groups, was opened in 1959. Rayzor Hall, containing classrooms, offices, and laboratories for social sciences and languages, is expected to be ready for occupancy in 1962.

Like the building program, all other phases of the post-war plans announced by the Trustees have been vigorously developed. The number of faculty members has grown from less than seventy before the war to over one hundred seventy. A department of geology and several courses in music and anthropology have been added, and a department of Fine Arts created. The undergraduate curricula have been revised and are continuing to undergo revision; procedures for selecting students for admission have been made increasingly rigorous; and programs of graduate study and research have been greatly expanded. During the academic year 1960-61 there were 319 graduate students enrolled and there were thirty post-doctoral fellows and research associates working in the laboratories of the Institute. In 1959 President Houston announced the appointment of two new academic deans as administrators of the humanities and engineering programs of the university.

In September, 1949, the directing body of the Institute was enlarged to a fifteen-member Board of Governors, composed of the seven permanent trustees and eight governors appointed by the trustees for terms of one to four years. Then, in 1954, a new body, the Rice University Associates, was formed to provide a channel for the free exchange of ideas between the students and teachers of the Institute and a group of representative citizens who have influence in civic, cultural, and educational affairs of the region.

The name, the Rice Institute, was changed to William Marsh Rice University on July 1, 1960.

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 has pleasure in recognizing on these pages some of these contributors to its academic excellence.

The Bartlett Aesthetics Program

In the fall of 1959 the chamber music concerts which had been for several years supported by Dr. and Mrs. H. L. Bartlett were expanded into an Aesthetics Program consisting of lectures and concerts which, it is hoped, will be an annual feature of the University calendar. The first two Bartlett Lecturers were Dr. Theodore Greene and Dr. Iredell Jenkins.

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.

The Harris Masterson, Jr. Chair in History

The late Reverend Harris Masterson, Jr. was deeply interested in the Rice Institute 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 Institute with which the Board of Governors established a memorial to him in this chair.

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

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, and Dr. Joseph Sittler.

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 Institute. 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 the gift maintains a lectureship and a number of courses and activities in music.

The Harry Carothers Wiess Chair of Geology

In 1952, Mrs. Olga Keith Wiess gave a substantial endowment to the Institute 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 Institute, 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 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. Recent lectures have been delivered by Sir John Sheppard, Dr. William B. Hesseltine, Dr. Felix Block, Dr. Edwin G. Nourse, Dr. Arne Tiselius, and Professor David Ogg.

"Research At Rice" Television Series

For several years Rice University has presented a series of programs in cooperation with KTRK-TV, Houston, representing to the region some aspects of research in the various areas of study in science, engineering, and the humanities at the university.

UNDERGRADUATE ADMISSION

In selecting members of the Freshman class from the large number of well-qualified candidates who apply for admission, William Marsh Rice University undertakes to identify and to admit those with exceptional ability and potential who appear best prepared to grow to intellectual maturity during their residence at the University.

The criteria used in the prediction of such development are of four basic types: 1) past scholastic performance as evidenced by high school grades; 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, scholastic enthusiasm, and desire to learn. 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. Interviews and ratings obtained from high school teachers and counselors give some insight into 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 ten 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 Academic, Architectural, and Science-Engineering divisions of the University.

For further information, publications, 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.

ADMISSION OF FRESHMEN

1. **The High School Record.** Graduation from an approved public or private high school with not less than sixteen acceptable units is required. These units should include:

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

An introductory high school course in chemistry, or the equivalent, must be taken if any chemistry is to be studied at Rice. Likewise, a high school course in physics, or the equivalent, should precede the study of any physics at Rice.

Variations from the above distribution of units may be approved in exceptional cases at the discretion of the Committee on Admissions.

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. requesting 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 27896, Los Angeles 27, 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.

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
      Social studies
      Mathematics
      A science

(3) The Writing Sample

Science Engineering

(1) Scholastic Aptitude Test

(2) Three Achievement Tests as follows:
   a. English composition
   b. Advanced mathematics
   c. Chemistry or physics

(3) The Writing Sample

Academic majors are offered in biology, economics-business administration, English, German, history, mathematics, philosophy, psychology, and Romance languages. Students preparing for later work in dentistry, medicine or law should take their work in the academic or science major of their choice.

Science-Engineering majors are available as follows: biology, chemistry, geology, mathematics, physics, chemical engineering, civil engineering, electrical engineering, and mechanical engineering.

3. **Personal Interviews.** All applicants who can conveniently present themselves at the University will be interviewed between December 15 and March 1 of each academic year. Applicants living at such a distance that they cannot conveniently come to Houston will be given opportunities for interviews during the month of March in such population centers as Beaumont, Dallas, Fort Worth, and San Antonio. Each applicant who has filed all his application forms by March 1 and has requested such an interview will be sent a notice of the time and place of the interview. Applicants who have completed their application files and who are unable, because of distance, to meet interview engagements in Houston or in one of the other interview centers, will be interviewed individually by alumni. If an applicant cannot readily be interviewed by one of these methods, the interview may be waived, without prejudice.

4. **Ratings 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 March College Board tests are available in April. Notices regarding the action taken by the Committee are sent to applicants during the first two weeks of May.

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 five full-year 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, if possible. When requesting application forms, the applicant should indicate clearly the number of years of work 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 Test.

Decisions regarding transfer applications will be reached in the latter part of April, and notice mailed to candidates by approximately May 15.

ADVANCED PLACEMENT

Entering freshman students who have done work beyond the usual high school courses in certain subjects and who make superior scores on the Advanced Place-

ment 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: mathematics, American history, English, French, German, Spanish, physics, chemistry, and biology.

SPECIAL INFORMATION

A student who has been admitted to the University will be 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 $25.00 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 June 1, 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 $25.00 payment will be forfeited.

SCHOLARSHIP AID AND LOAN FUNDS AVAILABLE TO NEW STUDENTS

William Marsh Rice University has a number of modest scholarship awards available to incoming students. These awards, ranging from $200 to $500, are limited to entering freshmen; none are available for transfer students.

The University has a loan fund which attempts to meet the needs of students for loans on a long-term as well as short-term basis. The loans are limited to $1,000 per year, with a maximum of $2,000 for any one person through the normal four-year period as a student. These loans are available to entering freshmen, transfer students, or graduate students.

ADMISSION TO GRADUATE STUDY

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 Committee 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 Director of Admissions at Rice for the necessary forms.

CURRICULA AND DEGREES

William Marsh Rice University offers baccalaureate degrees in arts and sciences, physical education, engineering, and architecture. 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. Curricula leading to the Bachelor of Science degree in engineering require five years for completion; the Bachelor of Arts degree is awarded on successful completion of four years in these courses of study. The course of study in Architecture is of five years duration, leading to the degree of Bachelor of Science in Architecture. The degree of Bachelor of Science in Physical Education is awarded after four years of successful study in that curriculum.

Graduate study is offered in the arts and sciences, architecture and engineering. In the arts and sciences, programs leading to the Master of Arts and Doctor of Philosophy degrees are offered. 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. Application for admission to graduate study is made through the department concerned to the Committee on Graduate Instruction. Applicants are required to submit evidence of suitable preparation and of ability to do work of the quality expected. For further information about graduate study and for detailed description of the requirements for advanced degrees, see pp. 41-43.

UNDERGRADUATE PROGRAMS

During the first two years, students are registered in the four basic curricula (academic, science-engineering, architecture, physical education), in which a considerable part of the work is prescribed. During the second two years, wider choice of majors and individual courses is given. Throughout the entire four-year period, however, each student pursues a broad program of the fundamental sciences and humanities, rather than a narrrow course of specialization.

Humanities

In the majority of courses the formal instruction offered consists of three lectures a week throughout the academic year, together with concurrent laboratory in certain subjects.

The schedule of every student must be approved by his department of specialization in each of the last two years. Special arrangements may be made through the appropriate dean's office for modification of any curriculum leading to a bachelor's degree in order that courses in naval or military science may be taken, or that premedical, prelegal, or teacher training requirements may be met.

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 specified in each group.

Group A — languages, literature, and music

Group B — history, social studies, philosophy, psychology and education

Group C — engineering, mathematics and science.

First Year

(1) Mathematics 100 or 101
(2) Laboratory Science
(3) English 100
(4) French or German[1]
(5) History 100 or 110
(6) Physical Training 100
(7) R.O.T.C., if elected (see pp. 127-130)

Second Year

(1) Mathematics 200 or 210, or a laboratory science
(2) English or general literature elective
(3) French or German (continuation of language elected in first year)
(4) Elective in Group B
(5) Elective in Group A, B or C
(6) R.O.T.C., if elected (see pp. 127-130)

Third and Fourth Years

Academic majors are offered in biology, economics and business administration, English, German, history, mathematics, philosophy, psychology, and Romance languages. A major in biology or mathematics may be taken in either an academic or science curriculum.

Ten courses are required, including two in Group A, two in Group B, and one in Group C (or an advanced course in psychology). At least seven of the ten courses must be advanced (numbered 300 or higher). Not less than three nor more than five of the third and fourth year courses and not more than six 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 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 both Group A electives.

Science

Students majoring in a 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, as well as selection of electives 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) Mathematics 100
(2) Physics 100
(3) Chemistry 120
(4) History 100 or 110
(5) English 100
(6) Physical Training
(7) R.O.T.C., if elected (see pp. 127-130)

[1] 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) Mathematics 200 or 210
(2) Physics 200a (first semester)
Physics 200b or engineering elective (second semester)
(3) German, French, or Russian[1]
(4) English or general literature elective
(5) Elective in Group A, B or C (except Accounting)
(6) Elective in Group A, B or C, or R.O.T.C.

Third, Fourth and Fifth Years

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

Ten courses are required, including at least four in the major field of study, two in Group C outside the major field, one in the language started in the sophomore year, and of the remaining three courses two must be chosen from Groups A or B. Seven of these ten courses must be advanced (numbered 300 or higher). Not more than six 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 of the last two years.

Engineering

Degrees are awarded in Chemical Engineering, Civil Engineering, Electrical Engineering and Mechanical Engineering. Curricula leading to the degree of Bachelor of Science in Engineering require five years for completion. The degree of Bachelor of Arts is awarded on successful completion of four years in these courses of study.

During the first two years students with 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 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 his 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. Admission to fifth-year studies is accomplished through application to the Committee on Examinations and Standing. Applicants 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 to the Dean of Engineering for evaluation. Acceptance or rejection is determined after consideration of past academic performance and the recommendation of the department concerned.

Beyond the second year students must follow one of the programs described below.

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[1] Students having two or more high school units in a foreign language are not permitted to enroll in a beginning course in that language.

Third and Fourth Years

Eleven courses are required for completion of the Bachelor of Arts degree, eight to be in Group C and two chosen from Groups A or B. The other is an undesignated elective. At least seven 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 or naval science courses for one of the requirements in each of the last two years, except that these substitutions may not be made in Groups A or B.

Fifth Year

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

Civil Engineering. Five advanced courses in Civil Engineering numbered 500 or higher, approved by the major department, plus a departmental seminar. For particularly qualified students with directed interests, flexibility in course offerings may permit some specialization in structural or sanitary engineering.

Electrical Engineering. Five advanced courses in Electrical Engineering numbered 500 or higher, approved by the major department, plus a departmental seminar.

Mechanical Engineering. Four advanced courses numbered 500 or higher in Mechanical Engineering and one elective in engineering or science approved by the major department plus associated laboratories and departmental seminar. For properly qualified and prepared students, flexibility in courses offered may permit specialization in Engineering Mechanics, Thermodynamics and Heat Transfer, or Physical Metallurgy.

Architecture

First Year

(1) Mathematics 100
(2) Physics 100
(3) English 100
(4) History 100 or 110
(5) Architecture 100
(6) Physical Training

Second Year

(1) Mathematics 200 or 210, English, or Philosophy
(2) French or German
(3) History of Art 215 or elective in Group B
(4) Elective
(5) Architecture 200
(6) Drawing 225

(Students who take History 100 in the First Year will be required to take the Group B elective in the Second Year, in place of History of Art 215.)

Third and Fourth Years

Architectural students will be required to take their major work in Principles of Architecture in each of the third and fourth years. In addition, they will be required to take two courses in History of Art and two electives chosen from

Group A, Group B, or Group C, except that both electives may not be chosen from the same group. Students who have already completed History of Art 215 will register for only one course in History of Art and will take an additional elective. Advanced students in Architecture will also be required to take one course in Drawing.

Fifth Year

Students registered in Architecture will be required to take their major departmental work in Principles of Architecture and two electives in Group A, B, or C. Beginning in June 1965, candidates for the degree of Bachelor of Science in Architecture will be required to complete a minimum of twelve weeks of training in the office of a registered architect, and four weeks of travel directed toward architectural study. A report of such employment and travel will be required by the Department of Architecture.

Physical Education

First Year

(1) English 100
(2) Biology 100
(3) Physical Education 100 and 125
(4) Physical Science 150
(5) French, German or Spanish, or R.O.T.C.[1]

Second Year

(1) Physical Education 200 and 225
(2) English or general literature elective
(3) French, German or Spanish (continuation of language elected in first year)
(4) Elective
(5) Elective, or R.O.T.C.

Third and Fourth Years

At least ten courses are required, including at least three in the major, one in psychology and one in anatomy and public health. A minimum of seven of the ten courses must be advanced (number 300 or higher).

Students planning to enter educational work must elect one course in American History, Political Science 210, and two courses in Education.

ADVANCED DEGREES

The degree of Doctor of Philosophy may be awarded in the fields of biology, chemical engineering, chemistry, civil engineering, economics, electrical engineering, English, French, geology, German, history, mathematics, mechanical engineering, philosophy or physics. This degree represents the completion of at least three years of advanced study after the award of a suitable bachelor's degree, and in most cases four or more years are required. It also represents

[1] Students having two or more high school units in a foreign language are not permitted to enroll in a beginning course in that language. Students in R.O.T.C. take History 110 and military science or naval science in the first year, completing the required foreign language requirements in the Junior and Senior years.

the completion of an original piece of investigation, the report of which constitutes the thesis. The thesis must be deposited in the University library in accordance with the established regulations (see page 43). 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 degree of Master in Architecture or Master of Science may be obtained, the latter being awarded in chemical, civil, electrical, or mechanical engineering. Each of these degrees represents the completion of at least one full year of advanced work in a special field. 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.

Oral Examinations. The Committee for an oral examination is appointed by the Graduate Committee upon request of the candidate's Thesis Director and the Chairman of the Department. Such request must be made prior to the beginning of the second semester of the year in which the degree is expected. The Oral Committee 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. After the committee has been named no changes in its membership will be made.

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 the previous week. In the event that the examination is scheduled during the summer, the posting of an appropriate notice 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. After a second failure, the student will be required to withdraw from the University.

Language requirements for advanced degrees are as follows:

A candidate for the master's degree will be expected to demonstrate a reading knowledge of one foreign language to a committee composed of one representative of the appropriate language department and one representative of the candidate's major department.

A candidate for the degree of Doctor of Philosophy will be expected to demonstrate a reading knowledge of either French or German to a committee composed of one representative of the appropriate language department and one representative of the candidate's major department. In addition, he will be expected to demonstrate to the satisfaction of the Graduate Committee a reading knowledge of one other language approved by his major department.

The Committee on Graduate Instruction has authorized three scheduled periods for the language examinations required of all candidates for the M.A. and Ph.D. 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 M.A. degree may satisfy the language requirements in any of these three examination periods.

Graduate students must consult with the language department to determine the exact time and place of these examinations and must request their research directors to select a suitable book or journal. The choice of the material and the judgment of ability to read this material rests with the language department.

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 below be followed.

1. The thesis, in final form, should be presented in triplicate to the professor in charge of the thesis work, not later than the beginning of the final Examination Week. It should be fastened together in such a way as to avoid loss or mutilation of pages without punching holes in the sheets. A compression binder is recommended.

2. After securing the approval of the three members of the Oral Committee on the title page, the candidate must then present the three copies, together with a fee of $9.00 to cover the cost of binding ($3.00 per copy), to the secretary to the Committee on Graduate Instruction on the second floor of Lovett Hall, *not later than the Friday before Commencement.* Theses more than one inch in thickness must be bound in more than one volume. Candidates may have additional copies of the theses bound for their own use at the rate of $3.00 per copy.

The latest time at which the thesis in final form, with the title page signed by all members of the Committee, will be accepted by the Secretary to the Graduate Committee will be 5:00 P. M. on the Friday before Commencement Day of the year in which the degree is expected.

More specific information about requirements for advanced degrees in each field of study is given under department headings in the section of this catalogue describing course offerings, which begins on page 61.

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. Laboratory fees only will be charged.

Applicants for admission to graduate study are advised to take the Graduate Record Examination, arrangements for which may be made by writing to the Educational Testing Service, 20 Nassau Street, Princeton, New Jersey. Preference will be given to applicants who earn high scores on examinations given by this organization. At the discretion of the Committee on Graduate Instruction, the Graduate Record Examination or other examinations may be required of individual applicants.

Application for admission to graduate study should be made as early as possible to the chairman of the instructional department in which the applicant wishes to specialize.

RULES GOVERNING REGISTRATION, EXAMINATIONS, AND STANDING

All students seeking a bachelor's degree are subject to the rules of the faculty Committee on Examinations and Standing. The Committee 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. Entering students are sent registration materials during the summer. All registrations must be completed by September 1.

The course registration card of each student must be approved and signed. The Registrar approves course registrations of all entering freshmen; the members of the Committee on Examinations and Standing approve registration of sophomore students; others are approved by an adviser appointed by the head 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 5). A student who makes a change of course or section within the first two weeks of the term is charged a fee of $10.00 per course. This fee is not charged when a change in a 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. Normal course programs for all undergraduate students are described on pp. 37-41 and in more detail in supplementary sheets supplied each student before registration. Any irregular program must be approved by the Committee on Examinations and Standing, except that 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.

No student may reduce the program for which he is registered without approval of the Committee on Examinations and Standing.

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

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

Other tests and examinations are given from time to time at periods decided by the instructors. Tests and examinations are conducted under a student honor system. (See p. 59). In determining grades, instructors consider both performance during the term and the record of examinations.

Grade symbols have the following meanings: *1*, Very high standing; *2*, High standing; *3*, Satisfactory standing; *4*, Poor standing; *5*, Failure. Most courses require two consecutive semesters for completion. Grades are recorded for the first term in February; in June, grades are recorded for the second term and for the year. The yearly grade incidates the student's final standing in the course.

Dean's List. Outstanding students are honored each semester through the publication of the Dean's List, which includes all students who have no grade less than 2 in any course. This distinction is made a part of the student's permanent record and he is also granted certain special privileges.

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 full schedule 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 required to withdraw from the University.

A student who goes on probation at the end of the year in which he is a degree candidate but who is eligible to re-register 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 college publication.

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.

Enforced Withdrawal. A student shall be required to withdraw from the University:

(1) If he fails to earn passing grades in at least 50 per cent of his full schedule in any semester, or for any academic year. This clause does not apply to an undergraduate student at the end of his first semester at the University.

(2) If he has already been placed on probation twice and his semester grades, at any subsequent time, are such as would result in a third probation.

(3) If he fails to fulfill all the terms of special probation, as outlined above.

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 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***.

SCHOLARSHIPS, FELLOWSHIPS AND AWARDS

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.

American Oil Company Fellowship in Chemical Engineering.

American Society for Testing Materials Fellowship in Civil Engineering.

M. D. Anderson Fellowships in Physics.

M. D. Anderson Foundation Post-Doctoral Fellowship.

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.

Samuel Fain Carter Fellowship. Established in 1932 for Graduate study in Economics.

Celanese Corporation Fellowship in Chemical Engineering.

John B. Coffee Graduate Awards in Geology.

Continental Oil Company Fellowship in Chemical Engineering.

M. D. Davidson Fellowship in Architecture.

Dow Chemical Company Fellowships. One Fellowship is restricted to the field of Chemistry, Chemical Engineering, or Physics; a second Fellowship is restricted to the field of Mechanical Engineering.

Fluor Corporation Fellowship. The field of study is unrestricted.

Humble Oil and Refining Company Fellowships. Four Fellowships are available, one in each of the following departments: Chemistry, Geology, Physics, and X-Ray Diffraction.

Ideal Cement Company Fellowship in Civil Engineering.

Kobe Steel Works Fellowship in Chemical Engineering.

Edgar Odell Lovett Fellowship in Mathematics.

Magnolia Petroleum Company Fellowship in Physics.

National Aeronautics and Space Administration Fellowship in Chemical Engineering.

National Institute of Health Traineeship Award in Civil Engineering.

Ohio Oil Company Foundation Fellowship in Physics.

Pan American Petroleum Fellowship in Chemical Engineering.

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

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.

Texas Company Fellowship in Electrical Engineering.

Texas Eastman Fellowship in Chemical Engineering.

Texas Gulf Producing Fellowship in Geology.

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 Architectural Society of Rice University.

Robert A. Welch Foundation Fellowships.

Graduate Assistantships-Fellowships. Graduate students with high academic records and outstanding qualifications may receive assistance through awards of graduate assistantships-fellowships in the various departments of Rice. These awards are of equal value; the stipend for such dual appointments is $1600-$1800 with exemption from fees. A student holding a graduate assistantship must be a candidate for an advanced degree; he will be expected to devote a substantial part of his program to study and research, and at the same time to teach one section in an elementary course or to do an equivalent amount of other departmental work. He will thus get a certain amount of valuable practical training in preparation for an academic career. Appointments carrying larger stipends, with a schedule equivalent to a teaching load of two sections, are occasionally available; such appointments depend on the interests and attainments of the student and on the requirements of the department.

In 1960-61, there were 121 Graduate Assistantships - Fellowships awarded. Graduate students holding these appointments were studying in 14 different departments, distributed as follows:

Architecture	2	English	14
Chemistry	15	Foreign Languages	9
Economics	3	Geology	8
Chemical Engineering	15	History	9
Civil Engineering	2	Mathematics	9
Electrical Engineering	1	Philosophy	1
Mechanical Engineering	9	Physics	24

Graduate 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 scholarships with exemption from all fees but without stipend. Graduate scholars may carry a full schedule of graduate work, and are not required to render any service to the University.

Non-Institutional Fellowships. In addition to the above fellowships, students may pursue advanced research through Atomic Energy Commission Fellowships.

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 Charles A. Coffin and Gerard Swope Fellowships awarded by the General Electric Educational Fund, the Frank B. Jewett Fellowships awarded by the Bell Telephone Laboratories, and the National Science Foundation Fellowships. Applicants for predoctoral fellowships under the Fulbright Act administered by the Institute of International Education, and for postdoctoral research and teaching exchanges under the same act administered by the Committee on International Exchange of Persons, should also file with the Committee on Graduate Instruction.

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.

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

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 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 *Robert Pilcher Quinn Award* is presented annually to a student who has demonstrated outstanding qualities in athletics, leadership, schloarship 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 has indicated a desire for further study of history, preferably Biblical or ancient history.

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 *Alcoa Foundation Scholarships* are awarded to four students of engineering who are in either the Junior, Senior, or fifth year of study.

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

The *American Society for Metals, Texas Chapter*, has established a scholarship fund for an advanced student in engineering whose primary interest is in metallurgy.

The *Samuel S. Ashe Scholarship* is awarded annually to the student having highest standing at the end of the Freshman year.

The *Max Autrey Memorial Scholarships* were 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.

The *Axson Club's Ellen Axson Wilson Scholarship* was established in 1922 for a young woman student of Junior or Senior standing.

The *Axson Club's Katie B. Howard Scholarship* for young women, in memory of Mrs. A. R. Howard, has been awarded annually since 1937.

The *B. & H. Instrument Company* has provided two scholarships annually since 1956 to encourage and assist worthy students in electrical and mechanical engineering.

The *Mr. and Mrs. Val T. Billups Scholarship* fund was established by the named donors in 1953 for students of engineering above Freshman standing.

The *Black-Brollier Scholarship* was established in 1956 for students in Architecture above Sophomore standing. Awards are made annually during the first semester.

The *Borden Freshman Prize* is given to the student having the highest grades for all work of the Freshman year.

The *Cabot Engineering Scholarships* are two and three year awards made available to Junior students in Engineering by the Cabot Foundation.

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

The John B. Coffee Scholarship is awarded to an advanced student in Geology.

The *College Women's Club of Houston* established a fund 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.

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

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

The *John L. and Exna Doré Scholarship* provides a fund annually to assist deserving students of the Sophomore, Junior and Senior classes.

The *Dow Chemical Freshman Awards in Chemistry and Chemical Engineering* are given annually to the outstanding Freshman student in each of those fields of study.

The *Eastern States Petroleum Company Scholarship in Mechanical Engineering* gives financial assistance to an outstanding fourth or fifth-year student.

The *Edwards Scholarships* are given to entering Freshman students who are planning careers in government service.

The *Elizabeth Baldwin Literary Society Scholarship* is available to both men and women students of the University on recommendation of the officers of the society.

The *Elks Scholarship* is provided by the B. P. O. Elks Lodge, No. 151, of Houston for a Sophomore student of the University.

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

The *Farb, Miller & Beerman Company Scholarship* in Accounting is awarded to a student entering the Junior Year.

The *Fish Foundation Scholarships* were established in 1958 by Mr. Ray C. Fish to benefit needy, worthy undergraduate students.

The *Thomas R. and Julia H. Franklin Scholarship Fund,* established in 1937, provides income to be devoted to the awarding of annual scholarships to well-qualified necessitous students.

The *Mary Parker Giescke Scholarship* is awarded annually to a student who has been in residence at least one year.

The *Graham Baker Studentship* was 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.

The *Blanche Randall Haden Scholarship* is awarded annually to a deserving undergraduate specializing in economics.

The *Wm. D. and Lucy L. Haden Scholarships* were founded by Mr. Cecil R. Haden for entering students in Architecture.

The *Haskins & Sells Foundation Scholarship* in Accounting is awarded to one of the five Senior students having the highest academic standing in accounting.

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

The *Will Hogg Memorial Fund* was established by the will of the late 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.*

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

The *Hughes Tool Company Scholarship* is an award to a student entering the fifth year of the curriculum in mechanical engineering.

The *John McKnitt Alexander Chapter* of the Daughters of the American Revolution provides an endowed undergraduate scholarship for a young woman student of Rice University.

The *Jones College Scholarships* are made available by the Mary Gibbs Jones College Cabinet for a member of the college who has maintaind high academic standing and has contributed significantly to the college life.

The *Grant William Jordan and Cora Jordan Memorial Fund* is available in trust to assist young men and women in obtaining an education at Rice University.

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

The *Charles L. Lake Memorial Scholarships* were established in 1955 by friends of the late Charles L. Lake to provide assistance to worthy students to enable them to attend required geology field trips and camps.

The *Patrons of E. L. Lester and Company Scholarship* is 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.

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

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

The *Mission Manufacturing Company Scholarships* in Mechanical Engineering are supported by the Mission Manufacturing Company for meritorious student in that field of study who show potential capacity for leadership.

The *Monsanto Chemical Company Scholarship* is awarded to a fourth or fifth-year student of high standing in recognition of accomplishment in Chemical Engineering.

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

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

The *Rebecca and Lilly G. Nussbaum Scholarship* was established under the will of the late Miss Ida R. Nussbaum in memory of her mother and sister.

The *Pallas Athene Literary Society Scholarship* is available to young women students of Rice University on recommendation of the officers of the society.

The *Emanuel and Mose Raphael Scholarship* was established by bequest of Miss Ida R. Nussbaum in memory of her uncles.

The *Richardson Fund* for Rice Students was 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.

The *Daniel Ripley Scholarship* was established in 1927 to be awarded to a self-supporting young man or woman completing the Freshman year with outstanding scholarship.

The *Edith Ripley Scholarships* are awarded annually to three young women students from the income of a fund donated by Mrs. Edith Ripley in 1928.

The *James M. and Sarah Wade Rockwell Scholarships* were established by a fund donated in 1958 in memory of the founders of the Rockwell Fund, Inc. The number of awards and the students to receive each scholarship are determined by a committee of the faculty appointed by the President of the University.

The *Benjamin E. and Catharine W. Roper Memorial Scholarships* were established through the will of their daughter, Miss Mary Withers Roper, to assist worthy students of the University.

The *Sarah Lane Literary Society Scholarship* is provided for by the membership of the Society to be awarded to an undergraduate student on recommendation of the officers of the Society.

The *Schlumberger Collegiate Award* is given by the Schlumberger Foundation for an advanced student with high standing in Physics, Geology, or Electrical or Mechanical Engineering.

The *Sara Stratford Scholarship* for women students of Rice University commemorates the late Mrs. Sara Stratford, first Adviser to Women.

The *Superior Oil Company Scholarships* are provided for through a gift from the Superior Oil Company to assist worthy entering students who are planning to study geology.

The *Texaco Scholarships*, made possible by Texaco, Inc., are awarded to Junior and Senior students of proven scholastic ability who have demonstrated qualities of leadership.

The *Union Carbide Scholarships* at Rice University are a part of a national scholarship program supported by the Union Carbide Corporation.

The *University Women's Alliance of Houston* awards a scholarship, based primarily on need of financial assistance, to a young woman in the Junior or Senior class. The recipient of the award is determined after consideration of scholarship, character and personality.

The *Walsh Prize in Architecture* is awarded by the Faculty in Architecture, on the basis of a competition, to an architecture student completing his fourth year of study.

The *Weingarten Scholarship* was endowed by the Weingarten Welfare Corporation in 1957 to assist a worthy scholar of good character.

The *Western Electric Company Scholarship* is maintained by the Western Electric Company for a student in engineering who has demonstrated exceptional promise and ability in his chosen field. Selection of the recipient is made by a committee of the faculty.

The *Westinghouse Achievement Scholarship* is given to Rice University to be awarded to a fifth-year student in Electrical or Mechanical Engineering who has achieved high scholastic standing and demonstrated qualities of leadership.

The *Blanche White Scholarships* are open to students of Rice University who have completed at least one year in residence.

The *Woman's Club of Houston* provides an annual award for an entering student, based upon scholarship and financial need.

LOANS AND SELF-HELP

Besides the stipends of graduate and undergraduate awards, there are, on the campus and in the city, opportunities in considerable variety for worthy and deserving students to earn a part of their living expenses while attending the University. Information concerning such openings may be obtained from the Placement Service.

Thanks to the generosity of a number of persons, there are available several student loan funds. Students who wish to make inquiries about loans should see the Bursar, who is Chairman of the Loan Fund Committee. Entering students, or those not currently enrolled, may address inquiries to the Bursar, Room 102, Lovett Hall.

Loans are available to assist students in payment of fees, room and board charges, or other necessary academic expenses. Terms of repayment are arranged individually at the time a loan is made.

GENERAL INFORMATION

EXPENSES

The opportunities for study and research offered by Rice University are open without tuition to men and women who are accepted for admission. Students are expected to meet all expenses incurred for textbooks and supplies, room and board, clothing and incidentals, and certain fees.

FEES

Undergraduates. Each student pays a comprehensive fee of $110 per year which covers a registration fee, a library fee, an examination fee, a fee for student activities, admission to athletic contests, use of the health service, use of the gymnasium, use of the Memorial Center, and participation in college activities. In addition, each student pays $10 for each semester of the laboratory courses he is taking.

Special Charges.

Freshman Week	$15.00
Late registration	15.00
Late examination (each course)	10.00
Diploma	6.00
Army R.O.T.C. (Deposit)	10.00

Graduate Students. Once a year, at registration, each student will pay $124.00 in General Fees, for registration and for use of the library, the laboratories, the gymnasium, the infirmary, and other campus facilities. In the year in which he is a candidate for a degree he will also pay $6.00 for his diploma. There will be no additional fees for laboratory courses. If a student is not in residence in the year of his degree, he will pay only $90.00 in General Fees, plus the $6.00 for his diploma.

A graduate student may purchase a Student Athletic Card, at a cost of $4.00, which will entitle him to admittance to all regularly scheduled athletic events. If married, he may purchase one additional card at the same price.

Every Student, both graduate and undergraduate, is required to provide a $300.00 guaranty signed by himself and a parent, guardian or other responsible person.

If a student withdraws during the two weeks following the opening day of classes all fees will be refunded. When withdrawal occurs within the third or fourth week one-third of the fees will be refunded. No refund of fees is made after the end of the fourth week of classes.

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.

OTHER COSTS

Undergraduate. 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 1960-61, the yearly fee for residence in the men's colleges was $950.00, in the women's college $1,000.00. 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. 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 assignment during the summer. These deposits are returnable only upon individual application, for good and sufficient cause. One-half of the residence fee should be paid upon taking up residence in September. The remaining sum should be paid before the commencement of classes in February. Students whose financial situation makes difficult the usual method of payment, outlined above, may make arrangements with the cashier to make a substantial payment in September followed by monthly payments throughout the year.

All items included, the young man or woman who is a resident member of one of the colleges will need to have available about $1400 for a year's work. For a student living at home the cost will run from $250 to $300. These figures are based on 1960-61 experience.

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 Adviser to Men 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 four undergraduate residential colleges for men ($950 per year) or in Mary Gibbs Jones College for Women ($1,000 per year). A graduate student wishing to be considered for such a room may write to the Adviser to Men or to the Adviser to 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 Advisers cannot know before the term begins about vacancies in the colleges.

STUDENT LOANS

Thanks to the generosity of a number of persons, several student loan funds are available to assist students in payment of fees, room and board, and other necessary academic expenses.

Loans are arranged on an individual basis to fit the needs of the student insofar as possible. Considerable latitude is permitted in arranging terms for

loans in amounts up to $1,000 per year. Inquiries about loans should be made to the Bursar, who is chairman of the Loan Fund Committee, the Director of Admissions, the Adviser to Men, or the Registrar.

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 50 to 60 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 income are advised to consult the Director of Admissions and the Director of the Placement Service.

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 contact the Placement Office in the Memorial Center as early as possible.

STUDENT LIFE

THE RESIDENTIAL COLLEGES

On entering Rice, every undergraduate student becomes and thereafter remains a member of one of five colleges: Baker, Hanszen, Wiess, and Will Rice for men, and Mary Gibbs Jones College 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. 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 also has a Master who, with his family, occupies the Master's House adjacent to the college. Members of the Faculty serve as resident and non-resident Associates.

Students are assigned to membership in a particular college by the Masters' Office, as authorized by the five Masters. 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 brother who is currently enrolled. No other choice of college can be allowed.

The buildings of each college include a dining hall and common rooms, available to resident and non-resident alike, as well as quarters for an average of about 215 students of all classes. Rooms are completely furnished except for linens.

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 admittance 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 Jones College. All other undergraduate women, except those who live with their families, must secure permission from the Adviser to 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 women students regarding residence in Jones College should be addressed to the Adviser to Women, Lovett Hall.

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 (reached by the east entrance of West Hall, Hanszen College). A Hospitalization and Accident Insurance policy with a nationally known company is available for students who desire this coverage.

MEMORIAL CENTER FACILITIES

Through the generosity of friends and alumni, the Rice Memorial Center was built. Ground was broken for this building on November 9, 1957, and it was dedicated on Homecoming weekend in the fall of 1958. The center and chapel comprise a memorial to those Rice Institute alumni who have died in the service of their country, and provision was made in the plans for commemorative inscriptions.

The center provides a chapel with associated offices; the latter are used by the various student religious groups. The chapel is utilized for regular interdenominational religious services, directed jointly by a faculty committee and the Student Religious Council. Denominational services are not held in the chapel, although it may be made available from time to time upon special request.

The center provides offices for 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.

ORGANIZATIONS AND STUDENT PUBLICATIONS

All students, upon matriculation, become members of the Student Association, which organizes and directs the various activities named below and through its officers, who form the Student Senate, represents the students.

Each of the five classes, Freshman, Sophomore, Junior, Senior and Class II Graduate, has an organization for its government and for the solution of special problems.

The various activities, covering cultural, professional, and avocational needs, comprise publications: *The Campanile* (annual), *The Rice Engineer* (quarterly), and *The Thresher* (weekly); the Elizabeth Baldwin, Owen Wister, Pallas Athene, Sarah Lane, Chaille Rice, Cleveland Lovett, and Olga Keith Literary Societies; musical groups: the band and several choral groups; foreign-language clubs; the Architectural Society, the Engineering Society, the Student Affiliates of the American Chemical Society, and the student branches of the American Institute of Chemical Engineers, the American Society of Civil Engineers, the American Institute of Electrical Engineers and the Institute of Radio Engineers, and the American Society of Mechanical Engineers; and other specialized organizations including the Rally Club, the Premedical Society, the Forum Committee, A.P.O., the Rice Sextant, the Radio Club, the Film Society, and an informally organized dramatic club under the sponsorship of the Department of English. There are also several religious clubs, organized under a Student Religious Council.

Through the generosity of the late Mrs. James L. Autry, as a memorial to her husband, the late James L. Autry, of Houston, the Diocese of Texas of the Protestant Episcopal Church is maintaining 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, Edward Albert Palmer, 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. Other religious bodies are considering provision for similar undertakings in the neighborhood of Rice University.

SERVICE AWARD

In memory of Hugh Scott Cameron, first Dean of Students at the Rice Institute, 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.

HONOR SYSTEM

Examinations are conducted under a student honor system, which is administered by an Honor Council whose members are elected annually from and by the student body. This council is responsible to the faculty, through the Adviser to Men, for the validity of all examinations and for the investigation and prosecution of cases of violation of the system.

HONOR SOCIETIES

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 Rice Institute in 1927.

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 Rice Institute, 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 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 the Rice Institute. The Theta chapter was formally installed in that year by a delegate of the national organization.

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 Rice Institute. 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 Rice Institute. 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 the Rice Institute.

The *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 Rice Institute was installed on May 14, 1953.

Sigma Gamma Epsilon is a College Honor Society in the Earth Sciences. The Beta Sigma chapter was established in the Geology Department of Rice 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 Rice Institute on May 20, 1953.

COURSES OF INSTRUCTION

Descriptions of courses are listed under five major divisions of the University: architecture, engineering, humanities, science, and physical education. Within the divisions departmental listings are alphabetical. Preceding course descriptions for most of the departments are statements of specific requirements for students majoring in the department at both the undergraduate and graduate levels. These statements are supplemental to the general degree requirements described on pp. 37-43.

Course 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 advanced courses requiring junior or senior standing. 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 makes 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" after course numbers indicate first-semester and second-semester courses respectively. Thus, Geology 330a is taught only the first semester and Geology 401b only the second semester. Courses for which the number is not followed by a letter *a* or *b* are two-semester or year courses in which it is necessary to take both semesters in normal sequence to secure credit for the course. In some cases, however, registration for only one semester is permissible, in which case the course number is followed by both letters, as, 400a or b.

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 (3-3-8) in Physics 100 means that the course meets three hours per week, has three hours of laboratory work per week and is evaluated at eight-semester-hours credit upon completion of the full year's work.

ARCHITECTURE

Professors: BARTHELME, MOREHEAD, *Chairman*

Associate Professors: DUNAWAY, LENT, RANSOM, TODD

Assistant Professor: LEIFESTE

Staff Specialists (Arch. 600):

PAUL BAKER, Director, Dallas Theatre Center
WILLIAM W. CAUDILL, Partner, Caudill, Rowlett & Scott
FELIX CANDELA, Architect and Engineer, Mexico City, Mexico

Major work in Architecture is organized into a single course entitled "Principles of Architecture." This is divided into the five basic parts listed below, with all areas of instruction carefully integrated into a single unit by material presented at the appropriate point of use. Each staff member contributes to the student's development in all phases. Staff specialists are increasingly utilized to broaden the teaching capacities of the staff.

In addition to the major work, auxiliary programs provide further student contacts outside the University. Among these are weekly visiting speakers, field trip programs, and visiting critics. These are designed to supplement the experience and training offered in the Department of Architecture and to bridge the gap between college and practice.

Graduate work in Architecture, leading to the degree of Master in Architecture, is open to students who hold the degree of Bachelor of Science in Architecture, or the equivalent five year degree and who give evidence of their qualifications to the satisfaction of the Department of Architecture and the Committee on Graduate Instruction. A minimum of one year of graduate study is required for the Master's degree when the candidate has completed five years' work in a recognized School of Architecture, and has received his degree with a record of high scholarship. The candidate must have had at least two years of college work in a foreign language. Applications of students who have a minimum of one year of practical experience in architecture will receive preferential consideration.

Students whose preparation has been limited to four years in a recognized School of Architecture may be admitted to candidacy for the degree of Bachelor of Science in Architecture. To be admitted to candidacy for the Master's degree, these students must reapply and will be reconsidered on the basis of their performance in residence at Rice University.

The candidate for the Master's degree must take Architecture 600, one advanced course outside the Department and must pass a public oral examination given by the faculty.

COURSES

Architecture 100. Principles of Architecture (0-10-6).

a. Theory and Philosophy: An elementary study of the place of history in architecture.
b. Architectural Design: Projects introducing basic design elements through elementary architectural problems with a brief introduction to the types and functions of buildings.
c. Architectural Communication: Introduction of basic communicative systems and media in all fields.
d. Architectural Construction: Awareness of materials, structure and building equipment.
e. Profession and Practice. The basic understanding of the practice of Architecture, its obligations and opportunities. Laboratory fee required. *Staff and Associates*

Architecture 200. Principles of Architecture (1½-14-12).

a. Theory and Philosophy: A beginning knowledge of History and the Theory and Philosophy of Architecture through a study of the relation of past architecture to past society. An elementry study of people and their reactions to the arts, particularly architecture.

b. Architectural Design: Beginning standards of skill in architectural design, and an elementary knowledge of building types through individual study under the problem system. Introduction to functional requirements of buildings.

c. Architectural Communication: Continued use of all media with the development of competence in their use; detailing, specification, etc., as a communicative art.

d. Architectural Construction: Introduction to basic materials and their characteristics; basic structural systems; introduction to types of building equipment and miscellaneous building components.

e. Profession and Practice. Introduction to the accomplishment of architecture within the current social framework. Laboratory fee required. *Staff and Associates*

Architecture 300. Principles of Architecture (6-18-24).

a. Theory and Philosophy: A continuation of the study and understanding of the relation of history and society to architecture as demonstrated in specific civilizations. Group reaction to society and architecture. A study of the temporary and permanent values in today's society. Study of architectural philosophies.

b. Architectural Design: Development of greater breadth in design through individual effort in the problem system on work of increasing complexity. Development of design values and skill in details.

c. Architectural Communication: The development of personal skill in the use of all media; expansion of the communicative arts to additional fields.

d. Architectural Construction: Basic principles and theory in structure; development of increased knowledge of materials; integration of building equipment.

e. Profession and Practice. Study of the fields in which architecture operates and of the architectural processes involved; expansion of the areas of obligation and opportunity. Laboratory fee required. *Staff and Associates*

Architecture 400. Principles of Architecture (6-18-24).

a. Theory and Philosophy: Instruction in the origin and development of concepts. Social problems and their solution in the Modern World, with instruction in the social forces in effect today; their strengths, weaknesses, and duration. Beginning development of a personal philosophy.

b. Architectural Design: Individual work in the problem system on projects involving multiple elements; testing design philosophies; refining design processes.

c. Architectural Communication: Development of technique and expression in communicative media. Study of law, contracts, specifications, working drawings as communication.

d. Architectural Construction: Development of skill in integration of all building techniques and systems; philosophy in construction.

e. Profession and Practice: Active participation in the profession; solving of architectural problems; service to University, community and profession; dealing with the total architectural problem. Laboratory fee required. *Staff and Associates*

Architecture 500. Principles of Architecture (7-18-26).

a. Theory and Philosophy: Development of a personal philosophy, conviction, and set of values. Analysis of trends and projections into the future.

b. Architectural Design: Exploration and experiment in design.

c. Architectural Communication: Exploration and experiment in communicative media.

d. Architectural Construction: Exploration and experiment in structure and building systems.

e. Profession and Practice: Development of a personal approach to the profession; increased active participation in the profession; analysis of trends and projections into the future of architecture. Laboratory fee required. *Staff and Associates*

Architecture 600. (8-15-26).

a. Elective choices in approach and subject matter in the area of Teaching, Specialization for Architectural Practice, and Research in the fields of Perspective, Design, History, Architecture, Building Types, Environmental Design, Surveys and Documentation, Shell Structures, Theatre, etc. The instruction is organized around a series of design problems intended to develop the student's ability to derive and present new architectural values, completely and comprehensively, in the framework of today's architecture and society. The design and research work culminates in a thesis report of some consequence which meets University requirements for a Master's degree. Laboratory fee required. *Mr. Barthelme, Staff Specialists, University Staff*

ENGINEERING

General Undergraduate Information. Curricula in Engineering at Rice University lead to degrees in the fields of Chemical Engineering, Civil Engineering, Electrical Engineering, Mechanical Engineering, and Nuclear Engincering.

The first two years of the Science-Engineering program, taken by all engineers, are described generally on pp. 38-39 of the catalogue. Sophomore students contemplating a major in engineering should pay particular attention to electives recommended under the departmental headings below. For convenience, course group designations are summarized as follows:

Group A: Language, Literature, Music
B: History, Social Studies, Philosophy, Psychology, Education
C: Engineering, Science, Mathematics

The following undergraduate courses listed as "Engineering" are offered for preparation of students majoring in all branches. For requirements of each department reference should be made to the subsequent sections.

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. Prerequisite: Engineering 201 and and completion or registration in Mathematics 200 or 210.

Engineering 211. Engineering Mechanics I — Statics and Introduction to Dynamics (3-0-3).

Foundations of Engineering Mechanics. Methods and Applications in Plane Statics; equilibrium, work and energy, centers of gravity, friction, beams, cables, frames; vector methods and space statics. Methods and applications of particle dynamics; motion of particles, moving frames of reference, projectiles, harmonic motion, central forces, and planetary orbits. Prerequisites: Physics 100, Mathematics 100.

Engineering 212. Engineering Mechanics II — Kinematics (3-3-4).

A study of the motion of rigid bodies. Plane motion, including rolling and sliding contact; elementary synthesis; considerations of three dimensional rigid body motion including orthogonal transformations, Euler's angles, Euler's theorem on rigid body motion, and small rotations. Introduction to relativity. Prerequisites: Physics 100, Mathematics 100, registration in Mathematics 200.

Engineering 213. Engineering Mechanics III — Dynamics (3-0-3).

Applications in plane dynamics, impulsive motion; dynamics in space, gyroscopics, general motion of a rigid body; methods of Lagrange and Hamilton; theory of vibrations. Prerequisites: Engineering 211, 212.

General Requirements for Graduate Degrees.

Rice University offers graduate work in the four major branches of engineering to its own graduates of superior standing, and to similarly qualified holders of bachelor's degrees from other recognized institutions. Possession of a bachelor's degree does not automatically guarantee admission to graduate work. Applicants will be screened by the department concerned and by the Committee on Graduate Instruction, and will be required to submit evidence of suitable preparation and of ability to do work of outstanding quality.

Students from other institutions interested in pursuing work toward the doctor's degree are encouraged to take the Graduate Record examination at the earliest opportunity, and to consult their prospective engineering department well in advance of registration relative to their qualifications. The awarding of a doctor's degree is not generally based upon an accumulation of credits or on compliance with formal requirements. The candidate is expected to show comprehensive knowledge of his field and to demonstrate ability in the techniques of scholarship and research appropriate thereto.

The program of studies permits a student to concentrate his efforts in one or more areas of interest, and students are encouraged to take courses outside of their major branch of engineering. Appropriate courses in mathematics, physics, chemistry, metallurgy and other branches of engineering are offered. Programs leading to the degrees of Master of Science and Doctor of Philosophy are available in each of the four major engineering fields.

Especially qualified students enrolled in the Rice University 5-year bachelor of science program in a branch of Engineering may, at the end of their fourth year, apply for admission to graduate study. Such a student may then omit the bachelor of science degree and fulfill the requirements for the master of science degree with a minimum of two years additional study.

In addition to the general University requirements for the master's and doctor's degrees as stated on pp. 41-43, which include presentation of an original thesis suitable for publication, certain language requirements, and a public oral examination, each candidate must fulfill the specific requirements of his major department stated in the following paragraphs.

Chemical Engineering.

A candidate for the Master of Science degree is required to complete a minimum of eight one-semester courses with high standing.

A candidate for the degree of Doctor of Philosophy must complete a minimum of twelve one-semester courses with high standing and pass a comprehensive written examination.

There are opportunities for research in unit processes, fluid mechanics, heat transfer, thermodynamics, mass transfer, chemical kinetics, nuclear chemistry, and nuclear processes.

Civil Engineering.

The department requirements for the degree of master of science include completion of two or three full-year courses in civil engineering and one in mathematics, physics, chemistry, biology, geology, or another branch of engineering. The candidate must also register for the graduate seminar for the year in which he graduates.

Requirements for the Doctor of Philosophy degree include a minimum of six full-year courses of graduate work. A course of study leading to this degree must be planned in individual consultation with members of the department, and course requirements will vary with the background of the candidate. As previously stated, an original investigation and thesis are a significant part of the qualifications for this degree.

Work is offered in two major areas of study: structures (including soil mechanics), and sanitary engineering.

Electrical Engineering.

A candidate for the master of science degree is required to complete the equivalent of three or four full-year courses, of which one, suitably related to the candidate's interests, should be chosen from science, mathematics, or another branch of engineering. In addition, he is required to complete an acceptable thesis, participate in the departmental graduate seminar, 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 must pass a final oral examination on the subject of his dissertation and upon related subjects.

Work towards the doctorate requires at least the equivalent of three full years of class I graduate study. At least one academic year of full-time residence at Rice is required of all candidates for the degree of Doctor of Philosophy. It should be emphasized that these are minimum requirements, and in most cases more time is required of the individual student.

Mechanical Engineering.

Candidates for the degree of master of science must complete four full-year courses and be enrolled in a graduate seminar each year.

In addition to the above requirements for the master of science degree, candidates for the degree of Doctor of Philosophy must complete five approved full-year 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, Theory of Elasticity; (2) Physical Metallurgy; (3) Thermodynamics, Fluid Dynamics, Heat Transfer.

Nuclear Engineering.

The graduate program in nuclear engineering is under the supervision of the Department of Chemical Engineering. The program is open to students with baccalaureate degrees in the fields of engineering, science, and mathematics. A special program of courses is offered in the Chemical Engineering and Physics Departments.

Course summaries described below under each department provide only a pattern and may not apply to specific cases. A graduate student will be admitted to candidacy for the doctor's degree only after passing appropriate preliminary examinations.

CHEMICAL ENGINEERING

Professors: AKERS, *Chairman*, HARTSOOK
Associate Professors: KOBAYSHI, LELAND
Assistant Professors: DAVIS, DEANS, DENNY, HELLUMS

The undergraduate chemical engineering courses are designed to provide thorough grounding in engineering, science and mathematics, and afford the student some opportunity for specialization in a particular area of interest. Students finishing the first four years of this curriculum receive the Bachelor of Arts degree with a chemical engineering major, and, if approved, may enter a professional program leading to the degree of Bachelor of Science in Chemical Engineering, or go directly to graduate work in chemical engineering, nuclear technology, chemistry, physics, mathematics, or industrial management.

The basic curriculum through the fourth year is outlined on pp. 38-39; and suggested course contents in three areas of specialty (chemical engineering science, nuclear technology, and petroleum production) are available. The year in which courses are taken is not fixed except where prerequisites for other courses require. Students should consult with the department advisers for specific courses of study.

Course content for the fifth year leading to the degree of Bachelor of Science in Chemical Engineering, and requirements for the graduate degrees, are broadly outlined on pp. 41-43.

COURSES

Chemical Engineering 301a. Chemical Engineering Fundamentals (3-0-3).

A first course in the application of the principles of mathematics; considered are: stoichiometric and equilibrium concepts, material balances, energy relationships for both chemical and physical changes and mechanical equipment, and the thermodynamic properties of fluids and energy.

Chemical Engineering 302b. Separation Processes I (3-0-3).

A systematic approach to the separation of matter based on differences in physical properties. Particular attention is devoted to the equilibrium state concept.

Chemical Engineering 343. Engineering Measurements (1-3-4).

A laboratory devoted to the development of experimental techniques for the precise measurement of various properties of matter. The use of statistics and error analysis is incorporated.

Chemical Engineering 401a. Introduction to Transport Phenomena (3-0-3).

Fluid dynamics, energy and mass transfer, macroscopic and microscopic analysis of engineering problems.

Chemical Engineering 412b. Thermodynamics I (3-0-3).

The course considers quantitative applications of the first and second laws; thermodynamic properties of pure fluids; the concepts of equilibrium, chemical potential, fugacity, activity and their application; thermodynamic properties of ideal solutions; equilibrium in systems involving a chemical reaction.

Chemical Engineering 421a. Plant Inspection (1-3-2).

A critical inspection of neighboring plants, laboratories, and engineering firms engaged in chemical engineering practices is made under the guidance of faculty and company personnel. Detailed reports of each inspection are submitted for examination and criticism.

Chemical Engineering 422b. Chemical Engineering Literature (2-0-2).

Sources of information on chemical engineering. Presentation of information in written and oral reports.

Chemical Engineering 443. Unit Operations Laboratory (1-3-4).

Laboratory work in the unit operations. Particular emphasis is placed on the measurement and analysis of data of important engineering operations.

Chemical Engineering 471a. Applied Mathematics for Chemical Engineers (3-0-3).

A one-semester course concerned with the application of the fundamental laws and principles of mathematics, physics, and chemistry to chemical engineering problems. Emphasis is placed on developing individual capability for representing process situations by suitable mathematical models and formulating properly posed boundary value problems. Several linear problems are solved in detail, employing various classical approaches; series of calculus of finite differences. separation of variables, integral-transform methods.

Chemical Engineering 472b. Numerical Analysis for Chemical Engineers (3-0-3).

Application of numerical techniques to the solution of non-linear problems of interest to chemical engineers. Differential equations are approximated by difference equations, and numerical solutions generated algebraically. Emphasis is placed on implicit methods, and the important question of stability and convergence treated in detail. The use of the analogue as well as the digital computer is an integral part of the course.

Chemical Engineering 501a. Rate Processes (3-0-3).

Derivation of basic transport equations. Microscopic analysis of diffusion, conduction and transport phenomena in laminar flow.

Chemical Engineering 502b. Advanced Rate Processes (3-0-3).

Advanced study of transport phenomena with emphasis on analysis of turbulent transport mechanisms and recent developments in applications to engineering problems.

Chemical Engineering 511a. Thermodynamics II (3-0-3).

An advanced treatment of the three laws of thermodynamics. Special attention is given to equations of state, chemical and physical equilibrium, non-ideal solutions, and electrochemistry.

Chemical Engineering 512b. Thermodynamics III (3-0-3).

An advanced treatment of special problems in thermodynamics and an introduction to statistical thermodynamics.

Chemical Engineering 522a. Plant Design (2-3-3).

The lectures consider the development of chemical manufacturing processes and the design of chemical manufacturing plants from the point of view of location, building, equipment, economics, and organization. The laboratory work consists of calculating and drawing up fundamental data, qualitative flowsheets, specifications, plant layout, and cost estimates for typical processes.

Chemical Engineering 531a. Nuclear Engineering (3-0-3).

An introductory course in: Nuclear properties, nuclear reactions, radioactive decay, the fission reaction. Theory and design of nuclear reactors using the one-group model, Fermi Age Treatment, neutron diffusion, their 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 groups and multi-group methods, neutron transport theory. Calculations for time-dependent reactor operation, temperature and heat transfer effects in a reactor, reactors with reflectors, breeder reactors. A more detailed consideration of related topics of fuel cycles, isotope separation, and shielding.

Chemical Engineering 541a. Nuclear Chemistry (2-4-3).

An introductory course in nuclear physics from the chemical viewpoint. Atomic structure, nuclear structure, nuclear stability, nuclear emissions, nuclear reactions, nuclear reaction generators, nuclear emission characteristics, interactions of radiation with matter, health physics, radiation detection and measurement. The laboratory provides a thorough training in the techniques and instruments used for radiation detection, measurement, and personnel protection.

Chemical Engineering 542b. Radiochemistry (2-4-3).

Lecture and laboratory covering the following topics: the physical and chemical manipulations of radioisotopes; application of radioisotopic techniques to research problems in science and engineering; utilization of radioactive byproducts from nuclear reactors. Research projects in individual fields and experimentation with a nuclear reactor for qualified students in this field of interest.

Chemical Engineering 543. Unit Operations Laboratory II (1-3-4).

A continuation of Chemical Engineering 443. In the second semester students will work on special projects.

Chemical Engineering 550a or b. Petroleum Production (3-0-3).

The nature of porous media, properties of hydrocarbons and associated components at high pressures, homogeneous and heterogeneous flow through porous media, and application of these principles to estimation of reserves, primary and secondary recovery techniques. Surface production problems are also discussed.

Chemical Engineering 551a. Separation Processes II (3-0-3).

A quantitative study of multi-stage calculations for multi-component systems. Special attention is given to computer solutions and the development of mathematical models for real stages.

Chemical Engineering 560a or b. Heterogeneous Equilibrium and the Phase Rule (3-0-3).

The organization of heterogeneous equilibrium behavior of mixtures using thermodynamic principles with special emphasis on the Phase Rule of Gibbs. The behavior of complex mixtures over extreme ranges of pressures and temperatures is discussed.

Chemical Engineering 561a. General Seminar (1-0-1).

A course for training chemical engineering students in the preparation and oral presentation of formal papers and discussions on topics of engineering interest. The papers and discussions are given by the students, using acceptable material secured from technical publications. This course is required of all fifth-year chemical engineers.

Chemical Engineering 571a. Statistics and Probability (3-0-3).

The application of statistical and probability theory to engineering problems: Analysis of data, design of experiments, evolutionary operation of complex process systems.

Chemical Engineering 575a or b. Process Dynamics (3-0-3).

Study of dynamic behavior of chemical processing equipment.

Chemical Engineering 590a or b. Chemical Reaction Kinetics (3-0-3).

A study of the principal facts and theories relating to the rates at which chemical reactions take place, including a study both of elementary reactions and of the way in which over-all rates of complex reactions are related to the rates of the individual steps.

Chemical Engineering 612. Irreversible Thermodynamics (3-0-3).

Entropy production ratio; Onsager's Reciprocal Relation applied to Irreversible Processes; and Non-Equilibrium Stationary States.

Chemical Engineering 662. Graduate Seminar (2-0-2).

Similar to Chemical Engineering 561 except that the course applies to graduate students above the fifth year.

Chemical Engineering 675. Process Control (3-0-6).

A mathematical approach to the problem of process control with particular emphasis on the analysis of response to process variations.

Chemical Engineering 680. Summer Graduate Research.

Open to students already admitted as candidates for the degree of Master of Science. At least forty hours of laboratory work per week.

Chemical Engineering 683. M. S. Research and Thesis.

At least nine hours of work weekly under the direction of a member of the staff on a problem of chemical engineering importance. Four copies of the accepted report will be required: two for deposit in the University Library and two for the chemical engineering department.

Chemical Engineering 685. Kinetic - Molecular Theory of Fluids (3-0-3).

A course in the kinetic theory of fluids as applied to non-equilibrium phenomena. Among the subjects covered are the properties of the fluids ranging from extremely dilute to dense fluids. Semi-theoretical relations to describe the behavior of real fluids are introduced and discussed.

Chemical Engineering 686. Non-Equilibrium Statistical Mechanics Applied to Hydrodynamics and Transport Phenomena (3-0-3).

The methods of statistical mechanics are applied to study hydrodynamics and the transport phenomena including evaluation of the transport properties.

Chemical Engineering 690. Kinetics and Catalysis (3-0-3).

Chemical reaction rates, reaction mechanisms, theories of catalysis, diffusion in solids.

Chemical Engineering 691. Reactor Analysis (3-0-3).

The analysis of physical as well as chemical rate steps in reactors. Mathematical simulation of various reactor configuration. Reactor stability and control.

Chemical Engineering 720. Advanced Topics in Chemical Engineering III (3-0-6).

A theoretical treatment of advanced phases of chemical engineering with special emphasis upon the development of individual abilities. *Mr. Hellums*

Chemical Engineering 780. Summer Graduate Research.

Open to students already admitted as candidates for the degree of Doctor of Philosophy. At least forty hours of laboratory work per week.

Chemical Engineering 783. Ph.D. Research and Thesis.

At least twenty hours of work weekly under the direction of a member of the staff on a problem of chemical engineering importance. Four copies of the accepted report will be required: two for deposit in the University Library and two for the chemical engineering department.

CIVIL ENGINEERING

Professors: AUSTIN, SIMS, *Chairman*
Associate Professors: McDONALD, THIBODEAUX
Assistant Professors: BUSCH, HOLT, KRAHL, SMITH
Instructor: BACKUS

Requirements for the degree of Bachelor of Science in Civil Engineering, and for graduate degrees, are summarized on pp. 38-40 and pp. 41-43, respectively.

Representative course contents, showing typical sequence of courses and registration for each of the five years leading to the Bachelor of Science degree, are available from the department. Students should consult with the department advisers for specific courses of study.

COURSES

Civil Engineering 332b. Materials Testing for Architects.

A series of standard tests of common building materials for architectural students registered in Architecture 300. Laboratory fortnightly. Laboratory fee required.

Civil Engineering 355a or b. Plane Surveying (2-3-3).

The development and study of the fundamental principles of engineering surveying, including the properties of errors, probability equation and least squares. Field and office work to familiarize the student with the tape, compass, level, transit and plane table. Introduction to digital computer programs for the solution of surveying problems. Laboratory fee required.

Civil Engineering 401a. Mechanics of Materials (3-1½-3).

Stress and deformation due to tensile, compressive, and shearing forces; bending moments, deflections, torsional stresses, and combined stresses. Theory of beams, columns, and shafts. Laboratory tests of steel, aluminum, cast iron, wood and concrete. Laboratory fortnightly. Laboratory fee required.

Civil Engineering 402b. Mechanics of Fluids (3-1½-3).

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. Laboratory fortnightly. Laboratory fee required.

Civil Engineering 421a. Route Surveying and Highway Design (3-3-4).

Simple and compound horizontal and vertical curves for highway and railway use. Problems in earthwork. Leveling. Error theory. Geometrical and structural design of highways. Laboratory fee required.

Civil Engineering 422b. Elementary Structural Analysis (3-3-4).

Analytical and graphical methods of determining stresses in statically determinate beams, frames, and trusses due to fixed and moving loads. Analysis of space frameworks. Approximate analysis of indeterminate structures. Deflections of beams and trusses.

Civil Engineering 431a. Hydrology (3-0-3).

A study of precipitation, evaporation, transpiration, climate and drainage-basin characteristics with emphasis on the relationship of these elements to surface-water and groundwater runoff. The collection and analysis of hydrological data for engineering design is emphasized.

Civil Engineering 432b. Environment Sanitation (3-0-3).

A presentation of the principles and techniques fundamental to basic sanitation. The study of communicable disease, water supply, waste disposal, refuse collection and disposal, pest and rodent control, milk and food sanitation, swimming pool and housing problems.

Civil Engineering 441a. 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 442b. 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 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 521a. Water Supply and Treatment (3-3-4).

Study of the engineering aspects of hydrology pertinent to collection of surface and ground waters. Principles and design of water transmission and distribution systems. Water quality characteristics. Study of unit operations and the synthesis of water treatment processes. Laboratory fee required.

Civil Engineering 522b. Waste Treatment and Water Pollution Control (3-3-4).

Study of the sources and characteristics of waste waters. Principles and design of collection systems. Study of unit operations and the synthesis of waste treatment processes. Concepts of water pollution control as related to waste treatment. Laboratory fee required.

Civil Engineering 541a. 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 542b. Design of Reinforced Concrete Structures (3-3-4).

Design of structural members and frameworks of reinforced concrete. Elastic and ultimate-strength design. Pre-stressed concrete. Design of typical parts of buildings, bridges, and foundations. Laboratory fee required.

Civil Engineering 561a. Advanced Mechanics of Materials (3-3-4).

Advanced topics in stress analysis. Shear center; unsymmetrical bending; curved beams; torsion of non-circular sections; column theory; local buckling; lateral buckling; stress-concentration; strength under combined loading; plastic analysis. Properties of steel, aluminum, and timber.

Civil Engineering 562b. 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. Working drawings, estimates of weight and cost. Introduction to plastic design of steel. Laboratory fee required.

Civil Engineering 581a. Introduction to Statically Indeterminate Structures (3-3-4).

A study of the stresses and deflections of such structures as continuous spans and rigid frames, by the methods of angle changes and moment distribution. Analysis of trussed structures with redundant members, analysis of secondary stresses in trusses. Williot-Mohr diagrams.

Civil Engineering 582b. Elementary Soil Mechanics and Foundations (3-3-4).

A study of the physical characteristics of soils and of the mechanics of soil masses subjected to loads. Earth pressures and stability. Design of foundations for buildings, bridges, and other major structures. Laboratory fee required.

Civil Engineering 605. Graduate Seminar (1-0-2).

Current problems and research developments in Sanitary and Structural Engineering. Two types of meetings are held: (1) A series of lectures by invited speakers and members of the staff; (2) A series of informal discussions among members of the staff and graduate students, devoted to the presentation and criticism of the research studies currently in progress in the department. *Staff*

Civil Engineering 611. Advanced Problems in Soil Mechanics and Foundations (3-3-4).

Stress conditions for failure in soils, plastic equilibrium, arching in ideal soils. Application to retaining wall problems and stability of slopes. Earth pressure on supports in cuts, tunnels, and shafts, anchored bulk-heads. Theory of consolidation, mechanics of drainage. Problems involving subgrade soil or pile reaction. Vibration problems. A study of foundation design and construction procedures. Site investigation, methods of soil exploration. Footing, raft, and pile foundations. Settlement due to exceptional causes. Cofferdams and other aids for open excavations, caissons. Bridge piers and abutments. Underpinning.

Civil Engineering 612. Design of Dynamically Loaded Structures (3-0-3).

Nature of dynamic loading from blast, earthquake, wind and wave forces. Behavior, analysis, and design of structures subjected to impulsive loading. *Mr. Austin*

Civil Engineering 621. 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. *Mr. Austin*

Civil Engineering 622. Numerical Methods in Engineering (3-0-3).

Study of the nature of complex problems in engineering analysis and of the means of obtaining practical solutions. Methods of formulating exact or approximate governing equations for complex physical situations involving discrete (lumped parameter) and continuous systems, including energy methods, variational methods, finite differences and others. Methods for solving basic types of equations, including: relaxation, iteration, and successive eliminations for simultaneous, linear equations; successive approximations, Holzer procedure, and Rayleigh-Southwell procedure for characteristic value problems; step-by-step numerical integration procedures for initial value or propagation problems. Applications to problems in solid mechanics and structural analysis, including equilibrium, buckling, dynamic, and vibration problems of complex systems. *Mr. Austin*

Civil Engineering 631. The Application of Electronic Computers to Structural Problems (3-3-4).

Introduction to computer programming. Matrix methods of structural analysis. Optimization of structures. *Mr. Holt*

Civil Engineering 632. Buckling Structures (3-0-3).

Buckling of axially and eccentrically loaded columns. Torsional buckling of columns. Lateral buckling of beams. Stability of frameworks. Local buckling. *Mr. Holt*

Civil Engineering 641. 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. *Mr. Austin*

Civil Engineering 642. Advanced Design of Reinforced Concrete Structures (3-0-3).

A critical study of modern methods of design of reinforced concrete structures. Evaluation and correlation of certain analytical and mathematical investigations, significant experimental investigations, code provisions and design practice. A consideration of ultimate strength design and prestressed members. *Mr. Krahl*

Civil Engineering 661. 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. *Mr. Krahl*

Civil Engineering 662. Design of Light-Weight Structures (3-0-3).

Analysis and design of structures and structural members of minimum weight. *Mr. Sims*

Civil Engineering 671. Advanced Sanitary Engineering I (3-0-3).

The theory of the chemical and physical principles utilized in water and waste treatment operations. Unit operations such as sedimentation, gas transfer, chemical treatment, filtration and sludge treatment are presented. The synthesis of these operations into water and waste treatment processes is developed. *Mr. Busch*

Civil Engineering 672. Advanced Sanitary Engineering II (3-0-3).

The theory of the biological and biochemical principles utilized in water and waste treatment operations. Unit operations such as biological oxidation, aerobic and anaerobic, and disinfection are presented. The synthesis of these operations into water and waste treatment processes is developed. *Mr. Busch*

Civil Engineering 681. Sanitary Chemistry (3-3-4).

The chemistry of water and waste treatment processes. Laboratory practice in the various chemical, physical and biochemical analytical procedures applicable to process design and evaluation. *Mr. Busch*

Civil Engineering 682. Industrial Waste Treatment (3-3-4).

A study of the chemistry and processes applicable to analysis and treatment of industrial wastes. *Mr. Busch*

Civil Engineering 691. 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. Plastic Analysis. *Mr. Thibodeaux*

Civil Engineering 692. A Critical Review of Codes for Steel and Concrete Structures (3-0-3).

A study of experimental and analytical investigations which form the basis for design codes. Behavior of steel and reinforced concrete structural members and the behavior of steel and reinforced concrete structures. *Mr. Krahl*

Civil Engineering 703. Research and Thesis.

This will consist of an original investigation along some approved line of civil engineering work, an original design, or a critical review of existing work. In every case three complete typewritten or printed reports will be required; two for deposit in the University Library and one for the civil engineering department. *Staff*

ELECTRICAL ENGINEERING

Professors: WATERS, PFEIFFER, WISCHMEYER
Associate Professors: GRAHAM, McENANY
Assistant Professors: BAKER, RABSON
Instructors: EMERY, WELCH
Lecturer: MacPHAIL

The first two years of the Science-Engineering program are described on pp. 38-39 of the catalog. Sophomore students contemplating a major in Electrical Engineering should elect Engineering 201 and 211 and a full year of Physics 200 or 210.

Representative programs showing the normal registration in courses for each year leading to the Bachelor of Science degree in Electrical Engineering are available from the department. Under suitable conditions, appropriate course substitutions may be made in some areas. Department approval is required for any such changes.

Requirements of a general nature for advanced degrees are outlined on pp. 41-43. Students should consult the department advisers for specific courses of study.

COURSES

Electrical Engineering 340. Elementary Electronics and Circuits (4-4-5).

Fundamental principles of vacuum tubes, gaseous conduction tubes, transistors, and their associated circuits. General circuit theory. For students of chemical, civil, and mechanical engineering. Prerequisites: Physics 200a or 210 and Mathematics 200 or 210.

Messrs. Baker and McEnany

Electrical Engineering 343. Circuits and Electronics (3-2-7).

Analysis of linear circuits. Fundamental principles of vacuum tubes, gaseous conduction tubes, transistors, and related devices as circuit elements. Four hours of laboratory weekly during the second semester. Prerequisites: Physics 200 or 210 and Mathematics 200 or 210.

Mr. Baker

Electrical Engineering 403. Electrical Machinery and Circuits (3-2-7).

Fundamental principles of electrical engineering for civil and mechanical engineering students. Prerequisites: Electrical Engineering 340 and Mathematics 300 or 310. Laboratory fortnightly.

Mr. Emery

Electrical Engineering 412. Introduction to Electrical Machinery and Controls (3-1½-3).

Fundamental principles of electrical machinery and controls for chemical engineering students. Prerequisites: Electrical Engineering 340 and Mathematics 300 or 310. Laboratory fortnightly.

Mr. McEnany

Electrical Engineering 413. Electrical Machinery (3-2-7).

Theory of d-c machinery, transformers, a-c machinery, and related devices. Laboratory fortnightly. Prerequisites: Electrical Engineering 343 and Mathematics 300 or 310.

Mr. Waters

Electrical Engineering 441. Electronics (3-4-4).

Continuation of the electronics portion of Electrical Engineering 343. Prerequisite: Electrical Engineering 340 and Mathematics 300 or 310.

Mr. Baker

Electrical Engineering 460. Topics in Modern Physics (3-4-4).

Some topics in modern physics fundamental to the study of many important electrical components and devices. Prerequisites: Electrical Engineering 343 and Mathematics 300 or 310.

Messrs. MacPhail, Rabson

Electrical Engineering 473. Electrical Engineering Analysis I (3-0-6).

Theoretical analysis of the behavior of discrete-parameter time-invariant linear systems. Electromagnetic field theory. Analogous fields and a study of boundary value problems. Prerequisites: Mathematics 300 or 310. *Messrs. Pfeifer, Rabson*

Electrical Engineering 503. Field Theory. Advanced Circuit Analysis (3-0-6).

Electromagnetic fields: dynamics, interactions with matter, moving media. Advanced circuit theory. Prerequisites: Electrical Engineering 473 and registration in or completion of Electrical Engineering 573. *Mr. Rabson*

Electrical Engineering 505. Seminar (1-0-2).

Electrical Engineering 543. Electronics (3-4-8).

Analysis and design of electronic devices, circuits, and systems applicable to a variety of engineering fields. Prerequisites: Electrical Engineering 441 and 460; registration in or completion of Electrical Engineering 503. *Mr. Wischmeyer*

Electrical Engineering 573. Elecrical Engineering Analysis II (3-0-6).

Electronic differential simulator; functions of a complex variable; Boolean algebra; probability. *Mr. Pfeifer*

Electrical Engineering 593. Electrical Engineering Problems (1-4-4).

Theoretical and experimental investigations under staff direction. *Staff*

The following one-semester elective courses will be offered according to demand and availability of faculty.

Electrical Engineering 511. Electrical Machinery (3-4-4).

Selected topics in the theory and application of electrical machinery and related controls. *Mr. Waters*

Electrical Engineering 515. Electronic Controls and Servomechanisms (3-4-4).

Theoretical and experimental study of various types of feedback control systems and typical components. Laboratory studies include use of the electronic differential simulator. *Mr. Waters*

Electrical Engineering 531. Communications Systems (3-4-4).

Study of important types of communications systems with respect to propagation media, frequency requirements, information handling ability, reliability, and noise. *Mr. Wischmeyer*

Electrical Engineering 535. Microwave Devices (3-4-4).

Basic physical theory applied to the study of the generation, transmission, control, and radiation of microwave energy. *Mr. Rabson*

Electrical Engineering 545. Pulse Circuit Design (3-4-4).

A study of various pulse circuits with an emphasis on those factors and methods of analysis which are important in circuit design. *Mr. Graham*

Electrical Engineering 551. Electric Power Systems (3-4-4).

Selected topics in the study of electric power systems. Prerequisite: Electrical Engineering 511. *Mr. Waters*

Electrical Engineering 561. Solid State Devices (3-4-4).

Study of some of the important electronic devices based on quantum mechanical principles. *Mr. Rabson*

Electrical Engineering 595a or b. Electrical Engineering Problem (0-4-1).

Theoretical and experimental investigations under staff direction; an extension of Electrical Engineering 593. Prerequisite: Registration in Electrical Engineering 593. *Staff*

The following courses are normally open only to students engaged in a program leading to an advanced degree.

Electrical Engineering 603. Advanced Circuit Analysis (3-4-8).

Advanced topics in the dynamics of time-invariant linear systems; foundations of statistical communication theory; selected topics in related fields of interest. Laboratory periods are devoted to seminars on supplementary topics as well as experimental studies. *Mr. Pfeifer*

Electrical Engineering 605. Graduate Seminar (1-0-2).

Electrical Engineering 607. Nonlinear Circuit Analysis (3-0-6).

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. *Mr. Graham*

Electrical Engineering 613. Advanced Servomechanisms (3-4-8).

Mathematical formulation of the control problem; linear servo analysis and synthesis; design criteria and optimum synthesis; sample-data systems; nonlinear systems. Prerequisite: Registration in or completion of Electrical Engineering 603. *Mr. Pfeiffer*

Electrical Engineering 643. Advanced Electronics and Communications Engineering (3-0-6).

Electromagnetic theory and wave propagation; angle modulation; frequency analysis; electroacoustical systems; selected topics in related fields of interest. *Mr. Wischmeyer*

Electrical Engineering 645. Electronic Circuit Synthesis (3-0-6).

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. *Mr. Graham*

Electrical Engineering 653. Theory of Electrical Machinery (3-4-8).

Treatment of electrical machinery from concepts of generalized circuit theory and energy flow. *Mr. Waters*

Electrical Engineering 661. Semiconductor Electronics (3-4-8).

Fundamental theory of semiconductor devices. The material of an introductory course in modern physics is assumed. The quantum mechanical theory needed for analysis of the electronic behavior of semiconductors is developed as a part of the course. Laboratory periods are devoted to seminars on supplementary topics as well as experimental work.
Mr. Rabson

Electrical Engineering 690. Research and Thesis.

MECHANICAL ENGINEERING

Professors: BROTZEN, CHAPMAN, *Chairman,* GRIFFIS
Associate Professors: BECKMAN, PASLAY, PLAPP, WILHOIT
Assistant Professors: ASIMOW, BURGHARD, JACOBSON, ROBERTS
Instructor: VERMEULEN
Assistant: HENDRICKSON

Requirements for the degree of Bachelor of Science and for graduate degrees in Mechanical Engineering are summarized on pp. 37-40 and pp. 41-43, respectively. Representative courses and normal sequence of registration in courses during the undergraduate years are available from the department.

COURSES

Mechanical Engineering 350a or b. Mechanical Processes (3-6-5).

Class and laboratory instruction dealing with welding, heat-treating, foundry and machine shop practice, and their effects on machine design. Practice with a variety of bench and machine tools, carefully selected for their fitness in affording actual contact with machine work and in developing a certain degree of skill and resourcefulness in the student. Plant inspection trips. One semester. Laboratory fee required. *Mr. Burghard*

Mechanical Engineering 380a or b. Process Metallurgy (3-3-4).

Instruction in the mechanical and metallurgical aspects of processes utilized to form metals into machine and structural components. The principles of flow and solidification of liquid metals, plastic deformation, and solid state transformations are considered in the description and analysis of casting, forming, welding, machining and heat treating processes. The laboratory instruction includes practice in the operation of basic machine tools and in foundry and welding techniques. One semester. Laboratory fee required. *Mr. Asimow*

Mechanical Engineering 390a or b. 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. One semester. Laboratory fee required.

Mechanical Engineering 395a or b. 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 100, Chemistry 120. One semester.

Mr. Brotzen

Mechanical Engineering 403. Thermodynamics and Heat Engines (3-1½-7).

A general course of lectures, recitation from the text, and laboratory. A detailed exposition of the laws of classical thermodynamics is followed by their application to systems of practical importance. Other topics included are: properties of liquids, gases, and vapors, the thermodynamics of high velocity flow, psychometric principles, and the thermodynamics of gas or vapor power systems and of refrigeration systems. Prerequisite: full fourth-year standing. Laboratory fortnightly. Two semesters. Laboratory fee required.

Messrs. Chapman and Beckmann

Mechanical Engineering 423. Engineering Mathematics (3-0-6).

The application of ordinary and partial differential equations to typical boundary value problems in vibrations, wave propagation, heat conduction, and fluid flow. An introduction to the theory of complex variables. Two semesters. *Mr. Wilhoit*

Mechanical Engineering 483. Introduction to Mechanical Design (½-3-3).

A study of those machine elements that require elementary mechanics and stress theory for their design. Attention is directed toward the manufacture of machine elements and their assembly into a working machine. Two semesters. *Mr. Hendrickson*

Mechanical Engineering 505. Seminar (1-0-2).

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 acceptable material 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 511. Design of Machine Elements (3-0-3).

The design of components of machines including shafting, beams, springs, clutches, and brakes. A study of stress and strain at a point and strain energy methods. Analysis of curved beams and thick walled cylinders. One semester. *Mr. Griffis*

Mechanical Engineering 512. Advanced Strength of Materials (3-0-3).

Bending of beams on elastic foundations, elastic stability problems, torsional problems with non-circular cross-sections, thin plates and shells, deformations beyond the elastic limit. One semester. *Mr. Griffis*

Mechanical Engineering 515. Machine Design Laboratory (0-6-2).

Investigation and design of problems in the field of machine design. One semester. Laboratory fee required. *Mr. Griffis*

Mechanical Engineering 521. Applied Thermodynamics and Heat Power (3-0-3).

Application of thermodynamics and related fields of study to the solution of problems encountered in mechanical engineering. Emphasis is placed on energy converting systems. Prerequisite: Mechanical Engineering 403. One semester. *Mr. Plapp*

Mechanical Engineering 522. Applied Fluid Mechanics and Fluid Machinery (3-0-3).

Applications of fluid mechanics in mechanical engineering. Particular emphasis is placed on hydraulic machinery, the basic principles of aircraft and missile propulsion, and incompressible and compressible flow in pipes. Prerequisites: Mechanical Engineering 403 and Civil Engineering 402. One semester. *Mr. Plapp*

Mechanical Engineering 525. Advanced Thermodynamics and Heat Power Laboratory (0-6-2).

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. This course is ordinarily taken concurrently with Mechanical Engineering 521. One semester. Laboratory fee required. *Mr. Plapp*

Mechanical Engineering 532. Internal-combustion Engines and Fuels (3-3-4).

A study of the theory, characteristics, and operation of gasoline, gas, and oil-burning engines for automotive, stationary, and marine service, including the production and characteristics of the fuels used. Prerequisite: Mechanical Engineering 403. One semester. Laboratory fee required.

Mechanical Engineering 541. Physical Metallurgy I (3-3-4).

A study of the fundamentals of alloying and heat treatment. Mechanical and non-mechanical properties of metallic systems. Analysis of various basic types of metal forming processes. An introduction to oxidation and corrosion of metals. One semester. Laboratory fee required. *Mr. Brotzen*

Mechanical Engineering 542. Physical Metallurgy II (3-3-4).

Introduction to X-ray metallography. Thermodynamics of alloy systems. Mechanism and kinetics of transformations. A fundamental study of the mechanical behavior of metals and alloys. Prerequisite: Mechanical Engineering 541 or equivalent. One semester. Laboratory fee required. *Mr. Brotzen*

Mechanical Engineering 555. Chemical Metallurgy (3-0-3).

Metals are considered from the standpoint of their chemical properties. The fundamental aspects of corrosion and oxidation of metallic materials are given primary consideration. Solubility and diffusion of gases in metals are also discussed. One semester.

Mechanical Engineering 563. Advanced Metallurgical Laboratory (0-4-2).

Students whose interest lies primarily in the fields of materials and metallurgy are given the opportunity for research in these fields. The student will be able to work on problems of a basic nature. Two semesters. *Staff*

Mechanical Engineering 570. Mechanical Vibrations (3-0-3).

Linear vibration theory beginning with a one-degree-of-freedom system and continuing to a multi-degree-of-freedom system and continuous systems. Effects of gyroscopic forces. Optimization of damping. Mobility methods. One-degree-of-freedom non-linear systems. Prerequisite: Mechanical Engineering 423. One semester. Undergraduate and graduate credit. *Mr. Paslay*

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. Prerequisites: Mechanical Engineering 403 and 423. One semester. *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.

Mechanical Engineering 605. Graduate Seminar (1-0-2). *Staff*

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 including gyroscopic motion and the vibration of elastic bodies. One semester. *Mr. Wilhoit*

Mechanical Engineering 623. Advanced Engineering Analysis I (3-0-3).

An introduction to the theory of the complex variable and to vector analysis with particular emphasis on engineering applications in the fields of fluid dynamics, heat conduction and elasticity. One semester. *Messrs. Plapp, Wilhoit, Chapman*

Mechanical Engineering 625. Advanced Engineering Analysis II (3-0-3).

Advanced topics in engineering analysis. The subject matter may vary from year to year depending on the background of those enrolled. Among topics which may be considered are: the calculus of variations, integral equations, matrix methods, tensor analysis, partial differential equations, statistics and probability, numerical methods, and their engineering applications. One semester. *Staff*

Mechanical Engineering 631. Constitutive Equations of Applied Mechanics (3-0-3).

A study of the formulation of the constitutive equations for isotropic continuous materials. Rigid body motion, non-orthogonal coordinate systems, stress, strain. Isotropic relations of elastic and fluid materials. Linear superposition theories. Plasticity. Thixotropic materials. Variational principles. One semester. *Mr. Paslay*

Mechanical Engineering 632. Rheology (3-0-3).

Applications of the results obtained in Mechanical Engineering 631 with emphasis on plastic, viscoelastic and thixotropic materials. One semester. *Mr. Paslay*

Mechanical Engineering 634. Thermodynamics of Alloys (3-0-3).

Discussion of equilibrium conditions in liquid and solid metallic solutions. Analysis of thermodynamic quantities from the classical and statistical points of view. Specific heat, thermal expansion coefficient and compressibility of metallic systems are studied. One semester. *Mr. Asimow*

Mechanical Engineering 635. Transformations in Alloys (3-0-3).

Diffusion and nucleation in the solid state. Order-disorder reactions. The kinetics and mechanisms of allotropic transformations, including diffusionless processes. One semester. *Mr. Asimow*

Mechanical Engineering 636. X-ray Metallography (3-0-3).

A study of the diffraction of X rays by crystals. Application of single crystal and powder techniques to physical metallurgy. Stress measurements, particle size determination, and the effect of crystalline defects on diffraction. One semester. *Mr. Asimow*

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 of and interstitials of solids. Production of these defects by different methods including irradiation. One semester. *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. One semester. Prerequisite: Mechanical Engineering 644. *Mr. Roberts*

Mechanical Engineering 646. Theory of Metallic Structures (3-0-3).

Electron theory of metals, starting with the Free-electron model and leading to Brillouin Zones and Band Theory. Metallic Structures and solid solubilities are interpreted in the light of these theories. One semester. *Mr. Brotzen*

Mechanical Engineering 647. Physical Properties of Solids (3-0-3).

Based on the electron theory of metals, the electrical and thermal conductivities of metals are studied. The origin and behavior of diamagnetic, paramagnetic and ferromagnetic materials are considered. A discussion of semiconductors will be included. Prerequisite: Mechanical Engineering 646 or equivalent. One semester. *Mr. Brotzen*

Mechanical Engineering 653. Research and Thesis.

A report on an engineering investigation carried out by the individual student under the direction of a member of the staff in mechanical engineering. Nine hours of research weekly. Three copies of the accepted report will be required: two for deposit in the University Library and one for the mechanical engineering department.

Mechanical Engineering 661. Theory of Elasticity (3-0-3).

State of stress at a point, state of strain at a point, and stress-strain relations. The general equations of three-dimensional theory of elasticity are considered. A treatment of the two-dimensional theory, including plane stress and plane strain is included. Also discussed are the states of stress in rectangular, circular and ring-shaped plates, and the torsion and flexure of uniforms bars of any cross-section. One semester. *Mr. Wilhoit*

Mechanical Engineering 662. Additional Topics in the Theory of Elasticity (3-0-3).

The use of complex variables is applied to two dimensional elasto-static problems. Three-dimensional problems in the theory of elasticity are considered. One semester. *Mr. Wilhoit*

Mechanical Engineering 663. Special Topics in Applied Mechanics.

A collection of several topics not currently included in other courses. The topics include engineering applications of variational calculus methods, thermodynamic conditions imposed on the formulation of stress-strain equations, stress wave propagation and nonlinear elasticity and vibration problems. One semester. *Messrs. Wilhoit, Paslay*

Mechanical Engineering 665. Theory of Plates and Shells (3-0-3).

The bending of rectangular and circular flat plates with various edge conditions is discussed. An introduction to plate buckling vibration is given. The membrane theory of shells and the general theory of cylindrical shells is treated. One semester. *Mr. Paslay*

Mechanical Engineering 670. Advanced Thermodynamics (3-0-6).

A continuation of the study of the principles of thermodynamics. Primarily a thorough course in the fundamental concepts of thermodynamics not usually covered in undergraduate courses. A detailed consideration of energy and its transformations, the laws of thermodynamics, reversibility, entropy, and examples of application to various fields. One semester. *Mr. Plapp*

Mechanical Engineering 673. Advanced Fluid Dynamics (3-0-6).

A course emphasizing topics in classical fluid dynamics. The material consists of the fundamentals of frictionless flow, airfoil theory, and ducted flow. Equal time is devoted to the flow of viscous fluids. Primary attention is given to boundary layer flow and to turbulent flow. Two semesters. *Mr. Beckmann*

Mechanical Engineering 675. Special Applications of Fluid Dynamic Theories (3-0-6).

Special topics of greater interest are emphasized, comprising the hydrodynamic theory of lubrication, cavitation, flow through porous materials, admixtures of solid particles to flowing fluids, flow of two non-mixing liquids of different densities, the fluid dynamics of meteorology and others. Two semesters. *Mr. Beckmann*

Mechanical Engineering 680. Advanced Heat Conduction (3-0-3).

Advanced work in the field of heat conduction. The course consists of a presentation of the general conduction equation and methods of solution in one-, two-, and three-dimensional problems and in the transient state. An examination is made of the problems of extended surfaces and internal heat sources. One semester. *Mr. Chapman*

Mechanical Engineering 682. Theory of Convective Heat Transfer (3-0-3).

A basic examination of the processes of forced and free convection in laminar and turbulent flow. Development cases for which they have been solved. One semester. *Mr. Plapp*

Mechanical Engineering 693. Advanced Gas Dynamics (3-0-6).

Analysis of the general equations of fluid flow. Properties of compressible fluids. Subsonic and supersonic flow in the steady and non-steady states and in one, two, and three dimensions. Shock waves and other phenomena connected with high-velocity flow. Analysis of the general properties of quasi-linear hyperbolic differential equations. Two semesters. *Mr. Chapman*

Mechanical Engineering 695. Special Research Topics in Mechanical Engineering.

Individual laboratory or library research investigations under the direction of a member of the mechanical engineering staff.

HUMANITIES

ANTHROPOLOGY AND SOCIOLOGY

Associate Profesor: NORBECK, *Chairman*
Lecturer: GILES
Visiting Lecturer: NOLAND

Additional faculty are anticipated for the academic year 1961-62; other courses will be added as new instructors join the staff.

COURSES

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

Human evolution, fossil man, human genetics, races of man and problems of race; major outlines of the ancient prehistory of the Old and New Worlds.

Anthropology 200b. Cultural and Social Factors (3-0-3).

Late prehistory of man and cultural growth; major aspects of culture (social organization, economics, religion); cultural patterns and sociocultural change.

Anthropology 300a. Primitive Religion (3-0-3).

Comparative survey of religion and magic; the relationship of religion and magic to other aspects of culture and their roles with respect to society and the individual.

Anthropology 300b. The Nature of Culture (3-0-3).

The nature and basic processes of cultural behavior; cultural and social change; dynamics of cultural life. Illustrative data taken from primitive and modern societies. *Not open to students who have taken or are currently enrolled in Anthropology 200b.*

Sociology 200. An Introduction to Sociology (3-0-6).

The course includes an analysis of the geographical and biological factors in social evolution, social psychology, and a study of the functions of citizenship. The subject matter involves a survey of modern social problems and their relation to a changing technological and institutional framework. *Mr. Giles*

ECONOMICS AND BUSINESS ADMINISTRATION

Professor: EDWARDS, *Chairman*

Associate Professors: AUTEN, BROTHERS, J. HODGES, W. MACKEY, RIMLINGER, SIMONS

Assistant Professors: JAKSCH, STEELE

Lecturer: GILES

Information for Undergraduate Major. Students primarily interested in accounting are advised to take Business Administration 200 in their sophomore year. Those interested in economics should take Economics 200 as sophomores.

Undergraduate majors are required to take 12 semesters of approved departmental courses. These must include Economics 200, Economics 350a, and Business Administration 200. A student with a principal interest in economics may be permitted to substitute electives outside the department for up to two semesters of elective courses in economics provided (1) that such substitution complements his major interest, and (2) that he secures approval of the Departmental Representative in Economics.

In lieu of three semesters of course work, the Department offers independent work to a limited number of students having a principal interest in economics who have taken Economics 200 as sophomores. Selections for this program are made late in the first term of the Junior year.

Departmental Representatives are:

Mr. Mackey — for class of 1963 students in accounting

Mr. Auten — for class of 1963 students in economics

Mr. Simons — for class of 1962 students in accounting.

Mr. Steele — for class of of 1962 students in economics

The Graduate Program in Economics. Admission to graduate study in economics will be granted to a limited number of students who hold an undergraduate degree (or the equivalent), whether in economics or another field. Some training in mathematics at the college level is advisable, but it is not a prerequisite of admission. Those candidates for the Ph.D. degree who have a 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 dissertation. A minimum of another year is usually necessary for the completion of the dissertation. Applicants in the United States must take the Graduate Record Examination. Others should do so if possible.

The aim of the graduate program is to provide a thorough training in economic theory supplemented by a knowledge of quantitative tools and 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) the Economics Seminar which meets at least once a month to hear visiting economists, departmental faculty, and graduate students present results of current research. Outside speakers in 1959-60 included Professor Philip Bell and Dr. Martin Shubik.

(2) a large scale digital computer which may be used for advanced research.

(3) graduate courses in such related subject areas as history, mathematics, and philosophy.

In addition to the regular staff, distinguished visiting professors are invited to Rice from time to time. Professor Leslie Wright of the University of Edinburgh, Scotland, served in this capacity during the fall term, 1959-60.

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 year and the other by the end of the second year of residence. Under special circumstances another language may be approved as a substitute for one of these.

(2) Demonstrate proficiency in statistics and elementary mathematical economics.

(3) Complete an approved program of graduate courses.

(4) Pass a general examination (written and oral) on four approved fields of economics, one of which must be economic theory. The fields offered include:

1. Economic Theory
2. Economic History and Development
3. Mathematical Economics
4. Quantitative Methods
5. Labor and Industrial Organization
6. Monetary Theory and Policy
7. International Trade and Finance
8. Managerial Economics

Note: Students may offer both fields 3. and 4. with special permission of the Departmental Graduate Committee.

(5) Submit (with the approval of the student's advisory committee) and successfully defend in an oral examination a doctoral dissertation setting forth in publishable form the results of original research.

Candidates admitted for the master's degree in economics will be expected to:

(1) Pass a reading examination in French or German.

(2) Demonstrate proficiency in statistics.

(3) Complete an approved program of graduate courses.

(4) Make a successful oral defense of a thesis presenting, in prescribed form, the results of original research.

COURSES

Economics 200. Principles of Economics (3-0-6).

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. *Staff*

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. A limited number of students are permitted to transfer to this course at the end of the first semester on the basis of interviews with those who apply. Preference is given to juniors having a principal interest in economics who are contemplating enrolling in Economics 404 as seniors. Prerequisite: Economics 200. *Staff*

Economics 350a. Elements of Statistical Method (3-2-3).

Collection, classification, and presentation of data; analysis of frequency distributions; analysis of time series; index numbers; correlation; introduction to the theory of sampling and statistical inference. *Mr. Hodges*

Economics 355b. Money and Banking (3-0-3).

The theory of money and credit; the theory and practice of commercial and central banking; treasury debt management policy; the nature of the money market. Prerequisite: Economics 200a. *Mr. Brothers*

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. *Mr. Edwards*

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. *Mr. Edwards*

Economics 404. Senior Independent Work (0-0-6).

Each student is required to undertake intensive research on the senior thesis topic approved in Economics 304a. The results of his research will be presented in the form of a scholarly paper. Prerequisite: Economics 304b. *Staff*

Economics 401b. The 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. *Mr. Giles*

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 200. *Mr. Auten*

Economics 430a. 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 200. *Mr. Rimlinger*

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. *Mr. Steele*

Economics 440a. Managerial Economics (3-0-3).

The meaning of management; criteria for management decisions; organization theory; managerial planning and control with emphasis on capital budgeting; information requirements and problems of measurement. Prerequisite: Economics 200. *Mr. Hodges*

Economics 445b. Mathematical Methods in Management (3-0-3).

An introduction to the solution of management problems by elementary methods of mathematical economics and operations research. Prerequisite: Economics 200a. *Mr. Jaksch*

Economics 455a. Financial Policies and Institutions (3-0-3).

The economics of finance; the financial policies of large-scale business organizations; the nature and functions of various financial institutions which serve as intermediaries in the saving-investing process. Prerequisite: Business Administration 200 and Economics 220a. *Mr. Brothers*

Economics 460a. Management I (3-0-3).

The meaning of management; forms of business organization; legal aspects of the corporation; problems in financial management, problems in human relations. Not open to departmental or engineering majors. *Mr. Hodges*

Economics 465b. Management II (3-0-3).

Organizational problems of the firm; management planning and control; informational requirements. Not open to departmental or engineering majors. *Mr. Hodges*

Economics 475b. 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. *Mr. Steele*

Economics 490a. The Development of Economic Institutions (3-0-3).

A seminar devoted to the analysis of the impact of technological change and political and social developments upon the evolution of economic institutions. Investigation will be made of economic forces which lie beyond supply-and-demand factors in the market economy. The course will survey the works of leading institutional economists and social anthropologists as a point of departure for research and discussion. *Mr. Giles*

Economics 500. Economic Research.

Research on an approved topic in partial fulfillment of the requirements for the master's degree. *Staff*

Economics 501. Price Theory (3-6-5).

A first graduate course in micro-economic 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. *Mr. Steele*

Economics 502. Income and Employment Theory (3-6-5).

Macro-economic theory of employment, interest and income. Considers the work of Keynes and subsequent developments including growth models. *Mr. Edwards*

Economics 503. Capital and Interest Theory (3-6-5).

The development of capital, income and interest theory from Böhm-Bawerk to the present. Offered in alternate years.

Economics 504. Topics in Economic Theory (3-6-5).

Deals with such topics as utility theory, welfare economics, uncertainty, cyclical models, and game theory.

Economics 505. Monetary Theory (3-6-5).

Modern monetary theory. The economics of money, banking and finance. *Mr. Brothers*

Economics 506. Monetary and Fiscal Policy (3-6-5).

Selected theories in monetary and fiscal policy and their interrelationships; analysis of selected policy proposals, and a study of their operation in practice.

Economics 507. Elementary Mathematical Economics (3-6-5).

The formulation of fundamental economic models and basic economic theory in elementary mathematical terms. *Mr. Jaksch*

Economics 508. Advanced Mathematical Economics (3-6-5).

The application of mathematical tools to special economic problems. Areas covered will include interindustry economics, growth and cyclical models, and selected applications of game theory. *Mr. Jaksch*

Economics 509. Advanced Statistics (3-0-3).

Statistical inference and the testing of hypotheses; multiple and partial correlation analysis; selected topics in time series analysis and index number construction. *Mr. Hodges*

Economics 510. Econometrics (3-6-5).

Mathematical models of economic behavior and their numerical evaluation by statistical methods.

Economics 511. Theory of Economic Accounts (3-6-5).

The nature and measurement of income and capital; the construction and use of economic accounts as a basis for analyzing the firm, interindustry relationships, the national economy, and international trade. National income accounts, money flows accounts, and input-output tables are discussed. Offered in alternate years. *Mr. Edwards*

Economics 512. International Trade Theory (3-6-5).

Classical, neo-classical, and modern trade theory; balance of payments equilibrium; some welfare aspects of trade. Offered in alternate years. *Mr. Auten*

Economics 513. Topics in Managerial Economics (3-6-5).

Theory of investment of the firm; organization theory; problems in applying theory in decision-making. *Messrs. Edwards and Hodges*

Economics 514. Industrial Organization and Control (3-6-5).

Industrial markets and public policy; the determinants and implications of price and production policies; a study of the adequacy of the antitrust laws in relation to the problems of industrial organization. *Mr. Steele*

Economics 515. Labor Economics (3-6-5).

The economics of the labor market and the economic implications of trade unions. Attention is given also to major policy questions such as the wage-price issue, the labor monopoly issue, and public control over unions and collective bargaining. *Mr. Rimlinger*

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. *Mr. Rimlinger*

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 neo-classical 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. *Mr. Auten*

Economics 600. Economic Research.

Research on an approved topic in partial fulfillment of the requirements for the doctor's degree. *Staff*

Business Administration 200. Introduction to Business (3-0-6).

Accounting principles; financial statements; business organization and procedures; financial structure, internal organization, and accounting problems of partnerships and corporations; manufacturing costs; analysis and interpretation of financial reports.

Messrs. Simons and Mackey

Business Administration 391a. Cost Accounting (3-0-3).

The methods of accounting for the various elements of manufacturing costs are treated with special emphasis on the use of cost information in administration and control. Job order, process, and standard cost procedures. Prerequisite: Business Administration 200.

Mr. Mackey

Business Administration 392b. Principles of Accounting, Intermediate (3-0-3).

Accounting procedures reviewed; working papers, closing; financial statements; net income concepts; capital stock, retained earnings, and dividends; miscellaneous topics relating to stockholders' equity; generally accepted accounting principles; cash; receivables; inventories; investments; tangible and intangible fixed assets; liabilities and reserves. Prerequisite: Business Administration 200.

Mr. Simons

Business Administration 411a. Advanced Accounting and Federal Taxation (3-3-4).

Analysis and interpretation of statements and operations; application of funds; cash flow; combinations, divisive and quasi-reorganizations; income tax allocation; price level impact on financial statements; partnerships; statement of affairs; receiverships; actuarial science; estates and trusts; parent and subsidiary accounting; consolidations. Laboratory hours devoted to the study of federal taxation of income of individuals. Prerequisite: Business Administration 392b.

Messrs. Simons and Mackey

Business Administration 412b. Auditing and Federal Taxation (3-3-4).

Financial examination theory and procedure as practiced by the independent certified public accountant; internal control; working papers and reports. Largely based on integrated case study. Laboratory hours devoted to a study of federal taxation of the income of fiduciaries, partnerships, and corporations; estate and gift taxation; oil and gas taxation. Prerequisite: Business Administration 391a, 392b, and 411a.

Mr. Mackey

ENGLISH

Professors: CAMDEN, *Chairman*, DOWDEN, McKILLOP, A. WILLIAMS, G. WILLIAMS

Associate Professors: CONNER, COPE, GALLEGLY, PARISH, THOMAS

Assistant Professors: MARSH, PICKARD

Visiting Lecturer: BLACK

Requirements for a major in English. Six courses in English, one preferably to be English 250, four to be advanced; an advanced course in French or German; two approved collateral courses in history, history of art, or philosophy, both to be advanced.

Requirements for the Degree of Master of Arts. Four advanced courses in English; the passing of a reading examination in French or German; the satisfactory completion of a thesis; the passing of an oral examination. Two years are usually required to complete the work for this degree.

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 or on compliance with formal requirements; 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: eight advanced courses in English, including those required for the degree of Master of Arts; 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, this requirement to be met at least a year before the submission of a thesis; 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 100. Introduction to Critical Reading, Thinking, and Writing (3-0-6).
Special attention will be given to expository writing and to the study of literary forms.
Messrs. Black, Conner, Dowden, Gallegly, Cope, Parish, Pickard, A. Williams, G. Williams, and others

English 210. Argumentation and Public Speaking (3-0-6).
Practical training in the fundamentals of effective speech, written argument, and debate. Designed to prepare the student for the ordinary demands of business life. Platform speaking, themes, conferences. This course is planned for students of physical education.
Mr. Gallegly

English 230. Selected Great Books of European Literature (3-0-6).
Readings, lectures, discussions, and reports. *Mr. McKillop*

English 240. Modern and Ancient Narrative in Prose, Verse, and Drama (3-0-6).
Through readings, lectures, discussions, and reports, a study will be made of prose fiction, poetic fiction, and drama. Specific forms to be treated are the fable, the tale, the epic, the romance, the dramatic monologue, the short story, the novel, comedy, and tragedy.
Messrs. Conner, Marsh, Parish, Pickard, and Thomas

English 250. Masters of English Literature (3-0-6).
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. A. Williams

English 300. English Drama from Its Beginnings to 1642 (3-0-6).
The development of the drama will be traced from the miracle plays and the moralities through the plays of Shakespeare and his contemporaries to the closing of the theaters. Some emphasis will be placed upon the development of Shakespeare as a dramatist, and upon the indebtedness of Shakespeare to the earlier drama. *Mr. Cope*

English 310. Modern British Poetry (3-0-6).
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. G. Williams*

English 320. Modern Drama (3-0-6).
A study of representative English, American, and Continental plays and dramatic movements since Ibsen against the background of antecedent theatrical traditions of the nineteenth century. Lectures and class discussions will be supplemented by reports on collateral reading. *Mr. Thomas*

English 330. Advanced Writing (3-0-6).

The writing of essays, stories, plays, and novels. Time is given also to problems of marketing manuscripts. Stories will be read and analyzed, and critical theories are discussed. Frequent conferences. *Mr. G. Williams*

English 340. The English Novel (3-0-6).

Major novelists of the nineteenth and early twentieth centuries. *Mr. McKillop*

English 350. Poetry and Prose of the Romantic Period (3-0-6).

Study of the poetry from Blake to Keats; reading of selected prose from Lamb to Carlyle. *Mr. Dowden*

English 355. Victorian Literature (3-0-6).

The main procedure is close reading and class discussion of assigned texts from the major writers. Connections with other literatures of the period, and with the social and political background, will be made through lectures, collateral reading, and reports. *Mr. Thomas*

English 360. English Drama from 1660 to 1900 (3-0-6).

This course begins with the opening of the theaters after the Puritan Revolution and covers the drama of the Restoration, the eighteenth century, and the nineteenth century. *Mr. A. Williams*

English 365. Literature of the Restoration and Eighteenth Century (3-0-6). *Mr. A. Williams*

English 380. Poetry of the English Renaissance (3-0-6).

Major poets of the period and their relation to the political, religious, and scientific issues. *Mr. Parish*

English 385. Chaucer (3-0-6).

English 390. American Literature from the Beginning to 1880.

A survey of American literature from Colonial times to the genteel tradition of post Civil War days and the beginnings of naturalism. Particular emphasis is placed on major nineteenth century figures like Poe, Hawthorne, Melville, Emerson, Whitman, Twain, and James. *Mr. Black*

English 393. American Literature from 1880 to the Present (3-0-6).

A survey of modern trends in American Literature, beginning with the naturalist writers. Major figures like Dreiser, Eliot, Hemingway, Faulkner, and O'Neill will receive special emphasis. *Mr. Pickard*

English 395. Life and Literature of the West and Southwest (3-0-6). *Mr. Gallegly*

English 400. Shakespeare (3-0-6).

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. *Mr. Camden*

English 404. Directed Reading and Independent Work in English Literature (0-0-6).

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. Students will be selected for participation after consultation with the instructor in charge. *Mr. Cope*

English 440. History of the English Language, and Modern English Grammar (3-0-6). *Mr. Conner*

English 450. Literary Allegory in the Sixteenth, Seventeenth, and Eighteenth Centuries (3-0-6).

A study particularly of *The Faerie Queene, The Winter's Tale, The Tempest, Paradise Lost, Pilgrim's Progress, Absalom and Achitophel,* and *A Tale of A Tub.* *Mr. Cope*

English 460. Sixteenth Century Literature (3-0-6).
A survey of nondramatic literature from Malory to the death of Elizabeth, with special emphasis upon *The Faerie Queene* and *Arcadia.* *Mr. Marsh*

English 500. Topics in English Literary History.
Graduate research and thesis for the degree of Master of Arts.

English 505. Chaucer (3-0-6). *Mr. G. Williams*

English 510. Medieval English (3-0-6).
Selected readings from the seventh to the fifteenth centuries; emphasis will be placed on the historical development of the language. *Mr. Conner*

English 515. Directed Reading in English Linguistics (3-0-6). *Mr. Conner*

English 520. Seminar in the Romantic Period (3-0-6). *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 535. Literary Criticism (3-0-6).
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 540. Seminar in Seventeenth Century Literature (3-0-6). *Mr. Cope*

English 550. Shakespeare Seminar (3-0-3). *Mr. Camden*

English 555. Seminar in Elizabethan and Jacobean Drama (3-0-3). *Mr. Camden*

English 560. Eighteenth Century Prose and Poetry (3-0-6). *Mr. McKillop*

English 570. Milton Seminar (3-0-6). *Mr. Cope*

English 580. Directed Reading in English Literature (3-0-6). *Staff*

English 595. Dryden, Swift, and Pope (3-0-6). *Mr. A. Williams*

English 600. Topics in English Literary History.
Graduate research and thesis for the degree of Doctor of Philosophy.

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.

FINE ARTS

Professor: CHILLMAN, *Chairman*
Associate Professor: DE ZURKO
Assistant Professor: PARSONS

The studios of the Department of Fine Arts are located in the North basement of the Fondren Library. They are completely air-conditioned with adequate north light and equipped for drawing, painting and modelling. The History of Art courses are held in Anderson Hall with complete equipment for slide and motion picture projection.

COURSES

History of Art 215. History of the Architecture, Sculpture, and Painting of the Ancient World (3-0-6).

Emphasis is placed upon the correlation of the arts and their reflection in Renaissance and contemporary developments. Open to all students. *Mr. Chillman*

History of Art 315. History of the Architecture, Sculpture, and Painting of the Middle Ages (3-0-6).

A study of outstanding examples of western sacred and secular art. Open to students in all divisions. *Mr. De Zurko*

History of Art 415. History of the Architecture, Sculpture, and Painting of the Renaissance and the subsequent Developments to the Present Time (3-0-6).

A general knowledge of ancient and medieval art is desirable. Open to students in all divisions. *Mr. De Zurko*

History of Art 450. Great Works of Architecture and Its Related Arts (3-0-6).

A history of art from 500 B.C. to modern times. Masterpieces of architectural composition which combine sculpture and painting. Examples: the Acropolis at Athens and the cathedral at Chartres. Lectures, discussion, and papers. Open to Juniors, Seniors, and graduate students. *Mr. Chillman*

History of Art 460. The Development of Modern Art (3-0-6).

A study of painting, sculpture and architecture during the past century in western Europe and the United States. *Mr. Chillman*

Drawing 255. Freehand Drawing and Painting (0-4-2).

Open to all students. *Mr. Parsons*

Drawing 325. Freehand Drawing and Painting (0-4-2).

Open to all students. *Mr. Parsons*

Drawing 425. Life Drawing and Painting (0-4-2).

Open to all students. *Mr. Parsons*

FOREIGN LANGUAGES

Professors: BOURGEOIS, LOUIS, MACKENZIE, *Chairman*

Associate Professors: BATTISTA, SHELTON

Assistant Professors: DVORETZKY, HODGES, JITKOFF, LEHNERT, MYERS, SHREFFLER, WILSON

Visiting Lecturer: SCHEIBLE

Instructors: GOODHAND, KAMINSKI, LAUDERDALE, MITCHELL, SAVAGE

Work is offered in the classical and modern languages: in 1961-62 courses will be given in Greek, Latin, French, German, Italian, Russian, and Spanish. Undergraduates may major in Romance Languages, French, or German, and there are graduate programs in French and German leading to the degrees of Master of Arts and Doctor of Philosophy.

Undergraduate Majors. Students who intend to major in Romance Languages, French, or German should consult the section of this catalogue dealing with curricula and degrees to familiarize themselves with the University requirements. At least three of the courses offered in fulfillment of major require-

ments must be numbered 300 or higher. 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 or German will be granted to a limited number of qualified students. Evidence of qualification would normally include a distinguished undergraduate record in the appropriate language, and a capacity for independent work is considered essential. The award of advanced degrees is not based solely on accumulation of credits or compliance 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 processes and results of scholarship in their chosen field. In most cases two years will be required for the completion of work for the degree of Master of Arts.

Classics

Professor: MACKENZIE

Note: It is expected that at least one other course in the classical field will be offered in 1961-62: students who plan to enroll in any of the classics courses are urged to consult Mr. Mackenzie well in advance of registration.

Greek 100. First Year Greek (3-0-6).

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.

Latin 200. Intermediate Latin (3-0-6).

A course designed for students who enter with two or three years of school Latin: rapid review of forms and grammar, and practice in reading. In the second term representative selections of Latin prose and poetry will be read, including a play of Terence.

Mr. Mackenzie

Latin 300. Horace and Pliny (3-0-6).

Reading of a representative selection of *Odes*, *Epodes*, *Satires*, and *Epistles*. Among topics studied will be Horace's relation to his Greek predecessors, his place in Augustan culture, and his ethical and literary views. In the second term a number of Pliny's *Letters* will be studied for the light they throw on Roman public and private life.

Classics 300. Greek Literature in Translation (3-0-6).

A study of some aspects of the Greek creative achievement. The work of the first term will be based on the Homeric epics and a representative group of tragedies: attention will be paid to literary techniques and to the function of literature as a reflection of the intellectual life of a society. In the second term the major Greek historians will be studied and their work considered in relation to the poetic and philosophical approaches to reality.

Mr. Mackenzie

German

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 a minimum of four advanced courses.

(b) Passing a reading examination in one language other than that of the candidate's specialization and approved by the department.

(c) Completion of an acceptable thesis.

(d) Passing an oral examination.

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 eight advanced courses.

(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 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 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 on the dissertation and related fields.

COURSES

Professor: LOUIS
Assistant Professors: DVORETZKY, LEHNERT, WILSON
Visiting Lecturer: SCHEIBLE
Instructors: KAMINSKI, MITCHELL

German 100. Elementary German (3-0-6).
Grammar, conversation, and extensive reading. *Staff*

German 200. Intermediate German: Literary (3-0-6).
Intensive and extensive reading throughout the year: study of *Faust* I in the second semester. *Staff*

German 201. Intermediate German: Scientific (3-0-6).
The work of the first semester is identical with that in German 200. May be offered as prerequisite for advanced courses. *Staff*

German 205. Intermediate German: Literary and Scientific (3-0-6).
The work of the first semester is identical with that in German 200. Study of *Faust* I in second semester. May be offered as prerequisite for advanced courses. Outside reading second semester in field of major study. *Staff*

German 305. Writing, Speaking, Translation (3-0-6). *Staff*

German 307. Philosophical Ideas in German Literature (3-0-6).
Readings in the original will be required. *Mr. Kolenda*

German 309. History of German Literature (3-0-6).
A comprehensive survey of German literature from its beginning to the present. *Mr. Dvoretzky*

German 330. Romanticism and Realism in German Literature (3-0-6).
Offered in alternate years: to be given in 1961-62. *Mr. Lehnert*

German 360. Lessing and Schiller (3-0-6).
Offered in alternate years. *Mr. Louis*

German 380. German Literature since 1880 (3-0-6).
Offered in alternate years. *Mr. Lehnert*

German 390. Goethe (3-0-6).
Offered in alternate years: to be given 1961-62. *Mr. Wilson*

German 404. Independent Work: Special Topics in German Literature (0-0-6).
Independent work for qualified upperclassmen: may be repeated for credit. *Staff*

German 460. German Literature, 1400-1750 (3-0-6).
Offered in alternate years.

German 500. Graduate Research.
Graduate research and thesis in partial fulfillment of the requirements for the degree of Master of Arts.

German 501. Special Topics in Literary Interpretation (3-0-6).
For graduate students: may be repeated for credit. *Staff*

German 502. Special Topics in Germanic Philology (3-0-6).
For graduate students: may be repeated for credit. *Staff*

German 520. Germanic Philology (3-0-6).
An introduction to the study of Gothic, Old Norse, Old Saxon, Old High German, and the history of the German language. Offered in alternate years. *Mr. Wilson*

German 530. Middle High German. (3-0-6).
Offered in alternate years: to be given in 1961-62. *Mr. Louis*

German 600. Graduate Research.
Graduate research and dissertation in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

ROMANCE LANGUAGES

Professor: BOURGEOIS
Associate Professor: BATTISTA, SHELTON
Assistant Professors: HODGES, MYERS, SHREFFLER
Instructors: GOODHAND, LAUDERALE, SAVAGE

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 three advanced courses.
(b) Passing a reading examination in one language other than that of the candidate's specialization and approved by the department.
(c) Passing a preliminary oral examination on the French authors indicated in a reading list provided.
(d) Completion of an acceptable thesis.
(e) Passing an 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 seven advanced courses.
(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 examination on the authors indicated in a reading list provided, and on the literature, culture, and civilization of France; knowledge of a second literature, preferably English, 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 on the dissertation and related fields.

FRENCH

COURSES

French 100. Beginning French (3-0-6).

A close study of the fundamentals of French grammar and pronunciation. Exercises in written French. Oral practice, dictations and translation of suitable texts. *Staff*

French 200. Intermediate French (3-0-6).

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. *Staff*

French 300. French Civilization and Advanced Composition (3-0-6).

A course intended for students who need more drill on syntax; also for those who, although not interested in literature, desire to acquire some knowledge of the development of the institutions, the customs and the culture of France up to the present time. Discussions, oral and written reports in French. *Mr. Shelton*

French 320. French Classicism (3-0-6).

A study of seventeenth century authors with particular emphasis on the theatre of Corneille, Racine and Molière. Selected readings from Malherbe, Descartes, Pascal, Boileau, La Rochefoucauld, La Fontaine, Madame de Sévigné and others. Discussion and analysis of texts in French.

French 330. The Age of Enlightenment (3-0-6).

Readings from the representative authors of the eighteenth century: Marivaux, Le Sage, Voltaire, Montesquieu, Diderot, Rousseau, and Beaumarchais. Discussion and analysis of texts in French. *Mr. Myers*

French 350. The French Romantic Movement (3-0-6).

Poetry, novel and drama. Special emphasis on the study of Chateaubriand, Constant, Lamartine, Vigny, Hugo, Musset and Mérimée. A thorough study of selected texts with discussions and essays in French. *Mr. Bourgeois*

French 380. Modern French Fiction and Drama (3-0-6).

Study and discussion in French of significant novels and plays of the twentieth century. *Mrs. Savage*

French 404. Directed Study and Senior Thesis (0-0-6).

Open only to Senior students selected after application to the Directing Committee of 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 two advanced courses in French are prerequisites.

French 450. French Realism and Naturalism (3-0-6).

Special emphasis on the study of Stendhal, Balzac, Flaubert, Maupassant, the de Goncourt brothers and Zola. Discussion and essays in French. *Mr. Bourgeois*

French 500. Graduate Research.

Graduate research and thesis in partial fulfillment of the requirements for the degree of Master of Arts.

French 521. The Seventeenth Century (3-0-6).

Studies in seventeenth century French literature. Offered in alternate years: to be given in 1961-62.

French 543. Voltaire, Part II (3-0-6).

A chronological study of Voltaire's life and work from 1750 to his death. Offered in alternate years: to be given in 1961-62. *Mr. Myers*

French 544. Diderot (3-0-6).

A systematic inquiry into his esthetics. Offered in alternate years. *Mr. Myers*

French 550. Nineteenth Century Drama (3-0-6).

The evolution of the dramatic conception in France during the nineteenth century. Offered in alternate years: to be given in 1961-62. *Mr. Bourgeois*

French 561. Balzac (3-0-6).

A critical study of his most representative novels. Offered in alternate years. *Mr. Bourgeois*

French 572. Proust: A Study of "A la Recherche du Temps Perdu" (3-0-6).

Attention will be given to its background and composition and to the thought and art of Proust. Offered in alternate years: to be given in 1961-62. *Mrs. Savage*

French 574. Baudelaire and Mallarmé (3-0-6).

A study of their poetry and of certain of their prose writings. Offered in alternate years. *Mrs. Savage*

French 600. Graduate Research.

Graduate research and dissertation in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

Italian

COURSES

Italian 100. Elementary Italian (3-0-6).

Oral exercises, grammar, composition, and reading of representative Italian authors.

Spanish

COURSES

Spanish 100. First Year Spanish (3-0-6)

Oral exercises, grammar, composition, and study of elementary Spanish texts. *Staff*

Spanish 200. Second Year Spanish (3-0-6).

Oral exercises, grammar, composition, and study of elementary Spanish texts. Open to students who have had two years of high school Spanish or Spanish 100. *Staff*

Spanish 300. Third Year Spanish (3-0-6).

Review of grammar, composition, essays, study of representative authors, collateral readings and reports. Conducted in Spanish.

Spanish 400. Outlines of the History of Spanish Literature (3-0-6).

Collateral reading of major authors representative of the various periods.

Russian

COURSES

Russian 100. Elementary Russian (3-0-6).

Pronunciation, grammar, introduction to conversation, graded reading, and practice in composition. *Mr. Jitkoff*

Russian 200. Intermediate Russian (3-0-6).

Designed to provide additional practice in reading and comprehension, with emphasis on Russian composition and an introduction to Russian literature. Texts in the fields of geography, history, and science will be read; translation from Russian scientific articles and newspapers. Outside reading. Prerequisite: Russian 100. *Mr. Jitkoff*

HISTORY AND POLITICAL SCIENCE

Professors: CRAIG, LEAR, MASTERSON, VANDIVER

Associate Professors: ABBOT, DREW, NELSON, *Chairman*

Assistant Professors: BARBER, GALAMBOS, LOEWENHEIM, MARSAK

Lecturers: HUDSPETH, MUIR

Both the undergraduate and graduate programs in history are in process of revision. The list of courses which follows represents the course offerings in 1960-61.

Admission to graduate study in history may be granted to qualified students holding the bachelor's degree. Two years are normally required for the master's degree, including the completion of four advanced courses in history, the passing of a written translation examination in German or French, and the presentation of a written thesis. The doctor's degree is offered only in certain fields of history, requires the completion of eight advanced courses, the passing of written translation examinations in French and German, the passing of qualifying, preliminary and final examinations, and the submission of a written thesis.

COURSES

History 100. Foundations of Western Civilization (3-0-6).

This course is intended to provide an historical background for the various humanistic branches of study. It includes a survey of human achievement from prehistoric times through antiquity and the middle ages to the eighteenth century. *Mrs. Drew*

History 110. American History (3-0-6).

A survey of the growth of the American nation, with considerable attention to its European background. Recommended as fulfilling the requirements of prelegal and premedical students and constituting a basic course in history for Freshmen. *Mr. Masterson*

History 200. Modern European History (3-0-6).

This course surveys the history of Europe since 1500, and is intended to serve as background for advanced work in European and American history, literature, and philosophy. *Mrs. Drew and Mr. Nelson*

History 300. Cultural History of the United States (3-0-6).

This course deals with the primary trends in the social and intellectual life of the American people from colonial times to the Civil War, and seeks to interpret them as expressions of the American national spirit. Prerequisite: History 110. *Mr. Lear*

History 310. The Early National Period (3-0-6).

A study of the society and thought of America from the late colonial period to 1850. The chronological limitation is intended to permit a close study of the personalities and characteristics of the nation in its formative years. Prerequisite: History 110. *Mr. Barber*

History 315. Greek and Roman History (3-0-6).

A survey in some detail of the main political, social and economic events of the Greek and Roman world. *Mr. Craig*

History 320. Trends in European Culture during Antiquity and the Middle Ages (3-0-6).

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 100. *Mr. Lear*

History 330. The Making of Modern Europe (3-0-6).

The first half of this course deals with the period from 1300-1600. The second semester covers that from 1600-1789. *Mrs. Drew*

History 350. Modern Europe, 1715-1870 (3-0-6).

The first half of this course contains a study of the Old Regime, the French Revolution, and Napoleon. The second half deals with the rise of liberalism, socialism, and nationalism from 1815 to 1871. *Mr. Loewenheim*

History 355. British History (3-0-6).

This course deals mainly with the period since 1485, although it includes a survey of the constitutional development of the earlier period. *Mr. Nelson*

History 370. Intellectual History of Modern Europe (3-0-6).

A history of scientific ideas and ethical systems from Descartes to Sartre. The first semester will include reading in the works of Descartes, Pascal, Hobbes, Locke, Newton, Bayle, Fontenelle, Montesquieu, Voltaire and Diderot. The second semester will consider Hume, Rousseau, Kant, Hegel, J. S. Mill, Comte, Marx, Nietzsche, James and Sartre. *Mr. Marsak*

History 380. American Economic History (3-0-6).

A study of the economic history of the United States from the colonial period through the Second World War. Examination of broad economic trends will be supplemented by histories of individual firms and business leaders. Prerequisite: History 110. *Mr. Galambos*

History 385. American Political and Social History Since the Civil War (3-0-6).

This course examines basic political, social, and intellectual developments in the United States from 1876 to the present. Prerequisite: History 110. *Mr. Galambos*

History 390b. History of the American West (3-0-3).

This course traces the westward movement from its beginnings 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 110. *Mr. Muir*

History 395. A History of the South (3-0-6).

A study of life and economy of the Southern people from the colonial period. Attention is given to such topics as the frontier, the plantation, slavery, sectionalism, and agrarian, social, and industrial problems. Primary emphasis is placed on the institutions and history of the ante-bellum period. Prerequisite: History 110. *Mr. Vandiver*

History 400. The Old Regime and the Enlightenment: 1610-1789 (3-0-6).

A study of the political and economic institutions, and the chief literary, philosophical and scientific currents in the great age of France. *Mr. Marsak*

History 404. Senior Thesis (0-0-6).

A limited number of seniors majoring in the Department are allowed to write a thesis of 15-25 thousand words on a subject to be approved in advance by their departmental advisers. Admission only on invitation of the Department. *Staff*

History 420. Medieval Sources (3-0-6).

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: three or four years of high school Latin. *Mr. Lear*

History 430. Topics in Ancient and Medieval Intellectual History (3-0-6).

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 100. *Mr. Lear*

History 440. Social and Economic History of Europe in the Middle Ages (3-0-6).

The work of this course begins with social and economic conditions in the late Roman Empire, traces their gradual evolution into the "stagnant" conditions of the early Middle Ages, and then considers the important economic changes associated with the eleventh century and their influence on the social and economic institutions of early modern Europe. Open only to advanced students after consultation with the instructor. *Mrs. Drew*

History 450. Contemporary History (3-0-6).

A survey of current world affairs, with lectures and readings on the background of present-day policies and events. *Mr. Craig*

History 455. Modern Europe Since 1871 (3-0-6).

The subject of this course is the political, diplomatic, and cultural history of Europe from the proclamation of the German Empire to the present. *Mr. Loewenheim*

History 460. English Constitutional History (3-0-6).

A survey of the development of the English constitution with particular attention to the period since 1485. *Mr. Nelson*

History 465a. American Colonial History (3-0-3).

A study of American society in the colonial period. Particular attention is given to the social and intellectual background of the Revolution. *Mr. Nelson*

History 480. American Politics (3-0-6).

An advanced survey of American political history. Emphasis is placed on the relationship of politics to economic and social events. Prerequisite: History 110. *Mr. Masterson*

History 490. Topics in American Constitutional and Political History (3-0-6).

Research in the fields of American political history and constitutional development. Open to properly qualified students after consultation with the instructor. *Mr. Masterson*

History 495. Civil War and Reconstruction (3-0-6).

A study of the rise of sectionalism, the abolition crusade, the secession crisis, United States versus Confederate States, aftermath of the war, reconstruction, economic and social consequences of the war, and emergence of a New South. Emphasis is placed on social, economic and military events during the years 1861-1865. Prerequisite: History 110. *Mr. Vandiver*

History 500. Historical Research (3-0-6).

Master's thesis. *Staff*

History 510. Directed Reading in American History (3-0-6). *Staff*

History 520. Directed Reading in Medieval History (3-0-6). *Staff*

History 530. Directed Reading in Modern History (3-0-6). *Staff*

History 545. Historiography (3-0-6).

Graduate Seminar. *Staff*

History 550. Studies in the History of the Atlantic Community (3-0-6).

A systematic study of the origins and development of the Atlantic Community from the 1750's to the 1950's. The first semester is devoted to a study of the intellectual and cultural history of the Atlantic Community; the second semester to its diplomatic and military history. Qualified seniors may be admitted by special permission. *Mr. Loewenheim*

History 570. The First World War (3-0-6).

A study of the causes of World War I, the course of the war itself, and the peace settlement of Versailles. Open to properly qualified students after consultation.

History 590. Seminar in Western American History (3-0-6).

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 595. Topics in Confederate History (3-0-6).

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. *Mr. Vandiver*

History 600. Historical Research.

Doctoral dissertation. *Staff*

POLITICAL SCIENCE

COURSES

Political Science 210. American Government (3-0-6).

A study of the history and operation of constitutional government in the United States with special emphasis on the historical background of the Federal government, the structure of the government, the formation of public policy, and the conduct of public business. For additional background and for contrast, reference is made to English constitutional history and to the present structure of the English government. This year course in American government, planned for the general student of government, is also designed to enable prospective lawyers, physicians, and teachers to meet the state requirements of a course in "Constitutions." *Mr. Hudspeth*

Political Science 310. Law and Society (3-0-6).

The study of law as a part of cultural anthropology and the history of organized society. Emphasis is placed upon the sources of legal doctrine, specifically illustrated by case law and legislation is the field of contracts, torts, commercial transactions, and domestic relations. *Mr. Hudspeth*

Political Science 410. Ancient and Medieval Political Theory (3-0-6).

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. *Mr. Lear*

Political Science 520. Topics in Legal History and Political Theory (3-0-6).

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. *Mr. Lear*

MUSIC

(The Shepherd School of Music)

COURSES

Music 300. Orientation and Historical Survey (3-0-6).

An investigation into the technical, psychological, and social aspects of music. Prerequisite: Junior standing. *Mr. Hall*

Music 315. Harmony and Sight-Singing (3-0-6).

Instruction in the theory and practice of traditional harmony and sight-singing and dictation. The translation of notation into rhythm and sound, and sound into notation. Includes inversions of the dominant 7th and the higher dominants, plus all major and minor triads and non-chords. *Mr. Hall*

PHILOSOPHY, PSYCHOLOGY, AND EDUCATION

Professors: FULTON, *Chairman*, HUDSON, NIELSEN
Associate Professors: BLACK, KOLENDA, MACKEY, WANN
Assistant Professors: ROBINSON, WALKER, WOOD
Instructor: SANDERS
Visiting Lecturer in Religions: WHALE

Philosophy

Undergraduate majors shall normally be expected to take Philosophy 220, or its equivalent, and eight semesters of upper division courses, of which four shall be Philosophy 301, 302, 303, and 304. In addition, qualified majors may elect Philosophy 400. At the end of the senior year, departmental majors write comprehensive examinations instead of course examinations in philosophy.

Graduate Study. College graduates who have shown ability in their undergraduate study of philosophy may be admitted to candidacy for the degrees of Master of Arts and Doctor of Philosophy. 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.

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) Satisfactory evidence, conforming to the requirements printed on page 42, of the student's ability to use French and German in his studies.

(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.

Requirements for the degree of Doctor of Philosophy include:

(a) The completion with high standing of courses approved by the department during at least three years of residence.

(b) Satisfactory evidence, conforming to the requirements printed on page 42, of the student's ability to use French and German in his studies.

(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.

(e) The passing of a final oral examination, not limited to the student's field of study.

COURSES

Philosophy 220. Introduction to Philosophy (3-0-6). *Staff*

Philosophy 301. Thales to Plotinus (3-0-3). *Mr. Fulton*

Philosophy 302. Augustine to Bruno (3-0-3). *Mr. Mackey*

Philosophy 303. Galileo to Hume (3-0-3). *Mr. Fulton*

Philosophy 304. Kant and the 19th Century (3-0-3). *Mr. Kolenda*

Philosophy 310. History of Religion (3-0-6). *Mr. Nielsen*

Philosophy 321. Logic (3-0-3). *Mr. Robinson*

Philosophy 322. Advanced Logic (3-0-3). *Mr. Robinson*

Philosophy 323. Philosophy of Science (3-0-3). *Mr. Robinson*

Philosophy 324. Problems in Philosophy of Science (3-0-3). *Mr. Robinson*

Philosophy 331. Approaches to Ethics: Historical (3-0-3). *Mr. Kolenda*

Philosophy 332. Approaches to Ethics: Contemporary (3-0-3). *Mr. Kolenda*

Philosophy 350. Philosophical Ideas in Literature (Given 1962-1963) (3-0-6). *Mr. Kolenda*

Philosophy 361. Aesthetics (3-0-3). *Mr. Mackey*

Philosophy 362. Theory of Literature and Music (3-0-3). *Mr. Mackey*

Philosophy 400. Independent Study and Senior Thesis (3-0-6). *Staff*

Philosophy 411. Philosophy of Religion (3-0-3). *Mr. Nielsen*

Philosophy 414. The Christian Faith in the Modern World (3-0-3). *Mr. Whale*

Philosophy 442. Bradley to Whitehead (3-0-3). *Mr. Fulton*

Philosophy 461. Social and Political Philosophy (3-0-3). *Mr. Nielsen*

Philosophy 500. Research and Thesis (3-0-6). *Staff*

Philosophy 511. Wittgenstein and His Influence (3-0-3). *Mr. Kolenda*

Philosophy 513. Peirce and Pragmatism (Given Fall 1962) (3-0-3). *Mr. Kolenda*

Philosophy 521. Readings in Non-Christian Religious Philosophy (Given Fall 1962) (3-0-3). *Mr. Nielsen*

Philosophy 522. Protestant Philosophy Since the Reformation (Given Spring 1963) (3-0-3). *Mr. Nielsen*

Philosophy 524. Hellenism and Christianity (Given Spring 1963) (3-0-3). *Mr. Nielsen*

Philosophy 541. Existentialism (Given Fall 1961) (3-0-3). *Mr. Mackey*

Philosophy 543. Hegel (Given Fall 1962) (3-0-3). *Mr. Mackey*

Philosophy 544. Metaphysics (Given Spring 1963) (3-0-3). *Mr. Mackey*

Philosophy 552. Husserl (Given Spring 1962) (3-0-3). *Mr. Fulton*

Philosophy 554. Whitehead (Given Spring 1963) (3-0-3). *Mr. Fulton*

Philosophy 556. The Problem of Time (Given Spring 1963). *Mr. Fulton*

PSYCHOLOGY

The student planning to major in psychology should take Psychology 210 in the sophomore year and the 300 and 400 series courses in the junior and senior years respectively. A student who has delayed in choosing psychology as his major field until the junior year should consult with members of the department in planning his schedule. Majors who plan to participate in practice teaching during their senior year should also consult with members of the department regarding their third and fourth year course schedules.

Students are encouraged to select Biology 100 as one of their laboratory courses in their freshmen or sophomore year. Anthropology 200 and 300 are recommended as B electives in their sophomore and junior years.

Independent Study. Qualified majors in psychology are encouraged to undertake a research problem under the supervision of members of the staff, substituting this (Psychology 404) for two semester courses in their senior year. Emphasis is placed upon a broad survey of literature pertaining to the area in which the research is to be undertaken as well as upon the research itself. The student may substitute this program for Psychology 415a and Psychology 420b. His work would be focused upon extending his knowledge and experience in the field of experimental psychology and research methodology *per se*, or in conjunction with the latter, expanding upon one of the other subject areas in psychology taken during the junior year.

COURSES

Psychology 210a. General Psychology (3-0-3).

An introduction to the subject matter of the several fields of psychology, its relationship to other disciplines, and some of its contemporary applications. *Mr. Hudson*

Psychology 212b. Current Psychology (3-0-3).

Current research in psychology, its historical background, and its theoretical implications; oriented toward preparing the student for further work in psychology. Prerequisite: Psychology 210a or consent of instructor. *Mr. Hudson*

Psychology 300. General Psychology (3-0-6).

A survey of the subject matter of the several fields of psychology to include consideration of some of its applications to contemporary problems. *Mr. Hudson*

Psychology 315b. Experimental Psychology and Research Methodology (2-5-3).

An introduction to research methods in psychology. In lectures, and in laboratory experiments, psychological concepts and methods are developed and examined. Prerequisite: Psychology 210a, 212b, 340a or consent of instructor. Laboratory fee required. *Mr. Hudson*

Psychology 320. Language, Thought, and Communication (3-0-6).

An examination of language, thought, and communication from the perspectives of psychology, linguistics, communication theory, cultural anthropology, and philosophy. Prerequisites: Psychology 210a and 212b, or 300. *Mr. Hudson*

Psychology 330a. Differential Psychology (3-0-3).

Designed to familiarize the student with the techniques for measuring individual differences. Critical reviews are made of various theories of individual differences in intelligence and personality. Prerequisites: Psychology 210a and 212b or 300. *Mr. Wann*

Psychology 330b. Personality (3-0-3).

Selections from literature on personality are analyzed and compared. Prerequisites: Psychology 210a and 212b or 300. *Mr. Wann*

Psychology 340a. Advanced Statistics (3-0-3).

Advanced correlational techniques, frequency comparisons, small sample methods, analysis or variance, and further consideration of sampling and statistical inference. Prerequisite: Elementary statistics. *Mr. Wann*

Psychology 340b. Elementary Statistics (3-0-3).

An introduction to the theories and techniques of the statistical method as applied to problems in psychology 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. Prerequisites: Psychology 210a and 212b or 300. (Not offered 1961-62.) *Mr. Wann*

Psychology 404. Independent Study (0-0-6). *Staff*

Psychology 410a. Development Psychology (3-0-3).

The year 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 adlescence, with the physical, social, and emotional processes that go into the making of an adult. *Mr. Wann*

Psychology 410b. 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. Prerequisites: Psychology 210a and 212b or 300. *Mr. Wann*

Psychology 415a. Experimental Psychology (2-5-3).

A continuation of Psychology 315b. Prerequisites: Psychology 210a, 212b, 315b. *Mr. Hudson*

Psychology 420b. History and Systems (3-0-3).

This course reviews the history of Western scientific psychology and the development of systems in psychological theory. Prerequisites: Psychology 210a and 212b, or 300.

Education

COURSES

Education 310. The History of Education (3-0-6).

A survey of education in theory, organization, and practice from ancient times to the present. Prerequisite: filing of teacher certification program with instructor. *Mr. Black*

Education 410. Professional Education (3-0-6).

By means of group preparation and presentation, lectures, and reading notes, the prospective teacher acquires knowledge required of a member of the teaching profession; how to locate educational information and data; methods; tests and measurements and elementary statistics; teaching as a profession; the organization, administration, and supervision of schools; educational psychology; the curriculum; current trends; philosophy of education. *Mr. Black, Mr. Wood*

Education 420. Methods, Observation, and Student Teaching, Grades 7-14 (Credit: 9 semester hours).

Required of students who plan to teach in the secondary schools. Meets three hours per week on the campus during the instruction period in methods of teaching and in preparation for the actual teaching. Observation and supervised student teaching off the campus in the schools for half-day placement for a period of sixteen weeks. Open only to Senior students and Class III graduate students who have the approval of the instructor, as an additional course not to be counted in the degree program. In planning his courses, the student who wishes to receive a recommendation for a teacher's certificate should:

(1) Take History 110 and Political Science 210, preferably during the Freshman and Sophomore years; Psychology 300, either the Junior or Senior year; Education 410 and Education 420, the Senior year.

(2) Consult early with the chairman of the department in which he plans to major.

Mr. Sanders, Mr. Wood

SCIENCES

Biology

Professors: READ, TALMAGE, *Chairman*

Associate Professors: AWAPARA, DAVIES, ENDERS, WOODWARD

Assistant Professor: SEGAL

Instructor: CAMPBELL

Lecturer: PULLEY

A biology major may be taken either in the Academic or the Science-Engineering program. The course requirements will differ slightly according to the specific requirements of these curricula. All majors are required to have introductory courses in biology, chemistry, physics and mathematics. Specifically, Biology 200a, Biology 210b and Chemistry 300 are required. A total of six to eight semester courses in biology must be taken in the Junior and Senior years to bring the biology courses taken to a total of ten (5 year courses equivalent). One of these courses must be either physiology or biochemistry. Those students who decide to major in biology too late to get all the freshman science requirements may take an approved course instead of Physics 100, in summer school. Biology majors who plan to go into high school teaching can take one advanced biology course (2 semesters) in summer school if practice teaching is necessary in the Senior year. This summer school course must be approved by the Department of Biology and the Committee on Examinations and Standing.

Honors Program in Biology: Qualified biology majors are encouraged to undertake a research problem under the supervision of a faculty adviser. Such students will substitute Biology 400 for a minimum of two and a maximum of three advanced biology semester courses. For more complete information concerning this program, consult with members of the departmental staff.

Graduate work in biology is open to qualified applicants who hold a bachelor's degree or its equivalent, with a major in a biological science. Graduate specialization is limited to fields related to the research interests of the staff. Prospective graduate students should take the Graduate Record Examination before applying, or as soon thereafter as practicable. If it is not taken prior to matriculation, it may be required during the first year of residence.

The following areas of specialization are currently offered in biology: biochemistry, cellular physiology, cytology, embryology, endocrinology, environmental physiology, general physiology, genetics, marine biology, microanatomy, parasitology, and symbiotic relationships.

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 six graduate courses in biological and related sciences (a course is here considered at least six semester-hours credit) 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 page 43.

(d) Completion of language requirements as described on pages 42-43.

(e) The following examinations must be passed:

A series of 10 written examinations are given annually. A student must have passed 8 of these examinations by June 15th of the year prior to that in which the Ph.D. is awarded.

Substitution in other sciences is permitted for 2 categories out of the 8.

(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 completion of the language requirements, four graduate courses, satisfactory work in three of the written examinations, 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.

Laboratory Instruction. Financial assistance in the form of graduate assistantships, predoctoral fellowships, research assistantships, and scholarships is available. All graduate students in biology are expected to engage in some laboratory instruction regardless of type of appointment, as this instruction is considered an important part of the training of the candidate. Graduate students are assigned to different courses from year to year to obtain the maximum benefit from this phase of training.

The Biological Laboratories: The Biology Department is located in the Anderson Biological Laboratories. These are new facilities completed in 1958 and furnished with all standard modern equipment for biological, physiological and biochemical studies.

COURSES

Biology 100. General Biology (3-0-8).

An introductory course in biology covering the general principles underlying living things. A general vertebrate type is considered first, and this is used as a basis for an introduction to physiology, immunology, embryology, cytology, genetics, ecology, and classification. Structure and function are, when possible, considered together; emphasis is placed on the former in the laboratory, and the more dynamic aspects are presented in lecture with the aid of demonstrations and motion pictures. The latter part of the course deals with various animal forms and their evolution, with emphasis on progressive differentation of structure and adaptation to environment. *Mr. Davies*

Biology 200a. Comparative Zoology (3-3-4).

A phylogenetic study of the invertebrate phyla, including the prochordates. Prerequisite: Biology 100. *Mr. Pulley*

Biology 210b. Comparative Anatomy (3-6-5).

The structure of the vertebrates is studied. The lecture material emphasizes the evolutionary patterns in the development of structures and the natures of homologous and analogous structures in various taxonomic groups. The laboratory is primarily devoted to learning the structure of the shark and cat in sufficient detail that references to homology and function may be meaningful. Prerequisites: Biology 100 and 200a. *Mr. Enders*

Biology 215b. Botany (3-3-4).

A comparative study of the plant kingdom with emphasis on phylogenetic relationships. Prerequisite: Biology 100. *Mr. Woodward*

Biology 310a. Genetics (3-3-4).

A course devoted to a study of heredity with frequent references to human material. Prerequisite: Biology 100. *Mr. Woodward*

Biology 320a. Parasitism and Symbiosis (3-3-4).

An introduction of the biology of symbiosis, with special emphasis on parasitism. The life histories, morphology, and physiology of parasites and hosts will be discussed with considerable emphasis on the evolution of parasitism. Illustrative examples demonstrating principles will be drawn from the plant or animal kingdom. Some attention will be given to the parasitic worms and protozoans responsible for human and animal disease. Prerequisites: Biology 100, Chemistry 120. *Mr. Read*

Biology 340a. General Physiology (3-3-4).

The fundamental processes of living systems are considered at the cellular level. The cellular environment is examined and some of the homeostatic mechanisms whereby the cell maintains a steady state are studied. The structure of the cell in terms of its chemical composition and physiochemical and functional organization is taken up. Certain aspects of cellular metabolism are considered. These include permeability, respiration and energy metabolism, synthesis, and growth and differentiation. Specialized cellular functions such as excitation and contraction are also studied. Prerequisites: Biology 100 and Chemistry 120. *Mr. Campbell*

Biology 350b. Embryology (3-3-4).

Early developmental stages from fertilization to germ layer formation are studied. Reference is made to determination, differentation, organizers, and other ontogenetic phenomena. Implantation, placentation, and organogenesis of mammals are studied. The laboratory work is primarily concerned with the development of organs and systems of vertebrates. Prerequisite: Biology 210 (can be taken concurrently). *Mr. Segal*

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

A study of the marine and estuarine environments with particular attention given to the local fauna. The laboratory will include weekend field trips, and class size is limited to 15 students. Prerequisite: Invertebrate Zoology or Invertebrate Paleontology. *Mr. Pulley*

Biology 370a. Histology (3-3-4).

Cells, tissues, and organs are studied microscopically. Much of the material studied is mammalian, but whenever desirable and feasible, comparable materials from other animals are presented. Laboratory work includes observation, drawings, and introduction to histological technique and study of electron micrographs. Prerequisites: Biology 100, 210b. *Mr. Enders*

Biology 380b. Field Biology (3-3-4).

A review of the principles of ecology based primarily on field observations of the local flora and fauna. The laboratory will include weekend field trips, and class size is limited to 15 students. Prerequisites: Biology 200a, 215b. *Mr. Pulley*

Biology 390. Anatomy and Public Health (3-3-8).

A course of lectures and laboratory work open only to students of physical education. The first term is devoted to the study of human anatomy and physiology and the physiology of exercise. The second term covers health legislation, social problems, vital statistics, epidemiology, care of water, milk, and other foods, sewage disposal, housing, and ventilation, including trips to study the health practices and conditions of public utilities. *Mr. Welch and Mr. Bland*

Biology 400 (a, b, or c). Special Problems and Honors Work (2-6-4) or (2-6-8).

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

Biology 440b. Comparative Physiology (3-3-4).

The specialized physiology of the different animal phyla is considered. This includes a study of feeding and digestion, circulation and oxygen transport, respiration and intermediary metabolism, excretion and nitrogen metabolism, behavior, and the hormonal control of growth and development as these processes occur in the different animal groups. Prerequisite: Biology 340a. *Mr. Campbell*

Biology 450a. Introduction to Biochemistry (3-3-4).

The chemistry of proteins, nucleo-proteins, lipids, carbohydrates and growth factors. The application of some physico-chemical laws to living systems. Prerequisites: Biology 340a and Chemistry 300. *Mr. Awapara*

Biology 460b. Advanced Biochemistry (3-2-3).

A study of enzymes, and their function. Intermediary metabolism and biosynthesis of cell components. Prerequisite: Biology 460a or permission of the instructor. *Mr. Awapara*

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

Lectures on the classification, evolution, growth, nutrition, and metabolism of unicellular organisms. Consideration will be given to bacteria, fungi, and protozoa, with emphasis on features common to all. Laboratory work will include methods of isolation, culturing, and identification of micro-organisms, the chemical basis of staining, mutualism and antibiosis, use of micro-organisms for chemical assay, and selected experiments illustrating physiological attributes. Prerequisites: Biology 100 and 200a. *Mr. Read*

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

A study of the primary endocrine glands of mammals and their relationships to the physiological homostasis of the mammal. While emphasis is placed on the function, morphology, and inter-relationships 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. Prerequisites: Biology 210b and Biology 340a. *Mr. Talmage*

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

An introductory study of the applications of nuclear radiation to biological problems. The purpose of the lectures and laboratory is to acquaint the student with characteristics of nuclear emissions, problems of health physics, an 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. *Mr. Talmage*

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

Held weekly for the purpose of hearing papers on current research by members of the staff, visiting investigators, and graduate students. Graduate students in Biology are required to attend, and the seminar is open to visitors from on and off the campus. Undergraduate biology majors are invited. *Staff*

Biology 510. Special Topics in Biochemistry.

Readings, conferences and laboratory work in current developments in biochemistry. Prerequisites: Biology 450a and 460b. *Mr. Awapara*

Biology 519. Research in Biochemistry. *Mr. Awapara*

Biology 520. Advanced Cellular Physiology.

Readings, conferences, and laboratory work in current fields of investigation in cellular physiology and biochemistry. Prerequisite: Consent of instructor. *Mr. Campbell*

Biology 521. Advanced Comparative Physiology.

Conferences and laboratory work on the physiology of invertebrate animals. Reading in the literature dealing with ionic and osmotic regulation, permeability, respiration, nutrition, nitrogen metabolism, excretion, energy metabolism, neurosecretion, and muscle-nerve physiology. Prerequisite: Permission of instructor. *Mr. Campbell*

Biology 529. Research in Molecular or Comparative Physiology. *Mr. Campbell*

Biology 530. History of Biology.

A seminar and reading covering the history of various fields of biology.
Mr. Davies and Mr. Read

Biology 539. Research in Vertebrate Anatomy. *Mr. Davies*

Biology 540. Cytology.

The course consists of student reports and discussions concerning the anatomical and chemical properties of the cell, its formed constituents, and inclusions. Morphological and cytochemical indications of specific activity are emphasized. Students are introduced to the use of the electron microscope. Prerequisite: Biology 210b, 370a. Open to senior majors by permission of instructor. *Mr. Enders*

Biology 541. Special Cytology.

An analysis of the methods of investigating cellular organization and activity. Particular emphasis is placed on cytochemical studies of parenchymal cells. *Mr. Enders*

Biology 549. Research in Histochemistry and Microanatomy. *Mr. Enders*

Biology 559. Research in Marine Biology. *Mr. Pulley*

Biology 560. Physiology of Parasitism.

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 physiological problems, with examples drawn from the animal or plant kingdom. *Mr. Read*

Biology 561. Protozoology.

Conferences and laboratory study of the protozoan parasites of vertebrates. Attention will be given to the morphology, classification, life histories, and ecology of parasitic protozoa, with some consideration of related free-living species. Laboratory study will include methods of cultivation, and husbandry, preparation for study, and specific diagnosis, but emphasis will be placed on the experimental study of protozoan biology. *Mr. Read*

Biology 562. Helminthology.

Conferences and laboratory work on the morphology classification, life histories, and evolution of the helminth parasites of vertebrates. Emphasis will be placed on study of original literature. *Mr. Read*

Biology 563. Medical Entomology.

Conferences and laboratory study of the arthropods involved in the transmission of infectious agents. Attention will be given to morphology, classification, life histories, in relation to the ecology of viruses, rickettsias, bacteria, and helminths. Some consideration will be given to parasitic arthropods. Control of the medically important arthropods will be discussed. *Mr. Read*

Biology 569. Research in Parasitology or Comparative Physiology. *Mr. Read*

Biology 570. Environmental Physiology.

The functional adaptations of cold-blooded organisms to environmental factors. Analysis of the physiological characters which provide the basis for animal distribution. Readings, conferences and laboratory work. *Mr. Segal*

Biology 579. Research in Environmental and Comparative Physiology. *Mr. Segal*

Biology 580. Seminar in Endocrinology I.

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.

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 589. Seminar in Endocrinology. *Mr. Talmage*

Biology 590. Topics in Genetics.

Readings, conferences and laboratory work in current problems in microbial genetics. *Mr. Woodward*

Biology 599. Research in Genetics. *Mr. Woodward*

Chemistry

Professors: KILPATRICK, LEWIS, MILLIGAN, RICHTER, TURNER, *Chairman*

Associate Professors: ETTLINGER, SALSBURG

Assistant Professors: BRACKETT, CURL, SASS

A student who has completed a course for the degree of Bachelor of Arts may be admitted as a candidate for the degree of Master of Arts or of Doctor of Philosophy.

Preparation for the degree of Doctor of Philosophy involves at least three years of graduate work. The thesis must present a distinctly original contribution to the subject. It should be acceptable for publication in an accredited journal or series, and copies must be deposited in the University Library.

The following specific requirements must be met by candidates for advanced degrees taking their major work in chemistry:

(a) For admission to graduate standing, candidates for advanced degrees must possess a reading knowledge of scientific German, and must have completed general courses equivalent to the work through organic and physical chemistry offered during the first three years of an undergraduate major in chemistry at Rice University, and at least one full-year course of more advanced study equivalent to Senior work in chemistry.

(b) For admission to graduate standing in chemistry, preference will be given to applicants who earn high scores on the Graduate Record Examination, including the advanced test in chemistry. (See page 36.) A new graduate student who has not taken the Graduate Record Examination may be required to do so at the earliest examination time during his first semester of residence.

(c) A candidate for the degree of Master of Arts is required to complete, in addition to a thesis, three approved full-year courses; also, he must pass a final public oral examination.

(d) Monthly cumulative examinations in physical - inorganic or organic chemistry will be given to all graduate students beginning their second year of work. The results of these examinations will determine the progress toward the degree.

(e) A candidate for the degree of Doctor of Philosophy must have met the course requirements for the master's degree in chemistry; in addition he must complete three advanced full-year courses approved by the department, together with the doctoral thesis. He must satisfy the University language requirements (see page 42) by demonstrating a reading knowledge of scientific French and scientific German. Also, he must pass a final public oral examination.

Graduate assistants who devote as much as six hours per week to teaching will, in general, be expected to spend two years in residence for the Master's Degree and four years in residence for the Doctor's Degree.

COURSES

Chemistry 120. General Inorganic Chemistry and Qualitative Analysis (3-4-8).

A general introductory course dealing with the fundamental phenomena and principles of the science. During the second half-year the laboratory exercises are arranged to verify and illustrate the principles and facts which are discussed in the lectures. During the first half-year the laboratory work deals with the general principles and methods of qualitative analysis. This course is required of science-engineering students, and is also open to academic students who may wish to proceed beyond the Sophomore year in chemistry. Chemistry 120 is one of the prerequisites for Chemistry 220. Prerequisite: High School Chemistry. Laboratory fee required. *Mr. Brackett and Mr. Sass*

Chemistry 220. Quantitative Analysis (3-4-8).

The course aims to familiarize the student with the fundamental principles of analytical chemistry and, by laboratory and problem work, with the application of these principles to a variety of representative analytical processes. Special emphasis is placed on chemical mathematics and stoichiometry, and throughout the work attention is given to general analytical technique. Prerequisites: Chemistry 120 and Physics 100. Laboratory fee required. *Mr. Curl*

Chemistry 230. Analytical Chemistry (0-6-4).

A laboratory course required of and open only to Junior chemistry majors. This course is designed to supplement and extend the previous work in analytical chemistry in order to meet certain professional requirements. During the first semester four hours of laboratory work each week will be devoted to qualitative analysis. The second semester will require two four-hour laboratory periods weekly directed to the study of quantitative analysis. Laboratory fee required. *Mr. Curl*

Chemistry 300A. Organic Chemistry (3-4-8).

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. Prerequisite: Chemistry 220. Laboratory fee required. *Mr. Richter*

Chemistry 300B. Organic Chemistry (3-4-8).

A course arranged primarily for premedical students and academic students not specializing in chemistry. This course differs from Chemistry 300a only in the type of laboratory preparations. The laboratory work is devoted chiefly to the synthesis of typical examples of general and local anesthetics, disinfectants, analgesics, biological preparations, alkaloids, and dyes. Prerequisite: Chemistry 220 or special permission from the department of chemistry. Laboratory fee required. *Mr. Richter*

Chemistry 310. Physical Chemistry (3-0-6).

A quantitative study of theoretical and physical chemistry dealing with the forms of matter, changes of state and energy, kinetics, equilibria, electrochemistry, photochemistry, and atomic structure. Prerequisites: Chemistry 220 and Physics 200. *Mr. Salsburg*

Chemistry 311. Physical Chemistry Laboratory (0-3-1).

Laboratory exercises in Physical Chemistry. May be taken concurrently with Chemistry 310 or in the following year. Laboratory fee required. *Mr. Salsburg*

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

Introduction to theoretical organic chemistry with emphasis on reactions of general synthetic importance. *Mr. Ettlinger*

Chemistry 410a. Colloid Chemistry (3-4-4).

An introductory course dealing with the theories of colloid chemistry and their applications. Prerequisites: Chemistry 300 and 310. Laboratory fee required. *Mr. Milligan*

Chemistry 420a. Statistical Mechanics (3-0-3). *Mr. Salsburg*

Chemistry 420b. Introduction to Quantum Mechanics (3-0-3).

Modern concepts of structural chemistry based on the principles of quantum mechanics, including a discussion of current methods of structure determination. *Mr. Brackett*

Chemistry 430b. Special Topics in Physical Chemistry (3-0-3). *Mr. Sass*

Chemistry 440b. Advanced Organic Chemistry and Qualitative Analysis (2-6-4).

This course embodies a systematic procedure for the separation and identification of pure organic compounds. It aims to review, by actual laboratory contact, many important reactions of the main series of organic substances. (Owing to limitations of space, enrollment will be limited to thirty-five students.) Laboratory fee required. *Mr. Lewis*

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

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

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

A study of important types of natural products of current interest to biology and chemistry. *Mr. Turner*

Chemistry 500. M.A. Thesis.

Graduate students who are working toward the Master of Arts degree in chemistry are expected to elect at least nine hours a week in research under the direction of some member of the staff.

Chemistry 510. Chemistry of the Steroids (3-0-6).

A theoretical consideration of the reactions and stereochemistry of the steroids, including a discussion of the physiological importance of these compounds. *Mr. Turner*

Chemistry 520b. Theory of Adsorption of Gases (3-0-3).

An advanced treatment of modern theories of adsorption of gases on solids. *Mr. Milligan*

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

Chemistry 545a. Physical-organic Chemistry (3-0-3).

The application of physical methods to the determination of the structure of organic compounds. *Mr. Lewis*

Chemistry 545b. Physical-organic Chemistry (3-0-3).

A study of the mechanisms of various important organic reactions. *Mr. Lewis*

Chemistry 550a. Reaction Kinetics (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. *Mr. Lewis*

Chemistry 560b. Electrochemistry (3-0-3).

The application of thermodynamics to the study of electrolytic cells. Prerequisite: Chemistry 450a. *Mr. Kilpatrick*

Chemistry 570. Absorption Spectra of Organic Compounds (3-0-6).

The application of ultraviolet and infrared absorption spectra to the study of molecular structure. *Mr. Ettlinger*

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

A consideration of the chemistry of selected groups of alkaloids. *Mr. Turner*

Chemistry 590. Advanced Topics in Theoretical Chemistry. *Mr. Salsburg*

Chemistry 600. Ph.D. Thesis

Graduate students who are working toward the Ph.D. degree in chemistry are expected to elect at least twelve hours a week in research under the direction of some member of the staff of instruction. *Staff*

Chemistry 610. Application of X-ray Diffraction Methods (3-0-6).

Application of X-ray diffraction methods to inorganic and physical chemistry. Identification of solid phases, determination of crystal size, X-ray analysis of simple types of structures, electron diffraction. Principles and operation of modern X-ray apparatus. This course alternates with Chemistry 660. *Mr. Milligan*

Chemistry 620. Molecular Structure Determination (3-0-6).

Theory and practice of various physical methods of molecular structure determination. Theory of the chemical bond.

Chemistry 630b. Statistical Thermodynamics (3-0-3).

A development of the principles of thermodynamics from the standpoint of statistical mechanics. The relation of the structure of molecules to their thermodynamic properties. Prerequisites: Chemistry 450a and Mathematics 300 or 310. *Mr. Kilpatrick*

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

Chemistry 650. Quantum Mechanics (3-0-6).

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

Chemistry 660. X-ray Crystal Structure Analysis (3-0-6).

X rays, and their interaction. Experimental methods. Symmetry and space groups. Fourier methods. Dynamic theory of X-ray diffraction. This course alternates with Chemistry 610. *Mr. Sass*

Chemistry 680. Modern Methods in Crystal Structure (3-0-6).

Fourier and Patterson methods, modification functions, inequalities, and order-disorder phenomena. *Mr. Sass*

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

Mr. Lewis

Geology

Professors: ADAMS, CRONEIS, *Chairman*

Associate Professors: DE BREMAECKER, ROGERS

Assistant Professors: DONNELLY, PURDY

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, a department of geology has been 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 new geology laboratory, completed in June, 1958, provides ample space and facilities for undergraduate and graduate instruction and research.

Undergraduate Requirements. In addition to satisfaction of the general requirements of the Science-Engineering 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 310; taken in the junior year

Geology 330a - 331b; taken in the junior year

Geology 400a - 401b; taken in the senior year

1 to 2 year courses (2 to 4 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 petrology, stratigraphy, sedimentation, and sedimentary petrology, 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.

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 map and structure interpretation in addition to the identification of hand specimens of rocks and minerals. Prerequisite: Consent of the Department. Prospective majors in geology are expected to have had Chemistry 120, Physics 100, and Mathematics 100. 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. Purdy*

Geology 310. Mineralogy and Petrology, first term (3-4); second term (3-6); Credit: 9.

Basic introduction to the following topics: crystallography, crystal structure, hand specimen mineralogy, optical mineralogy, petrology and petrography of igneous and metamorphic rocks, and X-ray mineralogy. Laboratory includes work with crystal models, mineral hand specimens, optical techniques such as identification of minerals in immersion oils, hand specimen and thin section petrography, and X-ray technique. Prerequisite: Mathematics 200, Physics 200, or consent of the Department. Laboratory fee required.

Messrs. Donnelly 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. Prerequiste: 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. Prerequisites: Geology 200a and 201b. Laboratory fee required.

Mr. Rogers

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. *Messrs. Purdy and Rogers*

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 (ordinarily eight 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. Inverterbrate Paleontology (3-4-4).

An introduction to the morphology and geological record of the major invertebrate groups characterized by significant fossil representation. Prerequisites: Geology 201b and consent of the Department. Laboratory fee required. *Mr. Purdy*

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. Croneis

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 worldwide correlations. Prerequisite: Geology 401b or consent of the Department. Laboratory fee required.

Mr. Croneis

Geology 411a. 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 310. Laboratory fee required.

Mr. Donnelly

Geology 455. Geochemistry (3-4-8).

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. Prerequisites: Geology 310a and consent of the Department. Laboratory fee required. *Mr. Adams*

Geology 460. Geophysics (3-3-8).

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. De Bremaecker

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. Prerequisites: Geology 400a and 540a (may be taken concurrently). *Mr. Purdy*

Geology 506a. Advanced Paleontology (3-3-4).

A study of the major features of evolution. Topics considered include rates of evolution, adaptation, and extinction. Prerequisite: Geology 505a. *Mr. Purdy*

Geology 510-517. Seminars in Geology.

Courses covering the subjects listed in sequence under Research Courses numbered 590-597. Individual seminars may cover different topics in different years and may be taken more than once. All seminars three units per semester.

Geology 518. Seminar in Marine Geology (3-3-4).

Geology and geophysics of oceanic areas. Topics covered include the basic structure of oceanic parts of the crust, marine geologic processes, and the origin and development of submarine geomorphologic features. *Mr. Officer*

Geology 519. Seminar in Geotectonics (3-3-4).

Basic problems of world-wide geology with particular emphasis on tectonic features.

Mr. Officer

Geology 530b. 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.

Messrs. Rogers and Purdy

Geology 535b. Optical Mineralogy and X-ray Techniques (3-6-5).

The course is devoted largely to the techniques of making optical measurements on minerals. Rock-forming minerals are studied by universal stage and X-ray powder diffraction techniques. *Mr. Donnelly*

Geology 540a. 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 550. Chemical Geology (3-3-8).

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 560. Advanced Topics in Geophysics (3-3-8).
Study of selected topics in geophysics, including seismology, gravitation, and geomagnetism. *Mr. De Bremaecker*

Geology 565b. Advanced Structural Geology (3-3-4).
Elasticity, viscosity and plasticity. Properties of anisotropic media. Introduction to photoelasticity. The course will be partly a seminar. *Mr. De Bremaecker*

Geology 590. Research in Physical and Structural Geology (0-9-3).
Messrs. Rogers and De Bremaecker

Geology 591. Research in Mineralogy (0-9-3). *Messrs. Adams and Donnelly*

Geology 592. Research in Petrography and Petrology (0-9-3).
Messrs. Donnelly and Rogers

Geology 593. Research in Geochemistry (0-9-3). *Messrs. Adams and Rogers*

Geology 594. Research in Geophysics and Oceanography (0-9-3).
Messrs. De Bremaecker and Officer

Geology 595. Research in Invertebrate Paleontology and Stratigraphy (0-9-3).
Messrs. Croneis and Purdy

Geology 596. Research in Economic and Petroleum Geology (0-9-3). *Staff*

Geology 597. Research in Regional Geology (0-9-3). *Staff*

MATHEMATICS

Professors: MacLANE, MANDELBROJT, ULRICH, *Chairman*
Associate Professors: BROWN, DOUGLAS, DURST, LOHWATER
Assistant Professor: JOHNSON

Rice University has always placed great emphasis on the study of mathematics, and has acquired a very complete mathematical library including all the important mathematical journals.

Admission to graduate study in mathematics will be granted to a limited number of students who have earned the bachelor's degree from Rice University, or another institution of similar standing, and whose undergraduate work in mathematics is such as to indicate the ability for advanced and original work. Those students who have completed a large amount of undergraduate mathematics and who devote full time to graduate study may earn the degree of Master of Arts in one year. The minimum time required by candidates for the degree of Doctor of Philosophy is three years. It is to be expected that most students will require longer than the minimum time, particularly holders of graduate assistantships.

For the master's degree, the requirements are:

(a) The completion with high standing of at least four advanced courses.
(b) The presentation of a written thesis on a subject approved by the department.
(c) The passing of an examination in either French or German demonstrating ability to read scientific literature in the language.

In order to be admitted into candidacy for the doctor's degree the student must pass a comprehensive oral examination on the fundamental concepts and facts in the major fields of mathematics.

For the doctor's degree, the requirements are:

(a) The completion with high standing of at least eight advanced courses.

(b) The presentation of a written thesis on a subject approved by the department. The purpose of the doctor's thesis is to demonstrate the candidate's ability to make an original contribution to a field of mathematics in which he has become expert. This is a more extensive and advanced type of study than that required for the master's degree, and is expected to reveal definite originality and inventiveness, and to be suitable for publication.

(c) The writing of a minor thesis. This is a study of an assigned topic in a field outside that of the candidate's principal thesis. The time allowed for writing the minor thesis is 5 weeks during the school year or 4 weeks in the summer.

(d) The passing of examinations in either French or German and a second language approved by the department, demonstrating ability to read scientific literature in these languages.

(e) The passing of an oral examination given by the faculty in the area of the student's thesis.

In order that they may obtain adequate experience in collegiate teaching, students holding assistantships are assigned a moderate schedule of regular teaching duties in the department. These duties usually consist of the instruction of one or two small sections in courses of elementary or intermediate character or assisting an instructor in charge of an advanced course. These duties constitute an important part of the training for a teaching career.

COURSES

Among courses which have been offered in recent years, and which may be offered in more or less modified form from time to time in the very near future, are the following:

Mathematics 100. Elementary Analysis (3-0-6) or (4-0-8).

Calculus and analytic geometry. The ideas of the calculus are introduced by considering the rate and area problems. The course includes the differentiation of the elementary function and some of the simpler integration formulae, with applications. Analytic geometry, through a study of the conic sections and the reduction of the general equation of second degree, is treated. Science-engineering sections meet four hours per week. *Staff*

Mathematics 101. Fundamental Concepts of Mathematics (3-0-6).

A course designed expressly for students in the academic division and intended to convey an appreciation of the edifice of mathematical ideas, the topics treated being largely chosen for the light they shed on the nature and role of mathematics. The elements of algebraic theory of ruler and compass construction. The ideas of the calculus are introduced in connection with the analysis of planetary motion. An important part of the program consists of a critical study of the number systems. The course begins with a brief introduction to the concepts and notation of logic. *Staff*

Mathematics 200. Differential and Integral Calculus (3-0-6).

Systematic integration, definite integral, improper integrals, infinite series, analytic geometry in three dimensions, algebra of vectors and multiple integrals. Application of physical problems. Prescribed for all science-engineering majors who do not take Mathematics 210. Students who have considerable facility in mathematical reasoning should register in Mathematics 210. *Staff*

Mathematics 210. Differential and Integral Calculus (3-0-6).

This course has the same scope as Mathematics 200 but is more complete and rigorous. It is open to students who have passed Mathematics 100 with high standing, or otherwise satisfy the instructor of their fitness to take the course. *Staff*

Mathematics 300. Advanced Calculus and Differential Equations.

Partial differentiation with applications to geometry of three dimensions, vector analysis and differential equations. This course, or Mathematics 310, is prescribed for all science-engineering students. Open also to other students who have passed Mathematics 200 or 210, or otherwise satisfy the instructor of their fitness to take the course.

Mathematics 310. Advanced Calculus and Differential Equations (3-0-6).

This course is designed for students with considerable facility in mathematical reasoning. The scope is essentially that of Mathematics 300 but the development is more systematic and rigorous. It is open to students who have passed Mathematics 200 or 210 with high standing or otherwise satisfy the instructor of their fitness to take the course. *Staff*

Mathematics 320. Analytical Mechanics (3-0-6).

Vector analysis, reduction of systems of forces and conditions for equilibrium, dynamics of systems of particles, rigid bodies. Prerequisites: Mathematics 200 and 300. (The latter may be taken concurrently.) *Mr. MacLane or Mr. Ulrich*

Mathematics 330. Introduction to Higher Algebra (3-0-6).

Properties of determinants and matrices, theory of linear dependence, bilinear and quadratic form, polynomials, invariants, lambda matrices and applications. *Staff*

Mathematics 360. An Introduction to Mathematical Probability and Statistics (3-0-6).

Topics covered will include: conditional probability, Bernouilli's Theorem, law of large numbers, distributions, central limit theorem, correlation, large and small sample theory, goodness of fit, testing statistical hypotheses, and the design of experiments. Insofar as possible, the mathematical foundations will be emphasized. Prerequisite: Mathematics 300 (may be taken concurrently). Enrollment with permission of instructor. *Mr. Douglas*

Mathematics 400. Theory of Functions of a Complex Variable (3-0-6).

This course is fundamental in analysis. Besides giving an introduction to basic concepts of analysis, it includes the study of analytic functions of a complex variable, the Cauchy's Integral Theorem, Taylor's series, calculus of residues, and conformal mapping.

Mr. Ulrich

Mathematics 410. Differential Equations and an Introduction to the Calculus of Variations (3-0-6).

Geometry of the integral curves and the classification of the singularities of equations of first order, existence theorems, theory of integrating factors and integration by elementary means, general theory of second order linear equations, oscillation and comparison theorems, fuchsian theory of regular singular points, eigenvalue problems, general partial differential equations of first order, boundary value problems for certain second order linear systems, and as much calculus of variations as time permits. *Mr. MacLane or Mr. Ulrich*

Mathematics 420. Differential Geometry (3-0-6).

Theory of curves and surfaces, geodesics, mapping of surfaces, the absolute geometry of a surface.

Mathematics 430. Introduction to Modern Geometry (3-0-6).

Synthetic and algebraic geometry, the group of projective transformations and certain subgroups of the group of projective transformations, the geometries defined by these groups, projective correspondences, projective theory of conics. *Staff*

Mathematics 440. Algebra and Topology (3-0-6).

Groups, rings, fields, vector spaces, topological spaces, fundamentals of homology theory, homotopy and covering spaces, classification of surfaces, Riemann surfaces.

Mr. Brown or Mr. MacLane

Mathematics 450. Number Theory (3-0-6).

The fundamental theorem of arithmetic, residue class rings and congruences, quadratic residues and reciprocity law. Numerical functions. Algebraic number fields, factorization and ideals. *Mr. Durst*

Mathematics 460. Numerical Analysis (3-0-6).

Approximate integration and differentiation by finite differences, interpolation, functional approximation, linear and non-linear algebraic equations, eigenvalues, approximate solution of ordinary differential equations and of some simple partial differential equations. A digital computer is available for laboratory use. Prerequisite: Mathematics 300 or 310. *Mr. Douglas*

Mathematics 500. Theory of Normal Families of Functions (3-0-6).

Equicontinuity and Ascoli's Lemma, limiting oscillation of Ostrowski and Carathedory's continuous convergence, Orsove's theorem on normal families of potential functions, theorems of Vitali and Montel and Mandelbrojt's theory of kernals, location and description of singularities of families of analytic functions. *Mr. Johnson*

Mathematics 501. Theory of Functions of a Complex Variable (3-0-6).

A study of special analytic functions of importance in mathematical physics. The course is usually given as a seminar. *Mr. Ulrich*

Mathematics 505a. Selected Topics from the Theory of Functions of a Complex Variable (3-0-3).

The subject matter of this course varies from year to year. In past years the following topics have been among those presented: singularities of a function defined by a Taylor series, elementary theory of Dirichlet series, approximation theory, and constructive theory of functions. *Mr. Mandelbrojt*

Mathematics 510. Theory of Functions of a Real Variable (3-0-6).

Theory of real numbers, limits and continuity, Lebesque and Stieljes integrals, general integrals, the theory of differentiation, Fourier series, function spaces, selected topics. The student should be familiar with some of the material of Mathematics 440. These courses could be taken concurrently. *Mr. Brown*

Mathematics 515. Conformal Mapping (3-0-6).

The Riemann mapping theorem; the Dirichlet problem, harmonic measures and the Green's function; the mapping of multiply connected domains onto canonical domains; extremal problems and the coefficient problem; boundary behavior and the theory of prime ends. *Mr. Lohwater*

Mathematics 520. Trigonometric Series and Related Topics (3-0-6).

Series expansions in terms of orthogonal systems of functions. Trigonometric series. Fourier transforms and integrals. The course is based upon Mathematics 510. *Mr. Bray*

Mathematics 525. Modern Theory of Meromorphic Functions (3-0-6).

Riemann surfaces and covering surfaces, harmonic measure and logarithmic capacity, the Nevanlinna theory of meromorphic functions and the defect relation, boundary behavior and the theory of cluster sets. *Mr. Lohwater*

Mathematics 530. Laplace Transformations (3-0-6).

Theory of the laplace transformation with particular reference to the properties of the transform as a function of a complex variable. Applications to the solution of difference equations, integral equations of the convolution type, and ordinary differential systems. Boundary value problems. Certain Sturm-Liouville systems. Abelian and Tauberian theorems. Asymptotic representations. *Mr. Ulrich*

Mathematics 535. Partial Differential Equations (3-0-6).

Theorems of Cauchy-Kowalewski and Holmgren, classification of partial differential equations. Cauchy problem for first order hyperbolic systems and the wave equation, boundary value problems for second order hyperbolic, elliptic and parabolic equations, numerical solution of partial differential equations and systems. Prerequisite: Mathematics 410 or 400; preferably both. *Mr. Douglas*

Mathematics 540. Topological Linear Algebra (3-0-6).

Vector spaces. The elementary geometric and algebraic properties of Banach and Hilbert spaces. Normed rings. Operators and spectral theory. Applications and topics of related interest. Prerequisite: Mathematics 510. *Mr. Brown*

Mathematics 545. Theory of Algebraic Functions (3-0-6).

Theory of elliptic functions. Properly discontinuous groups of linear transformations. Automorphic functions. Uniformization of algebraic functions. *Mr. MacLane or Mr. Ulrich*

Mathematics 550. Advanced Theory of Riemann Surfaces (3-0-6).

Topological properties, theory of entire and meromorphic functions, problem of type. *Mr. MacLane or Mr. Ulrich*

Mathematics 555. Recent Developments in the Theory of Riemann Surfaces (3-0-6). *Mr. MacLane or Mr. Ulrich*

Mathematics 560. Potential Theory (3-0-6).

Integral theorems of potential theory, Riez's theorem on potentials of negative mass and subharmonic functions, a flux integral for functions which have harmonic support, boundary value problems, Poisson Integral and Green's function, exceptional points of the boundary, theorems of Kellogg and Evans, recent researches on boundary topologies. *Mr. Johnson or Mr. Lohwater*

Mathematics 565. Partial Differential Equations (3-0-6).

Advanced topics in the study of partial differential equations. *Mr. Douglas*

Mathematics 570a. Selected Topics from Advanced Analysis (3-0-3).

The subject matter of this course varies from year to year. In past years the following topics have been among those presented: Fourier transforms in the complex domain, analytic continuation and infinitely differentiable functions, theory of composition, general Tauberian theorems, general problem of moments, closure theorems, general asymptotic representations, zeta-function of Riemann, and analytic theory of numbers, ergodic theory, and monogenic and isogenic functionals and harmonic analysis. *Mr. Mandelbrojt*

Mathematics 600. Thesis.

Mathematical Colloquium.

The colloquim usually meets one afternoon every other week to allow the exposition of original investigations by its members.

Physics

Professors: BONNER, *Chairman*, HOUSTON, PHILLIPS, RISSER, WILSON (*Emeritus*)

Associate Professors: CLASS, RORSCHACH, TOBOCMAN

Assistant Professors: DONOHO, JOSEPHSON

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 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.

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.

(3) Scattering of neutrons and disintegrations produced by neutrons.

(4) Theory of nuclear reactions.

(5) Nuclear resonance.

(6) Hall effect in metals and gases.

(7) Magnetic properties of iron and other materials.

(8) Physics of the solid state.

(9) Low-temperature physics.

(10) Superconductivity.

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 was completed in 1953 and a 12 mev Van de Graaff accelerator is being installed in 1961.

COURSES

Physics 100. Mechanics, Heat, Sound and Light (3-3-8).

An introductory course consisting of two lecture hours, one problem hour and three hours of laboratory work per week. This course is the first of the introductory physics courses required of all science-engineering students. In addition this course satisfies one of the laboratory science requirements for academic students. Topics of study include: geometrical optics; 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; interference. Students taking Physics 100 must have taken or be enrolled in Mathematics 100. Laboratory fee required. *Messrs. Bryan and Rorschach*

Physics 200. Electricity, Magnetism, and Atomic Physics (3-3-8).

A course of three lectures and three hours of laboratory work per week. This course with Physics 100 makes up a complete course on the principles of physics which is required of science-engineering students. In this second course the fundamental principles of electrical theory are explained and illustrated, including the elementary theory of direct and alternating currents, electronics, and electrical theory of matter. In the laboratory the students make measurements of all the important electrical quantities such as current, resistance, potential, capacity, inductance, magnetic properties of iron and steel, electro-chemical equivalents, characteristics of triodes; other experiments include measurements of radiations from radioactive elements. Students taking Physics 200 must have completed Mathematics 100 and must take Mathematics 200 or 210 at the same time as Physics 200. Laboratory fee required. *Messrs. G. Phillips, Barnard*

Physics 210. Electricity, Magnetism, and Atomic Physics (3-3-8).

Covers the material of Physics 200 but is more rigorous and mathematical in approach. Open to students with high grades in Physics 100. *Mr. Class*

Physics 310. Atomic and Nuclear Physics (3-3-8).

Outline of the principal experiments upon which the quantum theory is based. Particle-like properties of light and other electromagnetic radiation. Wave-like and particle-like properties of the electron. Optical spectra and energy levels. X rays. Radioactivity. Properties and spectra of alpha, beta, and gamma rays. Elementary facts of nuclear structure. Three hours of laboratory weekly. Laboratory fee required. *Mr. Risser*

Physics 400. Introduction to Mathematical Physics (3-2-7).

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 the electromagnet field. Three class hours and two problem hours per week. *Messrs. Rorschach and Donoho*

Physics 415. Physical Electronics (3-1½-7).

An introduction to the behavior of electrons in solids and in vacuum, with emphasis on metallic conductors, semiconductors, paramagnetic solids, and electron beams. The physical principles of electron devices, with applications to practical electronic circuits. Introduction to microwave electronics and quantum electronics. Laboratory exercises one semester. Joint laboratory fee with Physics 425. *Mr. Donoho*

Physics 425. Thermodynamics and Statistical Mechanics; Physical Optics (3-1½-7).

(a) Introduction to physical optics, principally through laboratory experiments. Polarization, diffraction, refraction, interference; dipole radiation.

(b) Postulational approach to thermodynamics. Thermodynamic equilibrium and processes, extremum principle; reformulation by Legendre transformations; Maxwell relations; thermodynamic stability, first- and second-order phase transitions. Selected applications to physical systems.

(c) Statistical Mechanics. Method of ensembles; statistical basis of thermodynamics; classical and quantum statistics. Selected applications to physical systems. Joint laboratory fee with Physics 415. *Mr. Josephson*

Physics 510. Advanced Dynamics (3-0-6).

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 520. Principles of Quantum Mechanics (3-0-6).

A deductive presentation of the principles of quantum mechanics with applications to various problems in spectroscopy, collisions of atomic particles, molecular binding, etc. *Mr. Phillips*

Physics 530. Electromagnetic Theory (3-0-6).

Electrostatics, magnetostatics, boundary value problems, stress-energy relations; electromagnetic wave equations, Lienard-Wiechert potentials, multiple fields, radiation; special relativity, radiation from accelerated charges.

Physics 540. Nuclear Physics (3-0-6).

Radiation dectors; interaction of alpha particles, electrons, neutrons and gamma radiation with matter; properties of nuclei; theory of nuclear structure; nuclear shell model, nuclear magnetic moments and spins; beta disintegrations; artificial disintegration of nuclei; nuclear scattering; mesons; fission; cosmic rays. *Mr. Bonner*

Physics 560. Structure of Solids (3-0-6).

A review of the structure and vibration of crystals, and the motions of electrons in them, based on quantum mechanics. *Mr. Houston*

Physics 570. Low-temperature Physics (3-0-6).

Production and measurement of extremely low temperatures. Properties of liquid helium. Superconductivity. Magnetism and low temperatures. Specific heats. Recently published research. Laboratory techniques and participation in research problems (Physics 590).

Physics 580. Physics Colloquium (1-0-2).

One meeting a week at which results of researches in physics will be discussed. *Staff*

Physics 590. Research Work.

Physics 600. Special Topics in Solid State Physics (2-0-4). *Staff*

Physics 610. Neutron and Reactor Physics (3-0-6).

Fundamental properties of the neutron: mass, magnetic moment, 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 620. Theoretical Nuclear Physics (3-0-6).

General nuclear properties, two-body problems, scattering, nuclear spectroscopy, nuclear reactions, interaction of nuclei with electromagnetic and electron-neutrino fields, nuclear shell theory. *Mr. Tobocman*

Physics 630. Advanced Quantum Mechanics (3-0-6).

Radiation detectors, interaction of alpha particles, electrons, neutrons and gamma radia- and electromagnetic fields; quantum electrodynamics; scattering matrix theory; radiative corrections.

Physics 640. Applications of Group Theory to Quantum Mechanics (3-0-6).

An introductory treatment of abstract group theory and the general theory of group representations for finite and compact groups with application to the symmetric, orthogonal, and symplectic groups. Particular emphasis is given to the three dimensional rotation group, including the application of the Wigner and Racah coefficients.

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.

PHYSICAL EDUCATION

Professors: HERMANCE, *Chairman*, WESTON

Assistant Professors: BARKER, BEARDEN, BLAND

Instructors: HAHAMIS, LEBAR

COURSES

Physical Training 100. (0-4-0).

A course designed to familiarize the students with the physical education facilities and equipment available to them at Rice University, to discuss the place and importance of health and physical education in our modern society and to teach the skills and knowledge of physical education activities, including recreational games and sports. Required of all freshmen. Two two-hour periods each week. Non-credit. *Staff*

Physical Education 100. Introduction to Health, Physical Education, and Recreation (3-0-6).

An introductory course to the professional study of health, physical education, recreation, and camping. Units of instruction include orientation, vocational analysis, educational and scientific foundations, and personal hygiene. *Messrs. Hermance and LeBar*

Physical Education 125. Laboratory Experiences in Team and Group Activities (0-6-4).

Activities covered are soccer, speedball, tennis, gymnastics, touch football, swimming, diving, Senior Red Cross Life Saving, and water safety. For each of the activities the history, specific values, court and field construction, activity skills and game formations, techniques and methods of teaching and coaching, audio-visual aids, and officiating are studied. Laboratory fee required. *Mr. Weston*

Physical Education 150. Physical Science (3-0-6).

An introduction to the study of physiography, chemistry, and physics for students preparing to enter the field of health education and physical education. The course covers the fundamental principles of chemistry including matter, elements, gases, acids and bases, metals and alloys, biochemistry, and the science of nutrition. The physics unit includes the fundamental principles of mechanics, heat, magnetism, electricity, sound and light. Laboratory fee required. *Mr. Weston*

Physical Education 200. Fundamentals of Health Education and Physical Education (3-0-6).

The first semester is a study of the principles, organization, administration, methods and materials of programs of community recreation, intramural sports, and safety education and athletics with special emphasis on social and economic factors that have influenced their development. *Messrs. Barker and Weston*

Physical Education 225. Laboratory Experience in Individual Recreational Activities (0-6-4).

Activities covered are archery, casting, handball, squash, volleyball, badminton, fencing, and apparatus. For each of the activities the history, specific values, court and field construction, activity skills and game formations, techniques and methods of teaching and coaching, audio-visual aids, and officiating are studied. Laboratory fee required.
Mr. Barker

Physical Education 300. Scientific Foundations of Health Education and Physical Education (3-0-6).

A course including a systematic study of tests and measurements, physiology of exercise, kinesiology, and adaptive physical education in the fields of health education, physical education, recreation and camping. *Mr. Bearden*

Physical Education 325. Laboratory Experiences in Developmental, Recreational, and Sports Activities (0-6-4).

Activities covered are lead-up games, indoor and outdoor recreational games, basic rhythms, golf, boxing and wrestling. For each of the activities the history specific values, facilities, equipment, activity skills, techniques and methods of teaching and coaching, audio-visual aids, officiating and tournaments are studied. Laboratory fee required.
Mr. Bearden

Physical Education 400. The Program of Physical Education for Elementary and Secondary Schools (3-0-6).

The principles, organization, administration, materials, methods, and supervision of the programs of physical education in elementary and secondary schools. *Mr. Hermance*

Physical Education 410. Health and Physical Education for Teachers of Elementary and Secondary Schools (3-3-8).

A course designed for prospective teachers who desire to increase their proficiency to teach health and physical education. The course includes a study of the purpose, content, and method of instruction of health and physical education in the elementary and secondary schools. *Staff*

Physical Education 425. Laboratory Experiences in Team Sports, Training Room Procedure, and Student Teaching (0-6-4).

Activities covered are football, basketball, baseball, and track. In addition to the history, specific values, court-field-diamond construction, activity skills, game formations, audio-visual aids, officiation, and scouting, emphasis is placed on the psychology and techniques of teaching and coaching physical education activities, including interscholastc athletics. Also included is a unit on training room procedure and one semester of student teaching. Laboratory fee required. *Messrs. Bland, Weston, and Wojecki*

Physical Education 430. The Program of Health Education in Elementary and Secondary Schools (3-0-6).

The organization, administration, principles, methods and materials of the program of school-health education. During the first semester, a foundation is established for school-health programs through a study of the history of medicine, hospitalization and medical benefit plans, social security, workman's compensation, and life insurance programs. The second semester is based upon a study of school-health services, school-health environment, and school-health instruction. *Mr. Weston*

RESERVE OFFICERS' TRAINING CORPS PROGRAMS

Rice University offers two Reserve Officers' Training Corps Programs: Army and 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 ROTC programs and graduation with a baccalaureate degree, the student may be given a commission in the appropriate service. The Navy has two types of memberships, one leading to a reserve commission and the other leading to 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 dropped by the University for academic failure or other cause is immediately disenrolled from the ROTC programs. Any student performing unsatisfactory work in military or naval science courses, or possessing unsatisfactory officer-like qualities may be disenrolled from the ROTC programs regardless of the quality of his academic work. Students taking five-year courses are considered eligible for enrollment at the beginning of their first or second year. Enrollment in the ROTC 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 by 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 and in tactics and techniques of the Corps

of Engineers. The course is a four-year program consisting of two main subdivisions: (1) Basic and (2) Advanced. Students electing the AROTC do so for only two years at a time. The first election is for the two-year Basic Course, after which, if the student is recommended for further training, he may elect the Advanced Course.

The Basic Course is the course of study normally pursued by the student during his Freshman and Sophomore academic years. The Basic Course consists of two to four hours per week of formal instruction of a general type applicable to the Army as a whole.

The Advanced Course consists of five hours per week of formal military instruction during one semester of the Junior and Senior years in Corps of Engineers subjects. The remaining semester for both years consists of two hours per week of formal military instruction and a three hour academic elective in selected fields. Completion of the Basic Course is a prerequisite for admission to the Advanced Course. Advanced Course students are required to attend one summer camp, which normally comes between the Junior and Senior years. This camp consists of practical military instruction specializing in Corps of Engineers functions.

The Advanced Course provides a stipend of about a dollar per day during the last two years and affords a draft deferment during these years.

COURSES

Military Science 101 (first half-year). Orientation and Individual Weapons and Marksmanship (1-1-1).
Military Organization. Introduction to weapons to include Marksmanship. History 110, American History, must be taken concurrently unless previously completed.

Military Science 102 (second half-year). U. S. Army and National Security (1-1-1).
History 110 must be taken concurrently unless previously completed.

Military Science 201 (first half-year). Military Tactics (2-2-2).
Principles of Land Warfare, Leadership.

Military Science 202 (second half-year). Military Tactics (2-2-2).
Map and Aerial Photograph Interpretation, Small Unit Tactics, Leadership.

Military Science 301 (first half-year). Military Leadership (1-1-1).
Principles of Military Leadership.

Military Science 302. (second half-year). Military Engineering (4-1-4).
Military Structures and Field Construction Procedures.

Military Science 401 (first half-year). Military Engineering (4-1-4).
Engineer operations, management and administration.

Military Science 402 (second half-year). Military Law (1-1-1).
Uniform Code of Military Justice.

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.

There are, therefore, two categories of NROTC students: (1) Regular; (2) Contract.

Regular Students. A regular NROTC student is appointed a Midshipman, U. S. Naval Reserve, on a nation-wide competitive basis and receives retainer pay at the rate of $50.00 per month for a maximum of four years, with all 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. In return, the Navy provides the required uniforms, pays them a subsistence allowance (currently about $30.00 per month) during their Junior and Senior years, provides draft deferment 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. Contract students are deferred from the draft.

U. S. Marine Corps. NROTC 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 NROTC course of training consists of courses of instruction, laboratory periods, and drill, together with such training duty or training cruises as may be prescribed.

The Navy prescribes certain course requirements for NROTC students as follows:

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

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

COURSES

Naval Science courses as described will be taken in succession as listed:

Naval Science 100. Sea Power and Orientation (1-2-2).

This course consists of a one hour weekly classroom period plus a two hour weekly lab in which fundamental concepts of Sea Power, traditions, customs, organization, seamanship and missions of the Navy are presented. In addition, History 110 (American History—taught by the History Department) is a course requirement for all Freshmen NROTC students.

Naval Science 201 (first half-year). Naval Weapons (3-2-3).

Introduction to naval weapons and space technology. Fire control system. Principles of sonar and radar. Guided missiles. Nuclear weapons and radiological defense. Anti-submarine warfare. Amphibious warfare.

Naval Science 202 (second half-year). Naval Leadership (3-2-3).

This course consists of a study of the principles and practice of leadership. In pursuance of these principles, the course examines human relations in the Naval environment and their effect on the application of leadership.

Naval Science 301 (first half-year). Naval Engineering (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 302 (second half-year). 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 401 (first half-year). 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 402 (second half-year). Principles and Problems of Leadership (3-2-3).

Application of the principles of Naval management, Naval administration and leadership.

NROTC 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 301M (first half-year). Evolution of the Art of War (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 302M (second half-year). Modern Basic Strategy and Tactics (3-2-3).

Basic strategic concepts and principles of offensive and defensive tactics through the battalion level.

Naval Science 401M (first half-year). Amphibious Warfare (3-2-3).

History of amphibious warfare. Development of amphibious tactics. Gunfire support. Planning. Logistics. Administration.

Naval Science 402M (second half-year). 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.

INDEX