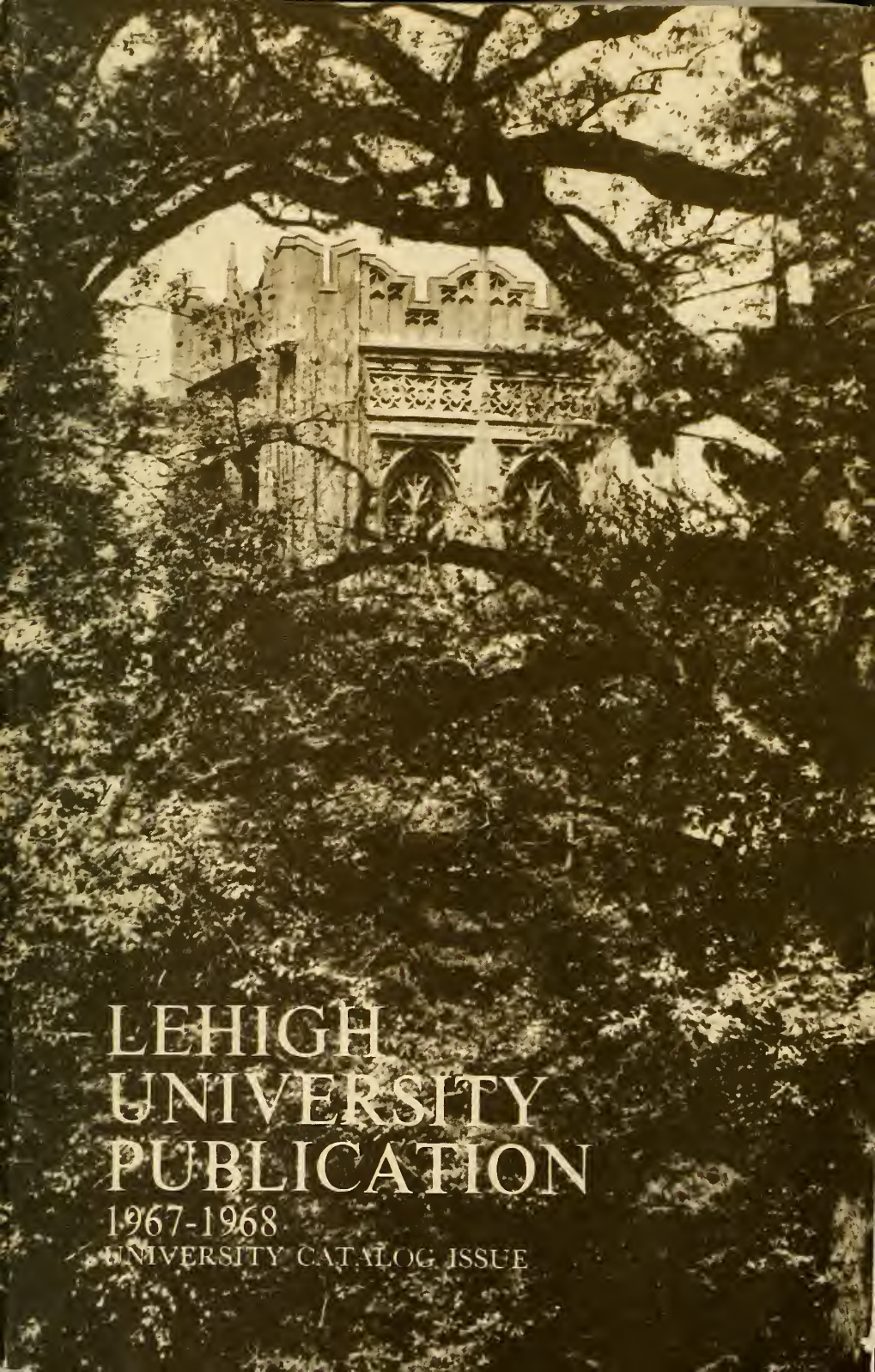

# LEHIGH UNIVERSITY PUBLICATION

1967-1968

UNIVERSITY CATALOG ISSUE

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Lehigh University Publication

Vol. 41 MARCH, 1967 No. 1

Published six times during the calendar year in March, April, July, August, September, and November, by Lehigh University, Bethlehem, Pennsylvania 18015. Second-class postage paid at Bethlehem, Pennsylvania.

# University Catalog


1967-1968

Lehigh University Bethlehem, Pennsylvania 18015

# UNIVERSITY CALENDAR

## January 1967-1968

### 1967

| | |
|---|---|
| January 8, 8:10 a.m. (Thurs.) | Christmas vacation ends<br>Last day for filing applications for degrees to be granted in January |
| January 7 (Sat.) | Last day of classes for arts seniors taking comprehensive examinations |
| January 11-14 (Wed.-Sat.) | Comprehensive examinations for arts seniors |
| January 14 (Sat.) | Last day of classes in fall semester<br>Last day for submission of honors theses to thesis advisors for February graduates |
| January 16 (Mon.) | Course examinations begin |
| January 25 (Wed.) | Course examinations end |
| January 31 (Tues.) | Registration for spring semester |
| February 1 (Wed.) | Spring semester instruction begins |
| February 11 (Sat.) | Last day on which registration for spring courses will be permitted |
| March 18, 1 p.m. (Sat.) | Spring vacation begins |
| March 27, 8:10 a.m. (Mon.) | Spring vacation ends |
| April 1 (Sat.) | Mid semester reports due |
| April 10 (Mon.) | Preregistration begins |
| April 15 (Sat.) | Preregistration ends<br>Last day for filing applications for degrees to be conferred in June |
| May 13 (Sat.) | Last day of classes for arts seniors taking comprehensive examinations |
| May 17-20 (Wed.-Sat.) | Comprehensive examinations for arts seniors |
| May 20 (Sat.) | Last day of classes in spring semester<br>Last day for submission of honors theses to thesis advisors for June graduates |
| May 23 (Tues.) | Course examinations begin |
| June 2 (Fri.) | Course examinations end |
| June 11 (Sun.) | Baccalaureate Sunday |
| June 12 (Mon.) | University Day |
| September 10 (Sun.) | Freshman Orientation begins |
| September 11 (Mon.) | Last day for filing applications for degrees to be conferred on Founder's Day |
| September 11-12 (Mon.-Tues) | Make-up examinations and special examinations |
| September 13 (Wed.) | Registration for fall semester |
| September 14 (Thurs.) | Fall semester instruction begins |
| September 18 (Mon.) | First faculty meeting |
| September 25 (Mon.) | Last day on which registration for fall courses will be permitted |

October 8 (Sun.) ..... Founder's Day
October 16-18 (Mon.-Wed.) ..... Engineering inspection trips
November 6 (Mon.) ..... Mid-semester reports due
Pre-registration begins
November 11 (Sat.) ..... Pre-registration ends
November 22, 10 p.m. (Wed.) ..... Thanksgiving vacation begins
November 27 8:30 a.m. (Mon.) ..... Thanksgiving vacation ends
December 20, 10 p.m. (Wed.) ..... Christmas vacation begins

**1968**

January 4, 8:10 a.m. (Thurs.) ..... Christmas vacation ends
Last day for filing applications for degrees to be granted in January
January 6 (Sat.) ..... Last day of classes for arts seniors taking comprehensive examinations
January 10-13 (Wed.-Sat.) ..... Comprehensive examinations for arts seniors
January 13 (Sat.) ..... Last day of classes in fall semester
Last day for submission of honors theses to thesis advisors for February graduates
January 15 (Mon.) ..... Course examinations begin
January 24 (Wed.) ..... Course examinations end
January 30 (Tues.) ..... Registration for spring semester
January 31 (Sat.) ..... Spring semester instruction begins
February 10 (Sat.) ..... Last day on which registration for spring courses will be permitted
March 23, 1 p.m. (Sat.) ..... Spring vacation begins
April 1, 8:10 a.m. (Mon.) ..... Spring vacation ends
Mid semester reports due
April 8 (Mon.) ..... Preregistration begins
April 13 (Sat.) ..... Preregistration ends
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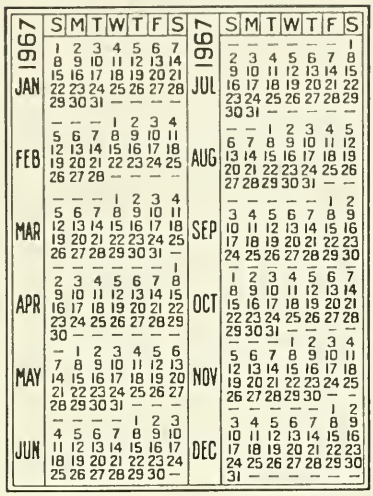
May 15-18 (Wed.-Sat.) ..... Comprehensive examinations for arts seniors
May 18 (Sat.) ..... Last day of classes in spring semester
Last day for submission of honors theses to thesis advisors for June graduates
May 21 (Tues.) ..... Course examinations begin
May 31 (Fri.) ..... Course examinations end
June 9 (Sun.) ..... Baccalaureate Sunday
June 10 (Mon.) ..... University Day



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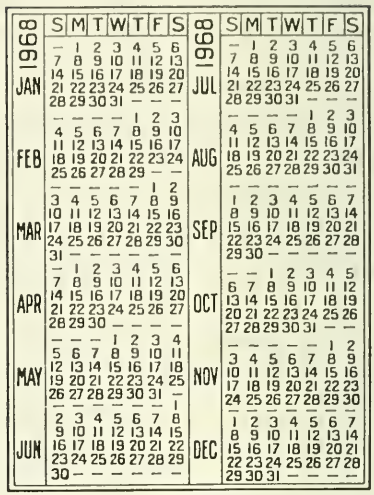

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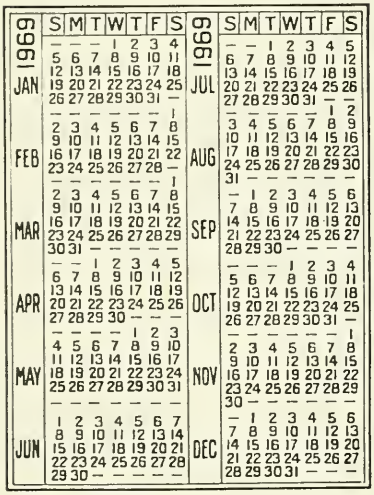

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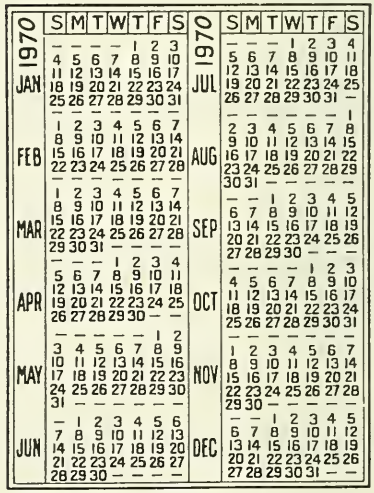

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Paul Edward Short, B.S. in Bus. Adm., *Assistant Director and Business Manager*
John Stohler Steckbeck, B.S. in Phys. Ed., M.S., *Assistant Director of Physical Education*

# FACULTY AND STAFF

(The first date after the name indicates date of first appointment to continuous service on the faculty or staff; the second date, when the first fails to do so, indicates the date of appointment to present classification as to professional rank.)

EDWARD CARLTON ABBOTT (1960) ..... *Part-Time Lecturer in Education*
Ph.B., University of Vermont, 1926; M.A., Columbia University, 1933; Ph.D., University of Pennsylvania, 1943.

JOHN RODGER ADAMS (1965, 1966) ..... *Assistant Professor of Civil Engineering*
B.S., Marquette University, 1959; M.S., Michigan State University, 1961; Ph.D., Michigan State, 1966.

JOHN WILLIAM ADAMS (1965) ..... *Associate Professor of Industrial Engineering*
B.S., University of Nebraska, 1952; Ph.D., University of North Carolina, 1962.

CARL ELMER ALLEN (1930, 1964) ..... *Professor Emeritus of Accounting*
B.S., Illinois 1923; M.S., 1925; Ph.D., 1930; C.P.A., Pennsylvania, 1939.

ALFRED NICHOLAS AMATANGELO (1964) ..... *Instructor in Civil Engineering*
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DAVID C. AMIDON, JR. (1965) ..... *Instructor in History*
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*GEORGE WILLIAM ARMOLD, JR. (1962) ..... *Assistant Director of Public Information*
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RAY LIVINGSTONE ARMSTRONG (1946, 1958) ..... *Associate Professor of English*
B.A., Williams, 1930; B.A., Oxford, 1932; M.A., 1936; Ph.D., Columbia, 1941.

STEPHEN DOUGLAS ARMSTRONG (1966) ..... *Professor of Aerospace Studies*
B.A., University of North Dakota, 1965; Lt. Colonel, U.S.A.F.

JAY RICHARD ARONSON (1965) ..... *Assistant Professor of Economics*
A.B., Clark University, 1959; M.A., Stanford University, 1961; Ph.D., Clark University, 1964.

LLOYD WILLIAM ASHBY (1966) ..... *Associate Professor of Education*
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B.Sc. and Dip. Ing., Israel Institute of Technology, 1949; M.S., University of Michigan, 1956; Ph.D., 1960.

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B.A., Rice University, 1952; M.A., 1954.

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Dipl. rer. pol., Gottingen, 1949; M.A., Rutgers, 1953; Ph.D., 1956.

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B.S., Rhode Island State, 1941; Ph.D., Yale, 1954.

*Resigned, August 8, 1966.

THORBURN VAIL BARKER (1953, 1962) ..... *Associate Professor of Speech*
B.A., Ohio Wesleyan, 1943; M.A., Columbia, 1951.

ROBERT FEATHERSTON BARNES, JR. (1965) ..... *Associate Professor of Philosophy*
B.S., Massachusetts Institute of Technology, 1957; M.A., Dartmouth, 1959; Ph.D., University of California, 1965.

LUCILE LEWIS BARRETT (1944) ..... *Assistant to Director of Public Information*
A.B., Syracuse, 1939.

WILLIAM A. BARRETT (1966) ..... *Assistant Professor of Electrical Engineering*
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DONALD DELYLE BARRY (1963) ..... *Associate Professor of Government*
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B.A., Lehigh, 1921; Ph.D., Yale, 1931.

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DAVID REED BASCO (1965) ..... *Instructor in Civil Engineering*
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EMMI BAUM (1965) ..... *Assistant Professor in History*
B.A., University of New Mexico, 1955; New York University, 1961; Ph.D., 1965.

FRANK SWAN BEALE (1930, 1964) ..... *Associate Professor Emeritus of Mathematics*
B.S., Maine, 1921; M.S., 1923; Ph.D., Michigan, 1931.

JACOB LYNFORD BEAVER (1917, 1952) ..... *Professor Emeritus of Electrical Engineering*
E.E., Lehigh, 1904; M.S., 1921; Sc.D., Harvard, 1932.

LYNN SIMPSON BEEDLE (1947, 1957) ..... *Professor of Civil Engineering; Director, Fritz Engineering Laboratory; Acting Chairman, Department of Civil Engineering*
B.S. in C.E., California, 1941; M.S., Lehigh, 1949; Ph.D., 1952.

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B.S., Geneva (Switzerland), 1933; M.S., 1935; Ph.D., 1937; M.S., Paris (France), 1938.

JAMES ANDREW BEGLEY (1966) ..... *Instructor in Metallurgy and Materials Science*
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RAYMOND BELL (1966) ..... *Instructor in Education*
Teaching Certificate, St. John's College, York, England, 1961; M.Ed., Temple, 1966.

RUSSELL EDWARD BENNER (1962) ..... *Associate Professor of Mechanical Engineering*
B.M.E., Cornell University, 1947; M.S. in M.E., Lehigh, 1951; Ph.D., 1959.

LOIS REED BENSON (1955, 1958) ..... *Chief Nurse and Administrative Assistant, University Health Service*
B.A., Michigan, 1932; R.N., Allentown Hospital, 1939.

EDWARD JOHN BENZ (1956, 1963) ..... *Adjunct Professor of Medical Microbiology*
B.S., Pittsburgh, 1944; M.D., 1946; M.S., Minnesota, 1952.

RAM GOPAL BHANDARI (1966) ..... *Research Associate and Lecturer in Mechanics*
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CHARLES CLARENCE BIDWELL (1927, 1947) ..... *Professor Emeritus of Physics*
A.B., Rochester, 1904; Ph.D., Cornell, 1914.

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*Resigned, June 30, 1966.

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*JOSEPH WADE BINGEMAN (1963) .....*Coordinator, Educational Placement, Assistant Professor of Education*
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B.S., Colorado, 1904; A.B., Kansas, 1906; M.D., Jefferson Medical, 1909.

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*Resigned, June 30, 1966.
*Resigned, June 30, 1966.
*Resigned, June 30, 1966.
*Resigned, July 30, 1966.
*Deceased, April 9, 1966.

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*PETER BRUCE COOPER (1958, 1965) .....*Research Assistant Professor of Civil Engineering*
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FRANK ROBERT CUNNINGHAM (1966) .....*Instructor in English*
B.A., Villanova University, 1959; M.A., 1962.

CASSIUS WILD CURTIS (1946, 1948) .....*Professor of Physics*
A.B., Williams, 1928; Ph.D., Princeton, 1936.

EDWARD HUTCHINS CUTLER (1930, 1947) .....*Associate Professor of Mathematics*
A.B., Harvard, 1925; A.M., 1926; Ph.D., 1930.

ROBERT BENJAMIN CUTLER (1954, 1962) .....*Professor of Music, Chairman of the Department of Music, University Organist*
A.B., Bucknell, 1934; M.A., Columbia, 1935.

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*Resigned, July 30, 1966.
*Resigned, July 31, 1966.

JEROME DAEN (1958, 1962) .....*Associate Professor of Chemistry*
B.Ch.E., City College of New York, 1950; Ph.D., Brooklyn Polytechnic Institute, 1955.

CALVIN C. DAETWYLER (1965) .....*Assistant Professor of Geology*
B.S., Syracuse University, 1952.

WALTER EMIL DAHLKE (1964) .....*Professor of Electrical Engineering*
Diploma, University of Berlin; Ph.D., 1936; Ph.D. (habil), University of Jena, 1939.

H. BARRETT DAVIS (1946, 1953) .....*Professor and Chairman of the Division of Speech*
B.L.I., Emerson, 1929; Cert. American Academy of Dramatic Arts, 1930; M.A. (Hon.), Emerson, 1958.

EDNA SOPHIA DEANGELI (1963, 1965) ....*Assistant Professor of Classical Languages*
B.S., Temple, 1938; M.A., Pennsylvania, 1960; Ph.D., 1965.

JOHN JOSEPH DEBARBADILLO (1965, 1966) .....*Instructor and Research Assistant in Metallurgy and Materials Science*
B.S., Lehigh, 1963; M.S., 1965.

JACK ANGELO DEBELLIS (1964) .....*Assistant Professor of English*
A.B., University of Florida, 1957; A.M., University of California at Los Angeles, 1959; Ph.D., 1964.

JANET M. DECHERT (1965) .....*Science Cataloger*
B.A., Oberlin, 1963; M.S., Columbia, 1965.

MARGARET LINN DENNIS (1953, 1954).....*Reference Librarian*
A.B., Allegheny, 1939; B.S. in L.S., Syracuse, 1940.

ALBERT WILLIAM DE NEUFVILLE (1948, 1957) .....*Associate Professor Emeritus of Mechanics*
Dipl. Ing., Berlin, 1922; M.S., Stevens Institute of Technology, 1948; Ph.D., Lehigh, 1952.

HERBERT MAYNARD DIAMOND (1927, 1964) .....*Professor Emeritus of Economics*
B.A., Yale, 1914; Ph.D., 1917.

*ALPHA ALBERT DIEFENDERFER (1902, 1946) .....*Professor Emeritus of Quantitative Analysis and Assaying*
B.S. in Chem., Lehigh, 1902; M.S., 1908.

ALFRED JAMES DIEFENDERFER (1961, 1965) .....*Associate Professor of Chemistry*
B.S., Pittsburgh, 1957; Ph.D., Massachusetts Institute of Technology, 1961.

ELIZABETH HOFFMAN DIETZ (1965) .....*Part-Time Lecturer in Education*
B.A., Northwestern University, 1940; M.A., 1942; Ed.D., New York University, 1955.

WILLIAM ALBERT DIGEL (1960, 1964) .....*Instructor in English*
B.A., Lehigh, 1959; M.A., 1963.

ERNEST NEVIN DILWORTH (1949, 1961).....*Associate Professor of English*
Ph.B., Kenyon, 1933; M.A., Pittsburgh, 1937; Ph.D., Columbia, 1948.

GEORGE ANSON DINSMORE (1955) .....*Assistant Professor of Civil Engineering*
B.E., Yale, 1946; M.S., Colorado, 1955.

THOMAS L. DINSMORE (1965) .....*Associate Director of Institute of Research*
B.S., University of Rochester, 1946; M.S., Princeton University, 1948.

JOSEPH ALBERT DOWLING (1958, 1961).....*Associate Professor of History*
A.B., Lincoln Memorial, 1948; M.A., New York, 1951; Ph.D., 1958.

GEORGE CLARENCE DRISCOLL, JR. (1950, 1965) .....*Professor of Civil Engineering*
B.S. in C.E., Rutgers, 1950; M.S., Lehigh, 1952; Ph.D., 1958.

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*Resigned, January 13, 1967.
*Deceased, October 26, 1966.

ROY HELVERSON DUNGAN (1966) .....*Part-Time Lecturer in Education*
B.S., Millerville State College, 1941; Ed.M., Temple University, 1947; Ed.D., 1960.

AURIE NICHOLS DUNLAP (1948, 1957).....*Associate Professor of International Relations*
A.B., Union (New York), 1929; A.M. Columbia, 1931; Ph.D., 1955.

FREDERICK HOMER DUNLAP (1965) .....*Assistant Professor of Physical Education, Varsity Head Football Coach*
B.A., Colgate, 1950.

NIKOLAI EBERHARDT (1962) .....*Associate Professor of Electrical Engineering*
Dipl. Engr., University of Munich, 1957; Ph.D., 1962.

EVELYN STRAWN EBERMAN (1955, 1966) .....*Assistant to the Dean of Residence*
B.A., Swarthmore, 1921.

ARTHUR ROY ECKARDT (1951, 1956) .....*Professor of Religion, Chairman of the Department of Religion*
B.A., Brooklyn, 1942; B.D., Yale, 1944; Ph.D., Columbia, 1947.

JONATHAN BRITTON ELKUS (1957, 1965) .....*Professor of Music*
B.A., California, 1953; M.A., Stanford, 1954.

RAYMOND JAY EMRICH (1946, 1958) .....*Professor and Chairman of the Department of Physics*
A.B., Princeton, 1938; Ph.D., 1946.

*WILLIAM JOSEPH ENEY (1936, 1957) .....*Joseph T. Stuart Professor of Civil Engineering*
B.E., Johns Hopkins, 1927; M.S., Lehigh, 1938; P.E., Pennsylvania, 1939.

JAMES VANDEUSEN EPPES (1950) ....*Associate Professor of Mechanical Engineering*
B.A., Virginia, 1928; M.E., Cornell, 1931; M.S. in M.E., Lehigh, 1943.

FAZIL ERDOGAN (1952, 1963) .....*Professor of Mechanics*
Yuk. Muh., Technical University of Istanbul, 1948; Ph.D., Lehigh, 1955.

*WARREN WALTER EWING (1920, 1955) .....*Professor Emeritus of Physical Chemistry*
B.S., Parsons, 1912; M.S., Chicago, 1918; Ph.D., 1920.

HSAI-YANG FANG (1966) .....*Assistant Professor of Civil Engineering*
B.S., Hangchow University, 1947; M.S., Purdue University, 1956; Ph.D., West Virginia University, 1966.

*GEORGE DORMER FARNE (1927, 1945) .....*Assistant Professor of Romance Languages*
A.B., Columbia, 1926; M.A., 1927.

DOUGLAS DAVID FEAVER (1956, 1966) .....*Professor of Classical Languages*
B.A., Toronto, 1948; M.A., Johns Hopkins, 1949; Ph.D., 1951.

JACQUELINE MARIE FETSKO (1949, 1966) .....*Assistant to the Director, Center for Surface and Coatings Research*
B.A., Pennsylvania, 1946; M.S., Lehigh, 1953.

HOWARD T. FIEDLER (1963) .....*Lecturer in Psychiatry*
B.S., Pittsburgh, 1926; M.D., Hahnemann, 1930.

*FREDERIC N. FIRESTONE (1963) .....*Associate Professor of Economics*
B.A., Olivet College, 1948; M.S., Wisconsin, 1952; Ph.D., 1958.

JEROME I. FISCHMAN (1962) .....*Assistant Professor of History*
B.S.S., City College of New York, 1950; M.A., 1952; Ph.D., New York University, 1962.

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*On leave, 1967.
*Retired, July 1, 1966.
*Resigned, July 31, 1966.

JOHN WILLIAM FISHER (1961) ..... *Associate Professor of Civil Engineering*
B.S., Washington University; M.S., Lehigh, 1958; Ph.D., 1964; P.E., Illinois, 1960.

ANNE STROWD FLANNERY (1960) ..... *Associate Librarian*
A.B., Duke, 1934; A.B. in L.S., Emory, 1942; M.A., Duke, 1945.

THOMAS FLECK, JR. (1965) ..... *Instructor in Education and Principal, Laboratory School*
B.S., West Chester State College, 1956; M.Ed., Temple University, 1960.

CATHERINE RILEY FLECKSTEINER (1945, 1965) ..... *Serials Cataloger*

WILLIAM MEYLIN FLEISCHMAN (1964) ..... *Instructor in Mathematics*
B.A., Lehigh, 1959; M.S., 1964.

ROBERT THOMAS FOLK (1961, 1966) ..... *Professor of Physics*
B.S. in E.E., Lehigh, 1953; B.S. in Phys., 1954; M.S., 1955; Ph.D., 1958.

ADELBERT FORD (1931, 1955) ..... *Professor Emeritus of Psychology*
A.B., Michigan, 1920; A.M., 1923; Ph.D., 1926.

ROBERT DARROW FOUCHAUX (1963) ..... *Assistant Professor of Physics*
B.A., B.S., Lehigh, 1956; M.S., University of Illinois, 1958; Ph.D., 1963.

ALAN SHIVERS FOUST (1952, 1965) ..... *McCann Professor of Chemical Engineering*
B.S., Texas, 1928; M.S., 1930; Ph.D., Michigan, 1938; P.E., Michigan, 1947.

WYMAN BEALL FOWLER (1966) ..... *Associate Professor of Physics*
B.S., Lehigh, 1959; Ph.D., University of Rochester, 1963.

JAMES RICHARD FRAKES (1958, 1964) ..... *Associate Professor of English*
B.A., Pennsylvania State, 1948; M.A., Chicago, 1949; Ph.D., Pennsylvania, 1953.

PAUL JUSTUS FRANZ, JR. (1944, 1962) ..... *Vice-President—Development*
B.S. in Bus. Adm., Lehigh, 1944; M.A., 1955.

AUGUSTUS HENRY FRETZ (1918, 1948) ..... *Associate Professor Emeritus of Geology*
Ph.B., Lafayette, 1903; C.E., 1906; M.S., 1924.

GILBERT DARREL FRIEND (1966) ..... *Assistant Professor of Mathematics*
A.B., Bradley University, 1960; M.A., University of Maryland, 1964; Ph.D., 1966.

MERTON OTIS FULLER (1912, 1955) ..... *Associate Professor Emeritus of Civil Engineering*
C.E., Syracuse, 1910; M.S., Lehigh, 1934.

RAYMOND EUGENE FUESSLE (1953) ..... *Chaplain of the University, Associate Professor of Religion*
B.A., New York, 1930; B.D., Virginia Episcopal Theological Seminary, 1933.

ROBERT TAYLOR GALLAGHER (1942, 1964) ..... *Professor of Mining Engineering; Associate Dean, College of Engineering*
B.S. in E.M., Pennsylvania State, 1927; M.A. in Geol., Missouri, 1938; D.E.M., Colorado School of Mines, 1941; P.E., Pennsylvania, 1945; New Jersey, 1955.

ARTHUR PARCEL GARDNER (1958, 1966) ..... *Associate Professor of German*
A.B., Duke, 1944; A.M., Harvard, 1945; Ph.D., 1950.

MARK GARIS (1966) ..... *Instructor in Education*
A.B., Messiah College, 1960; M.Ed., Temple, 1965.

JACOB MYER GEIST (1959) ..... *Lecturer in Chemical Engineering*
B.S., Purdue, 1940; M.S., Pennsylvania State, 1942; Ph.D., Michigan, 1950.

BHASKAR KUMAR GHOSH (1961, 1963) ..... *Associate Professor of Mathematics*
B.Sc., Calcutta (India), 1955; Ph.D., London, 1959.

RICHARD ALLEN GIBBONEY (1966) ..... *Part-time Lecturer in Education*
B.S., Penn State, 1950; M.Ed., Wayne State University, 1955; Ed.D., George Peabody, 1957.

LEANOR RUTH GILBERT (1930, 1943) ..... *Recorder*

ARTHUR R. GILL (1964) ..... *Instructor in Military Science*
Master Sergeant, U.S.A.

LAWRENCE HENRY GIPSON (1924, 1952) .... *Research Professor Emeritus of History*
A.B., Idaho, 1903; B.A., Oxford, 1907; M.A., 1915; Ph.D., Yale, 1918; Litt.D. (Hon.), Temple, 1947; L.H.D. (Hon.), Lehigh, 1951; LL.D. (Hon.), Idaho, 1953; L.H.D. (Hon.), Yale, 1955; L.H.D. (Hon.), Kenyon, 1961; LL.D. (Hon.), Moravian, 1962; LL.D. (Hon.), Wabash, 1963.

FREDERICK ROBERT GLADECK (1966) ..... *Instructor in International Relations*
B.A., Lehigh, 1960; M.A., University of Pennsylvania, 1964.

ELMER WILLIAM GLICK (1949, 1952) ..... *Treasurer*
B.A., Lehigh, 1933.

WILLIAM MONROE GLOSE III (1960) ..... *Assistant Accountant*
B.S. in Bus. Adm., Lehigh, 1958.

LAWRENCE PETER GOLAN (1964) ..... *Instructor in Mechanical Engineering*
B.S., West Virginia University, 1961; M.S., 1964.

RICHARD ALLYN GONCE (1965, 1966) ..... *Assistant Professor of Economics*
B.B.A., University of Wisconsin, 1954; M.B.A., 1959.

RONALD L. GOUGHER (1965) ..... *Instructor in German*
A.B., Muhlenberg, 1961; M.A., Lehigh, 1964.

ARTHUR FREEMAN GOULD (1947, 1953) ..... *Professor and Chairman of the Department of Industrial Engineering*
S.B., Massachusetts Institute of Technology, 1938; M.S., Lehigh, 1949; P.E., Pennsylvania, 1949.

JAMES LARMOUR GRAHAM (1930, 1954) ..... *Associate Professor Emeritus of Psychology*
B.A., Muskingum, 1911; B.D., Union Theological Seminary, 1922; M.A., Columbia, 1922; Ph.D., Peabody, 1927.

MARGARET C. GRANDOVIC (1962) ..... *Part-time Lecturer in Education*
B.S., Temple, 1938; M.Ed., 1957.

THOMAS R. GRAVETTE (1965) ..... *Associate Professor of Military Science*
B.S., John Carroll University, 1957; Major USA.

MARGUERITE B. GRAVEZ (1957) ..... *Instructor in Mathematics*
B.A., Hunter, 1950; M.A., Radcliffe, 1951.

DAVID MASON GREENE (1958, 1964) ..... *Associate Professor of English*
B.A., San Diego State, 1951; M.A., California, 1952; Ph.D., 1958.

ROGER GRISMORE (1962) ..... *Associate Professor of Physics*
B.S., University of Michigan, 1947; M.S., 1948; Ph.D., 1957.

MIKELL PORTER GROOVER (1964, 1966) ..... *Instructor in Industrial Engineering*
B.A., Lehigh, 1961; B.S., 1962; M.S., 1966.

ANDREW C. GROSS (1966) ..... *Instructor in Economics*
B.Sc., Case Institute of Technology, 1957; M.B.A., Western Reserve University, 1962.

HOWARD DIETRICH GRUBER (1914, 1948) ..... *Associate Professor Emeritus of Electrical Engineering*
E.E., Lehigh, 1909; M.S., 1923.

MARY ELIZABETH GRUBER (1953, 1965) ..... *Assistant Reference Librarian*
B.A., Pennsylvania State, 1952; M.S. in L.S., Drexel Institute of Technology, 1953.

CHARLES GUDITUS (1964, 1965) ..... *Assistant Professor of Education*
B.S., Penn State University, 1950; M.S., Bucknell University, 1952; Ed.D., Lehigh, 1965.

ALBERT ALEXANDER GUILFORD (1962, 1963) ..... *Instructor in Civil Engineering*
B.S., Tri-State College, 1954; M.S., Michigan State University, 1960; P.E., Indiana, 1961

SAMUEL LINIAL GULDEN (1953, 1965) ..... *Assistant Professor of Mathematics*
B.S., City College of New York, 1949; M.A., Princeton, 1950.

WALTER CHARLES HAHN, JR. (1963) ..... *Assistant Professor of Metallurgy and Materials Science*
B.S., Met. Engr., Lafayette, 1952; M.S., Pennsylvania State, 1958; Ph.D., 1960.

JOHN MCVICKAR HAIGHT, JR. (1949, 1964) ..... *Associate Professor of History*
A.B., Princeton, 1940; M.A., Yale, 1947; Ph.D., Northwestern, 1953.

THEODORE HAILPERIN (1946, 1961) ..... *Professor of Mathematics*
B.S., Michigan, 1939; Ph.D., Cornell, 1943.

ROBERT J. HALL (1963, 1966) ..... *Assistant Professor of Management*
B.B.A., State University of Iowa, 1960; M.A., 1961.

GEORGE DEWEY HARMON (1925, 1964) ..... *Professor Emeritus of American History*
B.A., Duke, 1921; M.A., 1922; Ph.D., Pennsylvania, 1930.

ROBERT AUSTIN HARRIER (1951) ..... *Executive Secretary, Alumni Association, and Editor, Lehigh Alumni Bulletin*
E.M., Lehigh, 1927.

ROBERT HARRIS (1965) ..... *Assistant in Military Science*
Staff Sergeant, U.S. Army.

ROBERT RICHARD HARSON (1966) ..... *Assistant Professor of English*
B.A., Wagner College, 1963; M.A., Ohio University, 1964; Ph.D., 1966.

RONALD JOHN HARTRANFT (1966) ..... *Assistant Professor of Mechanics*
B.S., Lehigh, 1963; M.S., 1964; Ph.D., 1966.

ALBERT EDWARD HARTUNG (1947, 1961) ..... *Associate Professor of English*
B.A., Lehigh, 1947; M.A., 1949; Ph.D., 1957.

EMIL ANDREW HAVACH (1941, 1949) ..... *Head Trainer*
D. Surg. Chirop., Temple, 1936.

THOMAS MORRIS HAYNES (1952, 1961) ..... *Associate Professor of Philosophy*
A.B., Butler, 1941; M.A., Illinois, 1949; Ph.D., 1949.

STANLEY FREDERICK HEFFNER (1930, 1946) ..... *Manager of the Supply Bureau*

NED D. HEINDEL (1966) ..... *Assistant Professor of Organic Chemistry*
B.S., Lebanon Valley College, 1959; M.S., University of Delaware, 1961; Ph.D., 1963.

*ROY JAMES HENSLEY (1964) ..... *Chairman of the Department of Finance and Professor of Economics*
B.S., Oregon, 1942; Ph.D., University of California (Berkeley), 1955.

JOHN BRONISLAW HERBICH (1957, 1965) ..... *Professor of Civil Engineering*
B.Sc., Edinburgh (Scotland), 1949; M.S., Minnesota, 1957; Ph.D., Penn State University, 1963.

SIDNEY SAMUEL HERMAN (1962, 1966) ..... *Associate Professor of Biology*
B.S., Georgetown University, 1953; M.S., Rhode Island, 1958; Ph.D., 1962.

JOHN WILLIAM HERRMANN (1961, 1966) ..... *Instructor in Physics*
B.S., Providence, 1961; M.S., Lehigh, 1963.

ROY CECIL HERRENKOHL, JR. (1966) ..... *Assistant Professor of Social Psychology and Methodology*
B.A., Washington & Lee University, 1954; Ph.D., New York University, 1966.

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*On leave, 1966-67.
*Resigned, June 30, 1966.
*Resigned, February 1, 1967.

*John Atlee Hertz (1945, 1964) ..... *Associate Professor of English, Director of Adult Education*
A.B., Moravian, 1938; M.A., Lehigh, 1947; Ph.D., 1958.

Richard Warren Hertzberg (1964, 1965) ..... *Assistant Professor of Metallurgy and Materials Science*
B.S., City College of New York, 1960; M.S., Massachusetts Institute of Technology, 1961; Ph.D., Lehigh, 1965.

Anna Pirscenok Herz (1966) ..... *Associate Professor of Russian*
B.S., University of Pennsylvania, 1949; M.A., 1950; M.A., Columbia, 1951; Ph.D., Pennsylvania, 1956.

Richard Charles Hess (1966) ..... *Instructor in Speech, and Debate Coach*
A.B., Fairmont State College, 1963; M.A., Temple University, 1965.

Donald John Hillman (1960, 1964) ..... *Professor of Philosophy, and Chairman of the Department of Philosophy*
B.A., Cambridge (England), 1955; M.A., 1959; M.Litt., 1962.

Lloyd Hitchcock, Jr. (1966) ..... *Adjunct Assistant Professor of Psychology*
A.B., Southwest Missouri State, 1954; M.S., Georgia, 1956; Ph.D., Purdue, 1961.

James B. Hobbs (1966) ..... *Associate Professor of Business Administration*
A.B., Harvard, 1952; M.B.A., University of Kansas, 1957; D.B.A., Indiana University, 1962.

John Anthony Hogan (1965) ..... *Assistant Professor Physical Education, Assistant Varsity Football Coach*
B.S., University of Cincinnati, 1951.

Robert Mark Holcombe (1963, 1966) ..... *Associate Director of Development*
B.S., Lehigh, 1958.

William Fowler Hollabaugh (1960, 1966) ..... *Assistant Professor in Electrical Engineering*
B.S. in E.E., Lehigh, 1959; M.S. in E.E., 1960; Ph.D., 1966.

*Lawrence Rozier Holland (1960, 1962) ..... *Assistant Professor of Physics*
A.B., Harvard, 1952; M.A., Bryn Mawr, 1957; Ph.D., 1962.

*Kendrick Holle (1964) ..... *Assistant Professor of Military Science*
B.S., Tulane, 1952, Major, U.S.A.

Richard Edward Holleran (1965) ..... *Assistant in Aerospace Studies*
Technical Sergeant, U.S.A.F.

Carl Sanford Holzinger (1959, 1964) ..... *Assistant Professor of Electrical Engineering*
B.S., Lehigh, 1956; M.S., 1957; Ph.D., 1963.

Frank Scott Hook (1952, 1965) ..... *Professor of English*
A.B., Missouri, 1942; M.A., 1947; Ph.D., Yale, 1952.

*Ladd E. Hoover (1960) ..... *Associate Director, University Health Service*
B.S., Nebraska, 1924; M.D., 1926.

Evan Eric Howard (1966) ..... *Instructor in Education*
B.S., Cornell, 1961.

Chuan-Chih Hsiung (1952, 1960) ..... *Professor of Mathematics*
B.S., National Chekiang (China), 1936; Ph.D., Michigan State, 1948.

Ti Huang (1967) ..... *Associate Professor of Civil Engineering*
B.S., Tangshan Engineering College, 1948; M.S., Michigan University, 1952; Ph.D., 1960.

*Resigned, June 30, 1966.
*On leave, 1966-67.
*Resigned, September 29, 1966.
*Resigned, January 31, 1967.

HOWARD ALLAN HUNT (1965, 1966) ..... *Instructor in Economics*
B.S., University of Wisconsin, 1964; M.S., Lehigh, 1966.

JON TERENCE INNES (1965) ..... *Instructor in Economics*
B.S., Pennsylvania State University, 1958.

THOMAS EDGAR JACKSON (1937, 1946) ..... *Associate Professor of Mechanical Engineering*
B.S. in M.E., Carnegie Institute of Technology, 1934; M.S., Lehigh, 1937; P.E., Pennsylvania, 1946.

ELSIE LONGENECKER JAMES (1966) ..... *Research Associate in Center for Surface and Coatings Research*
A.B., Mt. Holyoke College, 1959; Ph.D., University of Pennsylvania, 1963.

EUSTACE ANTHONY JAMES (1962, 1966) ..... *Assistant Professor of English*
A.B., Princeton, 1958; M.A., Pennsylvania, 1960; Ph.D., 1965.

GEORGE ROBERT JENKINS (1948, 1963) ..... *Director of the Institute of Research, Professor of Geology*
B.A., Colorado, 1936; Ph.M., Wisconsin, 1938.

FINN BJORN JENSEN (1947, 1954) ..... *Professor and Chairman of the Department of Economics*
A.B., Southern California, 1934; M.A., 1935; Ph.D., 1940.

DARLENE MARILYN JOHNSON (1965) ..... *Instructor in Education*
B.A., Hood College, 1964; M.Ed., Lehigh, 1965.

FLETCHER ALFRED JOHNSON, JR. (1966) ..... *Instructor in Physical Education, Assistant Trainer & Hockey Coach*
B.S., Boston University, 1964.

ROBERT GRIFFITH JONES (1965) ..... *Assistant Professor of Social Psychology*
A.B., Davidson College, 1958; B.D., Yale, 1961; Ph.D., Duke University, 1966.

CAREY BONTHRON JOYNT (1951, 1960) ..... *Professor and Chairman of the Department of International Relations*
B.A., Western Ontario, 1945; M.A., 1948; Ph.D., Clark, 1951.

JEAN CLAUDE JUVET (1966) ..... *Instructor in Electrical Engineering*
Dipl., Ecole Polytechnique De L'Universite De Lausanne Epul University, Switzerland, 1962.

ARTURS KALNINS (1965) ..... *Associate Professor of Mechanics*
B.S., University of Michigan, 1955; M.S., 1956; Ph.D., 1960.

*ROBERT WILLIAM KAMPMEINERT (1965) ..... *Assistant to the Director of Development*
B.S., Lehigh, 1965.

LAVEEN KANAL (1966) ..... *Adjunct Professor in Electrical Engineering*
B.S.E.E., 1951; M.S.E.E., University of Washington, 1953; Ph.D., University of Pennsylvania, 1960.

GEORGE EUGENE KANE (1950, 1964) ..... *Professor of Industrial Engineering*
B.S., Pennsylvania State, 1948; M.S., Lehigh, 1954; P.E., Pennsylvania, 1955.

JOHN J. KARAKASH (1946, 1966) ..... *Distinguished Professor and Chairman of the Department of Electrical Engineering; Dean, College of Engineering*
B.S. in E.E., Duke, 1937; M.S. in E.E., Pennsylvania, 1938; P.E., Pennsylvania, 1948.

CHETAN LALCHAND KARNA (1963, 1966) ..... *Assistant Professor of Mechanics*
B.E., College of Engineering, Poona (India), 1953; M.S. in M.E., Lehigh, 1960; M.S. in Appl. Mech., 1960; Ph.D., 1966.

ROBERT PAUL KERFOOT (1966) ..... *Instructor in Civil Engineering*
B.S., Iowa State University, 1962; M.S., Lehigh, 1964.

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*Resigned, August, 1966.

SAMIR ANTON KHABBAZ (1960, 1964) .....*Associate Professor of Mathematics*
B.A., Bethel College, 1954; M.A., Kansas, 1956; Ph.D., 1960.

JERRY PORTER KING (1962, 1965) .....*Associate Professor of Mathematics*
B.S. in E.E., University of Kentucky, 1958; M.S. in Math., 1959; Ph.D., 1962.

MURRAY ROBERT KIRCH (1965) .....*Instructor in Mathematics*
B.A., Temple University, 1962; M.S., Lehigh, 1964.

*JEFFERY KIRK (1964) .....*Assistant Professor of Education*
B.A., University of Pennsylvania, 1949; M.Ed., Temple, 1960; Ed.D., 1964.

REINHARD HEINRICH KNERR (1966) .....*Instructor in Electrical Engineering*
Dipl., Rheinisch-Westfalische Technische Hochschule, Aachen (Germany), 1960; Dipl. d'Ing., Ecole Nationale d'Electrotechnique, d'Electronique et d'Hydraulique, Toulouse (France), 1962; M.S., Lehigh, 1964.

ALFRED PAUL KOCH (1946, 1961).....*Professor of Accounting*
B.S., Pennsylvania State College (Bloomsburg), 1939; M.S., Bucknell, 1940; C.P.A., Pennsylvania, 1952.

DOUGLAS ANDREW KOOP (1965, 1966) .....*Instructor in Metallurgy and Materials Science*
B.S., Rensselaer Polytechnic Institute, 1963; M.S., 1965.

CELAL NIZAMETTIN KOSTEM (1966) .....*Post-Doctoral Research Associate in Civil Engineering*
B.S., Technical University of Istanbul, 1960; M.S., 1961; Ph.D., University of Arizona, 1966.

ALBERT BARRY KUNZ (1966) .....*Research Associate in Physics*
B.S., Muhlenberg, 1962; M.S., Lehigh, 1964.

RALPH WAYNE KRAFT (1962, 1965) ....*Professor of Metallurgy and Materials Science*
B.S. in Met.E., Lehigh, 1948; M.S. in Met.E., University of Michigan, 1956; Ph.D. in Met.E., 1958.

CHARLES STEPHEN KRAIHANZEL (1962, 1966) .....*Associate Professor of Chemistry*
Sc.B. in Chem., Brown, 1957; M.S., University of Wisconsin, 1959; Ph.D., 1962.

RALPH M. KRAUS (1961).....*Assistant Professor of Accounting*
A.B., Bethany, 1951; M.Litt., Pittsburgh, 1954.

GEORGE KRAUSS, JR. (1963, 1966) .....*Associate Professor of Metallury and Materials Science*
B.S., Lehigh, 1955; M.S., Massachusetts Institute of Technology, 1958; Sc.D., 1961.

ROLF BROOKS KREITZ (1966) .....*Associate Professor of Military Science*
B.S., Lehigh, 1957; Major, U.S.A.

THERON LAMONT KROPP (1958, 1962) .....*Executive Secretary, Committee on Undergraduate Financial Aid; Assistant Director of Admission*
B.A., Lehigh, 1956; M.A., 1963.

LEON ELWOOD KROUSE (1951, 1963) .....*Associate Professor of Finance*
B.A., Susquehanna, 1941; M.S., Bucknell, 1947; Ph.D., New York, 1958.

THOMAS CHARLES KUBELIUS (1948, 1957).....*Associate Professor of Business Law*
B.S., Illinois, 1945; LL.B., 1947.

PAUL EDWARD KUKLENTZ (1963) .....*Part-time Lecturer in Education*
B.S., East Stroudsburg State College, 1947; M.S., University of Pennsylvania, 1949.

GUNNAR KULLERUD (1962) .....*Adjunct Professor of Geochemistry*
M.S.C., Technical University (Norway), 1946; Ph.D., University of Oslo (Norway), 1948; D.Sc., 1954.

*GEORGE WALLACE KYTE (1946, 1951) .....*Associate Professor of History*
A.B., California, 1940; M.A., 1941; Ph.D., 1943.

*Resigned, June 30, 1966.
*Resigned, July 30, 1966.

GARY BERNARD LAISON (1961) ..... *Instructor in Mathematics*
B.A., Pennsylvania, 1958; M.A., 1960.

NICHOLAS ANTHONY LAPARA (1964) ..... *Instructor in Philosophy*
B.S., Lehigh, 1959; B.A., 1961; M.A., University of Pittsburgh, 1962.

ARTHUR IRVING LARKY (1954, 1964) ..... *Professor of Electrical Engineering*
B.S., Lehigh, 1952; M.S., Princeton, 1953; Ph.D., Stanford, 1957.

NANCY LARRICK (1964) ..... *Part-time Lecturer in Education*
B.A., Goucher College, 1930; M.A., Columbia University, 1937; Ed.D., New York University, 1955.

VORIS V. LATSHAW (1931, 1947) ..... *Associate Professor of Mathematics*
B.A., Indiana, 1927; A.M., 1928; Ph.D., 1930.

BRUCE ALAN LAUB (1965) ..... *Accountant, Fritz Engineering Laboratory*
B.S., Lehigh, 1961.

WILLIAM BADER LECKONBY (1946, 1962) ..... *Professor of Physical Education, Director of the Division of Athletics and Physical Education*
B.S., St. Lawrence, 1939.

JAMES CHARLES LEE (1966) ..... *Assistant in Aerospace Studies*
Staff Sergeant, U.S.A.F.

GERALD GRANT LEEMAN (1950) ..... *Assistant Professor of Physical Education, Varsity Wrestling Coach, Freshman Soccer Coach*
B.A., State College of Iowa, 1948.

DANIEL LEENOV (1963) ..... *Associate Professor of Electrical Engineering*
B.S. in Chem., George Washington University, 1943; M.S. in Phys., University of Chicago, 1948; Ph.D., 1951.

ROBERT LEWIS LEIGHT (1963, 1966) ..... *Visiting Lecturer in Education*
B.S., Kutztown State College, 1959; M.A., Lehigh, 1961; M.Ed., 1964; Ed.D., 1966.

JOHN DOUGLAS LEITH (1945, 1966) ..... *Assistant to Vice President—Administration*
A.B., North Dakota, 1920; A.M., Columbia, 1924.

*ROY JUNIOR LEONARD (1959, 1961) ..... *Associate Professor of Civil Engineering*
B.C.E., Clarkson College of Technology, 1952; M.S., Connecticut, 1954; Ph.D., Iowa State, 1958; P.E., New York, 1959.

RICHARD C. LEWIS (1966) ..... *Assistant Professor of Business Law*
A.B., Dartmouth, 1962; LL.B., University of Miami (Florida), 1965; LL.M., New York University, 1966.

WILLARD DEMING LEWIS (1964) ..... *President*
A.B., Harvard, 1935; B.A., Oxford (England), 1938; Ph.D., Harvard, 1941; M.A., Oxford, 1945; LL.D., Lafayette, 1965; L.H.D., Moravian, 1966.

FERNANDO LEYTON (1964) ..... *Instructor in Romance Languages*
Degree of French Teacher, University of Chile, 1963; M.A., Lehigh, 1966.

MARGUERITE LEYTON (1965) ..... *Consultant in the Laboratory School*
B.A., University of Chile, 1963; M.Ed., Lehigh, 1966.

JOSEPH FRANCIS LIBSCH (1946, 1967) ..... *Alcoa Foundation Professor and Chairman of the Department of Metallurgy and Materials Science Director of the Materials Research Center*
B.S., M.S., Massachusetts Institute of Technology, 1940; Sc.D., 1941; P.E., Pennsylvania, 1947.

JAMES PATTERSON LIDDICOAT (1966) ..... *Instructor in Education*
B.S., East Stroudsburg State College, 1952; M.A., Lehigh, 1960.

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*Resigned, July 30, 1966.

JOHN ORTH LIEBIG, (1946, 1955) .....*Associate Professor of Civil Engineering*
B.S., Lehigh, 1940; M.S., 1949; P.E., Pennsylvania, 1951.

JOHN RALPH LINDGREN (1965) .....*Assistant Professor of Philosophy*
B.S., Northwestern University, 1959; M.A., Marquette University, 1961; Ph.D., 1963.

JUSTIN THOMAS LLOYD (1964) .....*Assistant Professor of Mathematics*
B.S., University of Arkansas, 1959; M.S., Tulane, 1962; Ph.D., 1964.

RALPH H. LONG, JR. (1963) .....*Professor and Chairman of the Department of Mechanical Engineering*
B.S., Tufts College, 1943; M.Eng., Yale, 1948; D.Eng., 1952; P.E., Maryland, 1954.

*NARENDRA PAUL LOOMBA (1962, 1963) .....*Professor of Management and Chairman, Department of Management Science*
B.Sc., University of Punjab, 1947; B.S. in E.E., B.S. in M.E., University of Nebraska, 1952; M.S. in E.E., Massachusetts Institute of Technology, 1954; Ph.D., Wisconsin, 1959.

LEONARD ANTHONY LOPEZ (1966) .....*Assistant Professor of Civil Engineering*
B.S., Tufts University, 1962; M.S., University of Illinois, 1963; Ph.D., 1966.

ROBERT WILLIAM LOREAUX (1966) .....*Assistant in Military Science*
Specialist Fifth Class, U.S. Army

ROLAND WILLIAM LOVEJOY (1962) .....*Assistant Professor of Chemistry*
B.A., Reed College, 1955; Ph.D., Washington State University, 1960.

LE-WU LU (1957, 1966) .....*Associate Professor of Civil Engineering*
B.S., National Taiwan, 1954; M.S., Iowa State, 1956; Ph.D., Lehigh, 1960.

ROBERT ALAN LUCAS (1958, 1964) .....*Assistant Professor of Mechanical Engineering*
B.S. in M.E., Lehigh, 1957; M.S., 1959; Ph.D., 1964.

FENG-SHYANG LUH (1965) .....*Assistant Professor of Accounting*
B.A., National Taiwan University, 1957; M.S., University of Illinois, 1961; Ph.D., Ohio State University, 1965.

WILLIAM L. LUYBEN (1967) .....*Associate Professor of Chemical Engineering*
B.S., Penn State, 1955; M.B.A., Rutgers, 1958; M.S., 1962; Ph.D., University of Delaware, 1963.

MIGUEL ANGEL MACIAS, JR. (1966) .....*Instructor in Civil Engineering*
B.S., Instituto Technologico y de Estudios Superiores de Monterrey, 1957; M.S., Lehigh, 1961.

JAMES DECKER MACK (1946, 1950).....*Librarian*
B.A., Lehigh, 1938; M.A., 1949.

FREDERICK T. MACKENZIE (1964) .....*Visiting Lecturer in Marine Geology*
B.S., Upsala, 1955; M.S., Lehigh, 1959; Ph.D., Lehigh, 1962.

RONALD BENNETT MADISON (1964) .....*Instructor in Civil Engineering*
B.S., Lehigh, 1954; M.S., University of Washington, 1956.

MARY ISABELL MALONE (1966) .....*Secretary to President*
B.A., Rosary College, 1945.

RICHARD GRIFFITH MALSBERGER (1959, 1966) .....*Professor of Biology*
B.A., Lehigh, 1948; M.S., 1949; Ph.D., 1958.

ARTHUR HOWARD MANN (1965) .....*Assistant Dean of Students*
B.A., Wesleyan University, 1940; S.T.B., General Theological Seminary, 1944.

JOHN ALEXANDER MANSON (1966) .....*Associate Professor of Chemistry, and Director of the Polymer Laboratory, Materials Research Center*
B.Sc., McMaster University (Ontario), 1949; M.Sc., 1950; Ph.D., 1956.

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*On leave 1966-1967.

GEORGE D. MARSH, JR. (1965) .....*Assistant Professor of Psychology*
B.A., Los Angeles State College, 1957; M.A., 1960; Ph.D., University of California (Berkeley), 1965.

PAUL MARX (1963, 1966) .....*Assistant Professor of English*
A.B., Michigan, 1953; M.F.A., Iowa, 1957; Ph.D., New York University, 1966.

HAROLD DEAN MATHENEY (1966) .....*Associate Professor of Military Science*
B.S., University of Dayton, 1950; Major, U.S.A.

JAMES PATRICK MATHEWS (1947).....*Physiotherapist, University Health Service*

GEORGE CHARLES MAUE (1966) .....*Instructor in Physical Education, Freshman Football Coach & Assistant Baseball Coach*
B.E., University of Buffalo, 1961.

JOSEPH ABELE MAURER (1947, 1964) .....*Professor and Chairman of the Department of Classical Languages*
B.A., Moravian, 1932; M.A., Lehigh, 1936; Ph.D., Pennsylvania, 1948.

*ALBERT JOSEPH MAZURKIEWICZ (1955, 1959) .....*Associate Professor of Education, Supervisor of the Reading and Study Clinic*
B.A., Ursinus, 1950; M.A., Pennsylvania, 1951; Ed.D., Temple, 1957.

GREGORY T. MCALLISTER (1965, 1966) .....*Associate Professor of Mathematics*
B.S., St. Peter's College, 1956; Ph.D., University of California, 1962.

GEORGE E. MCCLUSKEY (1965) .....*Assistant Professor of Astronomy*
A.B., University of Pennsylvania, 1960; M.S., 1965; Ph.D., 1965.

ETHEL MAY MCCORMICK (1964, 1966) .....*Assistant Professor of Education*
B.S., Northwestern University, 1931; M.Ed., Penn State University, 1941; D.Sc.Ed., Cedar Crest College, 1963.

GEORGE WALTER MCCOY, JR. (1956).....*Director, University Health Service*
B.S., Pennsylvania, 1929; M.D., 1932.

LESLIE GUY MCCRACKEN, JR. (1956)....*Associate Professor of Electrical Engineering*
B.S. in E.E., Massachusetts Institute of Technology, 1945; M.S. in E.E., Lehigh, 1947; Ph.D. in E.E., Pennsylvania State, 1952; P.E., Pennsylvania, 1958.

JOSEPH BRENDAN MCFADDEN (1948, 1961) .....*Professor of Journalism, Chairman of the Division of Journalism*
B.A., St. Joseph's (Canada), 1941; M.A., Syracuse, 1948.

JAMES WILLARD MCGEADY (1950, 1959).....*Associate Director of Admission*
B.A., Lehigh, 1950.

JAMES RATHBURN MCINTOSH (1966) .....*Instructor in Sociology*
B.A., Colby College; M.A., New School for Social Research, 1963.

CLYDE MCKINLEY (1960).....*Lecturer in Chemical Engineering*
B.A., Tri-State, 1937; M.S. in Chem.E., Michigan, 1941; Sc.D., 1943.

*JAMES ALAN MCLENNAN, JR. (1948, 1962) .....*Professor of Physics*
A.B., Harvard, 1948; M.S., Lehigh, 1950; Ph.D., 1952.

DONALD F. MCLEROY (1966) .....*Assistant Professor of Geology*
B.S., University of Mexico, 1960; M.S., 1962; Ph.D., Stanford, 1966.

BERNARD MICHAEL MCNAMEE (1966) .....*Instructor in Civil Engineering*
B.S., Drexel Institute of Technology, 1953; M.B.A., 1960; M.S., University of Pennsylvania, 1963.

NORMAN PAUL MELCHERT (1962, 1964) .....*Assistant Professor of Philosophy*
B.A., Wartburg College, 1955; B.D., Lutheran Theological Seminary, 1958; M.A., Pennsylvania, 1959; Ph.D., 1964.

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*Resigned, August 31, 1966.
*On leave, 1966-67.

JOSEPH ROBERT MERKEL (1962, 1965) .....*Professor of Biochemistry*
B.S., Moravian, 1948; M.S., Purdue, 1950; Ph.D., University of Maryland, 1952.

FORTUNATO JOSEPH MICALE (1962, 1966) .....*Research Assistant Professor of Chemistry*
B.A., St. Bonaventure, 1956; B.S., Niagara University, 1959; M.S., Purdue, 1961; Ph.D., Lehigh, 1965.

JOHN ANTHONY MIERZWA (1966) .....*Associate Professor of Education*
B.S., Ohio University, 1954; M.A., 1955; Ed.M., Harvard, 1958; Ed.D., 1961.

ARCHIE ROSCOE MILLER (1922, 1961)....*Professor Emeritus of Electrical Engineering*
B.S. in E.E., Illinois, 1918; M.S., Lehigh, 1925.

PAUL THEODORE MILLER (1961).....*Assistant Superintendent of Buildings and Grounds*

PAUL VAN REED MILLER (1966) .....*Assistant Professor of Education*
B.A., Yale, 1946; M.A., University of Pennsylvania, 1948; Ph.D., 1965.

THEODORE MILLON (1954, 1959) .....*Associate Professor of Psychology*
B.S., City College of New York, 1949; M.A., 1950; Ph.D., Connecticut, 1953.

ROBERT HUGH MILLS (1964) .....*Associate Professor of Accounting*
B.Sc., Colorado, 1949; M.S., 1955; Ph.D., Wisconsin, 1960; C.P.A. (Illinois, Wisconsin), 1957.

SAMUEL HAROLD MISSIMER (1950, 1962) .....*Director of Admission*
B.A., Lehigh, 1950.

ALBERT CHARLES MOLTER (1960).....*Purchasing Agent*
B.S., Norwich, 1928.

*SUTTON MONRO (1959, 1964) .....*Professor of Industrial Engineering*
B.S., Massachusetts Institute of Technology, 1942.

WALTER WILLIAM MONTGOMERY (1965) .....*Instructor in Education*
B.S., Ursinus College, 1958; M.Ed., Lehigh, 1965.

ROBERT PATTISON MORE (1916, 1956) .....*Dean Emeritus of the College of Arts and Science*
B.A., Lehigh, 1910; M.A., Harvard, 1913.

CARL LELAND MOORE (1948, 1963) .....*Professor of Accounting*
A.B., Bucknell, 1943; M.A., Pittsburgh, 1948; C.P.A., Pennsylvania, 1952.

*MORTON PETER MOYLE (1962) .....*Associate Professor of Chemical Engineering*
B.E., Johns Hopkins, 1949; M.S.E., University of Florida, 1951; Ph.D., University of Michigan, 1956.

JOHN ANTHONY MUELLER (1963) .....*Instructor in Civil Engineering*
B.S., Manhattan, 1958; M.S., Lehigh, 1960.

JOHN WAYNE MURPHY (1962, 1964) .....*Director of Publications, and Managing Editor, Lehigh Alumni Bulletin*
B.S., Marshall University, 1959; M.A., State University of Iowa, 1962.

PAUL BENTON MYERS, JR. (1962, 1965) .....*Associate Professor of Geology*
A.B., Colgate, 1955; M.S., Lehigh, 1957; Ph.D., 1960.

JAMES E. NANCARROW (1964, 1966) .....*Visiting Lecturer in Education*
B.S., Bucknell, 1916; M.A., 1924; M.A., Columbia, 1929; D.Ed., Pittsburgh, 1940.

HARVEY ALEXANDER NEVILLE (1927, 1964) .....*President Emeritus*
A.B., Randolph-Macon, 1918; M.A., Princeton, 1920; Ph.D., 1921; LL.D. (Hon.), Randolph-Macon, 1952; L.H.D. (Hon.), Moravian, 1962; LL.D. (Hon.), Lafayette, 1962; Sc.D., Lehigh, 1965.

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*On leave, 1966-1967.
*Deceased, July 23, 1966.

BENJAMIN EDWARD NEVIS (1960, 1965) ..... *Assistant Professor of Mechanical Engineering*
B.S., Lehigh, 1955; M.S., 1960; Ph.D., 1965.

SAMUEL GILBERT NORD (1964) ..... *Assistant Professor in Psychology*
*Director of the Bioelectric Laboratory*
B.A., University of Delaware, 1956; M.A., 1958; Ph.D., Brown, 1963.

ROBERT WARREN NUMBERS (1960) ..... *Superintendent of Buildings and Grounds*
B.S. in C.E., Lehigh, 1950.

WILLIAM EDWARD OHNESORGE (1965) ..... *Associate Professor of Chemistry*
Sc.B., Brown University, 1953; Ph.D., Massachusetts Institute of Technology, 1956.

JAMES HAROLD OLSEN (1966, 1967) ..... *Assistant Librarian, Reader Services*
B.A., George Washington University, 1962; M.L.S., University of Maryland, 1966.

KENNETH EVERETT ORBEN (1963) ..... *Assistant Superintendent of Buildings and Grounds*
B.S. in E.E., Pennsylvania State, 1947.

DAVID H. ORR (1963) ..... *Lecturer in Psychology*
B.A., University of New Hampshire, 1942; Ph.D. University of Kentucky, 1950; Dipl.-Clin. ABEPP; Dipl. — ABEPP — Clin.

*THOMAS JAMES ORSAGH (1957) ..... *Assistant Professor of Economics*
B.S., Pennsylvania, 1954; M.A., 1958; Ph.D., 1964.

THOMAS RUSSELL ORTOLANO (1965) ..... *Assistant Professor of Chemistry*
B.S., Loyola University of the South, 1960; Ph.D., Louisiana State University, 1964.

JOSEPH C. OSBORN (1946, 1961) ..... *Associate Professor of Mechanics*
B.S.M.E., Purdue, 1933; M.S., Michigan, 1946; P.E., Michigan, 1955.

NOBUNORI OSHIMA (1964) ..... *Research Associate in Physics*
B.S., University of Tokyo, 1944; D. Engr., 1961.

ALEXIS OSTAPENKO (1957, 1965) ..... *Professor of Civil Engineering*
Dipl. Ing., Munich Institute of Technology (Germany), 1951; Sc.D. in C.E., Massachusetts Institute of Technology, 1957.

WILLIAM WALLACE OSWALT, JR. (1956) ..... *Part-time Lecturer in Education*
A.B., Muhlenberg, 1949; Ed.M., Temple, 1950; Ed.D., 1962.

ERIC VAN TINE OTTERVIK (1966) ..... *Project Coordinator, Office of Vice President-Research*
B.S., Carnegie Institute of Technology, 1959; M.A., University of Pittsburgh, 1961; Ph.D., 1966.

ALBERT DEAN OTTO (1965) ..... *Assistant Professor of Mathematics*
B.A., University of Iowa, 1961; M.S., 1962; Ph.D., 1965.

JERZY ANTONI OWCZAREK (1960, 1965) ..... *Professor of Mechanical Engineering*
Dipl. Ing., Polish University College, London, 1950; Ph.D., University of London, 1954.

BRADFORD BRECKENRIDGE OWEN (1945, 1948) ..... *Associate Professor of Biology*
B.A., Williams, 1934; M.A., 1936; Ph.D., Harvard, 1940.

TEKIN OZBEK (1966) ..... *Research in Associate in Mechanics*
Yuh Muh, Technical University of Istanbul, 1951; Ph.D., 1955.

ANTHONY PACKER (1946, 1950) ..... *Assistant Professor of Physical Education, and Assistant to the Director In Charge of Fields*
B.S., St. Lawrence, 1938.

CHESTER ANTHONY PAGE, JR. (1966) ..... *Assistant Executive Secretary, Field Service, Alumni Association*
B.S., Lehigh, 1956.

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*Resigned, June 30, 1966.

ROBERT ROUPEN PANOS (1964) .....*Supervisor of Counseling and Testing*
B.A., Queens College, 1956; M.S., Penn State, 1958.

PAUL C. PARIS (1955, 1965) .....*Professor of Mechanics*
B.S. in Eng. Mech., Michigan, 1953; M.S., Lehigh, 1955; Ph.D., 1962.

BASIL WALDO PARKER (1940, 1954) .....*Professor of Biology*
S.B., Massachusetts Institute of Technology, 1933; A.M., Harvard, 1935; Ph.D., Massachusetts Institute of Technology, 1939.

PRESTON PARR (1949, 1964) .....*Dean of Student Life*
B.S., Lehigh, 1943; M.S., 1944.

CHARLES EDWIN PATTERSON, JR. (1962, 1963) ....*Assistant Professor of Government*
A.B., Emory, 1957; M.A., 1958; Ph.D., University of Illinois, 1963.

FRANK WATERS PAUL (1964) .....*Instructor in Mechanical Engineering*
B.S., Penn State, 1960; M.S., 1964.

ALAN WIGGINS PENSE (1957, 1966) .....*Associate Professor of Metallurgy and Materials Science*
B.S., Cornell, 1957; M.S., Lehigh, 1959; Ph.D., 1962.

ARMAND BENJAMIN PERLMAN .....*Assistant Professor of Mechanics*
B.S., Lehigh, 1961; M.S., Stanford, 1962; Ph.D., Lehigh, 1965.

JOSEPH ANTHONY PERNA (1961) .....*Instructor in Mechanics*
B.S., in E.E., Drexel Institute of Technology, 1944; M.S. in E.E., Pennsylvania, 1946.

JOHN T. PETRAKIS (1966) .....*Instructor in Finance*
B.A., American University, 1953; M.A., 1958.

RICHARD LITTLE PETTENGILL (1965) .....*Cataloger of Social Science Materials*
B.A., Bowdoin College, 1964; M.S., Columbia University, 1965.

WARREN AIKEN PILLSBURY (1962, 1965) .....*Associate Professor of Economics*
A.B., New Hampshire, 1953; Florida State University, 1958; Ph.D., University of Virginia, 1963.

ARTHUR EVERETT PITCHER (1938, 1960) ....*Distinguished Professor of Mathematics, Chairman of the Department of Mathematics and Astronomy;*
A.B., Western Reserve, 1932; A.M., Harvard, 1933; Ph.D., 1935; D.Sc. (Hon.), Western Reserve, 1957.

DAVID HUNTER PITTARD (1965) .....*Assistant Professor of Aerospace Studies*
B.M.E., North Carolina State College, 1957; Captain, U.S.A.F.

LUCILLE H. PLEISS (1961).....*Nurse, University Health Service*
R.N., St. Luke's Hospital School of Nursing, 1949.

JOHN POCZE (1960) .....*Part-time Instructor in Physical Education and Varsity Fencing Coach*

GARY WAYNE POEHLEIN (1965) .....*Assistant Professor of Chemical Engineering*
B.S., Purdue University, 1958; Ph.D., 1966.

*JOSEPH GEORGE POMPONIO (1956, 1961) .....*Associate Director, University Health Service*
B.S., Vermont, 1949; M.D., 1953.

THOMAS M. POWER (1966) .....*Instructor in Economics*
B.A., Lehigh, 1963; M.A., Princeton, 1965.

VELIMIR HELIODOR PRAVDIC (1964, 1966) .....*Research Assistant Professor of Chemistry*
B.Sc., University of Zagreb, 1955; Ph.D., 1959.

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*Resigned December 1, 1966.

EDITH CARROLL PRICE (1965) ..... *Secretary to the President*
B.S., University of Cincinnati, 1937.

HAYDEN NELSON PRITCHARD (1964) ..... *Assistant Professor of Biology*
A.B., Princeton, 1955; M.S., Lehigh, 1960; Ph.D., 1963.

LUIS PUJOL (1964) ..... *Instructor in Mechanical Engineering*
B.M.E., Villanova University, 1962; M.S., Marquette University, 1964.

WILLIAM LEROY QUAY (1963) ..... *Assistant Dean of Student Life*
A.B., Muhlenberg, 1956; M.A., University of Pennsylvania, 1957.

FRANCIS JOSEPH QUIRK (1950, 1953) ..... *Professor and Chairman of the Department of Fine Arts, Curator Permanent Collection, Director of Exhibitions*
Dipl., Rhode Island School of Design, 1929.

SHELDEN HENRY RADIN (1963) ..... *Assistant Professor of Physics*
B.S., Worcester Polytechnic Institute, 1958; M.S., Yale, 1959; Ph.D., 1963.

LINDA KAY RAMBLER (1966) ..... *Cataloger in Humanities*
B.S. in Ed., Millersville State College, 1961; M.S.L.S., Western Reserve University, 1964.

HARRY B. RAMSEY (1963) ..... *Assistant Executive Secretary, Alumni Association*
B.A., Lehigh, 1950.

VARANASI VENKATA SUBBA RAO (1966) ..... *Research Associate, Center for Surface and Coatings Research*
B.S., (Hon.) Audoura University, 1960; M.S., 1961; Ph.D., Poona, 1965.

ROBERT JOHN RAVERA (1964) ..... *Instructor in Mechanics*
B.S., Pratt, 1960; M.S., Lehigh, 1962.

HENRY WILLIAM RAY (1966) ..... *Part-time Lecturer in Education*
B.S., Kent State University, 1947; M.A., Columbia, 1951; Ed.D., 1955.

GERHARD RAYNA (1955, 1965) ..... *Assistant Professor of Mathematics*
A.B., Harvard, 1952; M.A., Princeton, 1953; Ph.D., 1965.

GEORGE EMIL RAYNOR (1931, 1964) ..... *Professor Emeritus of Mathematics*
B.S., Washington, 1918; M.A., Princeton, 1920; Ph.D., 1923.

GEORGIA EMILY RAYNOR (1961, 1964) ..... *Head Cataloger*
A.B., Chatham, 1945; M.A., Lehigh, 1954; M.S. in L.S., Columbia, 1954.

RICHARD JAMES REDD (1958, 1964) ..... *Associate Professor of Fine Arts*
B.Ed., Toledo, 1953; M.F.A., Iowa, 1958.

ESTOY REDDIN (1964) ..... *Assistant Professor of Education*
B.S., University of Pennsylvania, 1932; M.S., 1956; Ed.D., 1964.

*EDWIN WALTER REICHARD (1962) ..... *Assistant Librarian, Reader Services*
B.A., Trinity College, 1957; A.M. in L.S., University of Michigan, 1961.

CLAIR JAMES REILLY (1962) ..... *Instructor in Marketing*
A.B., Pennsylvania State University, 1948; M.A., 1949.

EDWARD FRANKLIN REIS ..... *Part-Time Lecturer in Electrical Engineering*
B.S., Lafayette College, 1956; M.S., Lehigh, 1958.

JOSEPH H. RENO (1947, 1961) ..... *Part-time Physician, University Health Service*
M.D., Temple, 1941.

FREDERICK EUGENE RESSLER (1952, 1964) ..... *Associate Registrar*
B.A., Lehigh, 1952.

RODNEY EARL RESSLER (1947, 1964) ..... *Assistant Registrar*

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*Resigned, July 1, 1966.
*Resigned, January 9, 1967.

JOSEPH BENSON REYNOLDS (1907, 1948).....*Professor Emeritus of Mathematics and Theoretical Mechanics*
B.A., Lehigh, 1907; M.A., 1910; Ph.D., Moravian, 1919.

BURGESS HAROLD RHODES (1960, 1962) .....*Instructor in Mathematics*
S.B., Massachusetts Institute of Technology, 1960; M.S., Lehigh, 1964.

*KAREN EILEEN RICE (1965) .....*Cataloger Humanities*
B.A., Pennsylvania State University, 1964; M.L.S., University of Pittsburgh, 1965.

WALLACE JAMES RICHARDSON (1952, 1959).....*Professor of Industrial Engineering*
B.S., U.S. Naval Academy, 1941; M.S. in I.E., Purdue, 1948; P.E., Delaware, 1956.

PETER JULES RICHETTA (1965, 1966) .....*Assistant Professor in Mathematics*
B.S., Yale, 1957; Ph.D., 1966.

MARTIN L. RICHTER (1965) .....*Assistant Professor of Psychology*
B.A., Rutgers, 1960; Ph.D., University of Indiana, 1965.

*ALBERT AUGUSTUS RIGHTS (1933, 1943) .....*Assistant Professor of English*
A.B., Maine, 1927; A.M., Harvard, 1931.

EDGAR HEISLER RILEY (1926, 1958) .....*Associate Professor Emeritus of English*
A.B., Cornell, 1915; Ph.D., 1925.

ALICE DUFFY RINEHART (1964) .....*Instructor in Education and Coordinator of Educational Placement*
B.A., Smith, 1940; M.A., Lehigh, 1965.

RICHARD ROBERTS (1964) .....*Assistant Professor of Mechanical Engineering*
B.S., Drexel, 1961; M.S., Lehigh, 1962; Ph.D., 1964.

VICTOR SMITH ROBINSON (1965, 1966) .....*Instructor & Research Assistant in Metallurgy and Materials Science*
B.S., Lehigh, 1962; M.S., 1964.

JOEL C. W. ROGERS (1966) .....*Instructor in Mathematics*
B.S., Massachusetts Institute of Technology, 1958.

GEORGE WARREN ROLAND (1961) .....*Research Associate in Geology*
B.Sc., Acadia University, 1961; M.S., Lehigh, 1964; Ph.D., Lehigh, 1966.

DONALD JOSEPH ROMANIK (1965) .....*Instructor in Chemistry*
B.S., Ursinus College, 1965.

EDWARD ROSENBAUM (1966) .....*Associate Professor of Economics*
B.A., Wayne State University, 1950; M.S., University of Wisconsin, 1951; Ph.D., 1954.

JOHN EDWARD ROTH .....*Part-Time Lecturer in Electrical Engineering*
B. S., Bucknell, 1952; M.S., Lehigh, 1963.

WILLIAM HENRY RUCKLE (1963) .....*Assistant Professor of Mathematics*
A.B., Lincoln University, 1960; M.S., Florida State University, 1962; Ph.D., 1963.

ROBERT BENJAMIN RUNK (1966) .....*Assistant Professor of Metallurgy and Materials Science*
B.S., Rutgers University, 1961; Ph.D., Alfred University, 1966.

SYLVIA RUTKOFF (1966) .....*Part-time Lecturer in Education*
B.A., Hunter College, 1940; M.A., Columbia University, 1942.

JOHN DONALD RYAN (1952, 1962) .....*Professor of Geology, Chairman of the Department of Geology*
B.A., Lehigh, 1943; M.S., 1948; Ph.D., Johns Hopkins, 1952.

IVAN JEROME SACKS (1962, 1964) .....*Instructor in Electrical Engineering*
B.S., Lehigh, 1962; M.S., 1964.

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*Resigned, August 29, 1966.
*Deceased, June 23, 1966.

PERCY LEE SADLER (1946, 1962) .....*Professor Emeritus of Physical Education*
Brig. Gen., Inf., U.S.A. (Ret.)

NORMAN HAROLD SAM (1962, 1964) .....*Associate Professor of Education, Director of Summer Sessions.*
B.S., Pittsburgh, 1951; M.Ed., 1955; Ed.D., 1962.

SAMPSON LEE SANDERS (1965) .....*Instructor in Physical Education, Assistant Varsity Football Coach and Head Varsity Track Coach*
B.Ed., University of Buffalo, 1960.

RAYMOND BURKETT SAWYER (1946, 1964) .....*Associate Professor Emeritus of Physics*
Ph.B., Ripon, 1921; M.S., Wisconsin, 1925; Ph.D., Chicago, 1930.

*EDWARD CHARLES SCANLAN (1961, 1964) .....*Associate Professor of Education, Director, Division of Counselor Education, School of Education*
B.A., Buffalo, 1954; Ed.M., Harvard, 1958; Ed.D., 1961.

WILLIAM DWIGHT SCHAEFFER (1956, 1966) .....*Acting Associate Director, Coatings, Center for Surface and Coatings Research*
B.S., Lehigh, 1943; M.S., 1947.

STEPHEN ALAN SCHAFER (1966) .....*Part-time Lecturer in Education*
B.A., University of Delaware, 1949; M.H.L., Hebrew Union College, 1955.

MURRAY SCHECHTER (1963, 1964) .....*Assistant Professor of Mathematics*
A.B., Brooklyn College, 1957; M.A., New York University, 1959; Ph.D., 1964.

*WILLIAM EDWARD SCHIESSER (1960, 1963) .....*Associate Professor of Chemical Engineering*
B.S., Lehigh, 1955; M.A., Princeton, 1958; Ph.D., 1960.

DONALD WALTER SCHMOYER (1946, 1962) .....*Assistant Treasurer*
B.S. in Bus. Adm., Lehigh, 1944.

ERNEST BERNHARD SCHULZ (1927, 1965) ....*Professor Emeritus of Political Science*
B.S., Michigan, 1920; M.A., 1921; Ph.D., 1927.

STANLEY ROBERT SCHULTZ (1966) .....*Instructor in Physical Education, Assistant Trainer, Assistant Basketball Coach & Varsity Baseball Coach*
B.A., Trenton State College, 1964.

ELI SCHWARTZ (1954, 1962) .....*Professor of Economics*
B.S., Denver, 1943; M.A., Connecticut, 1948; Ph.D., Brown, 1952.

CHARLES AUGUSTUS SEIDLE (1948, 1962) .....*Vice-President—Administration*
B.A., Pittsburgh, 1931; M.A., Columbia, 1936; Ed.D., 1948.

EDITH AMANDA SEIFERT (1923, 1960).....*Bursar*

*JONATHAN BURKE SEVERS (1933, 1951) .....*Distinguished Professor of English, Chairman of the Department of English*
A.B., Rutgers, 1925; A.M., Princeton, 1927; Ph.D., Yale, 1935; F.R.S.A., 1962.

MARGARET MELCHIOR SEYLAR (1966) .....*Part-time Lecturer in Education*
B.S., Kutztown State College, 1945; M.A., Lehigh, 1956.

WILLIAM GERALD SHADE (1966) .....*Instructor in History*
A.B., Brown University, 1961; M.A., 1962.

RUSSELL ALLEN SHAFFER (1964) .....*Assistant Professor of Physics*
B.S., Drexel Institute of Technology, 1956; Ph.D., Johns Hopkins, 1962.

*JAMAL KHALIL SHAHIN (1960, 1965) .....*Assistant Professor of Mathematics*
A.B., California, 1960; M.S., Lehigh, 1962; Ph.D., 1965.

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*Resigned, June 30, 1966.
*On leave, 1966-1967.
*Resigned, June 30, 1966.

KEITH DOUGLAS SHEFFLER (1963, 1966) .....*Instructor in Metallurgy and Materials Science*
B.S., Lehigh, 1963; M.S., Lehigh, 1964.

CHING SHENG SHEN (1964) .....*Assistant Professor of Economics*
B.A., Yen-Ching University, 1941; M.A., Boston University, 1951; Ph.D., University of North Carolina, 1957.

ROGER LONIS SHERMAN (1965) .....*Instructor in Physical Education, Assistant Varsity Football Coach and Varsity Lacrosse Coach*
B.A., Muskingum College, 1961.

RAYMOND SHETTEL (1963) .....*Lecturer in Psychology*
B.S., Dickinson, 1933; M.D., Hahnemann, 1938.

SHUANG YUAN SHIEH (1965) .....*Assistant Professor of Physics*
B.S., National Taiwan University, 1957; Ph.D. University of Maryland, 1965.

HAROLD EDWIN SHIMER (1966) .....*Assistant to Accountant*
B.S., Moravian, 1950.

*CLARENCE ALBERT SHOOK (1930, 1964) .....*Professor Emeritus of Mathematics*
A.B., Western Reserve, 1916; A.M., Harvard, 1918; Ph.D., Johns Hopkins, 1923.

PAUL EDWARD SHORT (1938, 1946).....*Assistant Professor of Physical Education, Assistant Director and Business Manager of Athletics*
B.S. in Bus. Adm., Lehigh, 1934.

ROBERT PETER SHURTLEFF (1963, 1966) .....*Assistant Dean of Residence*
B.A., Lehigh, 1955; M.Ed., 1964.

WILLIAM JOSEPH SIBLEY (1964) .....*Counselor in Placement and Counseling*
B.S. in Ed., East Stroudsburg State College, 1955; M.Ed., Lehigh, 1964.

GEORGE C. M. SIH (1958, 1965) .....*Professor of Mechanics*
B.S. in M.E., Portland, 1953; M.S. in M.E., New York, 1957; Ph.D., Lehigh, 1960.

DALE RODEKOHR SIMPSON (1960, 1966) .....*Professor of Geology, Chairman of the Comprehensive Honors Program*
B.S., Pennsylvania State, 1956; M.S., California Institute of Technology, 1958; Ph.D., 1960.

ROGER GEORGE SLUTTER (1961, 1966) .....*Assistant Professor of Civil Engineering; Engineer of Tests, Fritz Engineering Laboratory*
B.S. in C.E., Lehigh, 1953; M.S. in C.E., 1956; Ph.D., 1966.

EARL KENNETH SMILEY (1934, 1964) .....*Vice-President Emeritus*
A.B., Bowdoin, 1921; M.A., Lehigh, 1935; L.H.D. (Hon.), Moravian, 1947; LL.D. (Hon.), Waynesburg, 1952.

GEORGE LEONARD SMITH, JR. (1959) .....*Instructor in Industrial Engineering*
B.S., Pennsylvania State, 1957; M.S., Lehigh, 1959; P.E., Pennsylvania, 1964.

GERALD F. SMITH (1965) .....*Professor of Mechanics*
B.S., University of Buffalo, 1952; Ph.D., Brown, 1956.

JAMES THOMAS SMITH (1965, 1966) .....*Instructor in Metallurgy and Materials Science*
B.S., Cornell University, 1961; M.S., 1962.

WESLEY RICHARD SMITH (1958, 1962) .....*Associate Professor of Physics*
B.S. in E.P., Lehigh, 1950; M.S., 1951; Ph.D., Princeton, 1957.

WILLIAM ADAMS SMITH, JR. (1955, 1962) .....*Associate Professor of Industrial Engineering, Director of the Computer Laboratory*
B.S., U.S. Naval Academy, 1951; M.S., Lehigh, 1957; Ph.D., New York University, 1966; P.E., Pennsylvania, 1959.

OLES M. SMOLANSKY (1963, 1966) .....*Associate Professor of International Relations*
A.B., New York University, 1953; A.M., Columbia, 1955; Ph.D., 1959.

*Deceased, December 28, 1966.

JUDSON GRAY SMULL (1919, 1950).....*Associate Professor Emeritus of Chemistry*
B.S. in Chem., Lehigh, 1906; M.S., 1921.

MAX DONALD SNIDER (1946, 1963) .....*Associate Professor of Marketing, Assistant to the Dean of the College of Business Administration*
B.S., Illinois, 1936; M.S., 1937; M.B.A., Stanford, 1941.

MICHAEL PETER SOLTYS (1965) .....*Assistant Director of Placement*
B.S., East Stroudsburg State College, 1955; M.A., Lehigh, 1959.

WILBER DEVILLA BERNHART SPATZ (1946, 1954).....*Associate Professor of Physics*
B.S., Lafayette, 1930; M.S., Purdue, 1934; Ph.D., New York, 1943.

FRANCIS X. SPLANE (1966) .....*Instructor in Economics*
B.A., University of Delaware, 1963; M.A., 1966.

ROBERT STEACY SPRAGUE (1957, 1966) .....*Professor of Chemistry*
B.S., Washington and Jefferson, 1943; Ph.D., Illinois, 1949.

RICHARD MOORE SPRIGGS (1964) .....*Associate Professor of Metallurgy and Materials Science; Associate Director, Materials Research Center*
B.S., Penn State University, 1952; M.S., University of Illinois, 1956; Ph.D., 1958.

JOHN STOHLER STECKBECK (1962) .....*Assistant Professor of Physical Education, Assistant Director of Physical Education and Intramurals*
B.S. in Phys. Ed., West Chester State, 1936; M.S. in Phys. Ed., Pennsylvania, 1951.

FRED P. STEIN (1963, 1966) .....*Associate Professor of Chemical Engineering*
B.S., Lehigh, 1956; M.S.E., University of Michigan, 1957; Ph.D., 1960.

GILBERT ALLAN STENGLE (1960, 1965) .....*Associate Professor of Mathematics*
B.E.P., Cornell, 1954; M.S., Wisconsin, 1957; Ph.D., 1961.

ALAN HUGH STENNING (1965) .....*Professor of Mechanical Engineering*
B.Sc., Glasgow University, 1950; M.S., Masachusetts Institute of Technology, 1951; Sc.D., 1955.

GATES BARNET STERN (1965) .....*Professor of Military Science*
B.A., Lehigh, 1936, Colonel, U.S.A.

JOHN A. STOOPS (1959, 1966) .....*Professor of Education, Dean of the School of Education*
B.S., California State College, 1948; M.S., University of Pennsylvania, 1949; Ed.D., 1960.

ROBERT DANIEL STOUT (1939, 1960) .....*Professor of Metallurgy and Materials Science, Dean of the Graduate School*
B.S., Pennsylvania State, 1935; M.S., Lehigh, 1941; Ph.D., 1944; P.E., Pennsylvania, 1946.

CARL FERDINAND STRAUCH (1934, 1953).....*Professor of English*
A.B., Muhlenberg, 1930; M.A., Lehigh, 1934; Ph.D., Yale, 1946.

OTTIS STRONG (1966) .....*Assistant in Military Science*
Staff Sergeant, U. S. Army

MILTON CALEB STUART (1926, 1952).....*Professor Emeritus of Mechanical Engineering*
B.S. in M.E., Pennsylvania, 1909; M.E., 1924.

JAMES EDWARD STURM (1956, 1962) .....*Associate Professor of Chemistry*
B.A., St. John's (Minnesota), 1951; Ph.D., Notre Dame, 1957.

ROBERT JOSEPH SULLIVAN (1962) .....*Associate Professor of Journalism*
B.A., Syracuse, 1947; M.A., 1951.

RUTH Y. SUPER (1960).....*Assistant to the Dean, Graduate School*

WILLIAM HUMPHREY SUTCLIFFE (1964) .....*Research Associate Professor of Biology and Director of Marine Science Center*
B.A., Emory, 1945; M.A., Duke, 1947; Ph.D., 1950.

JOHN FRANCIS SZWED (1965) .....*Assistant Professor of Cultural Anthropology*
B.S., Marietta College, 1958; B.S., Ohio State University, 1959; M.A., 1960; Ph.D., 1965.

DONALD LEE TALHELM (1960).....*Instructor in Electrical Engineering*
B.S. in E.E., Lehigh, 1959; M.S. in E.E., 1960.

LAMBERT TALL (1955, 1966) .....*Associate Professor of Civil Engineering*
B.E., Sydney (Australia), 1954; M.S., Lehigh, 1957; Ph.D., 1961.

STEPHEN KENNETH TARBY (1961) .....*Assistant Professor of Metallurgy and Materials Science*
B.S., Carnegie Institute of Technology, 1956; M.S., 1958; Ph.D., 1962.

MERLE W. TATE (1965) .....*Professor of Education*
A.B., Central Wesleyan, 1926; M.A., University of Montana, 1943; Ed.M., Harvard University, 1946; Ed.D., 1947.

RICHARD NORMAN TAUBER (1966) .....*Assistant Professor of Metallurgy and Materials Science*
B. Met. E., New York University, College of Engineering, 1961; M.S., 1964; Ph.D., 1966.

DOUGLAS HENLEY TAYLOR (1964, 1965) .....*Assistant Professor of Mathematics*
B.S., University of Cincinnati, 1959; M.S., University of Illinois, 1961; Ph.D., 1965.

IVAN JACKSON TAYLOR (1953) ....*Instruments Associate, Fritz Engineering Laboratory*

ROBERT SAXON TAYLOR (1950, 1963) .....*Associate Professor and Chairman, Division of Information Sciences; Associate Librarian*
B.A., Cornell, 1940; M.S. in L.S., Columbia, 1950; M.A., Lehigh, 1954.

ROBERT SAYRE TAYLOR, JR. (1950).....*Legal Counsel*
B.A., Lehigh, 1925; LL.B., Pennsylvania, 1928.

EVERETT ANDERSON TEAL (1945).....*Director of Placement and Counseling*
B.S., Ball State Teachers, 1932; M.A., Columbia, 1941.

*JOSEPH TENO (1952, 1964) .....*Professor of Electrical Engineering*
B.S. in E.E., Lehigh, 1951; M.S. in E.E., 1952; Ph.D., 1960.

BLOSSOM WEISS TEPPER (1964) .....*Instructor in Education*
B.A., Brooklyn College, 1942; M.Ed., Lehigh, 1962.

THEODORE ALFRED TERRY (1951, 1955) .....*Assistant Professor of Mechanical Engineering*
B.S., Drexel Institute of Technology, 1950; M.S., Lehigh, 1951; Ph.D., 1963; P.E., Pennsylvania, 1957.

RICHARD MARTIN THODEN, JR. (1965) .....*Assistant Professor of Aerospace Studies*
B.S., St. Joseph's College, 1954; Captain, U.S.A.F.

HAROLD PRESCOTT THOMAS (1932, 1962) .....*Professor Emeritus of Education*
B.S., Colgate, 1920; Ed.M., Harvard, 1925; Ed.D., 1932.

CHARLES LEON TIPTON (1964) .....*Assistant Professor of History*
B.A., University of Southern California, 1958; M.A., 1961; Ph.D., 1964.

DORIS MAE TRANSUE .....*Nurse, University Health Service*
R.N., St. Luke's Hospital, 1947.

FRANCIS JOHN TREMBLEY (1928, 1949) .....*Professor of Ecology*
B.S., Hobart, 1928; M.S., Lehigh, 1931; Ph.D., Pennsylvania, 1934; D.Sc. Hobart, 1964.

JOHN SCHRADER TREMPER (1939, 1955) .....*Associate Professor of German*
A.B., Colgate, 1928; M.A., Cornell, 1932; Ph.D., 1938.

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*Resigned, June 30, 1966.

ROCCO JOHN TRESOLINI (1949, 1958) ..... *Professor of Political Science, Chairman of the Department of Government*
A.B., Hartwick, 1942; M.A., Syracuse, 1947; Ph.D., 1949.

SEYMOUR TRESTER (1966) ..... *Assistant Professor of Physics*
B.S., Brooklyn College, 1957; M.A., Columbia University, 1960; Ph.D., New York University, 1964.

L. REED TRIPP (1964) ..... *Dean of the College of Business Administration, Frank L. Magee Professor of Business Administration*
B.A., Union College, 1934; Ph.D., Yale, 1942.

WENDELL PIGGOTT TRUMBULL (1957, 1958) ..... *Professor of Accounting, Chairman of the Department of Accounting*
B.S., Illinois, 1937; M.A., Michigan, 1941; Ph.D., 1954; C.P.A., Mississippi, 1949.

DAVID TRUTT (1965) ..... *Assistant Professor of Mathematics*
B.S., Lafayette, 1959; M.S., Brown, 1962; Ph.D., Purdue University, 1964.

EFRAIM TURBAN (1966) ..... *Assistant Professor in Management Science*
B.S., Technion-Israel Institute of Technology, 1953; M.B.A., University of Berkeley (California), 1962; Ph.D., 1966.

JOHN HARMS UBBEN (1960, 1961) ..... *Associate Professor of German and Acting Chairman, Department of German*
A.B., Central College (Iowa), 1936; M.A., Kentucky, 1937; Ph.D., Chicago, 1942.

S. HERBERT UNTERBERGER (1965) ..... *Visiting Professor in Economics*
B.S., University of Pennsylvania, 1934; M.A., 1935; Ph.D., 1960.

DEAN UPDIKE (1965) ..... *Assistant Professor of Mechanics*
B.S., Princeton, 1957; M.S., New York University, 1960; Ph.D., Brown, 1964.

JOHN MATTHEW VALENTIC (1966) ..... *Instructor in Physical Education, Freshman Wrestling Coach, Varsity Cross Country Coach, & Assistant Track Coach*
B.E., University of Buffalo, 1963.

VICTOR MANUEL VALENZUELA (1957) ..... *Associate Professor of Romance Languages*
B.A., San Francisco State, 1951; M.A., Columbia, 1952; Ph.D., 1965.

RALPH NEWCOMB VAN ARNAM (1928, 1961) ..... *Associate Professor of Mathematics and Astronomy*
E.E., Cornell, 1926; M.S., 1927.

JOHN ANDREWS VAN EERDE (1960, 1963) ..... *Professor of Romance Languages*
A.B., Harvard, 1938; M.A., 1939; Ph.D., Johns Hopkins, 1953.

DAVID ALAN VANHORN (1962, 1966) ..... *Professor of Civil Engineering*
B.S., Iowa State University, 1951; M.S., 1956; Ph.D., 1959; P.E., Iowa, 1957.

WESLEY JOHNSON VAN SCIVER (1962, 1965) ..... *Professor of Physics*
B.S., Massachusetts Institute of Technology, 1940; Ph.D., Stanford, 1954.

JEANNETTE VEATCH (1964) ..... *Part-time Lecturer in Education*
B.A., Western Michigan University, 1936; M.A., New York University, 1947; Ph.D., 1953.

JOSEPH JEROME VEILLEUX (1966) ..... *Assistant in Aerospace Studies*
Technical Sergeant, U.S.A.F.

JACQUELINE IRENE VERBA (1958) ..... *Laboratory and X-Ray Technician, University Health Service*
Eastern School for Physicians' Aides.

THOMAS JOSEPH VERBONITZ (1966) ..... *Assistant, Office of Research Administration*
B.S., Lehigh, 1958; M.B.A., 1960.

CHARLES JOSEPH VERSACCI (1958, 1965) ..... *Assistant Professor of Education and Supervisor of Reading and Study Clinic*
A.B., Lafayette College, 1954; M.A., Lehigh, 1959; Ed.D., Temple University, 1966.

JOHN F. VICKREY (1961).....*Assistant Professor of English*
Ph.B., Chicago, 1949; A.M., 1952; Ph.D., Indiana, 1960.

EDWIN MARTIN WAGENER (1966) .....*Assistant Professor of Aerospace Studies*
B.G.E., University of Omaha, 1965; Major, U.S.A.F.

JAMES HAROLD WAGNER (1949, 1951) .....*Registrar*
B.A., Gettysburg, 1947; M.A., Pennsylvania, 1950.

ELVIN GALEN WARFEL (1966) .....*Assistant Professor of Education*
B.S., Shippensburg State College, 1950; M.Ed., Pennsylvania State, 1958.

JOHN LOREN WASHBURN (1965) .....*Instructor in Government*
A.B., Park College, 1962; M.A., Duke, 1965.

*RICHARD GLENN WARNOCK (1960) .....*Assistant Professor of Mechanics*
B.S.C.E., Illinois, 1950; M.S., Iowa, 1952; Ph.D., 1964.

EDMOND ARTHUR WATTERS, III (1964) .....*Assistant Director of Admission*
B.A., Lehigh, 1961; M.A., 1966.

JOHN HENRY WEBER, JR. (1966) .....*Instructor in Metallurgy and Materials Science*
B.S., Lehigh, 1963; M.S., 1966.

ROBERT PEH-YING WEI (1966) .....*Research Associate Professor of Mechanics*
B.S., Princeton, 1953; M.S., 1954; Ph.D., 1960.

ANDREW R. WEINTRAUB (1966) .....*Assistant Professor of Economics*
B.A., Rutgers University, 1961; M.A., 1964; Ph.D., 1966.

LEONARD ANDREW WENZEL (1951, 1962) .....*Professor and Chairman of the Department of Chemical Engineering*
B.S., Pennsylvania State, 1943; M.S., Michigan, 1948; Ph.D., 1950; P.E., Pennsylvania, 1958.

KARL LEROY WERKHEISER (1950, 1962) .....*Accountant*
B.S., Rider, 1950.

DONALD BINGHAM WHEELER, JR. (1947, 1957).....*Associate Professor of Physics*
B.S. in Engr. Phys., Lehigh, 1938; Ph.D., California Institute of Technology, 1947.

LAWRENCE WHITCOMB (1930, 1965) .....*Associate Professor Emeritus of Geology*
Ph.B., Brown, 1922; A.M., Princeton, 1928; Ph.D., 1930.

GARY E. WHITEHOUSE (1965) .....*Assistant Professor of Industrial Engineering*
B.S., Lehigh, 1960; M.S., 1962; Ph.D., Arizona State University, 1966.

ALBERT WILANSKY (1948, 1957) .....*Professor of Mathematics*
B.A., Dalhousie (Canada), 1941; B.S., 1942; Ph.D., Brown, 1947.

BRADFORD WILLARD (1939, 1959).....*Professor Emeritus of Geology*
B.A., Lehigh, 1921; A.M., Harvard, 1922; Ph.D., 1923.

*STEPHEN WILLARD (1965) .....*Assistant Professor of Mathematics*
B.A., University of Rochester, 1962; M.A., 1964; Ph.D. 1965.

ROBERT CLIFFORD WILLIAMSON (1963, 1964) .....*Professor of Sociology, Chairman of the Department of Social Relations*
B.A., University of California (Los Angeles), 1938; M.A., 1940; Ph.D., University of Southern California, 1951.

KEVIN F. WINCH (1963) .....*Instructor in Economics*
B.A., Wisconsin, 1958; M.A., Michigan State, 1960.

FRANKLIN EVERETT WITHROW, JR. (1966) .....*Instructor in Civil Engineering*
B.S., University of Oklahoma, 1958; M.S., 1961.

KENNETH E. WOLF (1966) .....*Visiting Lecturer in Biology*
B.S., Utah State, 1951; M.S., 1951; Ph.D., 1956.

*Resigned July 30, 1966.
*Resigned, June 30, 1966.

JOHN DUDLEY WOOD (1960, 1965) ..... *Associate Professor of Metallurgy and Materials Science*
B.S., Case Institute of Technology, 1953; M.S., Lehigh, 1959; Ph.D., 1962.

*RALPH CHARLES WOOD (1958, 1961) ..... *Professor Emeritus of German*
B.A. and B.E., Cincinnati, 1928; M.A., 1930; Ph.D., Cornell, 1933.

JOSEPH WHRITENOUR (1965) ..... *Assistant Director of Public Information*

FRANCIS JOSEPH WUEST (1961, 1965) ..... *Professor and Chairman of the Department of Psychology*
B.A., LaSalle College, 1951; M.A., Fordham, 1953; Ph.D., Brown, 1961.

WILLARD ROSS YATES (1955, 1963) ..... *Professor of Government, Dean of the College of Arts and Science*
B.A., Oregon, 1948; M.A., 1949; Ph.D., Yale, 1956.

BUNG-TSENG YEN (1957, 1964) ..... *Assistant Professor of Civil Engineering*
B.S., National Taiwan, 1955; M.S., Lehigh, 1959; Ph.D., 1963.

KOICHIRO YOSHIDA (1966) ..... *Post-Doctoral Research Associate in Civil Engineering*
B.S., University of Tokyo, 1961; M.S., 1963; Ph.D., 1966.

THOMAS EDWIN YOUNG (1958, 1966) ..... *Professor of Chemistry*
B.S., Lehigh, 1949; M.S., 1950; Ph.D., Illinois, 1952.

CHING-KUO YU (1962, 1967) ..... *Instructor in Civil Engineering*
B.S., Taiwan Cheng-Kung University, 1960; M.S., Lehigh, 1964.

*JOSEPH ANDREW YURA (1961, 1965) ..... *Research Assistant Professor of Civil Engineering*
B.S.C.E., Duke, 1959; M.S. in C.E., Cornell, 1961.

BARBARA LYNNE ZABOR (1965) ..... *Acquisitions Librarian*
A.B., University of Michigan, 1963; A.M.L.S., 1965.

ALBERT CHARLES ZETTLEMOYER (1941, 1966) ..... *Vice President — Research, Distinguished Professor of Chemistry; Director, Center for Surface and Coatings Research*
B.S. in Ch.E., Lehigh, 1936; M.S., 1938; Ph.D., Massachusetts Institute of Technology, 1941; D.Sc., Clarkson, 1965.

ZEEV ZIMERMAN (1966) ..... *Instructor & Research Assistant in Metallurgy and Materials Science*
B.Sc., Technion, Israel Institute of Technology, 1962; M.S., 1964.

CHARLES KELLER ZUG (1961) ..... *Advisor on Bequests, Trusts, and Insurance*
B.S. in I.E., Lehigh, 1927; B.S. in E.E., 1927.

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*Retired, January 31, 1967.
*Resigned, July 30, 1966.

## GRADUATE, RESEARCH AND TEACHING ASSISTANTS

RONALD NEIL ALLAN (1965) .....*Research Assistant in Civil Engineering*
B.S., Newark College of Engineering, 1965.

THOMAS AMMIRATI (1962) .....*Graduate Assistant in Physics*
B.S., Brooklyn Polytechnic Institute, 1962; M.S., Lehigh, 1964.

RONALD RAY ANDERSON (1966) .....*Rsearch Assistant in Information Sciences*
B.S., Iowa State University, 1963.

PETER HARWOOD ANSELMO (1966) .....*Graduate Assistant in Counseling & Testing*
B.S., Lehigh, 1966.

JAMES OLIVER ARMACOST, III (1966) .....*Research Assistant in Civil Engineering*
B.E., Vanderbilt University, 1966.

MAURICIO ASTORGA (1965) .....*Teaching Assistant in Chemical Engineering*
B.S.E., Catholic University, 1965.

LYDER ATTERAAS (1965) .....*Research Assistant in Metallurgy and Materials Science*
B.A.Sc., 1960; M.A.Sc. 1961, University of Toronto.

BOAZ AVITZUR (1965) .....*Research Assistant in Metallurgy and Materials Science*
B.Sc., Israeli Institute of Technology, 1953; B.S., University of Michigan, 1961; M.S., 1963.

DAVID ROBINSON BASSETT (1961) .....*Research Assistant in Chemistry*
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ROBERT L. BATEMAN, JR. (1965) .....*Graduate Assistant in Physics*
A.B., Ursinus, 1965.

DENNIS WILLARD BAUM (1963) .....*Research Assistant in Physics*
B.S., Muhlenberg, 1962; M.S., Lehigh, 1964.

DONALD RICHARDSON BECK (1962) .....*Research Assistant in Physics*
B.S., Dickinson College, 1962; M.S., Lehigh, 1964.

ANNE BEIDLER (1965) .....*Research Assistant in Education*
A.B., Earlham College, 1962; M.A., Lehigh, 1966.

PETER BEIDLER (1965) .....*Graduate Assistant in English*
B.A., Earlham College, 1962; M.A., Lehigh, 1965.

MARCEL BERLET (1966) .....*Graduate Assistant in French*
B.Ph., Lycee de Rennes, 1958; Certificat d'étude, Beaux Arts Rennes 1960.

ROBERT ERNEST BERTONE (1966) .....*Graduate Assistant in English*
B.S., Boston College, 1962; M.A., 1964.

VAHRAM BIRICIKOGLU (1966) .....*Research Assistant in Mechanics*
Dipl. Ing. Istanbul Technical University, 1963.

FREDERICK CARL BLECK (1965) .....*Research Assistant in Psychology*
B.S., Michigan State University, 1962; M.S., Lehigh, 1964.

THEODORE WILLIAM BOSSERT (1965) .....*Research Assistant in Civil Engineering*
B.S., Lehigh, 1965.

WILLIAM HENRY BOYD (1966) .....*Research Assistant in Chemistry*
B.A., Rutgers, 1966.

SIHAM CHUCRI BRAIDI (1966) .....*Graduate Assistant in Mathematics*
B.S., American University of Beirut, 1964; M.S., 1966.

JOHN ANTHONY BRESLIN (1964) ..... *Research Assistant in Physics*
B.S., St. Joseph's College, 1964; M.S. Lehigh, 1966.

CHARLES EDWARD BREWER (1966) ..... *Teaching Assistant in Civil Engineering*
B.S., The Citadel, 1966.

LAURENCE MICHAEL BRICKMAN (1966) ..... *Graduate Teaching Assistant in Biology*
B.A., Lehigh University, 1966.

DAVID WALTER BROADFOOT (1965) ..... *Graduate Teaching Assistant in Biology*
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DUDLEY CHAMBERLAIN BROWN (1962) ..... *Graduate Assistant in English*
B.A., Marietta College, 1962.

ANGELES VILLARINO BUAN (1965) ..... *Research Assistant in Chemistry*
B.S.Ch.E. Mapua Institute of Technology, 1959.

BARBARA JOAN BYRD (1966) ..... *Graduate Assistant in Physics*
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EDUARDO CALABRESE (1966) ..... *Research Assistant in Physics*
Dottore in Fisica, University of Messina, 1966.

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B.S., Penn State University, 1952; M.S., Bradley University, 1958.

PETER CHANDONNET (1965) ..... *Graduate Assistant in Economics*
B.S., Lehigh, 1958.

CHIANG-SHUEI CHENG (1965) ..... *Research Assistant in Physics*
B.S., National Taiwan University, 1958; M.S., National Tsing Hua University, 1960.

CHINGMIIN CHERN (1966) ..... *Research Assistant in Civil Engineering*
B.S., National Taiwan University, 1961; M.S., North Dakota State University, 1966.

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EDWARD JAMES CODY (1965) ..... *Graduate Assistant in History*
B.S., St. Peter's College, 1965.

ROBERT FRANCIS COOK (1965) ..... *Graduate Assistant in Economics*
B.S., University of Maryland, 1965.

DAVID MICHAEL COREY (1966) ..... *Graduate Assistant in English*
A.B., Brooklyn College, 1966.

PAUL BRUCE CORKUM (1965) ..... *Graduate Assistant in Physics*
B.S., Acadia University, 1965.

RONALD K. CORMICK (1966) ..... *Graduate Trainee in Geology*
B.Sc., Univ. of British Columbia, 1965.

DAVID VERNARD COSSEY (1966) ..... *Graduate Assistant in Mathematics*
B.A., King's College, 1966.

ELIZABETH ANN COTÉ (1966) ..... *Graduate Assistant in English*
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BRUCE CHARLES COULL (1965) .....*Graduate Research Assistant in Marine Biology*
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STEPHEN HAROLD COWEN (1965) .....*Research Assistant in Civil Engineering*
B.S., University of Vermont, 1965.

WILLIAM AUGUSTIN CRANSTON (1965) .....*Research Assistant in Civil Engineering*
B.E., Manhattan College, 1965.

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JOHN HARTLEY DANIELS (1964) .....*Research Assistant in Civil Engineering*
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LAWRENCE JOHN DAVIS (1966) .....*Research Assistant in Chemical Engineering*
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JAMES RICHARD DIMITRI (1966) .....*Research Assistant in Civil Engineering*
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LESLIE ROBERT DOLE (1966) .....*Research Assistant in Chemistry*
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GEORGE DUDASCIK (1966) .....*Graduate Assistant in Physics*
B.S., Wilkes College, 1966.

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A.B., Boston College, 1965.

JOSEPH A. DYGAS (1966) .....*Graduate Assistant in Geology*
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ABRAHAM BAGOT EASTWOOD, III (1966) .....*Graduate Research Assistant in Biology*
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SHELDON MERVEN EISENBERG (1966) ..... *Graduate Assistant in Mathematics*
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SHU-JIN FANG (1966) ..... *Research Assistant in Civil Engineering*
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CARL FRANCIS KOWALSKI (1966) ..... *Graduate Assistant in English*
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GEOFFREY LUTHER KULAK (1964) ..... *Research Assistant in Civil Engineering*
B.Sc., University of Alberta (Canada), 1958; M.S., University of Illinois, 1961.

HARRY JOSEPH KYLER (1965) ..... *Bioelectric Laboratory Research Assistant*
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JAMES HONYIN LEE (1966) .....*Research Assistant in Civil Engineering*
B.S., Ohio University, 1966.

RUEY-SHUANG LEE (1966) .....*Research Assistant in Information Sciences*
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B.S., University of Massachusetts, 1963; M.S., Stanford, 1964.

GARY LEWIS (1966) .....*Graduate Assistant in Mechanics*
B.S., Lehigh, 1966.

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MERIN LEE LEVY (1966) .....*Research Assistant in Psychology*
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CHENG-SHUNG LIN (1966) .....*Research Assistant in Civil Engineering*
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B.S., London University, 1966.

STEPHEN ANTHONY LONGO (1965) .....*Graduate Assistant in Physics*
B.A., LaSalle College, 1965.

MICHAEL L. LOSEE (1963) .....*Graduate Assistant in Chemistry*
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B.S., Queen's University (Ontario), 1966.

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STEPHEN ANTHONY MACK (1965) .....*Graduate Assistant in Physics*
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L. JOSEPH MALE (1965) .....*Teaching Assistant in Chemistry*
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Perc., Sir Theagaraya (India), 1956; B.E., PSG College of Tech. (India), 1962.

LORNA ANN JAYNE MAURIZ (1966) .....*Laboratory School Assistant in Education*
B.S., Moravian College, 1966.

RICHARD KENNETH MCFALLS (1965) .....*Research Assistant in Civil Engineering*
B.S., Drexel Institute of Technology, 1965.

JOHN FRANCIS MCHUGH (1966) ..... *Graduate Assistant in Education*
B.S., Kutztown State College, 1952; M.A., Lehigh, 1956.

GREGORY J. MCMANEMIN (1965) ..... *Teaching Assistant in Chemistry*
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CHARLES JOSEPH MESSA (1965) ..... *Graduate Assistant in Chemical Engineering*
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WILLIAM METLAY (1964) ..... *Research Assistant in Psychology*
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B.S., University of Pennsylvania, 1961.

PRATAP NARAIN MISRA (1965) ..... *Graduate Assistant in Mechanical Engineering*
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B.A., Lycoming College, 1961; M.A., Lehigh, 1964.

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Engineering Diploma, University of Tehran, 1963; M.S., University of Illinois, 1966.

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TIMOTHY LING-SUNG NEE (1962) ..... *Research Assistant in Physics*
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B.S., Montclair State College, 1958; M.A., 1962.

THOMAS PATRICK NOLAN (1964) ..... *Graduate Assistant in Physics*
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B.S., Osaka University, 1960.

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B.A., Haile Selassie University (Ethiopia), 1966.

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B.S., Johns Hopkins, 1966.

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Ingenieur in M.E., Staatl (Germany), 1964.

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CHARLES CHUN-SHU TSENG (1966) .....*Graduate Assistant in Mechanics*
B.S., Taipei Institute of Technology, 1958; M.S., Northwestern University, 1963.

THOMAS PATRICK VADASZ (1965) .....*Graduate Assistant in History*
B.A., Moravian College, 1965.

PETER DAVIES VAN DYKE (1963) .....*Research Assistant in Physics*
B.S., Lehigh, 1963; M.S., 1965.

PHILIP KAREL VAN ITALLIE (1966) .....*Graduate Assistant in Physics*
B.S., Drexel Institute of Technology, 1965.

JOSEPH FRANCIS VOJTA (1965) .....*Research Assistant in Civil Engineering*
B.S.C.E., Illinois Institute of Technology, 1965.

ERICO FRANCISCO JAVIER VON EUW (1966) .....*Research Assistant in Mechanical Engineering*
B.S., Cooper Union College, 1966.

JOHN WAYNE WAGENER (1966) .....*Graduate Assistant in Psychology*
B.A., Johns Hopkins University, 1965.

WILLIAM GARY WATSON (1965) .....*Research Assistant in Metallurgy and Materials Science*
B.S., State University of New York at Stonybrook, 1965.

JAMES HARLEY WESTON (1962) .....*Graduate Assistant in Mathematics*
B.Sc., McMaster University, 1962; M.S., Lehigh, 1964.

GRAHAM WHITE (1966) .....*Graduate Assistant in Industrial Engineering*
B.S., Lehigh, 1966.

LAWRENCE WHITE (1965) ..... *Graduate Assistant in Computer Laboratory*
B.S., Lehigh, 1964; M.S., 1965.

SCOTT WARNER WILLIAMS (1964) ..... *Graduate Assistant in Mathematics*
B.S., Morgan State College, 1964.

WILLIAM EUGENE WINTERS (1966) ..... *Graduate Assistant in Government*
A.B., Catawba (N.C.) College, 1966.

PASCAL FRANCOIS WIRZ (1966) ..... *Graduate Assistant in French*
H.E.C. Universite de Paris, 1965; Licence és Sciences Economiques, Faculte de Paris, 1966.

BRUCE WOOD (1964) ..... *Graduate Assistant in Mathematics*
B.S., Penn State University, 1960; M.S., University of Wyoming, 1964.

DAVID JOHN YAKE (1966) ..... *Teaching Assistant in Economics*
A.B., Lebanon Valley College, 1936; M.B.A., Stanford, 1941.

NORIAKI YOSHIDA (1966) ..... *Research Assistant in Civil Engineering*
B.E., Hokkaido University, 1963.

UMUR YUCEOGLU (1965) ..... *Research Assistant in Mechanics*
Dip. Eng. Technical University of Istanbul, Turkey, 1956; M.S., Polytechnic Institute of Brooklyn, 1965.

WILLIAM FRANK ZAK (1966) ..... *Graduate Assistant in English*
B.A., Boston College, 1966.

JOSEPH FRANCIS ZALESAK (1966) ..... *Graduate Assistant in Physics*
B.A., LaSalle College, 1963.

ZEEV ZIMMERMAN (1966) ..... *Research Assistant in Metallurgy and Materials Science*
B.Sc., Technion, Israel Institute of Technology, 1962; M.S., 1964.

ROBERT STANLEY ZUKOWSKI (1965) ..... *Research Assistant in Metallurgy and Materials Science*
A.B., Darmouth College, 1964; B.M.E., 1965.

## FELLOWS, SCHOLARS AND TRAINEES

PETER JOHN ACHRON (1964) ..... *National Printing Ink Research Institute Fellow in Chemistry*
B.S., Bates College, 1961; M.S., Lehigh, 1966.

SERGIO ALMEIDA ..... *University Scholar in Chemistry*
Diploma, Faculdada de Engenharia da, Universidad da Bahia, 1966.

STANLEY RICHARD ALMONEY ..... *National Science Foundation Trainee in Physics*
B.S., Lowell Tech. Institute, 1966.

JAMES ANDREW BEGLEY (1966) ..... *National Science Foundation Trainee in Metallurgy and Materials Science*
B.S., Lehigh, 1963.

JOHN R. BERG ..... *Management Science Fellow in Business Administration*
B.S., Lehigh, 1966.

HARRY AARON BICK ..... *U. S. Steel Fellow in Chemical Engineering*
B.S., Tufts, 1966.

GABRIEL BIGURIA ..... *Air Products & Chemicals Incorporated Fellow in Chemical Engineering*
B.S. in Ch.E., Case Institute of Technology, 1963.

THOMAS KENNETH BOLLAND .....*National Aeronautics and Space Administration Trainee in Physics*

B.S., Stevens College, 1962.

JEFFREY BRATSPIES (1964) .....*National Aeronautics and Space Administration Fellow in Metallurgy and Materials Science*

B.S., Lehigh, 1962; M.S., Lehigh, 1966.

ANDREW DUDLEY BRIDGES, JR. .....*William C. Gotshall Fellow in Electrical Engineering*

B.S., Lehigh, 1965.

JOSÉ SARMIENTO BUAN (1965, 1966) ....*Paint Research Institute Fellow in Chemistry*

B.S.Ch.E., Mapua Institute of Technology, 1959.

JAMES ROBERT BUCCI .....*National Aeronautics and Space Administration Fellow in Mechanics*

B.S., Northeastern, 1964.

ANTHONY MICHAEL BUTTO (1961, 1964) .....*Louis Calder Foundation Fellow in Chemistry*

B.S., Pennsylvania State University, 1961; M.S., Lehigh, 1964.

GARY M. CALLAHAN .....*National Aeronautics and Space Administration Fellow in Mechanical Engineering*

B.S., 1964; M.S., University of Miami, 1966.

JOHN J. CONVILLE .....*National Defense Education Act Fellow in Chemistry*

B.S., Clarkson College, 1965.

EVAN WALBERT CONYERS .....*National Defense Education Act Fellow in Philosophy*

B.A., Lehigh, 1966.

JOHN FREDERICK COPELAND .....*National Science Foundation Trainee in Metallurgy and Materials Science*

B.S., Drexel Institute of Technology, 1966.

MATTHEW CREAGER (1965) .....*National Science Foundation Trainee in Mechanics*

B.E., The Cooper Union, 1965; M.S., Lehigh, 1966.

RICHARD MICHAEL DAVITT (1964) ....*National Aeronautics and Space Administration Fellow in Mathematics*

B.S., Niagara University, 1963; M.S., Lehigh, 1966.

DAVID J. DEANGELO .....*Union Bank and Trust Company Fellow in Business Administration*

B.S., Lehigh, 1966.

ANDREW WILLIAM DEGRAFF .....*National Science Foundation Trainee in Chemical Engineering*

B.S., Newark College of Engineering, 1966.

NICHOLAS DINOS .....*National Aeronautics and Space Administration Fellow in Chemical Engineering*

B.S., Penn State, 1955.

JOSEPH JAY DUBOIS (1965) .....*National Aeronautics and Space Administration Fellow in Mathematics*

A.B., Boston College, 1963; A.M., 1965.

JOHN BEST DURKEE (1962) .....*Esso Educational Foundation Fellow in Chemical Engineering*

B.S., Lehigh, 1962; M.S., Lehigh, 1964.

JEROME MICHAEL EBERHABD .....*Baldwin Fellow in Philosophy*

B.A., University of San Francisco, 1965.

RICHARD ARNOLD EELMAN .....*National Printing Ink Research Institute Fellow in Chemical Engineering*

B.S., Lehigh, 1961.

WALTER LUDWIG ERHARD (1966) .....*Materials Research Center Fellow in Metallurgy and Materials Science*
B.S., Lehigh, 1966.

RICHARD W. FARRAND (1965) .....*National Defense Education Act Fellow in Chemical Engineering*
B.S., Penn State University, 1965.

JOHN MATTHEW FERNBACHER .....*National Aeronautics and Space Administration Trainee in Chemical Engineering*
B.S., Case Institute of Technology, 1962; M.S., Lehigh, 1965.

RICHARD A. FLORY (1966) .....*University Scholar in Geology*
B.S., Dickinson, 1961.

JAMES PATRICK FOSTER .....*National Defense Education Act Fellow in Information Science*
B.S. in E.E., Penn State, 1963.

LEO B. FREEMAN (1965) .....*National Science Foundation Fellow in Electrical Engineering*
B.S., Lehigh, 1964; M.S., Stanford, 1965.

JOHN FULTON .....*Union Bank and Trust Company Fellow in Economics*
B.S., Bus. Ad., Lehigh, 1966.

LARRY L. FUNCK .....*National Science Foundation Fellow in Chemistry*
B.S., Lebanon Valley College, 1964.

DARIEN ADAMS GARDNER .....*National Defense Education Act Fellow in Information Science*
B.A., Haverford College, 1965.

JOSEPH GORDON GELLINGS .....*University Scholar in Psychology*
B.A., Lehigh, 1965; B.S., 1966.

NICHOLAS GEORGALIS .....*National Defense Education Act Fellow in Philosophy*
B.A., University of Minnesota, 1966.

BARRY GILBERT (1963) .....*National Aeronautics and Space Administration Trainee in Physics*
B.S., Brooklyn Polytechnic Institute, 1963; M.S., Lehigh, 1965.

ELLEN GOODMAN (1964) .....*University Scholar in Education*
B.A., Moravian, 1931; M.A., Lehigh, 1951.

CHARLES THEODORE GRANT (1963) ..*National Aeronautics and Space Administration Trainee in Physics*
B.S., Yale, 1962; M.S., Lehigh, 1965.

ERVENE F. GULLEY .....*James Ward Packard Fellow in English*
A.B., Bucknell University, 1965.

ROBERT B. HAMMOND .....*Management Science Fellow in Business Administration*
B.S., Carnegie Institute of Technology, 1966.

GLENN KING HAUSER .....*National Science Foundation Trainee in Psychology*
B.A., University of Cincinnati, 1966.

LAURENCE J. HEITZ .....*National Defense Education Act Fellow in Chemistry*
B.S., Lehigh, 1966.

FRANK MICHAEL HENDEREK .....*National Defense Education Act Fellow in Mechanical Engineering*
B.S., Lehigh, 1966.

RICHARD WILLIAM HUTCHINSON .....*National Science Foundation Trainee in Chemical Engineering*
B.S., Penn State, 1966.

STANLEY A. IOBST .....*National Aeronautics and Space Administration Fellow in Chemistry*
B.S., Moravian, 1964.

JUDITH LYNN JANSSEN .....*National Science Foundation Trainee in Biology*
B.A., Denison University, 1966.

HUYLA NURIYE KANSIZ .....*University Scholar in International Relations*
B.A., Robert College, 1966.

PAUL KARPOV .....*Brink Fellow in Civil Engineering*
C.E., Belgrade University (Yugoslavia) 1939; Dipli.-Ing., Berlin Technical University (Germany), 1951.

RUDOLPH MARTIN KOCH (1966) .....*Teaching Fellow in Mathematics*
B.A., Rutgers University, 1966.

DOUGLAS ANDREW KOOP (1965) .....*Allegheny-Ludlum Fellow in Metallurgy and Materials Science*
B.S., Rensselaer Polytechnic Institute, 1963; M.S., 1965.

ELEANOR LANG .....*New Jersey Zinc Company Research Fellow in English*
B.A., Chestnut Hill College, 1963; M.A., Lehigh, 1964.

JOSEPH ARTHUR LAVELLE .....*Thomas R. Caton (Taga) Fellow in Chemistry*
B.S., University of Scranton, 1958.

JOHN F. LOEBER .....*National Aeronautics and Space Administration Fellow in Mechanics*
B.S., Lehigh, 1964; M.S., 1965.

FRANKLIN OTIS LOVELAND .....*Kingsley Fellow in Social Relations*
B.A., Dartmouth College, 1964.

BRUCE DAY MACDONALD .....*National Defense Education Act Fellow in Mechanics*
B.S., Drexel Institute of Technology, 1963; M.S., 1966.

CLIFFORD B. MARTIN (1965) .....*National Science Foundation Trainee in Mechanical Engineering*
B.S., University of Maine, 1965.

WILLIAM J. MCDONOUGH .....*National Aeronautics and Space Administration Fellow in Metallurgy and Materials Science*
B.S., Alfred University, 1960.

STEVEN JEFFREY MICHAELS (1966) .....*National Science Foundation Trainee in Mathematics*
A.B., Providence College, 1966.

L. FREDERICK MOOSE .....*National Science Foundation Trainee in Geology*
B.S., Lehigh, 1965.

STANLEY MELVIN MORRIS .....*National Science Foundation Trainee in Chemical Engineering*
B.S., Carnegie Tech, 1964; M.S., Lehigh, 1965.

JAMES T. MOYER .....*Union Bank and Trust Company Fellow in Business Administration*
B.S., Albright College, 1966.

LARRY ROBERT MUGRIDGE ....*National Defense Education Act Fellow in Mathematics*
B.A., Wartburg College, 1962; M.S., Lehigh, 1965.

MEREDITH MUNNS .....*U.S. Navy Fellow in Psychology*
B.S., Penn State, 1952; M.A. Temple University, 1965.

JOHN DONALD OAKEY (1965) .....*National Science Trainee in Metallurgy and Materials Science*
B.S., Lehigh, 1965.

DON R. OLIVE .....*Asoplate Fellow in Chemistry*
B.S., Lehigh, 1962.

JOHN FRANCIS O'LOUGHLIN .....*University Scholar in Social Relations*
B.A., Villanova University, 1966.

RICHARD WARD PELL (1966) .....*Teaching Fellow in Mathematics*
B.A., Lebanon Valley College, 1966.

MORTON N. PERLMAN .....*Air Reduction Fellow in Metallurgy and Materials Science*
B.ME., City College of New York, 1960.

PAUL H. PETTIT, JR. .....*National Science Foundation Fellow in Chemistry*
B.S., Princeton, 1964.

JAMES M. POBICKI .....*National Defense Education Act Fellow in Economics*
B.A., Duquesne University, 1966.

FRANK AUGUST POLLAK .....*National Defense Education Act Fellow in Chemical Engineering*
B.S., Newark College of Engineering, 1965.

GEORGE H. P. POPPER .....*Kingsley Fellow in Geology*
B.C., CCNY, 1962; M.S., University of Massachusetts, 1965.

JOAN POPYACH .....*University Scholar in English*
A.B., Moravian, 1952; M.A., Lehigh, 1966.

JOSEPH BERNARD PORCARO .....*Gotshall Scholar in Civil Engineering*
B.E., Manhattan College, 1966.

WAYNE BORIS POWELL .....*National Aeronautics and Space Administration Fellow in Philosophy*
B.S., Case Institute of Technology, 1964; M.S., Lehigh, 1965.

PAUL J. PRUTZMAN .....*Management Science Fellow in Business Administration*
B.S. in E.E., Lehigh, 1966.

ROBERT THOMAS QUINN (1965) .....*University Scholar in Metallurgy and Materials Science*
B.S., United States Naval Academy, 1952; M.S., United States Navy Postgrad School 1960.

ROBERT RICHARD REGL (1964) ....*National Aeronautics and Space Administration Fellow in Mechanics*
B.S.C.E., Drexel Institute of Technology, 1957; M.S., Lehigh, 1959.

ALLAN JON ROBERTSON .....*National Science Foundation Trainee and Graduate Assistant in Mechanics*
B.S., Lehigh, 1966.

DONALD ORLANDO ROCKWELL, JR. (1964) .....*National Science Foundation Trainee in Mechanical Engineering*
B.S., Bucknell, 1964; M.S., Lehigh, 1965.

EDWARD ARLEN ROEDER .....*Armstrong Cork Fellow in Physics*
B.S., Lafayette, 1961; M.S., Lehigh, 1963.

DOUGLAS ALAN ROSS .....*Public Health Service Fellow in Psychology*
B.A., Lebanon Valley, 1960; M.A., Bowling Green State U., 1962.

EDWARD SABOTKA (1966) .....*Teaching Fellow in Mathematics*
B.S., Castleton State College, 1966.

FRED ROBERT SAUERWINE .....*National Defense Education Act Fellow in Metallurgy and Materials Science*
B.S., Lafayette, 1966.

AUGUST J. SCHAU (1966) .....*National Science Foundation Trainee*
B.A., Newark (N. J.) State College, 1966.

JACK MARK SCHLEIN .....*Katherine Comstock Thorne Fellow in Biology*
B.S., Brooklyn College, 1966.

NEIL CHARLES SCHOEN .....*National Aeronautics and Space Administration Trainee in Physics*
B.S., Rensselaer Polytechnic Institute, 1963; M.S., Lehigh, 1965.

RICHARD EDWARD SCHROEDER .....*National Defense Education Act Fellow in Mechanical Engineering*
B.S., Newark College of Engineering, 1966.

JAMES PHILIP SCHWAR .....*National Science Foundation Faculty Fellow in Chemical Engineering*
B.S., Lafayette, 1957; Princeton, 1958.

BARRY KUHN SCHWARTZ ....*National Aeronautics and Space Administration Research Fellow in Psychology*
B.A., Tufts, 1964.

THOMAS MARSHALL SCOONOVER .....*National Science Foundation Faculty Fellow in Metallurgy and Materials Science*
B.S., University of Michigan, 1957; M.S., 1961.

JAMES HOWARD SHEA .....*National Aeronautics and Space Administration Trainee in Physics*
B.S., Lehigh, 1958; M.S., Lehigh, 1963.

KEITH DOUGLAS SHEFFLER .....*National Science Foundation Fellow in Metallurgy and Materials Science*
B.S., Lehigh, 1963; M.S., 1964.

RICHARD DAVID SIEGEL .....*United States Steel Fellow in Chemical Engineering*
B.S., Tufts University, 1964; M.S., 1966.

HUGH SILVERMAN .....*National Defense Education Act Fellow in Philosophy*
B.A., Lehigh, 1966.

JAMES THOMAS SMITH .....*Materials Research Fellow in Metallurgy and Materials Science*
B.S., Cornell University, 1961; M.S., 1962.

ROWAN PAUL SMOLCHA .....*National Science Foundation Fellow in Chemical Engineering*
B.S., Penn State, 1966.

ELAINE MICHELLE SPRAGUE (1966) .....*Teaching Fellow in Mathematics*
B.S., Chestnut Hill College, 1966.

JOHN JOSEPH SWETITS .....*National Defense Education Act Fellow in Mathematics*
B.S., Fordham University, 1964.

FRANK A. SZUMILO .....*National Defense Education Act Fellow in Business Administration*
B.S., Wilkes College, 1966.

THOMAS ERNST TAUBER .....*H. H. Byllesby Fellow in Physics*
Dipl. Vienna, 1965.

LAWRENCE AUGUST TAYLOR .....*National Aeronautics and Space Administration Fellow in Geology*
B.S., University of Indiana, 1961; M.A., 1963.

PAUL VINSON TEBO ....*National Science Foundation Trainee in Chemical Engineering*
B.S., Tufts University, 1965.

RICHARD ERNEST TOMALESKY .....*National Aeronautics and Space Administration Fellow in Chemistry*
B.S., Lehigh, 1965.

JERRY EDWARD TOMPKINS (1966) .....*National Science Foundation Trainee in Mechanical Engineering*
B.S., Villanova University, 1966.

GEORGE TREVINO (1965) .....*National Science Foundation Trainee in Mechanics*
B.S., Texas A & I College, 1965; M.S., Lehigh, 1966.

LARRY NICHOLAS TRUBILLA .....*National Science Foundation Trainee in Industrial Engineering*
B.S., Penn State, 1966.

MANTON BRENT WALL .....*National Defense Education Act Fellow in Philosophy*
B.A., Ursinus College, 1964.

JOHN HERBERT WEBER, JR. (1965, 1966) .....*International Nickel Company Fellow in Metallurgy and Materials Science*
B.S., Lehigh, 1963; M.S., Lehigh, 1966.

GORDON M. WHITE (1965) .....*National Aeronautics and Space Administration Fellow in Chemistry*
B.S., Miami University, Oxford, Ohio, 1965.

LANCE PETER WIMMER (1966) .....*National Defense Education Act Fellow in Mechanical Engineering*
B.S., Lehigh, 1965.

J. EMMET WOLFE, JR. .....*National Aeronautics and Space Administration Fellow in Mechanical Engineering*
Bachelor of Aerospace Engineering, University of Florida, 1964; M.S., Lehigh, 1966.

DOUGLAS HIDEO YANO .....*National Aeronautics and Space Administration Fellow in Mechanical Engineering*
B.S., Lehigh, 1962; M.S., 1964.

SHANE SHIANG YEN (1965) .....*Hornor Fellow in Metallurgy and Materials Science*
B.S., Taiwan Cheng-Kung U., 1961; M.S., University of Missouri, 1965.

DARELL RILEY ZERBE .....*Gotschall Scholar in Industrial Engineering*
B.A., Rutgers University, 1966; B.S., 1966.

## STANDING COMMITTEES OF THE FACULTY, 1966-67

(In each case the chairman is the member whose name appears first. The President and Vice-Presidents are ex officiis members of all committees.)

ADMISSION: S. H. Missimer (ex officio); D. D. Feaver, L. R. Tripp, W. J. Richardson.

ATHLETIC ELIGIBILITY: B. G. Brockway (1967), D. A. Van Horn (1968), J. B. McFadden (1969); W. B. Leckonby, executive secretary (ex officio).

DISCIPLINE: C. W. Brennan (ex officio), J. A. Maurer (1967), A. J. Diefenderfer (1968), student members: R. C. Gower '67, J. M. Smith '68.

EDUCATIONAL POLICY: R. H. Long, Jr. (1967), W. J. Van Sciver (1967), R. C. Williamson (1967), B. G. Brockway (1968), R. A. Eckhardt (1968), R. G. Malsberger (1968), J. A. Owczarek (1969), W. A. Pillsbury (1969), R. S. Sprague (1969), W. R. Yates, L. R. Tripp, J. J. Karakash, C. W. Brennan, R. D. Stout (ex officio), John A. Stoops, J. H. Wagner, secretary (ex officio).

FACILITIES: E. W. Glick, C. B. Campbell, W. R. Yates, L. R. Tripp, R. T. Gallagher, T. E. Jackson, R. W. Numbers, W. L. Quay (all members ex officiis).

HONORARY DEGREES: F. B. Jensen (1967), A. S. Foust (1968), K. E. Chave (1969), J. B. Severs (1970), T. Hailperin (1971), C. W. Curtis (1972).

NOMINATIONS: A. P. Koch (1967), W. C. Hahn (1967), D. D. Feaver (1967), J. B. McFadden (1968), L. A. Wenzel (1968).

PERFORMING ARTS: D. D. Feaver (1967), R. N. Van Arnam (1968), E. N. Dilworth (1969), H. B. Davis, J. B. Elkus, S. I. Connor, executive secretary (ex officiis) 3 student members.

PUBLICATIONS, BOARD OF: P. B. Myers, Jr. (1967), J. H. Cary (1967), W. L. Quay, R. J. Sullivan, S. I. Connor (ex officiis); student members: Les Spindle '67, John Van Deraue '67, L. S. Greenfield '68, S. E. Lusk '68, Thomas Hunt '69.

RELIGIOUS LIFE: G. E. Kane (1967), L. S. Beedle (1968), D. Leenov (1969); R. E. Fuessle, W. L. Quay (ex officiis) (3 students, 3 alumni).

SAFETY AND PREVENTIVE MAINTENANCE: T. E. Jackson, G. E. Kane, G. W. McCoy, L. A. Wenzel; R. W. Numbers (ex officio).

STANDING OF STUDENTS: G. J. Christensen; W. R. Yates, L. R. Tripp, J. J. Karakash; C. W. Brennan, executive secretary; J. H. Wagner, recording secretary (all members ex officiis).

STUDENT ACTIVITIES: P. Parr (ex officio), Alvin Cohen (1967), W. A. Pillsbury (1967), student members: J. W. Findley '67, W. R. Utke '67, W. E. Elcome III '68.

STUDENT LIFE: F. J. Wuest (1967), R. W. Kraft (1968), Francis M. Brady (1969), C. B. Campbell, R. E. Fuessle, P. Parr (ex officiis). Student members: J. W. Simpson '67, H. E. Schlenker '67, J. R. Oyler '67, R. L. Beganie '69.

UNDERGRADUATE AWARDS AND PRIZES: V. V. Latshaw (1967), R. H. Mills (1968), J. H. Wagner, secretary (ex officiis).

UNDERGRADUATE FINANCIAL AIDS: C. W. Brennan (ex officio), T. E. Jackson (1967), M. D. Snider (1968), P. Parr (1969), J. P. King (1970), S. H. Missimer (1971); T. L. Kropp, executive secretary (ex officio).

UNIVERSITY CENTER ADVISORY COMMITTEE: P. Parr, C. B. Campbell, E. W. Glick (ex officiis); N. H. Sam (1967), A. I. Larky (1968), C. E. Patterson (1969), W. D. Schaeffer (1970), R. J. Redd (1971); H. L. York '67 (ex officio) (6 student members).

UNIVERSITY EXERCISES: A. C. Molter, S. I. Connor, G. B. Stern, S. D. Armstrong (ex officiis); J. W. McGeady (1967), C. L. Moore (1968).

USHERS: R. W. Kraft (1969), F. P. Stein (1967), W. L. Quay (1967), R. M. Kraus (1968), P. B. Myers Jr. (1968), R. G. Malsberger (1969), J. D. Wood (1970), N. P. Melchert (1970), C. S. Kraihanzel (1971), R. D. Chiodo (1971).

WILLIAMS PRIZES: J. B. Severs, N. W. Balabkins, R. G. Cowherd, H. B. Davis, D .J. Hillman, F. J. Wuest.

SECRETARY OF THE FACULTY: R. N. Van Arnam (1967).

# LEHIGH UNIVERSITY

Lehigh University is a non-denominational, private institution comprising the College of Arts and Science, the College of Business Administration, the College of Engineering, the Graduate School, the School of Education, and the Institute of Research. Its offering of the baccalaureate degree is limited to men, although men and women are admitted to the Graduate School, the School of Education, the Summer Session, and the Adult Education Program.

Its buildings are located on a 180-acre campus on South Mountain above the City of Bethlehem, Pennsylvania, a site situated approximately halfway between New York City and Harrisburg. The University recently acquired additional land on the western slope of South Mountain and in Saucon Valley south of Bethlehem, bringing the total acreage to almost 700. A field house, gymnasium, and the new Saucon Valley playing fields are included among the University's athletic and recreation facilities.

Lehigh University is accredited by the Middle States Association of Colleges and Secondary Schools, which accreditation covers all programs offered by the University. In addition, specialized programs in Business Administration are accredited by the American Association of Collegiate Schools of Business, and the Engineering curricula are accredited by the Engineers' Council for Professional Development.

Supplementing the formal academic program is an extensive program of extra-curricular activities, in all of which students have the assistance of competent faculty advisers.

Lehigh is distinctly a university with a purpose. This purpose is a heritage from its founder, the Honorable Asa Packer, industrialist and philanthropist.

Beginning life as a poor farm boy in Connecticut, Asa Packer moved to Pennsylvania as a youth and became one of America's pioneer captains of industry. He recognized and developed the great natural resources of that richly endowed section of Pennsylvania known as the Lehigh Valley.

Looking back from the peak of his career, Mr. Packer saw clearly how much easier his tasks would have been and how much fuller the fruits of his labor had he been fortified in youth with a background of training in the arts and natural sciences. Looking forward with penetrating vision, he foresaw the great industrial development that was then just beginning. He realized that the training he lacked was to become more and more essential in the years to come.

Originally the founder had in mind a school primarily technical, catering to the youth of the Lehigh Valley. However, as the details of the project

were worked out by Judge Packer and his educational advisers, the scope of the educational services contemplated were greatly broadened. They foresaw the complex social, economic, and technical problems which the future would bring, and the need for service and leadership in these areas.

Thus it was that in 1865 Lehigh University was founded to provide young men with a sound basis for successful living, in the fullest sense of the phrase, and to insure leadership for the complex business and industrial civilization of the future.

During his lifetime and by bequest Judge Packer gave Lehigh over three million dollars, including land, buildings, and endowment. The generosity of the Packer family and other friends of Lehigh, the distinguished faculty originally assembled, and the prominence of early alumni firmly established the reputation of Lehigh in college education, and the young University took its place proudly among older and larger institutions.

The endowment fund of the University now exceeds twenty-four million dollars. The value of equipment, buildings, and grounds is more than twenty-nine million dollars.

The new institution, which opened its doors to young men from the country at large in 1866, was given the character of a small university. From the very beginning Lehigh combined in a unique fashion the traditional American college of liberal arts, the continental university, and the new technical institute of university rank.

Lehigh continues to base its program on the premise that an education for successful living must combine the acquisition of knowledge and skills fundamental in the professions with courses designed to broaden the vision and to enrich the personal life of the individual. Therefore, at Lehigh requirements for graduation include studies preparatory to a career and a generous number of courses to acquaint the student with the nature and problems of the world in which he lives; there are also opportunities to develop himself as an individual.

The organization of Lehigh as a small University contributes to the goal of meeting individual needs by enabling students enrolled in one college to pursue in other undergraduate divisions those studies for which they are qualified and from which they can best profit.

It is also important to note that students may move from one curriculum to another. For instance, a freshman may discover that his first choice was ill-founded. After consultation and investigation he is permitted to transfer to a curriculum more suited to his interests and abilities.

A comprehensive student advisory system assures that a student will seek and obtain advice in planning for his future career. The services of the officers and departments concerned with advising students are provided on a compulsory and voluntary basis so that when help is needed, it is available.

Lehigh students have ample opportunity to discuss with qualified and sympathetic advisers problems related to courses of study and problems of a personal nature. (See "Placement and Counseling Services," page 393).

Lehigh's location in Bethlehem places it approximately 60 miles north of Philadelphia and 90 miles west of New York City, in the center of the cultural East and in the heart of the industrial production of the Middle Atlantic states.

It was no mere chance that Lehigh was placed on the slope of Old South Mountain. When Judge Packer selected a large tract of land near the banks of the Lehigh River, he knew he was establishing a new University at the very doors of the mighty industries and the historic institutions of the Atlantic seaboard. Bethlehem was at the gateway to westward expansion by railroad and highway. It was (and is) a city which could serve admirably as a "college town"—providing a bustling industrial community and historic cultural background as laboratories for students.

Settled in 1740 by Moravians, Bethlehem is rich in historic traditions with picturesque homes and well-kept gardens. Numbered among its historic places of interest is the Bell House, erected in 1745. The bell served the settlers as a call to worship as well as warning them of fire or Indians. Colonial Hall, erected in 1748, was used during the Revolutionary War as a hospital for wounded soldiers of the Continental Army.

Each spring Bethlehem is the mecca for thousands of music-lovers from far and near, who come to hear the famous Bach Choir in Packer Memorial Church on the Lehigh Campus.

With a population of about 76,000, Bethlehem is a city of modern commercial and industrial importance. But the 180-acre campus of Lehigh on a hillside on the south side of the Lehigh River ensures the residential character of the University.

# Undergraduate Admission Requirements

The enrollment of Lehigh University is strictly limited by action of its board of trustees, with a resulting limitation in the number of candidates who can be admitted each year to the several divisions of the University.

In the selective procedure necessitated by this limitation, the University, through its Office of Admission, takes into account a number of criteria which are believed to have some individual validity and in combination a high degree of validity in predicting probable success in college work.

### (1) SECONDARY SCHOOL UNITS

The sixteen yearly courses or units required as entrance credit represent the quantitative equivalent of the usual four-year college preparatory program and include certain prescribed subjects and sufficient electives to make up the totals listed in the accompanying chart.

It is recommended that in addition to the minimum subject matter requirements all candidates include as many courses in science, history, mathematics, and language as their programs and schools will permit.

The *recommended program* for admission to all courses of study at Lehigh University includes (in secondary school grades nine through twelve) four years of English, two to four years of one foreign language (or two years each of two foreign languages), four years of college preparatory mathematics, two to four years of laboratory science, and two to four years of history or social studies. These will total sixteen to twenty yearly courses or units of college preparatory study.

The statement above is the recommended preparatory program and preference will be given to candidates who present such a pattern of studies, particularly to students who have taken the opportunity to go beyond minimum subject matter requirements.

The *minimum requirements* for *all* entering freshmen are four yearly courses or units in English, four in mathematics (including algebra, plane geometry, plane trigonometry), two years of one foreign language, and six elective units (including chemistry for candidates for science, arts-engineering, and engineering).

SUMMARY OF MINIMUM SUBJECT MATTER REQUIREMENTS

| *Subjects* | *Units* |
|---|---|
| English | 4 |
| Foreign Language (4 units are recommended) | 2 |
| College Preparatory Mathematics | 4 |
| Electives | 6 |
| Total | 16 |

*Note: Chemistry is required and physics is recommended for candidates planning programs in science, arts-engineering, and engineering. Electives should include such college preparatory subjects as languages, social studies, and sciences.*

**(2) QUALITY OF WORK**

The quality of the candidate's work is more important than merely meeting minimum subject matter requirements. The strength of his preparation is judged primarily by his rank or relative grade in class; by the extent to which he has made grades distinctly higher than the average grade; by evidence of improvement or deterioration in quality of record as he has progressed through secondary school; by his relative success or failure in the particular subjects which he proposes to continue in college; and by the comments and recommendations of his principal or headmaster.

Most secondary schools specify two minimum grades: one as the pass-

ing grade and the other as the recommending grade for admission to college. In the process of selective admission for Lehigh, particular emphasis is placed on the extent to which a candidate has significantly exceeded these minimum grades and has ranked high in his graduating class.

Today when four to five times as many candidates apply for admission to the University as can be accommodated in the freshmen class, meeting minimum standards is not sufficient. A candidate must have shown by his school record and class rank and College Board test scores that he is well prepared to do satisfactory work at Lehigh University.

**(3) ENTRANCE EXAMINATIONS**

All candidates for admission to the freshman class at Lehigh University are required to write entrance tests prepared and administered by the *College Entrance Examination Board*. Tests required by Lehigh University are listed below.

Scholastic Aptitude Test: Each candidate is required to write the Scholastic Aptitude Test (SAT) to provide the University with a measure, on a national scale, of his aptitude and readiness for college study. Lehigh prefers that this test be written either on the December or the January testing date of the senior year. (The 1967-68 schedule is shown below.)

Achievement Tests: Each candidate is required to write *three* additional afternoon College Board Achievement Tests. One of these must be either English Composition or the Writing Sample. Candidates for a science program, for engineering, and for arts-engineering are required to write Mathematics, either *Level I (Standard) or Level II (Intensive)*, and Chemistry or Physics Achievement Tests. Other candidates are required to write two tests which they may choose in consultation with their advisers. The Achievement Tests should be written in December, January, or March of the senior year unless satisfactory results were submitted to Lehigh University from junior year tests.

Schedule of College Board Tests 1967-68

| | |
|---|---|
| December 2, | 1967 |
| January 13, | 1968 |
| March 2, | 1968 |
| May 4, | 1968 |
| July 6, | 1968 |

*Note:* The SAT and Achievement Tests, will be offered on all five testing dates.

Information and application forms for the tests should be secured from the *College Entrance Examination Board* at one of the following addresses (whichever is closer to the candidate's home or school): *P. O. Box 592, Princeton, New Jersey 08540 or P. O. Box 1025, Berkeley, California 94701* or from the candidate's school.

Candidates should register for the tests early in the senior year and not later than one month prior to the test date (two months for candidates who will be tested in Europe, Asia, Africa, Central and South America, and Australia).

The candidate is responsible for requesting that his test score be sent to Lehigh — either by indicating Lehigh on his College Board application blank or, if he failed to do this, by special request to the College Board office. In addition to requesting College Board scores, the candidate must submit an application for admission to the freshman class at Lehigh.

#### (4) OTHER CRITERIA AND INTERVIEWS

Information about other qualifications of candidates is obtained from principals, headmasters, and counselors. Such information relates to the candidate's health, emotional stability, intellectual motivation, social adjustment, participation in school activities, and established habits of industry and dependability.

Candidates are invited to visit Lehigh so that they may see the University and talk with an officer of admission. *An appointment should be made in advance of the visit.*

The most convenient hours for admission conferences are at 1:30 on weekday afternoons and between 9:00 and 11:00 o'clock on Saturday mornings during the school year. The Office of Admission is closed Sundays, national holidays, Saturday afternoon during the school year, and all day Saturday during the summer months. A particularly good time for a candidate and his parents to visit Lehigh is during the summer between the junior and senior years in secondary school.

Although a personal interview is not required of all candidates, the University reserves the right to require an interview whenever this appears desirable or necessary and to base determination of admission in part on the report of the interviewing officer.

## Undergraduate Admission Procedures

### ADMISSION TO THE FRESHMAN CLASS

If a candidate has determined that he is sincerely interested in Lehigh and if he believes that he will meet admission requirements of subject matter and school record, he should secure from the Office of Admission an application blank for the freshman class entering in September. (Lehigh does not admit a freshman class in February.)

The application should be submitted early in the last year of preparation for college. Lehigh gives first consideration to applications returned promptly after receipt. Every effort should be made to submit an application during

the fall semester of the senior year and definitely not later than March first. In practice the University is sometimes forced to limit applications after January first.

The candidate should arrange with his school adviser to register for morning and afternoon tests administered by the College Entrance Examination Board. As indicated in the section on Entrance Examinations (No. 3), Lehigh recommends that the SAT be written in December or January of the senior year and the three afternoon Achievement Tests in December, January, or March.

Most important of all he should maintain a good academic record. He should learn how to budget his time. He should work hard to develop study habits which will assure a strong record in secondary school and will give him a good start in his freshman year in college.

**APPLICATION FEE**

Each undergraduate application for admission to the freshman class or with advanced standing or to the General College Division must be accompanied by an application fee in the amount of $10.00. The check or money order for the application fee should be made payable to Lehigh University. The application fee is non-refundable in the event the candidate does not matriculate at Lehigh University. It is not applied toward tuition if the candidate matriculates. An application cannot be accepted without the application fee.

**ACCEPTANCE OF ADMISSION AND DEPOSIT**

Selection of candidates for the freshman class entering in September is made between the end of February and the first of April following receipt of January College Board scores and of preliminary secondary school records. Lehigh subscribes to the "Candidates' Reply Date," which has been set at May first.

When a candidate's preliminary credentials are complete and he has been offered formal admission to Lehigh University, he will be asked to notify the Director of Admission of his acceptance of the offer of admission by making a deposit of $50 to hold a place for him in the limited enrollment. This deposit is not an additional fee but is applied toward tuition charges for the first semester. However, the deposit is forfeited in case of failure to enroll for the specified semester.

**ADVANCED STANDING FROM SECONDARY SCHOOLS**

Advanced standing for freshman courses may be earned by secondary school students in two ways: through Advanced Placement Tests administered by the College Entrance Examination Board or by advanced standing examinations administered at Lehigh University. Both methods require that the candidate shall have studied significantly advanced work.

A few private and public secondary schools now offer truly advanced courses for limited numbers of selected students. If a candidate has completed, or expects to complete, such a course in an approved secondary school, he may establish advanced standing by taking an Advanced Placement Test or a Lehigh test in the subject. In either case he should confer with his school principal and with the Director of Admission of Lehigh University.

The privilege of taking an advanced standing examination at Lehigh is granted only on written request to the Director of Admission not later than July first of the year the student plans to enter college. Such examinations are scheduled by the University usually at the beginning of Freshman Orientation.

## ADVANCED STANDING FROM ANOTHER COLLEGE

Candidates for admission by transfer from other institutions may be admitted with advanced standing subject to the enrollment limitations of the several divisions of the University. Such candidates must have met the entrance requirements prescribed for undergraduates at Lehigh and must have completed at least two semesters of study at an accredited institution of higher learning.

A candidate who has studied at another college prior to applying for admission to Lehigh will be considered on the basis of the quality of his record at that college. *A candidate who has been dropped from another college for disciplinary reasons or for poor scholarship or who is not in good standing at his former college is not eligible for admission to Lehigh University.*

A student who is planning to transfer to Lehigh University should so arrange his work in college that he will cover as many as possible of the subjects of the freshman and sophomore years of the curriculum he selects.

A student who desires to transfer to Lehigh University from another university, college, or junior college must submit an application for admission (on a special transfer form) with the $10 application fee. He must request each college previously attended to submit to the Office of Admission at Lehigh University an official transcript of his academic record. Such a transcript must include a complete list of all courses taken, a list of entrance credits accepted for admission, and a statement of honorable dismissal. Catalog pages describing the courses completed at other colleges should be enclosed with the application. It is not necessary to send complete catalogs.

A candidate who has attended more than one university, college, or junior college must present a record from each institution. Failure to submit a complete record of former academic experience will result in cancellation of admission or registration.

# Undergraduate Fees

The tuition for undergraduates is $900 per semester in the College of Engineering, the College of Arts and Science, the College of Business Administration and the General College Division. A student regularly enrolled in any of the undergraduate divisions of the University who registers for fewer than the normal hours of work will pay either $75 for each semester-hour carried or the regular tuition, whichever amount is lower.

There are no fees for athletics, health service, library, student activities, or student concerts-lectures. In addition, there are no matriculation, graduation, or laboratory fees.

Undergraduate fees are payable prior to registration. A bill will be rendered by the Bursar's Office which will indicate the payment date. If desired, payment may be made in installments of 60 per cent, plus a service charge of $3 per semester, due prior to registration, 20 per cent due one month after registration, and 20 per cent due two months after registration. The $3 service charge is not refundable.

Military and Band Deposits. A deposit of $25 is made by each student enrolling in military or air science or in band. This deposit is refunded when the property issued to the student is returned.

Chemistry Breakage. Students taking chemistry laboratory courses are required to reimburse the University for returnable equipment broken or otherwise damaged and for all chemicals used in excess of reasonable amounts. To cover possible charges of this nature, all students registering for laboratory courses in chemistry purchase coupon books costing $5, the unused portions of which are redeemed.

Examination Fees. Students who for satisfactory reasons absent themselves from final examinations will be allowed, upon petition, to take make-up examinations without payment of an examination fee. A fee of $5 is charged for any examination subsequent to the first regular final or make-up examination allowed upon petition in any course. This regulation applies to the psychological and placement examinations required of new students if taken at some time other than those scheduled.

Shop and Surveying Courses. A three-week shop course for industrial and mechanical engineering students is required during the summer following the sophomore year, and three-week surveying courses are required by the Department of Civil Engineering during the summer following the sophomore year. Tuition charges are made for the shop course which is given in Bethlehem under the Department of Industrial Engineering, and for the surveying courses which are conducted at camps or on campus under the auspices of the Department of Civil Engineering. The tuition charge for all of these courses is the regular summer rate per semester hour. To this is added the cost of room and board at prevailing rates.

Late Registration Fees. The penalty for procuring a registration ticket after the time specified by the Registrar shall be $10. A student who does not complete his registration within three days after the date of his registration ticket is subject to a penalty of $10. No registration will be accepted later than the tenth day of instruction in a regular semester or the fifth day of instruction in any summer term.

Late Pre-Registration Fee. The penalty for a late pre-registration or a change in pre-registration is $10. This will be waived for cause upon the recommendation of the college dean.

Change-of-Roster Fee. Having once registered in any semester, a student may not add or drop any course except on the recommendation of the director of his curriculum. There will be a $10 change-of-roster fee for each such change unless it is waived by the college dean.

Late Installment Payment. In certain cases, students are permitted to pay semester bills in three payments. In other cases, emergency short term loans are granted to be repaid in period installments within the semester in which the loan is granted. A penalty fee of $10 is levied on any student who fails to make payment in accordance with the agreed schedule.

Late Payment of Fees. University fees are payable prior to registration. If payment, or provision for payment satisfactory to the University, is not made prior to registration, a fee of $10 will be assessed if such payments, or provisions for payments, are made after the registration date.

Late Application for Degree Fee. Refer to General Regulations—Notice of Candidacy for Degree, page 345.

Application for Admission Fee. A fee of $10 is required with each application for admission to the undergraduate colleges of the University.

Listener's Fee. Undergraduate students enrolled in less than a full program who wish to attend a course or courses without obtaining credit will be charged a listener's fee of $35 for each such course attended.

Transcripts. Each student is entitled to one copy of his record free of charge. This can be an official or unofficial transcript. Unofficial copies are released to the student; official copies are sent directly to the educational institution, company, state board, etc., as the circumstances may require. After the first copy is released a fee of $1 is assessed for each subsequent copy.

**REFUNDS**

Undergraduate. If a student withdraws from the University, he is entitled to receive a refund of his tuition less $50 and less a deduction of 2 per cent of the tuition for each day of instruction completed, computed from the first day of instruction in the semester. In the event of the death of a student or his involuntary induction into the Armed Forces, tuition will be refunded in proportion to the fraction of the semester remaining at the time of his death or induction. No student who is suspended or expelled from the University shall be entitled to any refund.

A summer session student who formally withdraws from the University is entitled to receive a refund of his total tuition less $5 for each credit hour for which he is registered and less a deduction for each day of regular instruction of 4 per cent of the total tuition paid computed from the first day of instruction in the session.

No refunds will be made to any undergraduate student for any reduction in his schedule after the tenth day of instruction in a regular semester or the corresponding relative date in a summer session.

Residence Hall Rental. Residence hall rental paid in advance is refundable in its entirety for any term in which the student does not register in the University or on a proportional basis for cancellation due to the student's death or involuntary induction into the armed forces. Otherwise, refunds are limited to the proportional charge for the unexpired portion of the student's lease less a charge of $25, and to cases of (a) withdrawal from the University (for reasons not involving misconduct) or (b) transfer of lease to another student (for whom no other accommodations exist), subject to approval of the Director of Residence Halls. Refunds authorized under this regulation shall be certified to the Bursar by the Dean of Students.

Note: Rooms are rented in September on an annual lease basis only. A freshman who does not live at home is required to live in the residence halls during his first year. An upperclassman who signs a lease is expected to occupy a room in the residence halls for the full college year.

Dining Services. Refunds will be allowed only on written request to the Treasurer approved by the Dean of Students. Normally such requests will be approved in cases of confining illness requiring absence from all University activities for a period longer than 14 consecutive days or in cases of voluntary withdrawal from the University, involuntary induction into the Armed Forces, or death of the student. Refunds will be computed on the basis of the cost per day for the board plan involved for each full day of absence.

If a student is suspended or expelled from the University, he may be allowed as a refund 50 per cent of the amount representing the unexpired portion of his original dining service contract for the semester.

Payment. All refunds, including overpayments of charges resulting from scholarship awards, loans financing arrangements with banks, etc., will be made by check payable to the student. A minimum of ten days is normally required to process refund checks.

## Estimate of Expenses for the College Year

Items of personal expense are dependent upon each student's personal habits and circumstances. There are certain basic expenses, however, which must be met by all students. An *estimate* of annual cost is listed below.

| | |
|---|---|
| Tuition | $1800 |
| Books and Supplies | 125 |
| Room (average) | 380 |
| Subsistence (estimate) | 550 |
| | $2,855 |

(Note: Students taking military or air science or band are required to make a $25 deposit which is refundable at the end of the school year.)

Books, stationery, and drawing instruments may be purchased at the Supply Bureau in the University Center.

Students living in Residence Halls are required to eat in the University Center. Board will be billed on a semester basis payable prior to registration.

## Living Arrangements

Lehigh undergraduates live in eleven University residence halls (50 per cent), or in 31 fraternity houses by invitation (40 per cent), or are commuters (10 per cent). All freshmen who do not live at home are required to live in the residence halls, which are staffed by a corps of carefully selected upperclass counselors responsible to the Dean of Residence.

### DINING SERVICES

Each student who lives in the Residence Halls is provided with board in the University dining service in the new University Center. The following three board plans are available:

A. Twenty-one meals per week (3 meals daily beginning with the evening meal before the first day of classes and continuing except for announced holidays through the noon meal of the last day of the examination period each semester) — $530 per school year.

B. Seventeen meals per week (Monday breakfast through and including Saturday lunch beginning with the evening meal before the first day of classes and continuing, except for holidays, through the last day of classes for each semester, and meals during the examination periods ending with the noon meal of the last day of examinations)—$480 per school year.

C. Fifteen meals per week (Monday breakfast through Friday dinner beginning with the evening meal before the first day of classes and continuing, except for announced holidays, through the last day of classes each semester, and meals during the examination periods ending with the noon meal of the last day of examinations)—$460 per school year.

Plan A is required for freshmen residing on the campus. Upperclassmen residing on the campus have the choice of any of the three plans.

The board plans and the student dining rooms are open only to students of the Residence Halls. A Snack Bar is operated in the University Center and is open to all students of the University.

Freshmen residing on the campus are required to eat their meals at the University dining service at the University Center during Freshman Orientation. There will be an additional charge of $8 for serving the three meals per day during Freshman Orientation.

Each student who participates in one of the board plans will receive a dining service identification card which is not transferable. Use of the card

by others than to whom it is issued is illegal and will result in disciplinary action. New cards will be issued to replace lost cards upon the payment of a fee of $5.

Visitors on campus may eat in the Asa Packer Room, the faculty and guest dining room in the University Center.

### RESIDENCE HALLS

Room rents in the residence halls range from $170 to $210 per student per semester with maid service included. Rooms are rented in September on an annual lease basis only. The typical room is shared by two students. For each student there is provided a bed, box spring, mattress, chest of drawers, desk and chair; residents supply desk lamps, waste baskets, bedding, etc. Commercial linen service is available at a rate presently $28 per year. Personal laundry on a commercial contract basis is available at $89.25 a year.

Residents will be held responsible for any damage done to their rooms or any other part of the Residence Halls and their equipment.

The University is not responsible for the loss or destruction of any student property whether such losses occur in the residence halls, lockers, classrooms, etc. The safekeeping of student property is the responsibility of each individual student and no reimbursement from the University can be expected for the loss of such property. Insurance protection, if desired, may be obtained by a student or his parents from an insurance broker or agent.

Information on off-campus housing may be secured from the office of the Director of Residence Halls.

## Study In Foreign Countries

To the extent that their courses of study permit it, students maintaining a "B" average or better are encouraged to consider spending one or two semesters of study in acceptable "junior year abroad" programs or as regularly enrolled students in a foreign university. Among the accepted programs are New York University in Spain, Smith College and Wayne State University in Germany, and Sweet Briar and Hamilton in France. Students declared qualified for acceptable foreign study remain eligible to apply for financial aid from Lehigh University.

In 1967-68 The University is participating in the Princeton University International Honors Program, which provides a qualified junior with an opportunity for travel and study abroad with honor students from other colleges and universities.

To further emphasize University interest in international study, the University has provided funds to cover transportation, tuition, and living expense stipend for a graduating senior desiring to study abroad.

# Comprehensive Honors Program

The Comprehensive Honors Program provides superior students with unusual opportunities for intellectual and scholarly development.

## FRESHMAN-SOPHOMORE YEARS

These are the years in which a student normally completes his exploration of possible major fields and lays the groundwork in the chosen major and in its collateral fields. Thus, honors opportunities are limited.

Honors opportunities for freshmen consist of (1) voluntary enrollment in Honors sections of certain multi-section courses, and (2) acceleration through the attainment of advanced standing. Freshmen who qualify for enrollment in Honors sections will be notified before registration. Advanced standing may be obtained through:

a) The CEEB Advanced Placement Program.
b) Certification by the Office of Admission and the Registrar of college credit for certain secondary school special courses.
c) Anticipatory Examinations during freshman week when there is substantial evidence of special achievement not covered in (a) and (b) above.

In the post-freshman summer the opportunity is offered to engage in guided but truly independent study in preparation for special examinations at the beginning of the sophomore year.

Sophomore opportunities are (1) continuation of enrollment in Honors sections and (2) automatic waiver of the junior-standing prerequisite for courses numbered "100" to "399", if the student has the course prerequisites.

Freshmen and sophomores interested in pursuing these opportunities should consult the Dean of the College in which they are registered.

## JUNIOR-SENIOR YEARS

Honor students are those students with a cumulative average of 3.0 or higher. During the junior and senior years, an honor student may choose to work for either Departmental Honors or Interdepartmental Honors. Particularly well-qualified students sometimes work for both. An honor student enrolled in one or both of these programs is designated a "University Scholar".

Students with cumulative averages of less than 3.0 may under some circumstances be permitted to work for Departmental Honors.

### Departmental Honors

Departmental Honors programs give the University Scholar the opportunity to study in his major field more intensively and in greater depth than the standard program provides. The precise nature of the program for each student is determined by his major department. The program may include:

a) *Unscheduled work* (up to four hours per semester in the junior year; up to six hours per semester in the senior year).

b) *Waiver of graduate standing to take "400" courses* if the student has the course prerequisites and if his semester schedule does not exceed fifteen hours. (Credits from such a course can be applied toward only one degree, either graduate or undergraduate.)

c) *Honors Thesis*

A candidate for Departmental Honors must announce to his major adviser, not later than the end of his junior year, his intention to work for Departmental Honors. Each major adviser shall send the registrar, the dean of the college, and the chairman of Honors Programs, no later than the close of registration of each fall semester, the names of seniors who are working for Departmental Honors in his major. Awards are based on grades obtained in the subject chosen, the results in extra work assigned, and the general proficiency of the candidate as evidenced by either a final examination or a thesis, as the head of the department involved may direct.

University Scholars registered in the College of Arts and Science must pass the comprehensive examination with distinction in order to qualify for graduation with Departmental Honors.

### Interdepartmental Honors

The Interdepartmental Honors Program is open to undergraduates from all three Colleges. It offers to students who have demonstrated outstanding ability the opportunity to devote part of their junior and senior years to independent study through a series of limited enrollment seminars and the writing of a thesis. The seminars, one in each of the four large areas of human knowledge, combine breadth, which balances the concentration in a major, with the depth which is possible in small classes of students carefully selected from all majors. The seminars and the thesis also provide a foretaste of the kind of work and of the standards the students will encounter in graduate and professional schools.

University Scholars in this program are graduated with Interdepartmental Honors if, in addition to meeting all requirements for graduation, they have:

(1) Completed three of the four Honors Seminars with an average grade of at least 3.33. (University Scholars are permitted to take all four Honors Seminars in which case the required average grade for graduation with Interdepartmental Honors is 3.25.)

(2) Completed an Honors Thesis with a grade of "A".

(3) Passed with distinction the senior comprehensive examination required by their major department.

(A University Scholar who has met all the requirements for graduation in his college but who fails to achieve the specified levels will receive his degree without Interdepartmental Honors.)

### Admission

Each sophomore eligible for admission to the College Honors Program will be notified of his eligibility early in his fourth semester. A

student is eligible to apply for admission if he has a cumulative three-semester average of at least 3.0, or in unusual cases, has had an outstanding record in his second and third semesters.

Admission requires the approval of the head of the department in which an applicant is majoring and of the Honors Council.

Each applicant will be notified of the decision on his application far enough in advance of preregistration for the ensuing fall semester to make appropriate plans.

In unusual situations, an outstanding student may, with the approval of the Honors Council, schedule one or more Honors Seminars without committing himself to the whole program. Such special permission will be granted, however, only when the Council feels certain that his admission will not interfere with the maximum effectiveness of the program for those regularly enrolled.

### The Program

A student admitted to the Interdepartmental Honors Program will:

(1) Continue with his departmental major.

(2) Schedule one Creative Concepts seminar (see course offerings, page 267) each semester of his junior year and at least one seminar during his senior year. (Those University Scholars who elect to schedule only three seminars are urged to schedule those which are farthest from their major field.)

(3) Schedule C.C.190, Honors Thesis (3 to 6 credits), during one or both of the semesters of his senior year or during the preceding summer. The work in this course will be directed by an approved member of the faculty and will culminate in the writing of an honors thesis.

University Scholars must file with the Chairman of Honors Programs a thesis proposal approved by their thesis adviser, department head, and the Interdepartmental Honors Council at least one week prior to the last day of registration for the semester during which C.C.190, Honors Thesis, is first scheduled.

The Interdepartmental Honors Program is administered by the Chairman of Honors Programs. The organization and conduct of the Honors Seminars will be directed by the Honors Council, which shall consist of (a) all faculty members currently teaching in the program or designated to teach in it, (b) the teacher or teachers who have conducted seminars during the preceding semester, and (c) the dean of the College, ex officio. Seminar teachers may be members of the faculty of any of the three colleges. The writing of the thesis will be directed by a member of the faculty with professorial rank.

University Scholars in the College of Arts and Science may, with the approval of the dean, substitute C.C. seminars for distribution courses other than foreign languages.

# THE COLLEGE OF ARTS AND SCIENCE

W. Ross Yates, *Dean of the College of Arts and Science*

The College of Arts and Science of Lehigh University comprises the departments of biology, classical languages, English, fine arts, geology, German, government, history, international relations, mathematics and astronomy, music, philosophy, psychology, religion, romance languages and social relations. Interdepartmental programs are offered in foreign careers, Natural Science, American Studies, and natural resources. Students in Arts and Science may also major in economics, accounting, finance, physics, and chemistry.

The degree of Bachelor of Arts is conferred upon graduates of the College.

## PURPOSES

Under the name "School of General Literature," the College of Arts and Science was a part of the original plan of the University, and its aims have remained constant, although the means employed have been adapted to the changing times.

The purpose of the College is to prepare a man for the exercise of his individual responsibility in the affairs of mature life. This purpose recognizes three distinguishing characteristics of an educated man: the ability to think in a disciplined manner, the ability and willingness to make discriminating judgments, and the capacity to apply his creative imagination.

In order to achieve this purpose the faculty shares with the student the range of human knowledge: the world of fact, and its counterpart, the world of ideas. The fundamentals of this experience remain what they have been for generations: a comprehensive study of all the broad areas of knowledge —the humanities, the natural and physical sciences, and the social sciences— and a rigorous training in one of them.

## PREPARATION FOR GRADUATE AND PROFESSIONAL SCHOOLS

A large proportion of the graduates of the College of Arts and Science continue their work in graduate or professional schools. Students preparing

for graduate or professional studies will work out a suitable program with the appropriate advisors.

Pre-Medical and Pre-Dental. Students preparing for medical or dental school will plan a program of studies in cooperation with the Dean of the College, the advisor of their major program, and the Pre-medical advisor, Assistant Professor Hayden N. Pritchard, Department of Biology. A Pre-Medical Advisory Committee assists in helping students prepare applications for medical or dental school.

Pre-Legal. Students interested in preparing for law school will work out a program of studies in cooperation with their major advisor. Information on requirements for entry into law school is available in the College Office and from Professor Rocco J. Tresolini, Chairman, Department of Government.

Pre-Theological. Students will select an appropriate major field and work out a program in connection with their major and spiritual advisors.

Graduate School. Students interested in preparing for graduate school will plan their program in collaboration with the department in which their major is located.

Teaching. Students planning teaching careers in primary or secondary schools are encouraged to select a major in the field in which they intend to teach and to postpone their professional courses in education to the graduate level. The School of Education provides information on graduate programs in education and requirements for certification in the several states.

## THE CURRICULA

The College of Arts and Science offers two curricula: the four-year curriculum with a major in one of the arts or sciences, and the five-year curriculum in Arts-Engineering. Both are based on the principles of distribution and concentration. Distribution requirements are the same for both curricula. In the Arts-Engineering program, the Engineering general studies requirements are met by completing the Arts College distribution requirements.

This reciprocal arrangement makes it impossible for an Arts-Engineer to qualify for a B.S. in engineering before he has met all requirements for the B.A.

### Distribution Requirements

The object of the distribution requirements is to give the student an elementary knowledge of the fields of contemporary thought and to orient him in the world of man and nature. The requirements also provide oppor-

tunities for students to take additional work in fields related to their major field of concentration.

The distribution requirements are administered by the dean of the College of Arts and Science in accord with the group regulations given below. The subjects required of the individual student depend in part upon the field in which he expects to major, in part upon his personal preference, and in part upon the subjects he has taken in secondary school.

Honors students in either curriculum may, with the approval of the dean, substitute Creative Concepts seminars for distribution courses other than foreign languages.

**I. Required Courses.**

A. FRESHMAN ENGLISH. The normal requirement is Engl. 1 and 2, Composition and Literature. Students who demonstrate satisfactory ability in written composition in the freshman placement tests will meet this distribution requirement by passing Engl. 11 and 12, Types of World Literature.

When a freshman completes Engl. 11 and 12 with a graduate of C or better, he is given, in addition to the 6 hours of credit for those courses, 6 hours of advance standing credit for Engl. 1 and 2.

B. MATH. 6, 21, or PHIL. 14. The course selected cannot also be used to satisfy the requirements enumerated under subheads III or IV below.

**II. Foreign Language.**

Number of hours varies depending on previous language study. Each student is required to achieve third-year level proficiency in one language, as determined by the appropriate language department. Students who present at entrance three or four years of foreign language normally are able to meet this requirement with one year of advanced college work. Eighteen hours of course work are normally taken by students who begin a new language in college.

A student is not allowed to receive college credit for course work in a language taken at a level lower than his previous study of that language warrants.

With the approval of the dean of the College, an option is offered those who find it necessary to pursue in college the study of two foreign languages, provided that neither language was studied in secondary school. Such students may offer in satisfaction of the language requirement two years (12 hours) of one foreign language and one year (6 hours) of another.

**III. Humanities.**

Twelve semester hours, chosen from at least two of the following groups:

A. LITERATURE (Courses in English or American Literature; Greek, Latin, or modern foreign literature in translation; or literature courses at the third-year level or higher in a foreign language, provided that such courses are not also used to satisfy the Foreign Language requirement).

B. FINE ARTS, MUSIC, OR ARCHAEOLOGY (if not used for social science requirement).

C. PHILOSOPHY.

D. RELIGION.

**IV. Natural Sciences and Mathematics**

Twelve semester hours, chosen from at least two of the following groups:

A. Astronomy.
B. Biology.
C. Chemistry.
D. Geology.
E. Mathematics.
F. Physics.
G. Psychology.

**V. Social Sciences.**

Twelve semester hours, chosen from at least two of the following groups:

A. Sociology, Cultural Anthropology, Social Psychology.
B. Ancient Civilization, History, Archaeology.
C. Government, International Relations, Economics.

## Concentration Requirements

### Concentration Requirements in Arts and Science

During the second semester of the freshman year if possible, and in any event no later than the end of the sophomore year, each student in the four-year Arts and Science curriculum must select some sequence of studies as his major field. *A major consists of at least twelve semester hours of advanced work in the field chosen.* Including preliminary college work, the minimum number of hours constituting a major is twenty-four. The actual major requirements are those stated under "Details of Major Sequences," pages 84-111.

The major work is designed to enable a student to master his chosen field so far as that is possible during undergraduate years. In all fields, certain courses are prescribed, but the mere passing of courses will not satisfy the major requirements. It is expected that the student will read widely in his subject and will prepare himself largely through his own reading and through independent work for his final comprehensive examination.

When a student selects a major, the head of the department offering the major or the official director of a non-departmental major becomes the student's major adviser and makes out his major program. This program must have the approval of the dean of the College, who continues to supervise the non-major portion of the student's roster.

### Concentration Requirements in Arts-Engineering

The standard major for students enrolled in the five-year Arts-Engineering curriculum is Applied Science (page 106). This major is normally completed during the first four years, during which the dean of the College of Arts and Science is the student's official adviser. At the end of the fourth

year it is expected that Arts-Engineering students will have taken their B.A. degree and will transfer to the appropriate engineering curriculum for their final year. The head of the appropriate engineering department, who has meanwhile been acting as adviser of the major sequence, becomes official adviser for the fifth year.

Pattern rosters which show the normal combination of courses for the first four years of the Arts-Engineering curriculum are given on pages 106-111.

Under special circumstances, Arts-Engineering students may take one of the other majors offered in the College of Arts and Science. Such a change in program, however, must have the approval of both the dean of the College of Arts and Science and the department chairman under whom work for the B.S. will be completed. In some instances it may be advisable to take the two degrees at the end of the fifth year.

To qualify for both the B.A. and the B.S. in Engineering, a student must submit for the second degree thirty credit hours in addition to the number required for the B.S. alone.

## SUPERVISION AND COUNSELING

Each student in the College of Arts and Science is considered from the beginning as an individual. The College expects every student to have a well-defined purpose at entrance, but recognizes the student's right to change his objectives and for that reason gives him time in which to find himself and establish the direction of his future career. To help the student in his decision, the College provides an advisory staff consisting of the dean of the College, his faculty assistants, and the directors of the major sequences. The individual program for each student is outlined tentatively in an interview with the dean of the College, or one of his assistants, at or before the beginning of the first semester of the freshman year. This preliminary program is determined by the nature and quality of the student's preparation and by his personal interests. The final program, which is made out in detail no later than the end of the sophomore year, takes into account, in addition, demonstrated aptitudes and pre-professional or vocational needs.

These individual programs admit of considerable elective choice, depending upon the demands of the distribution and concentration requirements. In general the student in the College of Arts and Science may elect any undergraduate course for which he has the prerequisites.

## REQUIREMENTS FOR GRADUATION

There are three basic requirements for graduation with a B.A. in either curriculum:

1. The completion with the required average of a minimum of 120 credit hours of collegiate work, apportioned so as to cover the distribution and concentration requirements. Physical education and basic courses in military or air science are carried in addition.

2. The passing of an impromptu writing test in the junior year.

3. The passing of a comprehensive examination in the major field.

### Junior English Impromptu

Toward the end of his junior year, each student in the College of Arts and Science must report to the department of English for an exercise in impromptu writing. Students found seriously deficient in this test are reported to the dean of the College, who may require that they take additional English without credit toward graduation.

Students in the College of Arts and Science who persistently use poor English may be reported at any time to the dean of the College. He may require that they undertake additional study in English without credit toward graduation.

### Comprehensive Examination

A comprehensive examination in the major subject is required of all students. This examination is given at the end of the senior year and may be oral or written or both. The comprehensive examination is given under the direction of the head of the major department. At least two University teachers and, whenever possible, representatives of at least two departments take part in the examination. At the discretion of the various departments, the appropriate Graduate Record Examination may be made a part of the comprehensive.

No student is allowed to take the senior comprehensive examination more than twice in any one field. In case of failure on the first attempt, a second trial is not permitted until a period of three months has passed.

### Arts—M. B. A. Program

This five-year, two-degree program is designed to meet the needs of competent students in any of the Arts and Science majors (other than Accounting, Economics, or Finance) who wish to supplement their liberal education with graduate training in business management.

The normal over-all time involved in the two-degree program is five years, but a certain amount of summer session work may be necessary for majors in the natural sciences. In addition to three hours in economics, which may be counted as part of the distribution requirements in Social Science, twenty-seven hours of basic business courses are necessary to meet the background requirements for the M.B.A. degree.

These background courses are:

| | | | |
|---|---|---|---|
| Fin. | 125. | Corporation Finance | (3) |
| Fin. | 129. | Money and Banking | (3) |
| Law | 1. | Business Law | (3) |
| Eco. | 45. | Statistical Method | (3) |
| Mkt. | 11. | Marketing | (3) |
| Acctg. | 108. | Fundamentals of Accounting | (3) |
| Acctg. | 115. | Cost Accounting | (3) |
| Eco. | 306. | Intermediate Economic Theory | (3) |
| Fin. | 326. | Problems in Financial Management (or other 300 level course) | (3) |

All students enrolled in this program will be required to take the Admission Test for Graduate Study in Business.

Arts and Science students who are interested in this program should confer with Dean L. Reed Tripp for additional information.

Transfer credits from a reputable accredited college or university will be accepted for background courses. Students wishing to take some of their background work elsewhere should consult Dean Tripp, Director of the Graduate Programs, to obtain approval of the proposed course or courses and of the institution at which they are to be taken.

## HONORS AND UNSCHEDULED WORK

Qualified students in both curricula in the College of Arts and Science may choose to work for either Departmental or Interdepartmental Honors. Particularly well-qualified students sometimes work for both.

### Departmental Honors

Departmental honors are awarded at the end of the senior year, on recommendation of the head of the department concerned and by vote of the faculty, to students who have done advanced work of unusual merit in some chosen field. A candidate for departmental honors must announce to his major adviser, not later than the end of his junior year, his intention to work for Departmental Honors. Each major adviser shall send the registrar and the dean of the college, no later than the close of registration of each fall semester, the names of seniors who are working for Departmental Honors in his major. Awards are based on grades obtained in the subject chosen, the results in extra work assigned, and the general proficiency of the candidate as evidenced by a thesis. No student who fails to pass his comprehensive examination with distinction is graduated with departmental honors.

A student in Departmental Honors is granted a waiver of graduate standing to take courses numbered 400 and above if the student has the course prerequisites and if his semester schedule does not exceed fifteen hours.

### Interdepartmental Honors

The Interdepartmental Honors Program offers students who have demonstrated outstanding ability the opportunity to devote part of their junior

and senior years to independent study through a series of limited enrollment seminars and the writing of a thesis. For a description of the program see p. 75.

Honor students in the College of Arts and Science may, with the approval of the dean, substitute C. C. seminars for distribution courses other than foreign languages.

### Unscheduled Work

On the advice of the head of the student's major department and with the consent of the dean of the College, a junior or a senior of unusual merit who wishes to concentrate in his chosen field may be allowed to substitute not more than four or six hours respectively of unscheduled work per semester for an equal number of hours of elective work otherwise required for graduation.

This provision is particularly useful for the honors candidate who wishes to pursue independent study in connection with his extra work of honors thesis. Interested students should consult their department chairmen.

## Details of Major Sequences

### Major Sequences in Arts and Science

**American Studies:** This is an interdepartmental major emphasizing the idea that the institutions and values of a society comprise a whole and not merely a sum of separate parts. By concentrating on the unique expressions of individuals contained in the literature of America and by studying the historical movements within which these expressions develop, American Studies reveals relationships which may not be clearly seen within the framework of a single discipline. By carefully chosen electives the student can add to the insights of literature and history. Thus, for example, a student may pursue the relationship of the behavioral sciences to history and literature or use the various disciplines to give greater comprehension of the problems of the American city. In addition, the study in depth of one's own environment provides the student with a greater awareness of the forces which have shaped his world and his character and should produce a greater sensitivity to the values of his own society.

The major consists of sequences in American history and literature, followed by eighteen hours of advanced study divided equally between American history and American literature. Six hours of either European literature or European history will be taken after consultation with the director. In his senior year the student will take two seminars, respectively, in

literature and history organized around some single theme in their respective fields. The major requirements total 42 hours.

Because the emphasis is strongly placed on American history and literature, an undergraduate American Studies major will provide thorough preparation for graduate work in American Studies and, with suitable collateral courses, American literature or American history. In addition, the major may help in preparing students for advanced work in law, theology, and teaching in secondary schools and community colleges.

A committee appointed by the Dean of the College and headed by a Director administers the major in American Studies.

**Required Preliminary Courses**

| | | | |
|---|---|---|---|
| Hist. | 13, 14. | American Civilization | (6) |
| Engl. | 20, 21. | American Literature | (6) |

**Required Major Courses**

| | | | |
|---|---|---|---|
| Engl. | 321. | 20th Century American Literature) | |
| Engl. | 341. | Contemporary American Literature) | |
| Engl. | 343. | American Romanticism ) | (9) |
| Engl. | 344. | American Realism ) | |
| Hist. | 319. | 17th Century America ) | |
| Hist. | 320. | 18th Century America ) | |
| Hist. | 327. | American Intellectual History ) | (9) |
| Hist. | 328. | American Intellectual History ) | |

**Option**

| | | |
|---|---|---|
| Hist. Option — | 6 Hours European History ) | |
| Engl. Option — | 6 Hours European Literature) | (6) |

(Choice to be made in consultation with Director)

**Required Senior Seminars**

| | | |
|---|---|---|
| Engl. | 345. | Themes in American Literature) |
| Hist. | 374. | Themes in American History) |

Electives will be chosen in view of the student's developing interests and in consultation with the director.

**Biology.** The biology major serves several purposes. It provides training for students aiming for graduate study in any of the biological sciences. The program also exceeds the minimum science requirements for admission to medical, dental and allied professional colleges. Finally, the major offers a terminal A.B. degree for students interested in the science of life yet aiming for a career in the business world, teaching at the pre-college level, or some other profession.

To fulfill all of these functions the biology major combines a maximum choice of biology elective courses with a strong requirement in chemistry, physics and mathematics. This enables students to channel their biology training along paths suitable to their interests, aims and competence while, at the same time, it ensures adequate training in other sciences upon which much of contemporary biology is based.

The required biology courses include 7 hours scheduled in the freshman year (Biol. 21, 22, 28 — Introductory Biology and Genetics) and 3 hours scheduled in the senior year (Biol. 272 — Senior Seminar). In ad-

dition the student is required to elect 18 credits from the following list of biology courses:

| | | | |
|---|---|---|---|
| Biol. | 34 | Comparative Vertebrate Anatomy | (4) |
| Biol. | 35 | Microbiology | (3) |
| Biol. | 221 | Undergraduate Research | (3) |
| Biol. | 261 | Special Topics in Biology | (1-3) |
| Biol. | 303 | Advanced Invertebrate Zoology | (3) |
| Biol. | 306 | Ecology | (3) |
| Biol. | 313 | General Histology | (3) |
| Biol. | 314 | Vertebrate Embryology | (3) |
| Biol. | 320 | Physiology | (3) |
| Biol. | 334 | Growth and Development in Plants | (3) |
| Biol. | 336 | Evolution of Land Plants | (3) |
| Biol. | 353 | Virology | (3) |
| Biol. | 361 | Sanitary Microbiology | (3) |

For students interested in applying to medical, dental or veterinary colleges, Biol. 34, Comparative Vertebrate Anatomy, and Biol. 314, Vertebrate Embryology, are recommended electives.

For students interested in graduate study, Chem. 91, Physical Chemistry, and Chem. 371, Elements of Biochemistry, are suitable electives that may be substituted for biology electives. For these students an additional mathematics course, Math. 23, is recommended, as well as substitution of Physics 3 & 4 for Physics 16 & 17.

| | | |
|---|---|---|
| Math. | 21 | Anal. Geo. & Calc. I |
| Math. | 8 | Elem. Statistics |
| or | | |
| Math. | 22 | Anal. Geo. & Calc. II |
| Chem. | 1 & 11 | Chem. Principles I & Lab. |
| Chem. | 3 & 13 | Chem. Principles II & Lab. |
| Chem. | 51, 52 & 53 | Organic Chem. & Lab. |
| Chem. | 39 | Analytical Chemistry |
| Phys. | 1, 16 & 17 | Mech. of Mass Points, General Phys. & Lab. |

Recommended Sequence of Courses

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Biol. | 21 | Principles of Biology | 3 | Biol. | 18 | Genetics | 3 |
| Biol. | 22 | Introd. Biology Lab. | 1 | Chem. | 3 | Chem. Principles II | 3 |
| Chem. | 1 | Chem. Principles I | 3 | Chem. | 13 | Chem. Principles II Lab. | 1 |
| Chem. | 11 | Chem. Principles I Lab. | 1 | Math. | 8 | Elem. Statistics | 3 |
| Math. | 21 | Anal. Geo & Cal. I | 4 | or | | | |
| | | | | Math. | 22 | Anal. Geo. & Cal. II | 4 |
| **Sophomore Year** | | | | | | | |
| Chem. | 51 | Organic Chem. | 3 | Chem. | 52 | Organic Chem. | 3 |
| Chem. | 53 | Organic Chem. Lab. | 2 | Phys. | 16 | General Physics | 3 |
| Phys. | 1 | Mech. of Mass Points | 3 | Phys. | 17 | General Physics Lab. | 2 |
| Biol. | | Elective | 3 | Biol. | | Elective | 3 |
| **Junior Year** | | | | | | | |
| Chem. | 39 | Anal. Chem. | 3 | Biol. | | Electives | 6 |
| Biol. | | Elective | 3 | | | | |
| **Senior Year** | | | | | | | |
| Biol. | | Elective | 3 | Biol. | 272 | Senior Seminar | 3 |

Biology: Natural Resources Option. Students interested in natural resources and their conservation may take the major in biology, slightly modified to permit taking collateral courses in geology and other pertinent fields.

**Chemistry.** Students in the College of Arts and Science who wish to major in Chemistry should consult the general description given on pages 135 and 136 of this catalog. The B.A. degree with major in Chemistry

permits somewhat greater latitude in the selection of courses than does the B.S. degree curriculum, but does require the student to take six more hours of language than the B.S. candidate. Adequacy in German will be found beneficial for those having a professional interest in Chemistry (See German requirements on page 95). Premedical students should note that the B.A. program in Chemistry has sufficient latitude to permit a very strong preparation for medical school.

It is to be emphasized that both B.A. and B.S. degrees are drawn up to permit a graduate to embark immediately upon graduate school work.

**FRESHMAN YEAR**

**Required Preliminary Courses**

| | | | |
|---|---|---|---|
| Chem. | 1, 11; 3, 13 | Chemical Principles | (8) |
| Math. | 21, 22 | Anal Geo. & Cal. I and II | (8) |
| Phys. | 1. | Mech. of Mass Points | (3) |

**Required Major Courses**

**SOPHOMORE YEAR**

| | | | |
|---|---|---|---|
| Math. | 23. | Anal. Geo. & Cal. III | (4) |
| Phys. | 3. | Heat and Electricity | (4) |
| Phys. | 4. | Elec. Light & Atom. Phys. | (4) |
| Chem. | 51, 52. | Organic Chemistry | (6) |
| Chem. | 53, 54. | Organic Chemistry | (4) |
| Chem. | 91. | Physical Chemistry | (3) |

**JUNIOR YEAR**

| | | | |
|---|---|---|---|
| Chem. | 190. | Physical Chemistry | (3) |
| Chem. | 192. | Physical Chemistry Laboratory | (1) |
| Chem. | 193. | Physical Chemistry Laboratory | (1) |
| Chem. | 235. | Analytical Chemistry | (3) |
| Chem. | 302. | Principles of Inorganic Chemistry | (3) |
| Chem. | 352. | Heterocyclic Compounds | (3) |
| Chem. | 358. | Advanced Organic Chemistry | (3) |

**SENIOR YEAR**

| | | | |
|---|---|---|---|
| Chem. | 236. | Analytical Chemistry | (3) |
| Chem. | 381. | Radiation and Structure | (3) |
| Chem. | 382. | Structure, Electrochem, and Kinetics and a selection from the following | (3) |
| Chem. | 303. | Nuclear and Radiochem | (3) |
| Chem. | 305. | Systematic Inorganic Chem. | (3) |
| Chem. | 306. | Inorganic Preparations | (2) |
| Chem. | 371. | Elements of Biochemistry | (3) |
| Chem. | 372. | Advanced Biochemistry | (3) |
| Chem. | 377. | Biochemistry Laboratory | (1-3) |
| Chem. | 378. | Biochemical Preparations | (1-3) |
| Chem. | 375. | Research Chem. Laboratory | (3) |
| Chem. | 392. | Polymer Science | (3) |
| Chem. | 397. | Colloid and Surface Chem. | (3) |

**Classical Languages.** Majors in Classical Languages seek, through insight into the culture of ancient Greece and Rome, to gain an appreciation of Greco-Roman achievements in art, literature, philosophy, and science, and to formulate an evaluation of the importance of these for modern culture. Readings in the original languages of masterpieces, chosen both for their usefulness in developing skill in the languages and for their intrinsic worth and abiding importance, aim at developing an accumulative growth in the mastery of the languages and in the ability to interpret, criticize, and evaluate the achievements of classical civilization.

The basic work is supplemented by studies in the history, archaeology, art, philosophy, and literary history of Greece and Rome, and by an introduction to the basic tools and disciplines of scholarly research in this area. Students are encouraged to undertake research in fields of their own interest.

Classical Languages as a major has stood the test of time, offering a general cultural background for careers in widely diverse fields in the professions, business, and public service. It has particular relevance as a preparation for careers in teaching, law, writing, archaeology, and the church.

Lehigh University is a cooperating institution of The American School of Classical Studies at Athens. Graduates of Lehigh University receive free tuition in the School.

## Group 1 (Emphasis upon Greek).

**Required Preliminary Courses**

| | | | | |
|---|---|---|---|---|
| Gk. | 1, | 2. | Elementary Greek | (6) |
| Gk. | 3, | 4. | Second-Year Greek | (6) |

**Required Major Courses**

| | | | | |
|---|---|---|---|---|
| Gk. | 11, | 12. | Greek Drama | (6) |
| Gk. | 13. | | Greek Historians | (3) |
| Gk. | 16. | | Greek Epic | (3) |
| Gk. | 311. | | Homer | (3) |
| Gk. | 316. | | Plato | (3) |
| Gk. | 21. | | Ancient History | (3) |
| Lat. | 22. | | Ancient History | (3) |

Six hours of Latin language, specific courses depending on the student's preparation.

## Group 2 (Emphasis upon Latin).

**Required Preliminary Courses**

| | | | |
|---|---|---|---|
| Lat. | 61. | Elementary Latin | (3) |
| Lat. | 62. | Caesar | (3) |
| Lat. | 63. | Nepos and Cicero | (3) |
| Lat. | 65. | Vergil | (3) |

**Required Major Courses**

| | | | |
|---|---|---|---|
| Gk. | 21. | Ancient History | (3) |
| Lat. | 22. | Ancient History | (3) |
| Lat. | 166. | Horace | (3) |
| Lat. | 167. | Roman Prose Writers | (3) |
| Lat. | 168. | Latin Drama | (3) |
| Lat. | 169. | Satire | (3) |
| Lat. | 211. | Readings | (3) |
| Lat. | 212. | Readings | (3) |

Six hours of Greek language, specific courses depending upon the student's preparation.

**Recommended Electives**

| | | | |
|---|---|---|---|
| Astr. | 1. | Descriptive Astronomy | (3) |
| Astr. | 2. | General Astronomy | (3) |
| F.A. | 1. | Survey of Painting and Sculpture | (3) |
| F.A. | 3. | Pre-Renaissance Architecture | (3) |
| Hist. | 25. | European History | (3) |
| Hist. | 351. | The Middle Ages | (3) |
| Phil. | 231. | Ancient Philosophy | (3) |
| S.R. | 31. | Cultural Anthropology | (3) |

**Conservation.** See Natural Resources, page 99.

**Economics and Business Administration.** Three majors are offered in the field of economics and business administration: economics, finance, and accounting.

See also the Arts-M.B.A. Program, page 122.

## Economics.

**Required Preliminary Courses**

**FRESHMAN YEAR**

| | | | |
|---|---|---|---|
| Eco. | 3, | 4. | Principles of Economics ..... (6) |
| Math. | 21. | | Analytic Geo. and Cal. I ..... (4) |
| Math. | 6. | | Finite Math. ..... (3) |

**Required Major Courses**

**SOPHOMORE YEAR**

| | | |
|---|---|---|
| Eco. | 306. | Intermediate Micro-Theory ..... (3) |
| Eco. | 316.[1] | Intermediate Macro-Theory ..... (3) |
| Eco. | 45. | Statistical Method ..... (3) |
| Fin. | 129. | Money & Banking ..... (3) |

**JUNIOR YEAR**

(6)[2]

**SENIOR YEAR**

(6)[2]

**TOTAL** 37

[1]This course should be to macro economic theory what Eco. 306 is to micro economic theory.
[2]This represents a minimum of twelve hours. The student is to select these from the available 300 level economics and finance courses.

## Finance.

**Required Preliminary Courses**

**SOPHOMORE YEAR**

| | | | |
|---|---|---|---|
| Eco. | 3, | 4. | Economics ..... (6) |
| Math. | 21. | | Anal. Geo. and Cal. I ..... (4) |
| Math. | 6. | | Finite Math. ..... (3) |

**Required Major Courses**

**JUNIOR YEAR**

| | | | |
|---|---|---|---|
| Fin. | 125. | | Principles of Corporation Finance ..... (3) |
| Fin. | 129, | 130 | Money and Banking ..... (6) |
| Fin. | 326. | | Problems in Financial Management ..... (3) |
| Eco. | 45. | | Statistical Method ..... (3) |
| Acctg. | 108. | | Fundamentals of Accounting ..... (3) |

**SENIOR YEAR**

| | | |
|---|---|---|
| Fin. | 323. | Investments ..... (3) |
| Fin.. | 351. | Public Finance: Federal ..... (3) |
| Eco. | 306. | Intermediate Economic Theory ..... (3) |

plus nine hours selected from the following:

| | | | |
|---|---|---|---|
| Acctg. | 305. | | Financial Statements and Reports ..... (3) |
| Eco. | 301. | | Business Management ..... (3) |
| Fin. | 337. | 338. | International Economics ..... (6) |
| Fin. | 324. | | Investments ..... (3) |
| Fin. | 331. | | Bank Credit Management ..... (3) |
| Fin. | 332. | | Monetary-Fiscal Policy ..... (3) |
| Fin. | 352. | | Public Finance: State and Local ..... (3) |
| Law | 1. | | Business Law ..... (3) |
| Eco. | 336. | | Business and Government ..... (3) |
| Eco. | 346. | | Business Cycles and Forecasting ..... (3) |

Accounting.*

Required Preliminary Courses

| | | | |
|---|---|---|---|
| Acctg. | 1, 2. | Accounting | (6) |
| Eco. | 3, 4. | Economics | (6) |
| Math. | 21. | Anal. Geo. and Cal. I | (4) |
| Math. | 6. | Finite Math. | (3) |

Required Major Courses

| | | | |
|---|---|---|---|
| Acctg. | 13, 14. | Intermediate Accounting | (6) |
| Acctg. | 115. | Cost Accounting | (3) |
| Fin. | 125. | Corporation Finance | (3) |
| Fin. | 129. | Money and Banking | (3) |
| Law | 1, 102. | Business Law | (6) |

plus nine semester hours to be selected from the following:

| | | | |
|---|---|---|---|
| Acctg. | 203, 204. | Federal Tax Accounting | (6) |
| Acctg. | 304. | Governmental and Institutional Acctg. | (3) |
| Acctg. | 315. | Advanced Accounting | (3) |
| Acctg. | 318. | Advanced Cost Budgeting and Analysis | (3) |
| Acctg. | 320. | Auditing | (3) |
| Acctg. | 325. | Controllership | (3) |

*Students interested in qualifying for the C.P.A. certificate in the State of New York should consult the head of the Department of Accounting.

Recommended Electives

| | | | |
|---|---|---|---|
| Eco. | 301. | Business Management | (3) |
| Eco. | 306. | Intermediate Economic Theory | (3) |
| Eco. | 45. | Statistical Method | (3) |
| Eco. | 346. | Business Cycles and Forecasting | (3) |
| Fin. | 323. | Investments | (3) |
| Law | 204. | Wills, Estates, and Trusts | (3) |

**English.** Two majors are offered by the department of English: English literature, and journalism.

English Literature.

Literature is a representation of life at the level of man's individual, human dealings with his fellow men. It is man's response to the physical, emotional, intellectual, and moral conditions of his existence. A literary work is one author's ordering and interpretation of his experience, revealing whatever wisdom and beauty his vision of the universe affords him. It both illuminates human experience and is a joy forever.

When these works are seen as the diverse and yet unified expressions of an epoch, they provide insight into the human problem and solution at a particular moment in time. Put together epoch after epoch, they thus become, in a peculiarly rich and inward sense, a form of history. Among world literatures English is perhaps the most varied and splendid and, together with American literature, presents in today's international setting an unusual breadth of national, racial, regional, and cultural subjects.

The English major student will come to know the varied richness of this literature. So that he may learn how to read thoughtfully and sensitively, he will be taught how to analyze the basic processes of the literary art. His own skill in using the written word will grow as he studies intensively the writings of those who have shown themselves to be the supreme masters of the skill. Above all, he will be challenged to formulate honest reactions to his reading just as writers originally did when confronted by experience; and so, by integrating his own experience with what Matthew Arnold called "the

best that has been thought and said," he will come to perceive whatever wisdom and beauty his own enriched vision will afford him. The resulting enlargement of mind and spirit not only should produce a flexible, yet well-integrated, personality but also can be put at the service of society in whatever profession or enterprise the student may undertake.

**Required Preliminary Courses**

| | | | | |
|---|---|---|---|---|
| Engl. | 1, | 2. | Composition and Literature .....(6) | |
| or | | | | (6) |
| Engl. | 11, | 12 | Types of World Literature .....(6) | |
| and | | | | |
| Engl. | 8, | 9. | English Literature .....(6) | |

**Required Major Courses**

| | | | |
|---|---|---|---|
| Engl. | 323, 324. | Shakespeare and the Elizabethan Drama | (6) |
| and twenty-four semester hours from the following courses: | | | |
| Engl. | 183, 184. | Readings in English Literature | (6) |
| Engl. | 321, 322. | Twentieth-Century Literature | (6) |
| Engl. | 325. | English Literature of the Romantic Era | (3) |
| Engl. | 326. | English Literature of the Victorian Era | (3) |
| Engl. | 331. | Milton | (3) |
| Engl. | 333. | Restoration and Augustan Literature | (3) |
| Engl. | 334. | The Age of Johnson | (3) |
| Engl. | 335. | History of the English Language | (3) |
| Engl. | 336. | Writing for Publication | (3) |
| Engl. | 337. | The Renaissance | (3) |
| Engl. | 338. | The Seventeenth Century | (3) |
| Engl. | 339. | Chaucer | (3) |
| Engl. | 340. | Advanced Composition | (3) |
| Engl. | 341, 342. | Contemporary Literature | (6) |
| Engl. | 343. | American Romanticism | (3) |
| Engl. | 344. | American Realism | (3) |
| Engl. | 345. | Themes In American Literature | (3) |
| Engl. | 346. | Middle English Literature | (3) |

Up to six hours of related courses in other departments may be substituted with the approval of head of department.

Collateral courses are recommended in history, philosophy, history and criticism of the fine arts, and classical and modern languages and literature. Students planning to pursue graduate studies should acquire a reading knowledge of German, French, and Latin as undergraduates.

Journalism.

Journalism is concerned with the exercise of social responsibility in human affairs; the profession of journalism deals with the truthful communication of facts and their explanation. It is the purpose of the program in journalism to bring its majors: (1) to the point where they can gather significant information, organize it quickly into effective form, and communicate it clearly, accurately, and with a disciplined objectivity; and (2) to an understanding of the legitimate role of the press in society.

The first of these objectives is obtained by extensive, professionally oriented practice in the writing, reporting, and editing of public affairs. The skill thus acquired is firmly rooted in rigorous training in vocabulary, in precision of expression, and in sophistication in style. It is concerned with clear writing and careful reporting, the kind that depicts the meaning of events. It develops from a purposeful curiosity and a capacity to be imaginatively in-

terested in human activity. The second objective is obtained: (1) by study of the rights and responsibilities of the press under the constitution, with emphasis upon the freedom of the press as conditioned by the liberties of the individual and the needs of society; (2) by examination of the journalistic tradition in the United States in relation to the political, economic, and social progress of the population; and (3) by independent study, culminating in an undergraduate thesis, of the press and society.

The basic program in journalism provides opportunity for concentration in at least one of the following areas: ancient history, economics, government, history, international relations, literature, philosophy, science, and sociology.

While the great majority of graduates in journalism enter some phase of written communication as a career—daily newspaper, wire services, magazine, public or industrial relations, advertising, technical writing—others have used their background in journalism as a base for the study and practice of law, service in government, teaching, business management, and graduate study in a variety of disciplines.

**Required Preliminary Courses**

| | | | |
|---|---|---|---|
| Journ. | 1-2. | Brown and White | (2) |
| Journ. | 11. | News Writing | (3) |

**Required Major Courses**

| | | | |
|---|---|---|---|
| Journ. | 3-8. | Brown and White | (2-6) |

(Brown and White must be rostered each semester while the student is in the Journalism major.)

| | | | |
|---|---|---|---|
| Journ. | 12. | Reporting of Public Affairs | (3) |
| Journ. | 17. | Magazine Article Writing | (3) |
| Journ. | 113. | Editing | (3) |
| Journ. | 115. | Interpretive Writing | (3) |
| Journ. | 120. | Journalism Proseminar | (3) |
| Journ. | 121, 122 | Law of the Press | (6) |
| Gk. | 21. | Ancient History | (3) |
| or | | | |
| Lat. | 22. | Ancient History | (3) |
| Phil. | 15. | Ethics | (3) |

**Recommended Electives**

Majors in journalism are advised to enroll in certain courses in economics, English, government, history, international relations, philosophy, and sociology. Electives should be chosen in consultation with the major adviser.

## Fine Arts.

Throughout history each civilization has found its identity in the creative expression of its artists. By his understanding and practice of the arts, man frequently is able to lead the way to new ideas of enduring importance. We pursue the study of art with these facts in mind.

Our courses in history and appreciation of art are given in lecture form. Ten thousand slides and over eight thousand books, monographs and indexed periodicals provide reference. Current exhibitions and the Permanent Collection afford additional study and research materials.

Drawing and painting courses focus on developing technical skills, on increasing sensitivity in response to content and broadening intellectual per-

ception, all in relation to increased creativity. For these the student must become familiar with artistic conventions of the past and with contemporary trends. Formal problems provide sequential steps and the measure of increased facility. Each student's creative expression is constantly encouraged. His understanding of man in relation to nature and society is developed to further his individual performances in art.

Architectural drafting room practices are related to the problems of man-space-function and good design. Here the concern is with the efficient and the beautiful. A study is made of the needs of man, of the effects of spatial environment and of the engineering requirements of structure and locale.

The creative solution becomes a problem of integrating site, plan, and structure with all determining factors in an artistic manner.

Visiting architects, visits to in-process buildings and to architects' offices assist in comprehending the practices and practical side of architecture.

**Required Preliminary Courses**

| | | | |
|---|---|---|---|
| F.A. | 1, 2. | Survey of Painting and Sculpture | (6) |
| F.A. | 31 or 32. | Elements of Art | (3) |
| Phil. or Phil. or Psych. | 14. or 15. or 1. | Logic or Ethics or Introduction to Psychology | (3)* |

**Required Major Courses**

| | | | |
|---|---|---|---|
| F.A. | 3. | Pre-Renaissance Architecture | (3) |
| F.A. | 4. | Architects and Architecture | (3) |
| F.A. | 15. | Italian Ren. Art | (3) |
| F.A. | 216. | Art in the United States | (3) |
| F.A. | 219. | Nineteenth Century Art | (3) |
| F.A. | 220. | Form and Milieu in Twentieth Century Art | (3) |
| F.A. | 33, 34. | Painting Practices and Principles | (6) |
| Phil. | 100. | Philosophy of Contemporary Civilization | (3) |
| Mus. | | Approved Course | (3) |

**Plus one of the following pair of courses:**

For students emphasizing architecture:

| | | | |
|---|---|---|---|
| F.A. | 41. | Basics in Architecture | (3) |
| F.A. | 42. | Contemporary Architectural Design | (3) |

For students emphasizing painting:

| | | | |
|---|---|---|---|
| F. A. | 131,132. | Advanced Studio Practice | (6) |

*Students emphasizing architecture may substitute Math. 21, Mech. 1 or C.E. 11.

**Foreign Careers.** The interdepartmental major in Foreign Careers is designed to give students the grounding in language, history, economics, and related subjects needed for successful work with private industry or governmental agencies in their overseas activities. The program is under the direction of Professor Finn B. Jensen of the department of economics.

Each student in the program will schedule all courses in the Common Core and in one of the Options. In addition, he will, in consultation with the director, select courses in language, history, and other subjects which will give him an intensive knowledge of the culture of the area in which he is interested. Students electing the Russian area option will be expected to study Russian.

The program also affords a broad base for graduate study in social

sciences and business administration. Students interested in this aspect of the major sequence should consult the director early in their college careers.

### Common Core

**Required Preliminary Courses**

| | | | |
|---|---|---|---|
| Eco. | 3, 4. | Economics | (6) |
| Govt. | 3. | Foreign Governments | (3) |
| Math. | 21. | Anal. Geo. and Cal. I | (4) |
| Math. | 6. | Finite Mathematics | (3) |
| Eco. | 45 | Statistical Method | (3) |

**Required courses for students concentrating in the Latin American area.**

| | | | |
|---|---|---|---|
| Eco. | 305. | Economic Development of Latin America | (3) |
| S.R. | 367. | Latin American Social Institutions | (3) |
| Hist. | 49, 50. | History of Latin America | (6) |
| Hist. | 365, 366. | Modern Latin America | (6) |

**Required Courses for students concentrating in the European area.**

| | | | |
|---|---|---|---|
| Eco. | 309. | Comparative Economic Systems | (3) |
| Hist. | 351. | *The Middle Ages | (3) |
| Hist. | 352. | *Renaissance and Reformation | (3) |
| Hist. | 353, 354. | European History, 1648 to the Present | (6) |

*Hist. 355 and Hist. 356 may be substituted for Hist. 351 and Hist. 352.

**Required courses for students concentrating in the Russian area.**

| | | | |
|---|---|---|---|
| Eco. | 309. | Comparative Economic Systems | (3) |
| Govt. | 362. | The Soviet System of Government | (3) |
| I. R. | 133, 134. | Diplomacy of Russia | (6) |
| I. R. | 334. | The Soviet Union in World Affairs | (3) |
| Hist. | 354. | European History, 1648 to the Present | (3) |

### Foreign Trade Option

| | | | |
|---|---|---|---|
| Acctg. | 1. | Accounting | (3) |
| or | | | |
| Acctg. | 108. | Fundamentals of Accounting | (3) |
| Fin. | 129. | Money and Banking | (3) |
| Fin. | 337, 338. | International Economics | (6) |
| | | Six hours of economics or finance in consultation with the adviser | (6) |

### Public Administration Option

| | | | |
|---|---|---|---|
| Acctg. | 1. | Accounting | (3) |
| or | | | |
| Acctg. | 108. | Fundamentals of Accounting | (3) |
| I.R. | 352. | International Organization | (3) |
| or | | | |
| I.R. | 361. | International Law | (3) |
| Fin. | 351. | Public Finance | (3) |
| Govt. | 360. | Public Administration | (3) |
| Govt. | 363. | Contemporary Political Thought | (3) |
| or | | | |
| Govt. | 364. | Contemporary Political Thought | (3) |
| Govt. | 361. | Comparative Administrative Systems | (3) |

### Open Option

In place of any of the three preceding options, a student may take an Open Option by meeting the advanced course requirements for one of the other Arts College majors. The Open Option is most feasible with humanities and social science majors but will require a careful combining of distribution courses and free electives with the eighteen hours normally given to the option. Students interested in the Open Option should consult the director of the Foreign Careers major as early as possible.

**Geology.** Geology is the science which deals with natural phenomena on or within the earth. It is a science which makes use of most other scientific disciplines in its practice; hence the student of geology must combine

thorough training in geology with a broad understanding of physical, chemical, and biological principles. The undergraduate program in geology at Lehigh emphasizes this relationship. About one-half of the courses required in the major are in geology; about one-half are in the collateral sciences. Students interested in geochemistry, geophysics, or geological engineering may be permitted to substitute certain additional courses in collaeral sciences or engineering for some required geology courses.

An extended field trip is held each year for advanced undergraduates in conjunction with work in advanced required major courses.

Attendance at an approved summer field camp is required for all majors. Lehigh does not operate its own field camp but arrangements are easily made for Lehigh students to attend field camps operated by other colleges and universities. In certain cases equivalent experience is accepted in lieu of attendance at field camp.

Geological training may be utilized in industry (especially in the petroleum, mining, highway construction, ceramics, and metallurgical industries), government service and in secondary school and college teaching.

**Required Preliminary Courses**

**FRESHMAN YEAR**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Geol. | 1 | Principles of Geology | 3 | Geol. | 2 | Principles of Geology | 3 |
| Chem. | 1 | Chemical Principles I | 3 | Chem. | 3 | Chemical Principles II | 3 |
| Chem. | 11 | Chemical Principles Lab. II | 1 | Chem. | 13 | Chemical Principles Lab. II | 1 |
| Math. | 21 | An. Geom. and Cal. I | 4 | Math. | 22 | Analytic Geometry and Cal. II | 4 |

**Required Major Courses**

**SOPHOMORE YEAR**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Geol. | 13 | Sedimentation | 3 | Geol. | 23 | Structural Geology | 3 |
| Phys. | 1 | Mechanics of Mass Points | 3 | Phys. | 16 | General Physics | 3 |
| Chem. | 39 | Analytical Chemistry | 3 | Phys. | 17 | General Physics Lab. | 2 |

**JUNIOR YEAR**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Geol. | 301 | Intro. to Geophysics | 3 | Geol. | 311 | Paleontology | 3 |
| Geol. | 333 | Crystallography | 3 | Geol. | 336 | Min. Phase Relations | 3 |
| Biol. | 21 | Principles of Biology | 3 | Geol. | 310 | Computer Applications | 1 |
| Biol. | 22 | Intro. to Biol. Lab. | 1 | | | | |

**SENIOR YEAR**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Geol. | 315 | Regional Stratigraphy | 3 | Geol. | * | | |
| Geol. | 334 | Petrology and Petrography | 4 | Geol. | * | | |

*Chosen with approval of major adviser from Geol. 302 (3), Geol. 337 (3), Geol. 351 (2), Geol. 354 (4), Geol. 357 (3), Geol. 390 (3).

Recommended electives in collateral sciences and engineering: Math. 23 (4), Phys. 3, 4 (8) (may be taken in place of Phys. 16, 17), Chem. 91, 190 (6) or Chem. 95 (3), Met. 333 (3), Biol. 306 (3), C. E. 239 (3), Astr. 1 (3).

**German.** In this major, required courses in the German language and literature constitute a core around which the student can build a program of study providing a broad as well as sound understanding not only of German cultural contributions per se but also as part of the culture of the Western World. Specific courses other than those listed will depend upon each student's previous educational experience; but, in general, collateral work should

include ancient and modern European history, fine arts, music, and the languages and literatures of other peoples, especially the English, French, Greeks and Romans.

**Required Preliminary Courses**

| | | | |
|---|---|---|---|
| Ger. | 1, 2. | Elementary German | (6) |
| Ger. | 11, 12. | Intermediate German | (6) |

**Required Major Courses**

| | | | |
|---|---|---|---|
| Ger. | 31. | Conversation and Composition | (3) |
| Ger. | 41, 42. | Survey of German Literature | (6) |
| Ger. | 251. | Goethe's Faust | (3) |

and at least two of the following:

| | | | |
|---|---|---|---|
| Ger. | 32. | Conversation and Composition | (3) |
| Ger. | 202. | The German Novelle | (3) |
| Ger. | 203. | Nineteenth Century German Drama | (3) |
| Ger. | 205. | Twentieth Century German Literature | (3) |
| Ger. | 211. | Nineteenth Century German Lyric Poets | (3) |
| Ger. | 212. | Modern German Lyric Poetry | (3) |
| Ger. | 250. | Special Topics | (3) |
| Ger. | 301, 302. | The Age of Goethe | (6) |
| Ger. | 321. | Middle High German | (3) |
| Ger. | 335. | German Poetry | (3) |

**Government.** The major in government is designed to promote understanding of political ideas, institutions, and practices; to develop skill in the analysis and appraisal of political problems; and to encourage an unbiased consideration of controversial issues in the governmental field. Various courses deal with both the theoretical aspects of government in general and the machinery, processes, functions, and purposes of government in the United States and other countries.

This major is suitable for undergraduates who may become attorneys, social science teachers, government officials, party or civic leaders, public affairs commentators, or staff members of governmental research bureaus. It provides thorough preparation for graduate work in political science and public administration. Graduate study is advisable for students contemplating certain careers, for example: the teaching of political science at the college level; research in the governmental field; and public service as city managers or as administrators at the top and middle management levels of the national and state governments.

**Required Preliminary Courses**

| | | | |
|---|---|---|---|
| Govt. | 1, 2. | American National and State Government | (6) |
| Govt. | 3. | American Political Ideas | (3) |
| Govt. | 4. | Foreign Governments | (3) |

**Required Major Courses**

| | | | |
|---|---|---|---|
| Govt. | 101. | History of Political Theory | (3) |

**Plus fifteen hours from the following:**

| | | | |
|---|---|---|---|
| Govt. | 6. | Democracy | (3) |
| Govt. | 304. | Political Parties | (3) |
| Govt. | 321. | Scope and Methods of Political Science | (3) |
| Govt. | 351, 352. | Constitutional Law, Civil Liberties | (6) |
| Govt. | 354. | Administrative Law | (3) |
| Govt. | 357. | City Government | (3) |
| Govt. | 359. | Law-Making | (3) |
| Govt. | 360. | Public Administration | (3) |
| Govt. | 361. | Comparative Administrative Systems | (3) |
| Govt. | 362. | The Soviet System of Government | (3) |
| Govt. | 363, 364. | Contemporary Political Thought | (6) |

**Plus one International Relations Course at the 300 level.** (3)

**TOTAL** (33)

**Majors in Government are advised to enroll for certain courses in the fields of economics, history, journalism, philosophy, psychology, public finance, and social relations. The particular course selections should be made in consultation with the chairman of the Department or his designated representative.**

**History.** History is the study of man's activities upon the planet he inhabits. As such, it encompasses not only a study of events and public policy, but the whole sweep of man's cultural achievements — his religion and philosophy, his literature and art, his economic and social life. Some of the most influential thinkers and public men of our time (Toynbee, Kennan, Churchill, and Kennedy, among others) have come to an understanding of contemporary problems by studying the forces in the past which have shaped the world of the present.

Majors in History take courses in the history of three culture areas, examining the major developments in each in terms of the problem of cause and effect, which is the historian's central concern. These courses provide training in the disciplines of research, the analysis of historical problems, and the formulation of historical judgments, as well as in writing. Majors in history have the foundation for law school, government service, journalism, teaching, or graduate study.

A major in history consists of thirty-six hours distributed in three of the four areas in which the department offers courses: American, British, European, and Latin-American history. No more than eighteen of these hours may be in one field. In the senior year, majors in history are examined on the three fields they have chosen. Honors students in the department may plan special programs, with suitable substitutions for some of the above requirements, in consultation with the major adviser.

**Required Preliminary Courses**

| | | | |
|---|---|---|---|
| Hist. | 25, 26. | European History | (6) |

**Plus one of the following sequences:**

| | | | |
|---|---|---|---|
| Hist. | 13, 14. | American Civilization | (6) |
| Hist. | 15, 16. | English History | (6) |
| Hist. | 49, 50. | History of Latin America | (6) |

**Required Major Courses**

**Twenty-four hours chosen from the following:**

| | | | |
|---|---|---|---|
| Hist. | 319, 320. | Colonial America | (6) |
| Hist. | 321, 322. | United States History since 1789 | (6) |
| Hist. | 323, 324. | American Constitutional History | (6) |
| Hist. | 325. | American Immigrant History | (3) |
| Hist. | 326. | American Urban History | (3) |
| Hist. | 327, 328. | American Intellectual History | (6) |
| Hist. | 329, 330. | American Foreign Policy | (6) |
| Hist. | 347, 348. | British Empire, 1603 to the Present | (6) |
| Hist. | 349, 350. | The Middle Ages | (6) |
| Hist. | 357. | Renaissance and Reformation | (3) |
| Hist. | 355, 356. | European Intellectual History | (6) |
| Hist. | 359, 360. | Modern Europe | (6) |
| Hist. | 358. | Age of the Baroque | (3) |
| Hist. | 365, 366. | Modern Latin America | (6) |
| Hist. | 367. | The Iberian Peninsula | (3) |
| Hist. | 368. | The Caribbean | (3) |
| Hist. | 371, 372. | Special Topics in History | (6) |
| Hist. | 374. | Themes in American History | (3) |

Majors in history will find it advantageous to enroll for certain courses in economics, English and American literature, government, international relations, philosophy, psychology, and social relations. Particular attention is called to Greek 21 and Latin 22. Students planning to pursue graduate studies should acquire a reading knowledge of at least one foreign language as undergraduates, choosing the language or languages appropriate to their area of concentration

**International Relations.** The field of international relations poses an unprecedented challenge to student and teacher alike and provides a stimulating focus of interest for undergraduate education. It demands full recognition and understanding of the vast forces which are shaping the world — wars, nationalism, political ideologies, and modern technology. The leadership and responsibilities of the United States in the world arena have created a need for broadly educated young men who possess a clear appreciation of the factors which influence the policies of nations.

Students will approach the study of state behavior through courses in the theory and techniques of diplomacy, the history of modern international relations, and special seminars in international law, international organization, and world politics. The ultimate objective is to shape and develop well-informed and independent observers and participants in the field of international affairs. The flexibility of the program permits added study in history, government, economics and other social sciences.

The broad knowledge and understanding acquired can be utilized in careers in teaching, the Foreign Service of the United States and other government agencies, international business, and the legal profession.

**Required Preliminary Courses**

| | | | |
|---|---|---|---|
| I. R. | 1, 2. | World Politics | (6) |

**Required Major Courses**

| | | | |
|---|---|---|---|
| I. R. | 341, 342. | International Relations | (6) |
| I. R. | 351, 352. | International Institutions | (6) |
| I. R. | 361, 362. | International Law | (6) |

and twelve semester hours to be selected, with the approval of the head of the department, from international relations, history, and government.

**Mathematics.** The major in mathematics is designed to cover each of the three main divisions of mathematics: Analysis, Geometry, and Algebra. Rigor and abstraction, properly motivated, are introduced early in the major in the firm belief that therein lies the essence of mathematics, not only as a liberal discipline studied for its own sake, but also in the deeper applications of mathematics to the sciences. On completion of the major program, it is expected that the student will have gained an appreciation of the universal character of the subject as well as the ability to think in mathematical terms. With this broad orientation, he could readily become a teacher with a penetrating knowledge of his field, a skilled user of mathematics in one of the rapidly multplying positions in industry and government, or a student in graduate school, continuing to advance to the frontiers of study and research in mathematics.

**Required Preliminary Courses**

| | | | |
|---|---|---|---|
| Math. | 21. | Analytic Geometry and Calculus I | (4) |
| Math. | 22. | Analytic Geometry and Calculus II | (4) |
| Math. | 23. | Analytic Geometry and Calculus III | (4) |

**Required Major Courses**

| | | | |
|---|---|---|---|
| Math. | 219. | Principles of Analysis | (3) |
| Math. | 220. | Principles of Analysis | (3) |
| Math. | 221. | Differential Equations | (3) |
| Math. | 241. | Higher Algebra I | (3) |
| Math. | 242. | Higher Algebra II | (3) |
| Math. | 315. | Theory of Functions of a Complex Variable | (3) |
| | | Approved electives | (12) |

The four elective courses are to be chosen with the approval of a designated representative of the head of the department.

Students interested in Actuarial Science can major in Mathematics, choosing appropriate courses, in consultation with a representative of the chairman of the department, to prepare for certain of the actuarial examinations.

**Natural Resources:** This is an interdepartmental major designed to give the student basic preparation for a career in management and conservation of natural resources and for research and graduate work in these fields. Integrated work in biology and geology with adequate background in chemistry and physics provides the best approach to an understanding of the environment, its influence on man and man's influence upon it.

**FRESHMAN YEAR**

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Biol. | 21 | General Biology | 3 | Biol. | 28 | General Biology | 3 |
| Biol. | 22 | Introduction | | Chem. | 3 | General Chemistry | 3 |
| Chem. | 1 | Chemical Principles | 3 | Chem. | 13 | General Chemistry Lab. | 1 |
| Chem. | 11 | Chemical Principles Lab. | 1 | Math. | 8 | Elementary Statistics | 3 |
| Math. | 21 | Anal. Geometry & Calc. | 4 | | | | |

**SOPHOMORE YEAR**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Chem. | 39 | Analytical Chem. | 3 | Biol. | 306 | Ecology | 3 |
| Geol. | 1 | Principles of Geol. | 3 | Phys. | 16 | General Physics | 3 |
| Phys. | 1 | Mechanics of Mass Points | 3 | Geol. | 2 | Principles of Geology | 3 |
| | | | | Phys. | 17 | General Physics Lab | 2 |

**JUNIOR YEAR**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Chem. | 51 | Organic Chemistry | 3 | Biol. | 35 | Microbiology | 3 |
| Chem. | 53 | Organic Chemistry Lab. | 2 | Biol. | 361 | Sanitary Microbiology | 3 |
| Geol. | 13 | Sedimentation | 3 | Geol. | 23 | Structural Geology | 3 |

**SENIOR YEAR**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Biol. | 303 | Advanced Invertebrate Zoology | 3 | | | Approved electives 6 or 9 | |
| Eco. | 311 | Economics Resource Use | 3 | | | | |

Approved and suggested electives:

| | | | |
|---|---|---|---|
| Biol. | 14 | Comparative Anatomy | 4 |
| Biol. | 320 | Physiology | 3 |
| Geol. | 311 | Palaeontology | 3 |
| Geol. | 315 | Stratigraphy | 3 |
| Geol. | 357 | Economic Geology | 3 |
| Phil. | 341 | Evolution of Scientific Ideas | 3 |
| Speech | 30 | Fundamentals of Speech | 3 |

A student who is taking a major in biology, geology, or journalism, and who is interested in natural resources and their conservation, should consult with his major adviser. His program can be so arranged as to provide an adequate major concentration combined with appropriate collateral work so selected as to develop his knowledge of natural resources and the problems of their management.

**Natural Science.** This major provides students with a broad background in the fundamentals of mathematics and science and the opportunity to concentrate to a reasonable degree in one area of science. The program is designed especially for (1) those students who desire preparation for graduate work or careers in certain of the derivative or interdisciplinary sciences or related professional fields (oceanography, astronomy, psychophysiology, geophysics, information science, medicine or dentistry, conservation, etc.), (2) those students who plan to teach science in secondary schools or community colleges, and (3) those students without fixed career objectives who desire undergraduate training in science.

Students who register for the program are required to select an area of concentration (or option) which must be approved by the Dean of the College of Arts and Science and Professor J. Donald Ryan, Department of Geology, Director of the program. The option may be chosen in Chemistry, Biology, Geology, Psychology, or in an approved interdisciplinary area (geophysics, marine science, biochemistry, information science, etc.). Courses included in the option will be worked out individually for the student by his major adviser. A committee, of which Professor Ryan is chairman, administers the program.

A student registered for this major normally is expected to choose his option no later than the beginning of his sophomore year.

**Required Preliminary Courses**

| | | | |
|---|---|---|---|
| Math. | 21, 22, 23 | Analytical Geometry and Calculus | (12) |
| Phys. | 1 | Mechanics of Mass Points | (3) |
| Phys. | 3 | Heat and Electricity | (4) |
| Phys. | 4 | Electricity, Light, and Atomic Physics | (4) |
| Chem. | 1, 11, 3, 13 | Chemical Principles | (8) |
| Geol. | 1 | Principles of Geology or | |
| Astro. | 1 | Descriptive Astronomy) | (3) |
| Biol. | 21, 22 | Principles of Biology or | |
| Psych. | 1 | Introduction to Psychology) | (3) |

**Required Major Courses**

| | | | |
|---|---|---|---|
| Chem. | 51, 52, 53, 54 | Organic Chemistry or) | (6-10) |
| Chem. | 95, 195 | Physical Chemistry) | |
| *Math. elective | | | (3) |
| *Option | | | (24) |

*Math. elective and courses included in option taken with the approval of major adviser.

A special program leading to a B.A. in Natural Science and an M.S. in Materials is available for interested students. See page 132 for prerequisites and typical program.

**Philosophy.** Few disciplines have experienced so radical a transformation of method and purpose as philosophy in recent times. The principal aim of the major in philosophy is to acquaint the student with these changes and to provide a systematic training in the use of new techniques of logical and philosophical analysis.

Modern philosophical practice resembles scientific method, in that successive approximations to the truth are made, in which each new stage results from an improvement of earlier stages. Accordingly, the student is introduced to the thought of major philosophers from ancient to modern times, and the development of analytical techniques within this period is carefully charted. The answers achieved with the aid of powerful logical and mathematical techniques have the quality of science rather than of philosophy, in the traditional sense of the term. Where scientific methods are inapplicable, as in the field of value judgments, the speculative nature of theory is emphasized.

Since the Department of Philosophy is closely associated with the Center for the Information Sciences, many courses are designed to provide the necessary tools in dealing with the complex problems of information, communication and the logical structure of science and recorded knowledge.

A preparation in modern philosophy will equip a student not only for graduate study, but for a career in research, government and industry.

**Required Preliminary Courses**

| | | | |
|---|---|---|---|
| Phil. | 14. | Logic | (3) |
| Phil. | 15. | Ethics | (3) |

**Required Major Courses**

| | | | |
|---|---|---|---|
| Phil. | 331. | Ancient Philosophy | (3) |
| Phil. | 335. | Modern Philosophy | (3) |
| Phil. | 339. | Twentieth Century Philosophy | (3) |
| Phil. | 261. | Philosophy of the Natural Sciences | (3) |
| Math. | 303. | Mathematical Logic | (3) |

and nine additional hours to be chosen from the courses listed below:

| | | | |
|---|---|---|---|
| Phil. | 337. | Nineteenth Century Philosophy | (3) |
| Phil. | 351. | Analytical Philosophy and Religion | (3) |
| Phil. | 271, 272. | Readings in Philosophy | (3) |
| Phil. | 301. | Philosophy of the Social Sciences | (3) |
| Phil. | 316. | Contemporary Ethics | (3) |
| Phil. | 341. | Evolution of Scientific Ideas | (3) |
| Phil. | 362. | Issues in the Philosophy of Science | (3) |
| Phil. | 361. | Logic and Language | (3) |
| Phil. | 391. | Information Retrieval Theory | (3) |
| I.S. | 311. | Introduction to Linguistics | (3) |

Physics. Designed primarily for students planning professional careers in science, this sequence includes the minimum mathematical and subject matter requirements for entrance to graduate schools. Most students who proceed to graduate school in physics elect, as undergraduates, several additional mathematics, mechanics and physics courses. Graduate schools in medicine, meteorology, geophysics, astrophysics, etc., will usually not require additional physics courses, but will require courses in electronics, biology, geology, astronomy, etc. A student interested in immediate professional employment is advised to study in an engineering curriculum. With specialization and careful planning, a student may embark on some graduate level work in his senior year, or gain an early familiarity with research techniques. Such intensive study will reduce the number of years required for study to the Ph.D. since the courses coordinate with the graduate program in physics.

**Required Preliminary Courses**

| | | | |
|---|---|---|---|
| Chem. | 1, 11; 3, 13, | Principles of Chemistry | (8) |
| Math. | 21, 22. 23. | Analytical Geometry and Calculus | (12) |
| Phys. | 1. | Mechanics of Mass Points | (3) |
| Phys. | 3. | Heat and Electricity | (4) |
| Phys. | 4. | Electricity, Light and Atomic Physics | (4) |

**Required Major Courses**

| | | | |
|---|---|---|---|
| Phys. | 32. | Electrostatics | (3) |
| Phys. | 90. | Electrical Phenomena | (1) |
| Phys. | 171. | Proseminar | (1) |
| Phys. | 191. | Laboratory Techniques | (2) |
| Phys. | 192. | Advanced Physics Laboratory | (1) |
| Phys. | 213. | Electromagnetism | (3) |
| Phys. | 215. | Particles and Fields | (3) |
| Phys. | 252. | Optics | (3) |
| Phys. | 254. | Optics Laboratory | (2) |
| Phys. | 268, 369. | Introduction to Modern Physical Theories | (6) |
| Phys. | 340. | Physical Thermodynamics | (3) |
| Phys. | 362 or 363 or 364. | Atomic or Solid State or Nuclear Physics | (3) |
| Math. | 219, 220. | Principles of Analysis | (6) |
| Math. | 221. | Differential Equations | (3) |

Psychology. The sequence of basic courses in psychology and related sciences is designed to expand the student's understanding of the processes which underlie the complex and varied forms of human and animal behavior, both individual and social. Throughout the required courses, the emphasis is on quantitative and experimental analysis. However, elective courses allow further exploration and deepening of knowledge in special areas of psychological theory and application as well as in many related fields. The

relatively small number of required courses makes the major program in psychology particularly well suited for the student who wishes a liberal arts program focused on the natural and social sciences. The nucleus of required courses also forms the foundation for graduate work in any field of psychology, including social psychology, leading to careers in research, college teaching, and a wide variety of applied fields, including clinical, engineering and industrial psychology. In social psychology, the opportunity to augment the psychology major program with electives chosen from social relations should be used. A joint major in psychology and social relations is an increasingly common program of study.

Students interested in medicine, dentistry or law may also profitably choose psychology as their major. Students with these interests would normally augment the major program with courses chosen from other departments related to their career interests. For example, students planning a career in medicine must meet the minimum requirements for admission to medical school which are: 1 year of biology, 1 year of inorganic chemistry, 1 year of organic chemistry, and 1 year of physics.

**Required Preliminary Courses**

| | | | |
|---|---|---|---|
| Biol. | 21. | Principles of Biology | (3) |
| Biol. | 22. | Intro. to Biology Laboratory | (1) |
| Math. | 6. | Finite Mathematics | (3) |
| Math. | 21. | Anal. Geo. and Cal. 1 | (4) |
| Phil. | 14, 261 or 301. | Logic; Phil. of Nat. Science; or Phil. of Soc. Sci. | (3) |

**Recommended Preliminary Courses**

**It is strongly recommended that any student considering post-graduate study in psychology take a minimum of 7 semester hours of course work in Physical Science. This recommendation would normally be met by choosing from Chem. 1, 11, 2, 12; Physics 1, 16, 17.**

**Required Major Courses**

| | | | |
|---|---|---|---|
| Psych. | 1 | Introduction to Psychology | (3) |
| Math. | 8. | Elementary Statistical Analysis | (3) |
| Psych. | 11. | General Experimental Psychology | (3) |
| Psych. | 12. | General Experimental Psychology Lab. | (2) |

**Two courses chosen with approval of head of department from**

| | | | |
|---|---|---|---|
| Psych. | 363. | Learning (4) | |
| Psych. | 364. | Sensation and Perception (4) | |
| Psych. | 365. | Physiological Psychology (4) | |
| Psych. | 367. | Experimental Psychodynamics (3) | |
| S. R. | 301. | Experimental Social Psych. (3) | (6-8) |

**Additional courses to bring the total number of hours in the major program to 24, to be selected from departmental courses; S. R. 21 or S. R. 201, with approval of head of department.**

**(5-7)**

For the student who chooses psychology as his major, early in his academic career, there will be extensive opportunities to take free electives throughout the junior and senior years. These electives may be chosen profitably from courses offered in a number of departments other than psychology. Psychology majors are encouraged to exercise this choice with the student's interests as the principal guide.

**Romance Languages.** The Department of Romance Languages offers separate major programs in French and Spanish aiming to show the development of the culture and civilization of France, Spain, and the Spanish-speaking countries of Latin America. These programs prepare for graduate work in several related fields as well as for teaching careers.

Each candidate is assigned a departmental adviser to correlate and integrate supplementary reading and study to meet special objectives. Candidates are urged to participate in junior-year-abroad programs and in study and travel in foreign countries during summer vacations.

Although the minimum requirement is eighteen credit hours of which at least six will be chosen from "200" courses, the normal requirement consists of eight semester courses above elementary and intermediate levels, through which the candidate is expected to gain a knowledge of literature and an adequate command of the language in preparation for the oral and written departmental comprehensives and the graduate record examinations.

French.

Required Preliminary Courses

| | | | |
|---|---|---|---|
| Fr. | 1, 2. | Elementary French | (6) |
| Fr. | 11, 12. | Intermediate French | (6) |

Required Courses in Major

Eighteen hours from the following of which at least six hours shall be chosen from Fr. 221, 222, 223, 224:

| | | | |
|---|---|---|---|
| Fr. | 13, 14. | Types of French Literature | (6) |
| Fr. | 23, 24. | Seventeenth Century French Literature | (6) |
| Fr. | 25, 26. | Eighteenth Century French Literature | (6) |
| Fr. | 31, 32. | Nineteenth Century French Literature | (6) |
| Fr. | 41, 42. | French Oral and Written Composition | (6) |
| Fr. | 221. | French Lit. before Seventeenth Century | (3) |
| Fr. | 222. | Contemporary French Literature | (3) |
| Fr. | 223, 224. | Proseminar | (6) |
| Fr. | 301. | French Classicism | (3) |
| Fr. | 302. | The Age of Enlightenment | (3) |

The student will be expected to complete supplementary reading, the list of which he will receive at the beginning of his major work, and to correlate the knowledge gained in courses and readings through the use of some recommended history of French literature.

Spanish.

Required Preliminary Courses

| | | | |
|---|---|---|---|
| Span. | 1, 2. | Elementary Spanish | (6) |
| Span. | 11, 12. | Intermediate Spanish | (6) |

Required Courses in Major

Eighteen hours from the following of which at least six shall be chosen from Spanish 231, 232, 303, 304, 305, 306.

| | | | |
|---|---|---|---|
| Span. | 13. | Cultural Evolution of Spain | (3) |
| Span. | 14. | Cultural Evolution of Latin-America | (3) |
| Span. | 21. | Introduction to Modern Spanish Fiction | (3) |
| Span. | 22. | Introduction to Modern Spanish Drama | (3) |
| Span. | 31, 32. | Spanish Conversation and Composition | (6) |
| Span. | 231, 232. | Spanish-American Literature | (6) |
| Span. | 303. | Cervantes | (3) |
| Span. | 304. | Lope de Vega | (3) |
| Span. | 305. | Spanish Literature in the Middle Ages | (3) |
| Span. | 306. | Spanish Literature since World War II | (3) |

In addition to the outside reading and reports required in connection with these courses, the student will be expected to acquire a knowledge of the history of Spanish literature as a whole.

**Social Relations.** The purpose of Social Relations is, among other things, to train the student to understand the individual, society, and culture. Three disciplines constitute the Major: Social Psychology, Cultural Anthropology, and Sociology, and the student will elect an option in one of these fields. However, these behavioral sciences are closely interrelated and each regards empirical research as the major means of extending knowledge.

These three fields may in varying degree provide a useful background in fields as diverse as law or the ministry. Particularly, these three social sciences provide pre-professional preparation for graduate work in social research and teaching, interracial and intercultural relations, personnel procedures, and for various civil service appointments with local, state, national, and international governmental and private agencies.

**Required Preliminary Courses**

| | | | |
|---|---|---|---|
| S. R. | 298. | Research Methods | (3) |
| Psych. 1 or 11. | | Introduction to Psychology | (3) |
| Math. | 6. | Finite Mathematics ( or Math. 21, Analytical Geometry and Calculus) | (3) |
| Two of the following: | | | |
| S. R. | 11. | Principles of Sociology | (3) |
| S. R. | 21. | Social Psychology | (3) |
| S. R. | 31. | Cultural Anthropology | (3) |

Strongly recommended: Economics 3, 4; Philosophy 14; Mathematics 8.

**Required Major Courses**

**Option in Social Psychology:**

| | | | |
|---|---|---|---|
| Twelve hours of the following: | | | |
| S. R. | 301. | Experimental Social Psychology | (3) |
| S. R. | 302. | Seminar in Social Psychology | (3) |
| S. R. | 303. | The Social Psychology of Groups | (3) |
| S. R. | 304. | Human Communication | (3) |
| S. R. | 305. | Personality and Social Processes | (3) |
| Psych. | 105. | Personality and Abnormal Behavior | (3) |
| Psych. | 302. | Theories of Personality | (3) |
| Six hours to be selected from approved courses in Psychology | | | (6) |
| One course from S. R. 331, 333, 335, 338, 339, or 394 | | | (3) |
| One course from S. R. 364, 365, 366, 367, 368, 369, 373, 375 or 384 | | | (3) |

**Option in Cultural Anthropology:**

| | | | |
|---|---|---|---|
| Twelve hours from the following: | | | |
| S. R. | 331. | Theories of Cultural Anthropology | (3) |
| S. R. | 333. | Primitive Political Systems | (3) |
| S. R. | 335. | Cultural Dynamics | (3) |
| S. R. | 336. | Religion and Magic | (3) |
| S. R. | 338. | Folklore and Culture | (3) |
| S. R. | 339. | Seminar in Anthropology | (3) |
| S. R. | 394. | The Individual, Society and Culture | (3) |
| I. S. | 311. | Introduction to Linguistics | (3) |
| One course from S. R. 301, 302, 303, 304 or 305 | | | (3) |
| One course from S. R. 364, 365, 366, 367, 368, 369, 373, 375 or 384 | | | (3) |
| Biol. | 13. | Human Biology | (3) |
| G.K. | 202. | Greek Archeaology | (3) |

**Option in Sociology:**

| | | | |
|---|---|---|---|
| Twelve hours from the following: | | | |
| S. R. | 364. | The Family | (3) |
| S. R. | 366. | Population Problems | (3) |
| S. R. | 367. | Latin American Social Institutions | (3) |
| S. R. | 368. | The Urban Community | (3) |
| S. R. | 369. | Social Disorganization | (3) |
| S. R. | 373. | Seminar in Sociology | (3) |
| S. R. | 374. | Social Stratification | (3) |
| S. R. | 375. | Minority Groups | (3) |
| S. R. | 381. | Development of Sociological Theory | (3) |
| S. R. | 384. | Social Structure | (3) |
| One course from S. R. 301, 302, 303, or 394 | | | (3) |
| One course from S. R. 331, 333, 335, 336, 338, or 339 | | | (3) |
| History 325 or 326 | | | (3) |
| Approved electives | | | (3) |

## Major Sequences in Arts-Engineering

The standard major for students in the five-year Arts-Engineering curriculum is Applied Science. This major is open only to Arts-Engineers.

### Applied Science.

| | | | |
|---|---|---|---|
| | | Required Preliminary Courses | |
| Chem. | 1, 11; 3, 13 | Principles of Chemistry | (8) |
| Math. | 21, 22. | Analytic Geometry and Calculus I and II | (8) |
| Phys. | 1. | Mechanics of Mass Points | (3) |
| | | Required Courses in Major | |
| Math. | 23. | Analytic Geometry and Calculus III | (4) |
| Mech. | 1. | Statics | (3) |
| Phys. | 3. | Heat and Electricity | (4) |
| Phys. | 4. | Electricity, Light, and Atomic Physics | (4) |

plus

(1) A minimum of twenty-four hours of the advanced work in the mathematical, physical, or engineering sciences required for the B.S. degree to be conferred on completion of the fifth year.
(2) All courses in mathematics, science, and engineering required in the first three years of the chosen engineering curriculum.
(3) Any additional courses necessary to prepare for the appropriate B.S. degree in one additional year.

### Other Arts or Science Major.

Able Arts-Engineers with special interests outside engineering frequently can combine another Arts or Science major with their engineering program. Interested students should consult the dean of the Arts College and the head of their engineering department.

## ARTS-ENGINEERING SEQUENCE PATTERN ROSTERS

The following pattern rosters, prepared with the help of the heads of the several engineering departments, show the most effective way to combine arts and engineering courses to prepare for the last year in the branch of engineering chosen. (For descriptions of the engineering curricula, see pages 134-152.)

Although the minimum number of credit hours needed for the B.A. in Applied Science is 120, the student in Arts-Engineering is expected to earn more than this in order to qualify for the B.S. degree at the end of the fifth year. The number needed for both degrees is shown for each pattern roster.

## ARTS - CHEMICAL ENGINEERING

Credit hours collegiate work needed for B. A. and B. S.: 168

FIRST YEAR

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Lang. | | | 3 | Lang. | | | 3 |
| Engl. | | | 3 | Engl. | | | 3 |
| Math. | 21 | Anal. Geom. & Calc. I | 4 | Math. | 22 | Anal. Geom. & Calc. II | 4 |
| Dist. | | | 3 | Phys. | 1 | Mech. of Mass Pts. | 3 |
| Chem. | 1 | Chem. Principles I | 3 | Chem. | 3 | Chem. Principles II | 3 |
| Chem. | 11 | Chem. Principles Lab. | 1 | Chem. | 13 | Chem. Principles Lab. | 1 |
| P. E. | 1 | Physical Education | | P. E. | 2 | Physical Education | |
| | | | 17 | | | | 17 |

**SECOND YEAR**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Lang. | | | 3 | Lang. | | | 3 |
| Dist. | | | 3 | Math. | 221 | Diff. Equations | 3 |
| Math. | 23 | Anal. Geom. & Calc. III | 4 | Phys. | 4 | Elect., Light, & Atomic Physics | 4 |
| Phys. | 3 | Heat & Elect. | 4 | Ch. E. | 10 | Ch. E. Computation | 1 |
| Ch. E. | 70 | Ind. Stoichiometry | 3 | Chem. | 91 | Physical Chemistry | 3 |
| | | | 17 | Met. | 63 | Eng. Met. & Processes or | |
| | | | | Met. | 91 | El. Mat. Science | 3 |
| | | | | | | | 17 |

**THIRD YEAR**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Lang. | | | 3 | Lang. | | | 3 |
| Chem. | 51 | Organic Chemistry | 3 | Eco. | 4 | Economics | 3 |
| Chem. | 53 | Organic Chem. Lab. | 2 | Chem. | 52 | Organic Chemistry | 3 |
| Eco. | 3 | Economics | 3 | Dist. | | | 3 |
| Chem. | 190 | Phys. Chemistry | 3 | Chem. | 193 | Phys. Chem. Lab. | 1 |
| Chem. | 192 | Phys. Chem. Lab. | 1 | Math. | 231 | Stat. Inference | 3 |
| Dist. | | | 3 | | | | 16 |
| | | | 18 | | | | |

**FOURTH YEAR**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Dist. | | | 3 | Dist. | | | 6 |
| Ch. E. | 163 | Units Operations I | 3 | Ch. E. | 164 | Unit Operations II | 4 |
| E. E. | 160 | Elect. Circuits | 3 | Chem. | 39 | Anal. Chem. | 3 |
| E. E. | 161 | Elect. Prob. | 1 | Mech. | 11 | Mech. of Materials or | |
| E. E. | 162 | Dynamo Lab. | 1 | | | | |
| Mech. | 1 | Statics | 3 | Mech. | 102 | Dynamics | 3 |
| Elective | | | 3 | | | | 16 |
| | | | 17 | | | | |

## ARTS - CIVIL ENGINEERING

**Credit hours collegiate work needed for B.A. and B.S.: 168**

**FIRST YEAR**

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Lang. | | | 3 | Lang. | | | 3 |
| Engl. | | | 3 | Engl. | | | 3 |
| Math. | 21 | Anal. Geom. & Calc. I | 4 | Math. | 22 | Anal. Geom. & Cal. II | 4 |
| Phys. | 1 | Mech. of Mass Points | 3 | Dist. | | | 3 |
| Chem. | 1 | Chem. Principles I | 3 | Chem. | 3 | Chem. Principles II | 3 |
| Chem. | 11 | Chem. Principles I Lab. | 1 | Chem. | 13 | Chem. Principles II Lab. | 1 |
| P.E. | 1 | Physical Education | — | P.E. | 2 | Physical Education | — |
| | | | 17 | | | | 17 |

**SECOND YEAR**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Lang. | | | 3 | Lang. | | | 3 |
| Eco. | 3 | Economics | 3 | Elec. | | | 3 |
| Math. | 23 | Anal. Geom. & Calc. III | 4 | *Math. | | | 3 |
| Phys. | 3 | Heat & Electricity | 4 | Dist. | | | 3 |
| Dist. | | | 3 | Phys. | 4 | Electric Light & Atomic Phys. | 4 |
| | | | 17 | | | | 16 |

**THIRD YEAR**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Lang. | | | 3 | Lang. | | | 3 |
| Elect. | | | 3 | Elect. | | | 3 |
| Mech. | 1 | Statics | 3 | Mech. | 11 | Mech. of Materials | 3 |
| C.E. | 11 | Engineering Graphics | 2 | Mech. | 13 | Materials Testing Lab. | 1 |
| Dist. | | | 6 | C.E. | 12 | Applied Eng. Graphics | 2 |
| C.E. | 10 | Problem Comp. Lab. | 1 | C.E. | 40 | Prin. of Surveying | 3 |
| | | | 18 | | | | 15 |

Summer: C.E. 41 Engineering Surveys (3).

**FOURTH YEAR**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| C.E. | 121 | Fluid Mechanics | 3 | C.E. | 126 | Water Resources Engineering | 3 |
| C.E. | 123 | Fluid Mechanics Lab. | 1 | | | | |
| C.E. | 150 | Structural Anal. I | 3 | C.E. | 162 | Sanitary Engineering | 3 |
| Mech. | 102 | Dynamics | 3 | C.E. | 154 | Structural Analysis II | 3 |
| Geol. | 1 | Principles of Geology | 3 | C.E. | 239 | Soil Mechanics | 3 |
| Met. | 63 | Materials or 91 | | Met. | 63 | Materials or 91 | |
| | | Approved Elective | 3 | | | Approved Elective | 3 |
| | | | 16 | | | | 15 |

Summer: C.E. 100. Eight (8) weeks industrial employment with report should precede fifth year. Consult chairman of the department.

*Approved by C.E. Department Chairman.

## ARTS - ELECTRICAL ENGINEERING

**Credit hours collegiate work needed for B.A. and B.S.: 168**

**FIRST YEAR**

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Lang. | | | 3 | Lang. | | | 3 |
| Engl. | | | 3 | Engl. | | | 3 |
| Math. | 21 | Anal. Geom. & Calc. I | 4 | Dist. | | | 3 |
| Phys. | 1 | Mech. of Mass Points | 3 | Math. | 22 | Anal. Geom. & Calc. II | 4 |
| Chem. | 1 | Chem. Principles I | 3 | Chem. | 3 | Chem. Principles II | 3 |
| Chem. | 11 | Chem. Principles I Lab. | 1 | Chem. | 13 | Chem. Principles II Lab. | 1 |
| P.E. | 1 | Physical Education | — | P.E. | 2 | Physical Education | — |
| | | | 17 | | | | 17 |

**SECOND YEAR**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Lang. | | | 3 | Lang. | | | 3 |
| C.E. | 11 | Eng. Graphics | 2 | Dist. | | | 3 |
| Math. | 23 | Anal. Geom. & Calc. III | 4 | Math. | 204 | Linear Analysis | 3 |
| Phys. | 3 | Heat & Electricity | 4 | Phys. | 4 | Electricity, Light & Atomic Physics | 4 |
| Mech. | 1 | Statics | 3 | Mech. | 11 | Mech. of Materials | 3 |
| | | | 16 | Mech. | 13 | Mat. Test. Lab. | 1 |
| | | | | | | | 17 |

**THIRD YEAR**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Lang. | | | 3 | Lang. | | | 3 |
| Eco. | 3 | Economics | 3 | E.E. | 14 | Circuit Theory I | 3 |
| Dist. | | | 3 | Dist. | | | 3 |
| Math. | 208 | Applied Math. II | 3 | Math. or | 309 | Theory of Probability | |
| Mech. | 102 | Dynamics | 3 | Math. | 231 | Statist. Inference | 3 |
| | | | 15 | Met. | 63 | Engr. Mat. & Proc. | 3 |
| | | | | | | | 18 |

**FOURTH YEAR**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Dist. | | | 3 | Dist. | | | 3 |
| E.E. | 103 | Physical Electronics | 3 | E.E. | 106 | Electrical Machinery | 5 |
| E.E. | 101 | Analog. & Digital Computation | 2 | E.E. | 105 | Electronic Circuits | 4 |
| E.E. | 104 | Circuit Theory II | 4 | E.E. | 231 | Elec. & Mag. Fields | 3 |
| Elect. | | | 6 | Elect. | | | 3 |
| | | | 18 | | | | 18 |

(E.E. 100. Summer employment should precede fifth year. Consult Chairman of Department.)

## ARTS - ENGINEERING MECHANICS

**Credit hours collegiate work needed for B.A. and B.S.: 167**

### FIRST YEAR

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Lang. | | ..... | 3 | Lang. | | ..... | 3 |
| Engl. | | ..... | 3 | Engl. | | ..... | 3 |
| Math. | 21 | Anal. Geom. & Calc. I | 4 | Eco. | 3 | Economics | 3 |
| Phys. | 1 | Mech. of Mass Points | 3 | Math. | 22 | Anal. Geom. & Calc. II | 4 |
| Chem. | 1 | Chem. Principles I | 3 | Chem. | 3 | Chem. Principles II | 3 |
| Chem. | 11 | Chem. Principles I Lab. | 1 | Chem. | 13 | Chem. Principles II Lab. | 1 |
| P.E. | 1 | Physical Education ... | — | P.E. | 2 | Physical Education ... | — |
| | | | 17 | | | | 17 |

### SECOND YEAR

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Lang. | | ..... | 3 | Lang. | | ..... | 3 |
| Eco. | 4 | Economics | 3 | Dist. | | ..... | 3 |
| Math. | 23 | Anal. Geom. & Calc. III | 4 | Math. | 221 | Diff. Equations ..... | 3 |
| Mech. | 1 | Statics ..... | 3 | Mech. | 11 | Mech. of Materials ..... | 3 |
| Phys. | 3 | Heat & Electricity ..... | 4 | Mech. | 13 | Mat. Testing Lab. ..... | 1 |
| | | | | Phys. | 4 | Elec., Light & Atomic Phys. ..... | 4 |
| | | | 17 | | | | 17 |

### THIRD YEAR

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Lang. | | ..... | 3 | Lang. | | ..... | 3 |
| Dist. | | ..... | 3 | Dist. | | ..... | 3 |
| C.E. | 11 | Engineering Graphics | 2 | Math. | 219 | Principles of Analysis | 3 |
| Math. | 204 | Linear Analysis ..... | 3 | Mech. | 104 | Fluid Dynamics ..... | 3 |
| Mech. | 102 | Dynamics ..... | 3 | C.E. | 123 | Fluids Lab. ..... | 3 |
| Math. | 208 | Complex Variables .... | 3 | Mech. | 10 | Problem Comp. Lab. .. | 1 |
| | | | | Met. | 91 | El. Mat. Science ..... | 3 |
| | | | 17 | | | | 19 |

### FOURTH YEAR

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Dist. | | | 3 | Dist. | | ..... | 3 |
| Math. | 220 | Principles of Analysis | 3 | Math. | 309 | Theory of Probability | 3 |
| Mech. | 301 | Adv. Mech. of Materials | 3 | Mech. | 302 | Adv. Dynamics ..... | 3 |
| EE. | 14 | Circuit Theory I ..... | 3 | Elect. | | ..... | 6 |
| Elect. | | ..... | 6 | | | | 15 |
| | | | 18 | | | | |

Mech. 100 Summer Employment

### FIFTH YEAR

**The following courses are required to complete a degree in Eng. Mech. (Additional courses will be necessary to satisfy graduation requirements for B.A. and B.S.).**

| | | | | | | |
|---|---|---|---|---|---|---|
| Math. | 322 | Methods of Applied Analysis I ..... | 3 | Mech. | 304 | Mech. of Cont. II ..... 3 |
| Mech. | 303 | Mech. of Continua I ... | 3 | Mech. | 306 | Exp. Methods in Mech . 3 |
| Mech. | 305 | System Dynamics ..... | 3 | | | Elect. ..... 3 |
| Phys. | 340 | Heat, Thermo. and Pyrometry ..... | 3 | | | |
| Phys. | 191 | Lab. Techniques ..... | 2 | | | |

## ARTS - ENGINEERING PHYSICS

**Credit hour collegiate work needed for B.A. and B.S.: 166**

Arts-Engineering Physics students will complete, during the first four years, the Physics major under the guidance of the head of the Department of Physics.

## ARTS - INDUSTRIAL ENGINEERING

**Credit hours collegiate work needed for B.A. and B.S.: 173**

### FIRST YEAR

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Lang. | | | 3 | Lang. | | | 3 |
| Engl. | | | 3 | Engl. | | | 3 |
| Dist. | | | 3 | Math. | 22 | Anal. Geom. & Calc. II | 4 |
| Math. | 21 | Anal. Geom. & Calc. I | 4 | Chem. | 3 | Chem. Principles II | 3 |
| Chem. | 1 | Chem. Principles I | 3 | Chem. | 13 | Chem. Principles II Lab. | 1 |
| Chem. | 11 | Chem. Principles I Lab. | 1 | Phys. | 1 | Mech. of Mass Pts. | 3 |
| P.E. | 1 | Physical Education | — | P.E. | 2 | Physical Education | — |
| | | | 17 | | | | 17 |

### SECOND YEAR

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Lang. | | | 3 | Lang. | | | 3 |
| Math. | 23 | Anal. Geom. & Calc. III | 4 | Eco. | 4 | Economics | 3 |
| Phys. | 3 | Heat and Elec. | 4 | Math. | 231 | Stat. Inference | 3 |
| Met. | 63 | Eng. Met. & Proc. | 3 | Phys. | 4 | Elec., Light and Atom. Phys. | 4 |
| Eco. | 3 | Economics | 3 | Met. | 67 | Engr. Mat. Lab. | 2 |
| I.E. | 10 | Problem Comp. Lab. | 1 | I.E. | 11 | Applied Prob. Lab. | 1 |
| | | | 18 | C.E. | 11 | Engineering Graphics | 2 |
| | | | | | | | 18 |

**SUMMER**
**I.E. 40 Machine Shop Practice (3)**

### THIRD YEAR

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Lang. | | | 3 | Lang. | | | 3 |
| I.E. | 221 | Industrial Statistics | 4 | Dist. | | | 6 |
| Mech. | 1 | Statics | 3 | I.E. | 222 | Operations Analysis | 4 |
| Dist. | | | 6 | Mech. | 11 | Mech. of Materials | 3 |
| Math. | 204 | Linear Anal. | 3 | Mech. | 13 | Materials Test. Lab. | 1 |
| | | | 19 | | | | 17 |

### FOURTH YEAR

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| I.E. | 121 | Analysis & Design I | 5 | I.E. | 122 | Analysis & Design II | 4 |
| Dist. | | | 6 | M.E. | 168 | Elem. Mach. Design | 4 |
| Psych. | 1 | Elem. Psych. | 3 | Elect. | | | 6 |
| Mech. | 102 | Dynamics | 3 | Acctg. | 108 | Fund. of Acctg. | 3 |
| I.E. | 140 | Mfg. Processes Lab. | 1 | | | | 17 |
| | | | 18 | | | | |

**SUMMER**
**(I.E. 100. Industrial employment should precede fifth year. Consult Head of Department.).**

## ARTS - MECHANICAL ENGINEERING

**Credit hours collegiate work needed for B.A. and B.S.: 170**

### FIRST YEAR

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Lang. | | | 3 | Lang. | | | 3 |
| Engl. | | | 3 | Engl. | | | 3 |
| Math. | 21 | Anal. Geom. & Cal. I | 4 | Math. | 22 | Anal. Geom. & Cal. II | 4 |
| Dist. | | | 3 | Phys. | 1 | Mech. of Mass Points | 3 |
| Chem. | 1 | Chem. Principles I | 3 | Chem. | 3 | Chem. Principles II | 3 |
| Chem. | 11 | Chem. Principles I Lab. | 1 | Chem. | 13 | Chem. Principles II Lab. | 1 |
| P. E. | 1 | Physical Education | — | P.E. | 2 | Physical Education | — |
| | | | 17 | | | | 17 |

### SECOND YEAR

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Lang. | | | 3 | Dist. | | | 3 |
| Dist. | | | 3 | Lang. | | | 3 |
| Eco. | 3 | Economics | 3 | Eco. | 4 | Economics | 3 |
| Math. | 23 | Anal. Geom. & Cal. III | 4 | Math. | 221 | Diff. Equations | 3 |
| Phys. | 3 | Heat and Electricity | 4 | Phys. | 4 | Elec. Light and Atomic Physics | 4 |
| M.E. | 10 | Anal. of Eng. Problems | 1 | C.E. | 11 | Engr. Graphics | 2 |
| | | | 18 | | | | 18 |

**THIRD YEAR**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Lang. | | | 3 | Lang. | | | 3 |
| Dist. | | | 6 | Dist. | | | 3 |
| M.E. | 111 | Anal. of Engr. Prob. | 2 | Mech. | 11 | Mech. of Mater. | 3 |
| Mech. | 1 | Statics | 3 | Mech. | 13 | Mater. Test. Lab. | 1 |
| Met. | 63 | Engr. Mat. and Proc. | 3 | Math. | 208 | Applied Math. II | 3 |
| | | | 17 | E.E. | 160 | Elec. Cir. and Appar. | 3 |
| | | | | E.E. | 161 | Elect. Prob. | 1 |
| | | | | E.E. | 162 | Dynamo Lab. | 1 |
| | | | | | | | 18 |

Summer School: I. E. 40 Machine Shop Practice (3)
(Preregister during Spring Pre-registration in M.E. Department)

**FOURTH YEAR***

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| M.E. | 101 | Mech. E. Design I | 3 | M.E. | 102 | Mech. E. Design II | 3 |
| M.E. | 104 | Thermodynamics I | 4 | M.E. | 105 | Thermodynamics II | 4 |
| Mech. | 102 | Dynamics | 3 | C.E. | 121 | Mech. of Fluids | 3 |
| Met. | 67 | Engr. Met. Lab. | 2 | C.E. | 123 | Fluid Mech. Lab. | 1 |
| Elect. | | | 6 | Elect. | | | 6 |
| | | | 18 | | | | 17 |

(M.E. 100 Summer Employment should precede Fifth Year. Consult Chairman of Department)

## ARTS - METALLURGY AND MATERIALS SCIENCE

Credit hours collegiate work needed for B.A. and B.S.: 169 (170 for the Industrial and Research option)

**FIRST YEAR**

| | | First Semester | | | | Second Semester | |
|---|---|---|---|---|---|---|---|
| Lang. | | | 3 | Lang. | | | 3 |
| Engl. | | | 3 | Engl. | | | 3 |
| Math. | 21 | Anal. Geom. & Calc. I | 4 | Math. | 22 | Anal. Geom. & Cal. II | 4 |
| Chem. | 1 | Chem. Principles I | 3 | Phys. | 1 | Mech. of Mass Points | 3 |
| Chem. | 11 | Chem. Principles I Lab. | 1 | Chem. | 3 | Chem. Principles II | 3 |
| Dist. | | | 3 | Chem. | 13 | Chem. Principles II Lab. | 1 |
| P.E. | 1 | Physical Education | — | P.E. | 2 | Physical Education | — |
| | | | 17 | | | | 17 |

**SECOND YEAR**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Lang. | | | 3 | Lang. | | | 3 |
| Met. | 91 | El. of Mat. Science | 3 | Dist. | | | 3 |
| Math. | 23 | Anal. Geom. & Calc. II | 4 | Phys. | 4 | Elec., Light and Atomic Physics | 4 |
| Phys. | 3 | Heat & Electricity | 4 | Met. | 10 | Met. Lab. | 2 |
| Eco. | 3 | Economics | 3 | C.E. | 11 | Engineering Graphics | 2 |
| | | | 17 | Eco. | 4 | Economics | 3 |
| | | | | | | | 17 |

**THIRD YEAR**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Lang. | | | 3 | Lang. | | | 3 |
| Dist. | | | 6 | Dist. | | | 6 |
| Met. | 230 | Phys. Met. I | 4 | Met. | 231 | Phys. Met. II | 4 |
| App. Math. | | Elective | 3 | Ch.E. | 60 | Engr. in Chem. Mfg. | 3 |
| Mech. | 1 | Statics | 3 | Mech. | 11 | Mech. of Materials | 3 |
| | | | 19 | | | | 19 |

**FOURTH YEAR***

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Dist. | | | 3 | Elect. | | | 6 |
| Elect. | | | 3 | Mech. | 102 | Dynamics | 3 |
| M.E. | 166 | Proc. of Mach. Des | 2 | Chem. | 195 | Phys. Chemistry | 3 |
| Met. | 210 | Met. Thermodynamics | 3 | Met. | 304 | Extractive Met. | 4 |
| Chem. | 95 | Phys. Chemistry | 3 | Met. | 101 | Prof. Development | 1 |
| Approved Elective | | | 3 | | | | |
| | | | 17 | | | | 17 |

**SUMMER**

(Met. E. 100 — Industrial Employment should precede fifth year. Consult Chairman of Department).

*Students selecting Research Option should also take Met. 340. Research Techniques in the second semester of the senior year.

# THE COLLEGE OF BUSINESS ADMINISTRATION

L. Reed Tripp, *Dean of the College of Business Administration*

The College of Business Administration, which is a member of the American Association of Collegiate Schools of Business, offers a program of study designed to provide thorough and systematic training in the fundamentals of business. The College aims to develop in the student an intelligent understanding of business principles, an ability to analyze industrial facts, and habits of thought which will enable him to cope with the problems that increasing executive responsibilities will bring him in later life. Stress is on building a sound foundation, since it is the firm belief of the College that no substitute can be furnished for the training and experience provided by actual contact with the complex problems of modern business. Accordingly, the student's interests are best served by equipping him with those fundamental principles and insights which will make it possible for him to profit more readily from practical experience after graduation.

In accordance with this plan of training in fundamentals, the student is required to learn the basic principles that underlie business. No student may omit basic work in the principles and problems of economics, accounting, corporation finance, money and banking, marketing, business law, labor problems, management, and statistical method, which are essential for a career in all types of business enterprise. Acquaintance with the fundamentals of the broad field not only equips the student with the elementary requisites for a career in a variety of commercial and industrial enterprises but also gives him an invaluable means of discovering his real abilities and making a sound choice of a profession. A major function of the curriculum in business administration is to aid students in their efforts to discover their best talents, not only students who enter college uncertain of their ultimate objectives but also those whose choice of a future profession or field of business may have been determined already but predicated upon inadequate grounds.

No student may devote himself exclusively to business subjects. He must acquire at least a rudimentary acquaintance with the cultural and humanitarian aspects of the world around him, and at least a brief contact with science. Consequently, a large part of the curriculum is devoted to work in liberal and scientific subjects. Throughout the entire four years' work there is emphasis on the social aspects of the subjects considered. If a student develops alongside his business work a special interest in some such field as languages, mathematics, or science, he is given opportunity through electives to pursue his special line. The College regards as important the principle that the training as a whole shall offer an education commensurate with the standards of a university.

In view of the breadth of training afforded by the variety of required and elective courses, satisfactory preparation for careers in fields other than commerce and industry is also available to students in the College of Business Administration. This is particularly true of law, for which liberal business curricula are now recognized as excellent preliminary training. Lehigh University has been included by the leading law schools of the country among the institutions whose business curricula meet their admissions requirements.

Perhaps the most distinctive feature of the work in business administration at Lehigh is the character of the class work. Much of the work of the curriculum is taken in the College of Arts and Science, while students of this division and of the College of Engineering avail themselves of the courses given in the College of Business Administration. There is no segregation of students by colleges, and students in business administration take their courses in competition with students trained in liberal arts and in the exact sciences. This condition has a marked influence on the standards of work and the quality of the student. Qualified students in Business Administration are eligible for the Interdepartmental Honors Program (see page 75). Also, on the advice of the head of the department in which the major work is being done, and with the consent of the Dean of the College, a junior or senior of unusual merit in the College of Business Administration who wishes to concentrate in his chosen field may be allowed to substitute not more than four hours (if a junior) or six hours (if a senior) of unscheduled work per semester for an equivalent number of hours of *elective* work otherwise required for graduation.

Although emphasis is upon broad training, rather than specialization, the College recognizes that some degree of concentration is desirable after the student's interests may reasonably be expected to have crystallized. Accordingly, in the junior and senior years, every student is required to pursue a series of related courses in some more restricted field. Seven fields of concentration are offered, viz: accounting, economics, economic statistics, finance, foreign careers, management, and marketing. The detailed programs of study in each of the above fields are set forth on the following pages.

In times of normal business activity, students who have made creditable records may reasonably expect to receive one or more offers of positions before the date of their graduation. The College of Business Administration

enjoys happy relations with many of the country's leading industries. Representatives regularly visit the campus to engage the services of students graduating in business administration. The University assumes no responsibility for finding positions for its graduates, but every effort is made by the College and by the University placement service to put its graduating students in touch with desirable opportunities for employment.

Graduates of this curriculum receive the degree of Bachelor of Science in Business Administration.

In recognition of the increasing demand in industry for management training personnel who have been educated both in engineering or arts and in business, the College has instituted five-year curricula which combine business education at the graduate level with undergraduate concentration in engineering or arts.

An Engineering — M.B.A., an Engineering — M.S. in Management Science, and an Arts — M.B.A. program are outlined on pages 121 and 122 respectively.

Graduate programs leading to the degrees of Master of Business Administration, Master of Arts in Economics, Master of Science in Business Economics, and Master of Science in Management Science are outlined on pages 182-186.

A five-year curriculum with a bachelor's degree in industrial engineering and a bachelor's degree in business administration is outlined on page 122.

The Ph.D. degree in Business and Industrial Economics is described on page 185.

## THE CURRICULUM IN BUSINESS ADMINISTRATION

### I. Required Courses (55 hours)

**Total hours required for Degree of B.S. in Business Administration: 121**

| Course | No. | Course Title | Cr. Hrs. | Course | No. | Course Title | Cr. Hrs. |
|---|---|---|---|---|---|---|---|
| Acctg. | 1 | Accounting | 3 | Eco. | 321 | Business and Organization Behavior | 3 |
| Acctg. | 2 | Accounting | 3 | or Eco. | 313 | Intro. to Mgmt. Science | 3 |
| Eco. | 11 | Intro. to Pol.-Eco. Thought | 3 | Eco. | 306 | Intermed. Eco. Theory | 3 |
| Eco. | 12 | Intro. to Pol.-Eco. Thought | 3 | Eco. | 346 | Business Cycles | |
| Eco. | 3 | Economics | 3 | or Eco. | 333 | Labor Problems | 3 |
| Eco. | 4 | Economics | 3 | Fin. | 125 | Corporation Finance | 3 |
| Mkt. | 11 | Marketing | 3 | Fin. | 129 | Money and Banking | 3 |
| Engl. | 1 | Composition & Lit. | | Math. | 21 | Anal Geom. & Calculus I | 4 |
| or Engl. | 11 | Types of World Lit. | 3 | Math. | 6 | Finite Math. | 3 |
| Engl. | 2 | Composition & Lit. | | P.E. | 1 | Physical Education | — |
| or Engl. | 12 | Types of World Lit. | 3 | P.E. | 2 | Physical Education | — |
| Eco. | 45 | Statistical Method | 3 | | | | |
| Law | 1 | Business Law | 3 | | | | |

### II. Major Program (24 hours)

Before the end of the second semester of their sophomore year students will select a major or field of concentration. A major program will consist of twenty-four hours of sequential or related courses prescribed by the dean of the College, chairman of the department or major curriculum advisor concerned.

**III. Optional Courses (33 hours)**

ENGLISH OR FOREIGN LANGUAGE OPTION (12 HOURS)

Except for the requirement of two high school units in one foreign language for entrance credit, students in the college are not required to take work in foreign languages. Foreign Careers students, however, will take at least 12 hours in an appropriate foreign language specialty. Credit for less than six hours in an elementary language will not be accepted in partial satisfaction of this option.

All courses offered by the Department of English which require work in composition, either oral or written, or a study of literature will be accepted in satisfaction of the English requirement. Journalism courses which do not require work in composition or study of literature will not be accepted. One-hour courses in speech and journalism will not be accepted for the English requirement but may be counted toward electives — See IV below.

OTHER ARTS OPTIONS (12 HOURS)

The Arts Options requirement may be met by taking a total of twelve hours work in the following fields, not more than six hours to be in any of the fields designated: astronomy, education, fine arts, government, history, international relations, mathematics, music, philosophy, psychology, religion, social relations. One-hour courses in music will not be accepted for the Arts Option but may be counted toward electives — See IV below.

SCIENCE OPTION (9 HOURS)

Not more than six hours from one department may be credited toward the Science Option. The following courses in the following sciences are acceptable in satisfaction of this distribution requirement: Biology, Geology, Physics and Chemistry. If four-hour sciences are taken, the additional hours by which four-hour courses exceed three credit units may be counted as electives. See IV below.

**IV. Electives (9 hours)**

Any courses in the University for which a student has the prerequisites may be used to meet this requirement.

# Courses of Study

**UNIFORM FRESHMAN YEAR**

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Course | No. | Course Title | Cr. Hrs. | Course | No. | Course Title | Cr. Hrs. |
| Eco. | 11 | Intro. to Pol.-Eco. Thought | 3 | Eco. | 12 | Intro. to Pol.-Eco. Thought | 3 |
| Math. | 6 | Finite Math. | 3 | Math. | 21 | Anal. Geom. & Calculus I | 4 |
| Engl. | 1 | English[1] | 3 | Engl. | 2 | English[1] | 3 |
| | | Two Optional Courses[2] | 6 | | | Two Optional Courses[2] | 6 |
| P.E. | 1 | Physical Education | — | P.E. | 2 | Physical Education | — |
| | | | 15 | | | | 16 |

[1]For a statement of the freshmen English requirement see page 230.
[2]Optional Courses fall into three groups: English or Foreign Language, Arts, and Science. For a general statement concerning these groups see this page above. Foreign Careers majors should devote options to two semesters of language of their area and two semesters of a science.

**Major in Accounting***

**SOPHOMORE YEAR**

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Course | No. | Course Title | Cr. Hrs. | Course | No. | Course Title | Cr. Hrs. |
| Acctg. | 1 | Accounting | 3 | Acctg. | 2 | Accounting | 3 |
| Eco. | 3 | Economics | 3 | Eco. | 4 | Economics | 3 |
| | | Optional Courses[1] | 9 | Eco. | 45 | Statistical Method | 3 |
| | | | 15 | | | Optional Courses[1] | 6 |
| | | | | | | | 15 |

| First Semester | | JUNIOR AND SENIOR YEARS | | | Second Semester | |
|---|---|---|---|---|---|---|
| Eco. or | 346 | Business Cycles | | Mkt. | 11 | Marketing 3 |
| Eco. | 333 | Labor Problems 3 | | Fin. | 125 | Corporation Finance 3 |
| Fin. | 129 | Money and Banking 3 | | Eco. | 306 | Intermed. Eco. Theory 3 |
| Law | 1 | Business Law 3 | | | | Optional Courses[1] 3 |
| Eco. or | 321 | Business and Organization Behavior — | | | | Free Electives 6 |
| Eco. | 313 | Intro. to Mgmt. Science 3 | | | | |
| | | Optional Courses[1] 3 | | | | |
| | | Free Elective 3 | | | | |
| | | Required Courses in Major | | | | |
| Acctg. | 13 | Intermediate Acctg. 3 | | Acctg. | 14 | Intermediate Acctg. 3 |
| Acctg. | 115 | Cost Accounting 3 | | Law | 102 | Business Law 3 |
| | | Major Program Elective[2] 6 | | | | Major Program Electives[2] 6 |
| | | 30 | | | | 30 |

[1]Optional Courses fall into three groups: English or Foreign Language, Arts, and Science. For a general statement concerning these groups see page 115.

[2]Electives in the Accounting Major may be chosen from the following in consultation with advisor:

| | | | | | | |
|---|---|---|---|---|---|---|
| Acctg. | 320 | Auditing 3 | Acctg. | 318 | Adv. Cost Budgeting and Analysis 3 |
| Acctg. | 325 | Controllership 3 | | | |
| Acctg. | 203 | Fed. Tax Accounting 3 | Acctg. | 304 | Govt. & Inst. Acctg 3 |
| Law | 204 | Wills, Estates, & Trusts 3 | Acctg. | 308 | Tax Planning and Research 3 |
| I.E. | 308 | Data Processing 3 | | | |
| Acctg. | 111 | Business Data Processing 3 | Acctg. | 315 | Adv. Accounting 3 |

[3]Eco. 313 is recommended either as a core course or as an elective.

*In addition, the New Jersey State Board requires 30 hours of accounting for candidates for the C.P.A. examination in that state. Lehigh University's College of Business Administration is registered with both the New York and New Jersey boards as an approved accounting curriculum.

## Major in Economics

| First Semester | | SOPHOMORE YEAR | | | Second Semester | |
|---|---|---|---|---|---|---|
| Course No. | | Course Title Cr. Hrs. | Course No. | | Course Title Cr. Hrs. | |
| Acctg. | 1 | Accounting 3 | Acctg. | 2 | Accounting 3 | |
| Eco. | 3 | Economics 3 | Eco. | 4 | Economics 3 | |
| Law | 1 | Business Law 3 | Mkt. | 11 | Marketing 3 | |
| | | Optional Courses[1] 6 | Eco. | 45 | Statistical Method 3 | |
| | | 15 | | | Optional Course[1] 3 | |
| | | | | | 15 | |

| First Semester | | JUNIOR AND SENIOR YEARS | | | Second Semester | |
|---|---|---|---|---|---|---|
| Course No. | | Course Title Cr. Hrs. | Course No. | | Course Title Cr. Hrs. | |
| Eco. | 346 | Business Cycles 3 | Fin. | 125 | Corporation Finance 3 | |
| Fin. | 129 | Money and Banking 3 | Eco. or | 321 | Business and Organization Behavior | |
| Eco. | 306 | Inter. Eco. Theory 3 | Eco. | 313 | Intro. to Mgmt. Science 3 | |
| | | Optional Courses[1] 9 | | | Optional Course[1] 3 | |
| | | Free Elective[3] 3 | | | Major Program Electives[2] 6 | |
| | | | | | Free Electives[3] 6 | |

Required Courses in Major

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Eco. | 307 | Hist. of Eco. Thought | 3 | Eco. | 333 | Labor Problems | 3 |
| Eco. | 347 | Nat. Income Analysis | 3 | Eco. | 308 | Hist. of Eco. Thought | 3 |
| Fin. | 351 | Pub. Fin: Fed | 3 | Eco. | 309 | Comp. Eco. Systems | 3 |
| | | | 30 | | | | 30 |

[1]Optional Courses fall into three groups: English or Foreign Language, Arts, and Science. For a general statement concerning these groups see page 115.

[2]Electives in the Economics major be chosen from the following in consultation with advisor:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Fin. | 337 | Inter. Economics | 3 | Eco. | 348 | Adv. Bus. Cycles | 3 |
| Eco. | 310 | Eco. Evolution | 3 | Fin. | 342 | Inter. Trade & Fin. | 3 |
| Eco. | 311 | Eco. Resource Use | 3 | Eco. | 336 | Bus. & Govt. | 3 |
| Eco. | 352 | Adv. Statistical Method | 3 | Eco. | 372 | Readings in Eco. | 3 |
| Eco. | 334 | Labor Legislation | 3 | Eco. | 303 | Eco. Development | 3 |
| Eco. | 337 | Transportation and Spatial Economics | 3 | Eco. | 305 | Eco. Dev. of Latin Amer. | 3 |
| | | | | Fin. | 332 | Monetary Fiscal Pol. | 3 |

[3]Suggested Free Electives:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Phil. | 14 | Logic & Scient. Meth. | 3 | Math. | 22 | Anal. Geom. & Cal. II | 4 |
| Hist. | 327 | Dev. Amer. Inst. | 3 | Math. | 23 | Anal. Geom. & Cal. III | 4 |
| Acctg. | 305 | Fin. State and Rep. | 3 | Math. | 204 | Linear Analysis | 3 |
| Hist. | 355 | Intel. Expan. Eur. | 3 | Hist. | 328 | Dev. Amer. Inst. | 3 |
| | | | | Hist. | 356 | Intel. Expan. Eur. | 3 |

## Major in Economic Statistics

SOPHOMORE YEAR

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Course No. | Course Title | Cr. Hrs. | | Course No. | Course Title | Cr. Hrs. | |
| Acctg. 1 | Accounting | 3 | | Acctg. 2 | Accounting | 3 | |
| Eco. 3 | Economics | 3 | | Eco. 4 | Economics | 3 | |
| Law 1 | Business Law | 3 | | Eco. 45 | Statistical Method | 3 | |
| | Optional Courses[1] | 6 | | | Optional Courses[1] | 6 | |
| | | 15 | | | | 15 | |

JUNIOR AND SENIOR YEARS

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Course No. | Course Title | Cr. Hrs. | | Course No. | Course Title | Cr. Hrs. | |
| Mkt. 11 | Marketing | 3 | | Fin. 125 | Corporation Finance | 3 | |
| Fin. 129 | Money and Banking | 3 | | Eco. 321 | Business and Organization Behavior | 3 | |
| Eco. 346 | Business Cycles | 3 | | Eco. 306 | Int. Eco. Theory | 3 | |
| | Optional Courses[1] | 6 | | | Optional Course[1] | 3 | |
| | Major Program Elective[2] | 3 | | | Major Program Elective[2] | 3 | |
| | Free Elective[3] | 3 | | | Free Electives[3] | 6 | |

Required Courses in Major

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Eco. | 347 | Nat. Inc. Analysis | 3 | Eco. | 302 | Survey of Mgmt. Science App. | 3 |
| Eco. | 352 | Adv. Stat. Method | 3 | Eco. | 333 | Labor Problems | 3 |
| Eco. | 313 | Intro. to Mgmt. Science | 3 | Eco. | 348 | Adv. Bus. Cycles | 3 |
| | | | 30 | | | | 30 |

[1]Optional Courses fall into three groups: English or Foreign Language, Arts, and Science. For a general statement concerning these groups see page 115.

[2]Electives in the Economic Statistics major be chosen from among the following:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Fin. | 337 | Inter. Economics | 3 | Fin. | 338 | Inter. Economics | 3 |
| Eco. | 310 | Eco. Evolution | 3 | Eco. | 336 | Bus. & Govt. | 3 |
| Eco. | 311 | Eco. Resource Use | 3 | Eco. | 372 | Readings in Eco. | 3 |
| Eco. | 309 | Comparative Eco. Sys. | 3 | Eco. | 303 | Eco. Development | 3 |
| Eco. | 371 | Readings in Eco. | 3 | Fin. | 332 | Monetary Fiscal Policy | 3 |
| Mkt. | 312 | Mktg. & Dist. Research | 3 | Eco. | 305 | Eco. Dev. of Latin America | 3 |
| Fin. | 326 | Prob. in Fin. Mgmt. | 3 | | | | |
| Fin. | 332 | Monetary & Fiscal Pol | 3 | Acctg. | 111 | Business Data Processing | 3 |
| Eco. | 337 | Transportation and Spatial Economics | 3 | | | | |

[3]Suggested Free Electives:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Hist. | 327 | Dev. Amer. Inst. | 3 | Math. | 22 | Anal. Geo. & Cal. II | 4 |
| Eco. | 371 | Readings in Eco. | 3 | Math. | 23 | Anal. Geo. & Cal. III | 4 |
| Math. | 233 | Math. Stat. | 3 | Hist. | 328 | Dev. Amer. Inst. | 3 |
| | | | | Eco. | 372 | Readings in Eco. | 3 |
| | | | | Math. | 204 | Linear Analysis | 3 |

## Major in Finance

SOPHOMORE YEAR

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Course No. | | Course Title | Cr. Hrs. | Course No. | | Course Title | Cr. Hrs. |
| Acctg. | 1 | Accounting | 3 | Acctg. | 2 | Accounting | 3 |
| Eco. | 3 | Economics | 3 | Eco. | 4 | Economics | 3 |
| Law | 1 | Business Law | 3 | Eco. | 45 | Statistical Method | 3 |
| | | Optional Courses[1] | 6 | | | Optional Courses[1] | 6 |
| | | | 15 | | | | 15 |

JUNIOR AND SENIOR YEARS

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Course No. | | Course Title | Cr. Hrs. | Course No. | | Course Title | Cr. Hrs. |
| Mkt. | 11 | Marketing | 3 | Eco. | 333 | Labor Problems | 3 |
| Fin. | 125 | Corporation Finance | 3 | Eco. | 321 | Business and Organization Behavior | 3 |
| Eco. | 306 | Intermed. Eco. Theory | 3 | or | | | |
| Fin. | 129 | Money and Banking | 3 | Eco. | 313 | Intro. to Mgmt. Science | 3 |
| | | Optional Course[1] | 3 | | | Optional Courses[1] | 6 |
| | | Major Program Electives[2] | 6 | | | Major Program Elective[2] | 3 |
| | | Free Electives[3] | 3 | | | Free Electives[3] | 6 |

Required Courses in Major

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Fin. | 323 | Investments | 3 | Eco. | 346 | Business Cycles | 3 |
| Fin. | 351 | Pub. Fin.: Fed. | 3 | Fin. | 326 | Prob. in Fin. Mgmt | 3 |
| | | | | Fin. | 130 | Money & Banking | 3 |
| | | | 30 | | | | 30 |

[1]Optional Courses fall into three groups: English or Foreign Language, Arts, and Science. For a general statement concerning these groups see page 115.

[2]Electives in the Finance major may be chosen from the following in consultation with advisor:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Fin. | 332 | Mon.-Fiscal Policy | 3 | Fin. | 324 | Investments | 3 |
| Fin. | 337 | Inter. Economics | 3 | Fin. | 331 | Bank Credit Mgmt. | 3 |
| Eco. | 347 | Nat. Inc. Analysis | 3 | Fin. | 342 | Inter. Trade & Fin. | 3 |
| Acctg. | 305 | Fin. Stat. & Reports or | | Fin. | 352 | Pub. Finance: State & Local | 3 |
| Acctg. | 13 | Intermed. Acctg. | 3 | Eco. | 348 | Adv. Bus. Cycles | 3 |
| | | | | Eco. | 336 | Business and Govt. | 3 |
| | | | | Law. | 204 | Wills, Estates & Trusts | 3 |
| | | | | Acctg. | 14 | Intermed. Acctg. | 3 |

[3]Suggested Free Electives:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Eco. | 307 | Hist. of Eco. Thought | 3 | Acctg. | 115 | Cost Acctg. | 3 |
| Fin. | 371 | Readings in Fin. | 3 | Eco. | 308 | Hist. of Eco. Thought | 3 |
| | | | | Fin. | 372 | Readings in Fin. | 3 |

## Major in Foreign Careers

SOPHOMORE YEAR

| First Semester | | | | Second Semster | | | |
|---|---|---|---|---|---|---|---|
| Course No. | | Course Title | Cr. Hrs. | Course No. | | Course Title | Cr. Hrs. |
| Acctg. | 1 | Accounting | 3 | Acctg. | 2 | Accounting | 3 |
| Eco. | 3 | Economics | 3 | Eco. | 4 | Economics | 3 |
| Law | 1 | Business Law | 3 | Mkt. | 11 | Marketing | 3 |
| Govt. | 3 | Governments | 3 | Sci. Opt. | | Science | 3 |
| Lang. Opt.* | | For. Language of Area | 3 | Lang. Opt.* | | For. Lang. of Area | 3 |
| | | | 15 | | | | 15 |

*With freshman year foreign language and science (See note on Uniform Freshman Year above for Foreign Careers Majors), the twelve credits of language of area fulfills the language option requirement.

**JUNIOR YEAR**

| First Semester | | | | Second Semster | | | |
|---|---|---|---|---|---|---|---|
| Course No. | | Course Title | Cr. Hrs. | Course No. | | Course Title | Cr. Hrs. |
| Fin. | 129 | Money and Banking | 3 | Fin. | 125 | Corp. Finance | 3 |
| Eco. | 303 | Money and Banking | 3 | Eco. | 305 | Eco. Dev. of Latin America | |
| Hist. | | European or Latin American History | 3 | or Fin. | 343 | European Economic Integration | 3 |
| | | Arts Option* | 3 | Hist. | | European or Latin American History | 3 |
| Eco. | 333 | Labor Problems | 3 | Eco. | 45 | Statistical Methods | 3 |
| or Eco. | 346 | Business Cycles | 3 | | | Major Program Electivel | |

*The arts option should be selected in a field other than history or government to complete the college arts option requirements of twelve credits.

**SENIOR YEAR**

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Course No. | | Course Title | Cr. Hrs. | Course No. | | Course Title | Cr. Hrs. |
| Eco. | 309 | Comp. Eco. Systems | 3 | Eco. | 321 | Business and Organization Behavior | |
| Eco. | 306 | Intermed. Eco. Theory | 3 | or Eco. | 313 | Intro. to Mgmt. Science | 3 |
| Fin. | 337 | Inter. Economics | 3 | Fin. | 338 | Inter. Economics | 3 |
| | | Major Prog. Elective[1] | 3 | | | Major Prog. Elective[1] | 3 |
| | | Free Elective | 3 | | | Free Elective | 6 |
| | | | 15 | | | | 15 |

[1]Electives in the Foreign Career major may be chosen from the following in consultation with advisor.

Major Program Electives

(Total of 12 hours required)

| Course No. | Course Title | Cr. Hrs. | Course No. | Course Title | Cr. Hrs. |
|---|---|---|---|---|---|
| Eco. 311 | Eco. of Resource Use | 3 | S.R. 366 | Pop. Problems | 3 |
| Govt. 51 | Am. Nat'l. Gov. | 3 | Govt. 360 | Public Admin. | 3 |
| I.R. 341 | Inter. Relat. | 3 | Govt. 361 | Comp. Ad. Systems | 3 |
| I.R. 361 | Inter. Law | 3 | I.R. 352 | Inter. Organ. | 3 |
| S.R. 31 | Cult. Anthro. | 3 | Phil. 14 | Logic & Sci. Meth. | 3 |
| Fin. 351 | Publ. Fin. Fed. | 3 | | | |

## Major in Management

**SOPHOMORE YEAR**

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Course No. | | Course Title | Cr. Hrs. | Course No. | | Course Title | Cr. Hrs. |
| Acctg. | 1 | Accounting | 3 | Acctg. | 2 | Accounting | 3 |
| Eco. | 3 | Economics | 3 | Eco. | 4 | Economics | 3 |
| | | | | Law | 1 | Business Law | 3 |
| | | | | Mkt. | 11 | Marketing | 3 |
| | | Optional Courses[1] | 9 | | | Optional Course[1] | 3 |
| | | | 15 | | | | 15 |

**JUNIOR AND SENIOR YEARS**

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Course No. | | Course Title | Cr. Hrs. | Course No. | | Course Title | Cr. Hrs. |
| Eco. | 45 | Statistical Method | 3 | Eco. | 346 | Business Cycles | 3 |
| Fin. | 125 | Corporation Finance | 3 | Fin. | 129 | Money & Banking | 3 |
| Eco. | 321 | Business and Organization Theory | 3 | | | Optional Courses[1] | 6 |
| Eco. | 306 | Inter. Eco. Theory | 3 | | | Maj. Prog. Elective[2] | 3 |
| | | Optional Course[1] | 3 | | | Free Electives[3] | 6 |
| | | Major Prog. Elective[2] | 3 | | | | |
| | | Free Elective[3] | 3 | | | | |

Required Courses in Major

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Acctg. | 305 | Fin. Statements & Reports | 3 | Eco. | 334 | Labor Legislation | 3 |
| Eco. | 313 | Intro. to Mgmt. Science | 3 | Fin. | 326 | Prob. in Fin. Mgmt. | 3 |
| Eco. | 333 | Labor Problems | 3 | Eco. | 302 | Survey of Mgmt. Science App. | 3 |
| | | | 30 | | | | 30 |

[1]Optional Courses fall into three groups: English or Foreign Language, Arts, and Science. For a general statement concerning these groups see page 115.

[2]Electives in the Management Program may be chosen from the following in consultation with advisor:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Eco. | 347 | Nat. Inc. Analysis | 3 | Fin. | 331 | Bank Credit Mgmt. | 3 |
| Mkt. | 217 | Industrial Marketing | 3 | Eco. | 336 | Bus. & Govt. | 3 |
| Psych. | 201 | Industrial Psychology | 3 | Acctg. | 203 | Fed. Tax Acctg. | 3 |
| I.E. | 329 | Wage & Salary Admin. | 3 | Mkt. | 312 | Market Research | 3 |
| Eco. | 337 | Transportation and Spatial Econ. | 3 | I. E. | 166 | Production Management | 3 |
| | | | | I.E. | 339 | Manpower Management | 3 |
| | | | | Acctg. | 111 | Business Data Processing | 3 |

[3]Suggested Free Electives:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| S.R. | 61 | Princ. of Sociology | 3 | Psych. | 1 | Elem. Psychology | 3 |
| | | | | Mkt. | 214 | Sell. & Sales Mgmt. | 3 |
| | | | | S.R. | 366 | Population Problems | 3 |
| | | | | Eco. | 303 | Eco. Development | 3 |

## Major in Marketing

| First Semester | | SOPHOMORE YEAR | | Second Semester | |
|---|---|---|---|---|---|
| Course No. | Course Title | Cr. Hrs. | Course No. | Course Title | Cr. Hrs. |
| Acctg. 1 | Accounting | 3 | Acctg. 2 | Accounting | 3 |
| Eco. 3 | Economics | 3 | Eco. 4 | Economics | 3 |
| Law 1 | Business Law | 3 | Mkt. 11 | Marketing | 3 |
| | Optional Courses[1] | 6 | | Optional Courses[1] | 6 |
| | | 15 | | | 15 |

| First Semester | | JUNIOR AND SENIOR YEARS | | Second Semester | |
|---|---|---|---|---|---|
| Course No. | Course Title | Cr. Hrs. | Course No. | Course Title | Cr. Hrs. |
| Eco. 45 | Statistical Method | 3 | Eco. 346 | Business Cycles | 3 |
| Fin. 129 | Money & Banking | 3 | Fin. 125 | Corporation Finance | 3 |
| Eco. 306 | Inter. Eco. Theory | 3 | Eco. 321 | Business and Organization Behavior | 3 |
| | Optional Course[1] | 3 | | Optional Courses[1] | 6 |
| | Major Program Elective[2] | 3 | | Major Program Elective[2] | 3 |
| | Free Electives[3] | 6 | | Free Elective[3] | 3 |

Required Courses in Major

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mkt. | 113 | Advertising | 3 | Mkt. | 115 | Retailing | 3 |
| Eco. | 313 | Intro. to Mgmt. Science | 3 | Mkt. | 214 | Sell. & Sales Mgmt. | 3 |
| Eco. | 333 | Labor Problems | 3 | Mkt. | 312 | Mkt. & Dist. Research | 3 |
| | | | 30 | | | | 30 |

[1]Optional Courses fall into three groups: English or Foreign Language, Arts, and Science. For a general statement concerning these groups see page 115.

[2]Electives in the Marketing major may be chosen from the following in consultation with advisor:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mkt. | 217 | Industrial Mkt. | 3 | S.R. | 366 | Population Prob. | 3 |
| Acctg. | 115 | Cost Accounting | 3 | Psych. | 201 | Industrial Psych. | 3 |
| Eco. | 303 | Eco. Development | 3 | Fin. | 338 | Inter. Economics | 3 |
| Eco. | 310 | Eco. Evolution | 3 | Eco. | 305 | Eco. Dev. of Lat. Amer. | 3 |
| Eco. | 347 | Nat. Inc. Analysis | 3 | Eco. | 336 | Business and Govt. | 3 |
| Eco. | 371 | Readings in Eco | 3 | Eco. | 372 | Readings in Eco. | 3 |
| Fin. | 337 | Inter. Economics | 3 | Eco. | 311 | Economics Res. Use | 3 |
| | | | | Eco. | 337 | Transportation and Spatial Econ. | 3 |
| | | | | Acctg. | 111 | Business Data Processing | 3 |

[3]Suggested Free Electives:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Journ. | 17 | Magazine Article Writing | 3 | Speech | 31 | Bus. & Prof. Speaking | 3 |
| | | | | Journ. | 21 | Creative Writing | 3 |

## ENGINEERING - M.B.A. PROGRAM AND ENGINEERING - M.S. IN MANAGEMENT SCIENCE PROGRAM

These programs are designed to meet the needs of competent students in any of the engineering curricula who wish to add to their engineering studies training in business management at an advanced level.

The over-all time involved in each program is five years, but a certain amount of summer session work would be necessary to attain both a bachelor's degree in engineering and a master's degree in business administration or management science within that period. In addition to a course in economics, which is required of all engineering undergraduates, twenty-one or twenty-four hours of basic business courses are necessary to meet the background requirements for both the M.S. in Management Science and the M.B.A. degrees. If as much as nine hours of such courses can be rostered in the student's engineering curriculum, the remaining twelve hours can be obtained in one summer. Otherwise, attendance at an additional summer session would be necessary. Candidates for each program will be required to take the Admission Test for Graduate Study in Business.

The background courses required for M.B.A. candidates are:

| | | | |
|---|---|---|---|
| Eco. | 3. | Principles of Economics | (3) |
| Fin. | 129. | Money and Banking | (3) |
| Fin. | 125. | Corporation Finance | (3) |
| Law | 1. | Business Law | (3) |
| Eco. | 45. | Statistical Method | (3) |
| Mkt. | 11. | Marketing | (3) |
| Acctg. and Acctg. | 108. 115. | Fundamentals of Accounting<br>Cost Accounting | (3)<br>(3) |
| Eco. | 306. | Intermediate Economic Theory | (3) |
| Fin. | 306. | Problems In Financial Management<br>or other 300 course | (3) |

The background courses required for the M.S. in Management Science candidates are:

| | | | |
|---|---|---|---|
| Acctg. and Acctg. | 108. 115. | Fundamentals of Accounting<br>Cost Accounting | (3)<br>(3) |
| Fin. | 125. | Corporation Finance | (3) |
| Math. | 233. | Mathematical Statistics or | (3) |
| Eco. | 45. | Statistical Method | (3) |
| Eco. | 306. | Intermediate Economic Theory | (3) |
| Mkt. | 11. | Marketing | (3) |

Transfer credits from a reputable accredited college or university will be accepted for background courses. Students wishing to take some of their background work elsewhere should consult Professor M. D. Snider, Office of the Dean (Graduate Studies), to obtain approval of the proposed course or courses and of the institution at which they are to be taken.

It is suggested that engineering students who are interested in these programs confer with Professor Snider for additional information. The graduate programs leading to the degrees of Master of Business Administration and M.S. in Management Science are outlined on pages 181-186. The Ph.D. in Business and Industrial Economics is described on page 185.

**ARTS — M.B.A. PROGRAM**

This program is designed to meet the needs of competent students in any of the Arts and Science Majors who wish to add to their Arts studies training in business management at an advanced level.

The over-all time involved in the program is five years, but a certain amount of summer session work may be necessary for majors in the sciences to attain both a B.A. and a master's degree in business administration within that period. In addition to a year's work in economics, which can be counted as part of the undergraduate social science distribution requirements, eighteen or twenty-one hours of basic business courses are necessary to meet the background requirements for the M.B.A. degree.

The background courses required for M.B.A. candidates are:

| | | | |
|---|---|---|---|
| Fin. | 129. | Money and Banking | (3) |
| Fin. | 125. | Corporation Finance | (3) |
| Law. | 1. | Business Law | (3) |
| Eco. | 45. | Statistical Method | (3) |
| Mkt. | 11. | Marketing | (3) |
| Acctg. and Acctg. | 108. 115. | Fundamentals of Accounting Cost Accounting | (3) (3) |

Transfer credits from a reputable accredited college or university will be accepted for background courses. Students wishing to take some of their background work elsewhere should consult Professor M. D. Snider, Office of the Dean (Graduate Studies), to obtain approval of the proposed course or courses and of the institution at which they are to be taken.

It is suggested that Arts and Science students who are interested in this program confer with Professor Snider for additional information. The graduate program leading to the degree of Master of Business Administration is outlined on pages 181-186. The Ph.D. in Business and Industrial Economics is described on page 185.

**FIVE-YEAR CURRICULUM IN INDUSTRIAL ENGINEERING AND BUSINESS ADMINISTRATION**

Students who desire to pursue both industrial engineering and business administration may complete the required work for the degree of Bachelor of Science in Industrial Engineering by the end of the fourth year and that required for the degree of Bachelor of Science in Business Administration by the end of the fifth year. It is necessary that a student be enrolled in the curriculum in industrial engineering for the first four years and that he complete the requirements in the curriculum as outlined on page 147. At the beginning of the fifth year the student transfers to the curriculum in business administration and is required to complete thirty-three semester hours in one of the following majors:

### Major in Accounting

| First Semester | | | | FIFTH YEAR Required Courses | | | Second Semester | |
|---|---|---|---|---|---|---|---|---|
| Law | 1 | Business Law | 3 | Law | 102 | Business Law | 3 |
| Fin. | 129 | Money and Banking | 3 | Mkt. | 11 | Marketing | 3 |
| Eco. | 346 | Business Cycles | 3 | Acctg. | 318 | Adv. Cost Budgeting & Analysis | 3 |
| Fin. | 125 | Corporation Finance | 3 | | | | |

and twelve semester hours to be selected from the following in consultation with the advisor:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Acctg. | 203 | Fed. Tax Acctg. | 3 | Acctg. | 315 | Adv. Accounting | 3 |
| Acctg. | 320 | Auditing | 3 | Acctg. | 308 | Tax Planning and Research | 3 |
| Acctg. | 325 | Controllership | 3 | | | | |
| I. E. | 308 | Data Processing | 3 | Law | 204 | Wills, Estates & Trusts | 3 |

### Major in Economics

| First Semester | | | | FIFTH YEAR Required Courses | | | Second Semester | |
|---|---|---|---|---|---|---|---|---|
| Law | 1 | Business Law | 3 | Eco. | 306 | Inter. Eco. Theory | 3 |
| Fin. | 129 | Money and Banking | 3 | Eco. | 308 | Hist. of Eco. Thought | 3 |
| Eco. | 307 | Hist. of Eco. Thought | 3 | Fin. | 125 | Corporation Finance | 3 |
| Fin. | 351 | Pub. Fin.: Federal | 3 | | | | |

and twelve semester hours to be selected from the following in consultation with the advisor:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Fin. | 337 | Inter. Economics | 3 | Fin. | 338 | Inter. Economics | 3 |
| Eco. | 347 | Nat. Inc. Analysis | 3 | Eco. | 348 | Adv. Bus. Cycles | 3 |
| Eco. | 371 | Readings in Eco. | 3 | S.R. | 362 | Social Problems | 3 |
| Eco. | 352 | Adv. Stat. Method | 3 | Eco. | 372 | Readings in Eco. | 3 |
| S.R. | 61 | Sociology | 3 | Eco. | 336 | Bus. & Govt. | 3 |
| Eco. | 334 | Labor Legislation | 3 | | | | |

### Major in Economic Statistics

| First Semester | | | | FIFTH YEAR Required Courses | | | Second Semester | |
|---|---|---|---|---|---|---|---|---|
| Law | 1 | Business Law | 3 | Eco. | 306 | Inter. Eco. Theory | 3 |
| Fin. | 129 | Money and Banking | 3 | Eco. | 348 | Adv. Bus. Cycles | 3 |
| Eco. | 347 | Nat. Inc. Analysis | 3 | Fin. | 125 | Corporation Finance | 3 |
| Eco. | 352 | Adv. Stat. Method | 3 | | | | |

and twelve semester hours to be selected in consultation with the advisor

### Major in Finance

| First Semester | | | | FIFTH YEAR Required Courses | | | Second Semester | |
|---|---|---|---|---|---|---|---|---|
| Law | 1 | Business Law | 3 | Fin. | 326 | Prob. in Fin. Mgmt. | 3 |
| Fin. | 129 | Money and Banking | 3 | Eco. | 306 | Inter. Eco. Theory | 3 |
| Fin. | 323 | Investments | 3 | Eco. | 346 | Business Cycles | 3 |
| Fin. | 351 | Pub. Fin.: Federal | 3 | | | | |

and twelve semester hours to be selected from the following in consultation with the advisor:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Fin. | 337 | Inter. Economics | 3 | Fin. | 338 | Inter. Economics | 3 |
| Fin. | 371 | Readings in Fin. | 3 | Fin. | 324 | Investments | 3 |
| Fin. | 332 | Mon.-Fiscal Policy | 3 | Fin. | 352 | Pub. Finance: State & Local | 3 |
| Eco. | 321 | Business and Organization Behavior | 3 | Eco. | 336 | Bus. & Govt. | 3 |
| Acctg. | 305 | Fin. Statements & Reports or | | Acctg. | 14 | Intermed. Acctg. | 3 |
| | | | | Fin. | 372 | Readings in Fin. | 3 |
| Acctg. | 13 | Intermed. Acctg. | 3 | Law | 204 | Wills, Estates & Trusts | 3 |

### Major in Management

| First Semester | | | | FIFTH YEAR | | | Second Semester | |
|---|---|---|---|---|---|---|---|---|
| Law | 1 | Business Law | 3 | Eco. | 306 | Inter. Eco. Theory | 3 |
| Fin. | 129 | Money and Banking | 3 | Fin. | 326 | Prob. in Fin. Mgmt. | 3 |
| Acctg. | 305 | Fin. Statements & Reports | 3 | Eco. | 302 | Survey of Mgmt. Science App. | 3 |
| Fin. | 125 | Corporation Finance | 3 | Eco. | 313 | Intro. to Mgmt. Science | 3 |
| Eco. | 321 | Business and Organization Behavior | 3 | | | | |

and six semester hours to be selected from the following in consultation with the advisor:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Eco. | 347 | Nat. Inc. Analysis | 3 | Fin. | 331 | Bank Credit Mgmt. | 3 |
| Mkt. | 217 | Industrial Marketing | 3 | Eco. | 336 | Bus. & Gvt. | 3 |
| I.E. | (300 level) | Courses not taken previously | 6 | Mkt. | 214 | Sell. & Sales Mgmt. | 3 |
| | | | | Mkt. | 312 | Market Research | 3 |
| | | | | Eco. | 334 | Labor Legislation | 3 |

### Major in Marketing

| First Semester | | | | FIFTH YEAR | | | Second Semester | |
|---|---|---|---|---|---|---|---|---|
| | | | | Required Courses | | | | |
| Law | 1 | Business Law | 3 | Mkt. | 115 | Retailing | 3 |
| Fin. | 129 | Money and Banking | 3 | Eco. | 306 | Inter. Eco. Theory | 3 |
| Mkt. | 113 | Advertising | 3 | Mkt. | 214 | Sell. & Sales Mgmt. | 3 |

and twelve semester hours to be selected from the following in consultation with the advisor:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Fin. | 337 | Inter. Economics | 3 | Fin. | 338 | Inter. Economics | 3 |
| Eco. | 371 | Readings in Eco. | 3 | Acctg. | 318 | Adv. Cost Budgeting & Analysis | 3 |
| Mkt. | 217 | Industrial Mkt. | 3 | | | | |
| Eco. | 301 | Business Policy | 3 | Eco. | 372 | Readings in Eco. | 3 |
| Eco. | 346 | Business Cycles | 3 | Mkt. | 312 | Mkt. Research | 3 |
| | | | | S.R. | 61 | Sociology | 3 |

### Major in Personnel and Industrial Relations

| First Semester | | | | FIFTH YEAR | | | Second Semester | |
|---|---|---|---|---|---|---|---|---|
| | | | | Required Courses | | | | |
| Law | 1 | Business Law | 3 | Eco. | 306 | Inter. Eco. Theory | 3 |
| Fin. | 129 | Money and Banking | 3 | Eco. | 334 | Labor Legislation | 3 |
| Psych. | 201 | Industrial Psych. | 3 | S.R. | 61 | Sociology | 3 |
| | | | | Eco. | 346 | Business Cycles | 3 |

and twelve semester hours to be selected from the following in consultation with the advisor:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Fin. | 323 | Investments | 3 | Psych. | 354 | Human Engineering | 3 |
| Fin. | 351 | Pub. Fin.: Federal | 3 | Govt. | 360 | Pub. Adm. | 3 |
| Fin. | 337 | Inter Economics | 3 | S.R. | 362 | Social Problems | 3 |
| Eco. | 347 | Nat. Inc. Analysis | 3 | Eco. | 372 | Readings in Eco. | 3 |
| Eco. | 371 | Readings in Eco. | 3 | I.E. | 339 | Industrial Manpower Management | 3 |
| Eco. | 352 | Adv. Stat. Method | 3 | | | | |
| Law | 102 | Business Law | 3 | Eco. | 321 | Business and Organization Behavior | 3 |

# THE COLLEGE OF ENGINEERING

John J. Karakash, *Dean of the College of Engineering*
Robert Taylor Gallagher, *Associate Dean of the College of Engineering*

The College of Engineering offers curricula in chemical engineering, chemistry, civil engineering, electrical engineering, engineering mechanics, engineering physics, fundamental sciences, industrial engineering, mechanical engineering, and metallurgical engineering.

The engineering curricula were formulated on the basis of an intense study, by the faculty of Lehigh University, of the problems of technical education and the changing needs of modern society. This study led to the conclusion that greater emphasis than heretofore should be placed upon the fundamentals of engineering, including mathematics, physics, chemistry, and theoretical and applied mechanics and less emphasis upon the highly specialized details of engineering practice; and that the engineer must know something of the social sciences and humanities, that is, the sciences which deal with human relations. The various engineering curricula accordingly emphasize the fundamental sciences and those subjects from the social sciences and the humanities which are part of the equipment of every well-educated man. These latter are now recognized as essential to the proper training of engineers, not only because of their practical applications in industrial, business, and civic life, but also because they enrich the whole of a man's private life.

Recommendation is made for a uniform freshman year in the College of Engineering. The student's tentative choice of a specific engineering curriculum, as recorded at the time of entrance, may be changed (within the limitations of enrollment in the various curricula) prior to his entering upon the sophomore year without loss of time. Engineering freshmen are admitted with "open" curriculum choice. Within a year of college experience, and on the basis of conferences with members of the faculty, it is hoped that any student who is uncertain as to his curriculum choice may choose wisely. In the second semester of his freshman year, just prior to preregistration for the sophomore year, each engineering student must select a particular

engineering curriculum. The sophomore year for many of the engineering curricula are sufficiently alike so as to be "tradeable" between these curricula, and it is thus possible for a student to transfer from one curriculum to another without loss of credit or having to make up courses at the end of his sophomore year.

The work of the first two years is fairly self-contained. To those who for one reason or another are unable to complete their engineering education, it affords preparation for careers as draftsmen, chiefs of party, shop foremen, or assistants in industrial laboratories or plants.

Since the University recognizes that the four-year programs are not intended to train specialists in a given area but rather to educate students in terms of principles, the degree awarded upon graduation is Bachelor of Science in the particular division of engineering, for example, Bachelor of Science in Civil Engineering. The successful completion of one year of full-time graduate study leads to the degree of Master of Science.

Students pursuing studies leading to a specific engineering degree have opportunities for elective sequences which provide the foundation for graduate work in special areas of interest. Even though elective opportunities in some curricula do not appear until the Senior year, students are urged to become aware of such opportunities as early as their Sophomore year and consult with their curriculum advisors for optimal planning of their programs.

Five-year courses combining the liberal arts and engineering, business administration and engineering, electrical and mechanical engineering, electrical engineering and physics are also provided. In each of these combined curricula one baccalaureate degree is awarded upon the successful completion of four years of study, and a second baccalaureate degree is awarded at the end of the fifth year. Similar programs may be worked out leading to an M.S. in Materials, or an M.B.A.

## GENERAL STUDIES

General studies are non-professional, non-specialized studies in the large areas of human knowledge and experience with which any educated man should be acquainted. These areas are three: the humanities, the natural sciences, and the social sciences. Since all engineers receive extensive training in the physical sciences, their general studies are restricted to the humanities, the life and earth sciences, and the social sciences.

The general studies sequence starts in the freshman year with six hours of English composition and literature, six hours of social sciences, and three hours of Economics. This is followed usually in the sophomore year with another three hours of an elective; in the junior year with six hours of electives. By the end of the junior year the student is expected to have completed all stipulations so that in the senior year he can take a final six hours freely selected and fulfill the total general studies requirement of thirty hours.

All courses must be on the approved list of courses for general studies. The distribution requirements of general studies are as follows:

*Group 1: Humanities* (9 hours)

Freshman English. Six semester hours (university-wide requirement). English 1 and 2, Composition and Literature. Students who demostrate satisfactory ability in written composition in the freshman placement tests may be admitted to English 11 and 12, Types of World Literature, which satisfies this requirement.

*Group 2: Life and Earth Sciences* (0 hours)

*Group 3: Social Sciences* (9 hours)

Economics 3. Three semester hours.

*Electives* Twelve (12) additional hours from the approved General Study List, with the total of elective and required courses not to exceed 12 hours in any one department.

On the recommendation of the department heads and with the approval of the Dean of the College of Engineering certain courses, not to exceed two above the stipulated requirements, from the general study list can be used toward regular curriculum requirements and also counted toward general study requirements.

Registration into any of the elective courses may be limited by the maximum class size.

*Total 30 hours*

The objective of the study of the humanities and the social sciences in technical schools has been stated by the American Society for Engineering Education to be the development of an "understanding of the evolution of the social organism within which we live. . . .; and the development of moral, ethical, and social concepts essential to a satisfying personal philosophy, to a career consistent with the public welfare, and to a sound professional attitude." We conceive it to be the duty of the engineer to be a professional man in the broadest sense of the term, a member of a group whose primary aim is to advance human well-being.

Several of these courses (notably History 11 and 12, "Development of Western Civilization"; Biology 13, "Human Biology"; and Philosophy 100, "Philosophy of Contemporary Civilization") have been developed particularly to satisfy the objectives of general studies. They are designed to acquaint the student with some broad segment of the heritage of our civilization, thereby opening intellectual doors for the student to facilitate the self-education which will continue throughout his life. The requirements

in various fields are planned to encourage the student to study as broadly as is possible yet retain the possibility that the student who has a strong interest in a field may pursue that interest to as great an extent as is reasonable within the time available. Since election of History 11 and 12 is encouraged in the freshman year, it is scheduled to fit with the normal freshman courses, whereas difficulty of schedules and conflicts may be expected in later years.

## GENERAL STUDIES COURSES

**Group I: Humanities**

Required Course. English 1 and 2, Composition and Literature

**Literature**

Classical — Greek 50 — Greek Literature in English Translation.
Latin 51 — Latin Literature in English Translation.

English and American — English 4, 5, 7, 8, 9, 11, 12, 18, 19, 20, 21; 35, 36, or any English Literature course above 100.

Foreign — any literature course in a foreign language (i.e., must be beyond intermediate level).

**Communication**

Speech 30 or 32

**Foreign Language**

Any language course on the intermediate or elementary level, classical or modern. (If elementary language study is elected a minimum of six hours must be in one language in order to receive General Studies credit. A student may not elect for elementary study any language in which he has entering credit.)

**Fine Arts**

Fine Arts, any course.
Music 20-32, any course.
Speech 61 (Dramatics).

**Philosophy and Religion**

Any course.

**Group 2: Life and Earth Sciences**

**Astronomy**

| | | |
|---|---|---|
| Astron. | 1. | Descriptive Astronomy. |
| Astron. | 2. | General Astronomy. |
| Astron. | 104. | Stellar Astronomy and Astrophysics. |

**Biology**

| | | |
|---|---|---|
| Biol. | 13, | Human Biology |
| Biol. | 21, 22. | Principles of Biology |
| Biol. | 28. | Genetics |
| Biol. | 35. | Microbiology |
| Biol. | 353. | Virology |

**Geology**

| | | |
|---|---|---|
| Geol. | 1, 2. | Principles of Geology. |
| Geol. | 12. | Historical Geology. |
| Geol. | 63. | Introduction to Oceanography. |
| Geol. | 311. | Paleontology. |

**Psychology**

| | | |
|---|---|---|
| Psych. | 1. | Introduction to Psychology. |
| Psych. | 101. | History of Psychology. |
| Psych. | 103. | Comparative Psychology |

**Group 3: Social Sciences**

Required Course. Economics 3.

**Economics**

| | | |
|---|---|---|
| Econ. | 4. | Economics |
| Econ. | 303. | Economics Development |
| Econ. | 306. | Intermediate Economic Theory. |
| Econ. | 307. | History of Economic Thought. |
| Econ. | 308. | History of Economic Thought. |
| Econ. | 333. | Labor Problems. |
| Econ. | 334. | Labor Legislation. |
| Econ. | 336. | Business and Government. |

Finance

| | | |
|---|---|---|
| Fin. | 129. | Money and Banking |
| Fin. | 337. | International Economics |
| Fin. | 338. | International Economics |
| Fin. | 351. | Public Finance — Federal. |

Government and International Relations
Any Course.

History

| | | |
|---|---|---|
| Greek | 21. | Ancient History. |
| Greek | 202. | Greek Archaeology. |
| Latin | 22. | Ancient History. |
| Latin | 203. | Archaeology of Italy. |

History, and Course.

Social Relations
Any Course.

## THE RECOMMENDED FRESHMAN YEAR

An outline follows of the work of the freshman year, most easily scheduled and satisfying appropriate requirements for all engineering students. For schedules of the work of the upper three years, varying according to the several specialized curricula, see pages 134-152.

FRESHMAN YEAR

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Course | No. | Course Title | Cr. Hrs. | Course | No. | Course Title | Cr. Hrs. |
| Chem. | 1 | Chem. Principles I | 3 | Chem. | 3 | Chem. Principles II | 3 |
| Chem. | 11 | Chem. Principles I Lab. | 1 | Chem. | 13 | Chem. Principles II Lab. | 1 |
| *Engl. | 1 | Composition & Lit. | 3 | Engl. | 2 | Composition & Lit. | 3 |
| Hist. | 11 | Dev. W. Civilization | 3 | Hist. | 12 | Dev. W. Civilization | 3 |
| Math. | 21 | Anal. Geom. & Calc. I | 4 | Math. | 22 | Anal. Geom. & Calc. II | 4 |
| Phys. | 1 | Mech. of Mass Points | 3 | Eco. | 3 | Economics | 3 |
| or | | | | or | | | |
| Eco. | 3 | Economics | 3 | Phys. | 1 | Mech. of Mass Points | 3 |
| UFY | | Engr. Orientation | — | P.E. | 2 | Physical Education | — |
| P.E. | 1 | Physical Education | — | | | | |
| | | | 17 | | | | 17 |

*Engl. 1 and 2, Composition and Literature, are the courses normally taken in the first and second semesters respectively of the freshman year. Students who demonstrate superior ability in composition on the English placement tests will be offered registration in Engl. 11 and 12, Types of World Literature.

## INSPECTION TRIPS

Inspection trips to industrial plants are a required part of specific courses in the various curricula in engineering. Written reports may be required. These trips are generally held during the senior year and involve an average expense of about $25. The location of the University in the center of industrial activities of various types furnishes unusual opportunities for visits of inspection to engineering plants.

## HONORS PROGRAMS

Outstanding students in the college may participate in the Honors Program. Each department offers Honors work, with some differences in detail to adapt to the specific needs of the department.

Outstanding students may receive permission to do independent study on an unscheduled basis, thereby proceeding more rapidly and more deeply than is possible in regularly organized classes. This permits the student who is qualified for and interested in this work to proceed in a direction agreed upon with his Honors Advisor, leading to the preparation of an undergraduate thesis.

During the first two years, the student who contemplates independent study should consult his department head to determine desirable accelerations or rearrangements in his standard program. Normally, the unscheduled work is begun in the junior year, but under conditions which vary slightly among departments.

Outstanding students are urged to consult their department heads concerning the requirements for independent study and the thesis which must be submitted. Within the limits of facilities and staff available special programs will be arranged for those accepted for Honors work. Students who successfully complete the program and submit an outstanding thesis are awarded Departmental Honors at graduation.

Students of the college are also eligible for Comprehensive Honors, award of which is based on a series of very broad Creative Concepts Seminars and the submission of a thesis. (See page 73-76)

**COMBINED ARTS AND ENGINEERING CURRICULA**

Under the five-year plan the student is in the College of Arts and Science for four years, earning the B.A. degree on completion of a program which includes, along with specific B.A. training, the fundamental mathematical, scientific, and engineering subjects of the engineering curriculum of his choice. The fifth year is spent in the College of Engineering, carrying on a program leading to the degree of B.S. in his selected branch of engineering. This is usually the senior year curriculum of the chosen branch of engineering.

An engineering student who decides at any stage of his course that he wishes to work for both the B. A. and B. S. degrees, may register in one of the colleges concerned for a period of years and complete the combined requirements of both degrees in five or six years, depending upon the program followed before the decision is made. His curriculum is so arranged that the work for one degree may be finished at the end of a four-year period and the work for the subsequent degree at the close of the fifth or sixth year.

**ENGINEERING-M.B.A. PROGRAM**

Qualified engineering students who wish to obtain supplementary training in business management may be interested in the Engineering — M.B.A. program described on page 121 of this Catalog. By attending one or two summer sessions, both the bachelor's degree in engineering and the master's degree in business administration may be attained in a period of five years.

## COOPERATIVE PROGRAMS

Lehigh University has entered into agreements with certain industrial organizations whereby undergraduate students in various branches of engineering may pursue an interleaved course of study and industrial employment, comprising eight semesters of study at Lehigh University, and two periods (each approximately equal to a semester in length) of employment in industry, totaling four calendar years, at the successful completion of which the student will receive a B.S. degree from Lehigh University and a suitable certificate from the industrial concern.

The objective of a cooperative program is to give the student an opportunity to become familiar with industrial methods, policies, and environment to the end that he will acquire a greater degree of motivation in his academic studies.

The scope of the academic part of a cooperative program is identical with that of the standard curriculum in which the student is registered. Exactly the same courses are taken and in substantially the same sequence.

The first industrial employment period commences at the end of the sophomore year. The degree is conferred upon the completion of the senior year. Students electing a cooperative program are expected to complete it.

During the two periods of industrial employment the student is closely supervised to guarantee that he acquires a balanced training in industrial practice. Representatives from the University make periodic inspections of the industrial training part of the program for the purpose of assuring that this training is in keeping with the above objectives and that the student is receiving maximum benefits from the cooperative program. The student is required to render a comprehensive report on his observations and work while employed in industry.

While engaged in industrial employment the student is paid at prevailing rates for the type of work in which he is engaged.

There is no obligation, either legal or moral, on the part of the student to agree to accept permanent employment with the industrial concern with which he is connected on a cooperative program; nor is there any obligation on the part of the industrial concern to offer him permanent employment.

The details of cooperative programs vary with different curricula and industrial organizations. Interested students should consult their curriculum directors. A typical four-year program between Electrical Engineering and the sponsoring company, which comprises ten approximately equal periods, is as follows:

| Fall Semester | Spring Semester | Summer Semester |
|---|---|---|
| 1. Freshman I | 2. Freshman II | Vacation |
| 3. Sophomore I | 4. Sophomore II | 5. Company Work |
| 6. Junior I | 7. Company Work | 8. Junior II |
| 9. Senior I | 10. Senior II | |

During Period 7, while the student is with the sponsoring company, a course in Electronic Circuits (E.E. 105) is required.
Students interested in such a program should apply to their curriculum director not later than the middle of the semester preceding the first scheduled period with industry.

## B.S. ENGINEERING – M.S. MATERIALS PROGRAM OF STUDY

A special program leading to an M.S. degree in Materials is offered for engineering graduates who complete prerequisite courses in physical chemistry, metallurgy, mechanics, etc. Careful selection of technical electives by interested undergraduate students can provide for the required prerequisite courses in typical engineering B.S. degree programs; alternately, the prerequisite courses are taken before proceeding with the program. This program is intended to give in-depth training in one of the normal engineering disciplines during four years, combined with an understanding of materials behavior in graduate study in approximately 15 months. While intended primarily as a terminal degree for those entering industry, the M.S. in Materials provides sufficient flexibility to permit those interested in a career in materials research to continue for a Ph.D. degree.

A typical schedule of prerequisite courses and the graduate program for mechanical engineers is given below. Graduate programs for other engineering disciplines can be developed by consultation with the appropriate department advisor and a representative of the Materials Research Center.

| Science Orientation | | | |
|---|---|---|---|
| Met. | 91 | Elements of Materials Science | 3 |
| *Chem. | 95 | Physical Chemistry | 3 |
| *Chem. | 195 | Physical Chemistry | 3 |
| Met. | 361 | Physics of Materials | 3 |
| Met. | 362 | Structure and Properties of Materials | 3 |
| | | +Electives | 6 |
| | | | 21 |

| Engineering Orientation | | | |
|---|---|---|---|
| Met. | 63 | Engineering Materials and Processes | 3 |
| *Chem. | 95 | Physical Chemistry | 3 |
| *Chem. | 195 | Physical Chemistry | 3 |
| Met. | 2XX | Structure and Behavior of Mat. | 3 |
| Met. | 358 | Selection of Materials | 3 |
| | | +Electives | 6 |
| | | | 21 |

***Alternately Chem. 91 and Chem. 190**
**+Generally chosen from one group of recommended electives listed below.**

### B. Recommended Electives

#### (1) Structure of Solids Group

| | | | |
|---|---|---|---|
| Met. | 316 | Physical Properties of Materials | (3) |
| Met. | 318 | Theoretical Physical Metallurgy | (3) |
| Met. | 333 | X-ray Methods | (3) |
| Met. | 334 | Electron Microscopy | (3) |
| E.E. | 304 | Semiconductor Electronics | (3) |
| E.E. | 306 | Solid State Magnetic and Dielectric Devices | (3) |
| Geol. | 333 | Crystallography | (3) |
| Phys. | 362 | Atomic and Molecular Structure | (3) |
| Phys. | 363 | Physics of Solids | (3) |

Approved Math. Elective

#### (2) Physical Metallurgy Group

| | | | |
|---|---|---|---|
| Met. | 315 | Physical Ceramics | (3) |
| Met. | 316 | Physical Properties of Materials | (3) |
| Met. | 318 | Theoretical Physical Metallurgy | (3) |
| Met. | 323 | Mechanical Metallurgy | (3) |
| Met. | 333 | X-ray Methods | (3) |
| Met. | 334 | Electron Microscopy | (3) |
| Met. | 352 | Physical Metallurgy III | (3) |

Approved Math. Elective

#### (3) Mechanics and Mechanical Behavior Group

| | | | |
|---|---|---|---|
| M.E. | 166 | Procedures for Mechanical Design | (2) |
| Mech. | 301 | Advanced Mechanics of Materials | (3) |
| Mech. | 303 | Mechanics of Continua I | (3) |
| Mech. | 304 | Mechanics of Continua II | (3) |
| Met. | 323 | Mechanical Metallurgy | (3) |

Approved Math. Elective

(4) Chemical Behavior Group

| | | | |
|---|---|---|---|
| Met. | 210 | Metallurgical Thermodynamics | (3) |
| Met. | 304 | Extractive Metallurgy I | (4) |
| Met. | 305 | Extractive Metallurgy II | (3) |
| Chem. | 381 | Radiation and Structure | (4) |
| Chem. | 382 | Structure, Electrochemistry and Kinetics | (3) |
| Chem. (Ch.E.) | 392 | Science of Polymers | (3) |
| Chem. | 397 | Colloids and Surface Chemistry | (3) |

Approved Math. Elective

### C. TYPICAL M.S. PROGRAM IN MATERIALS
(Mechanical Engineering Graduate)

| First Semester | | | Cr. Hrs. |
|---|---|---|---|
| Met. | 333 | X-Ray Methods | 3 |
| Met. | 408 | Transformation | 3 |
| Met. | 315 | Physical Ceramics | 3 |
| M.E. | 441 | Stress Analysis & Design | 3 |
| | | or | |
| | | Approved Technical Elective | |
| | | Materials Research | 3 |

| Second Semester | | | Cr. Hrs. |
|---|---|---|---|
| Met. | 412 | Elec. & Magnetic Properties of Materials | 3 |
| Chem. | 392 | (Ch.E.) Polymer Science | 3 |
| Met. | 418 | Deformation & Facture | 3 |
| | | or | |
| | | Approved Technical Elective | |
| M.E. | 444 | Experimental Stress Analysis | 3 |
| | | or | |
| | | Approved Technical Elective | |
| | | Materials Research | 3 |

Summer — Materials Research

## COURSE OFFERINGS IN MATERIALS

In addition to the courses noted in the list of recommended electives above, a number of other graduate courses concerned with the behavior of materials are taught in the engineering and science departments. Pertinent courses are listed below by department, number and title. Descriptions of these courses may be found in the respective department offerings.

| | | | |
|---|---|---|---|
| Ch.E. | 492 | Polymer Science | (3) |
| (Chem. | 392) | | |
| Ch.E. | 390 | Nuclear Reactor Engineering | (4) |
| Ch.E. | 470 | Cryogenic Engineering | (3) |
| Ch.E. | 401 | Chemical Engineering Thermodynamics | (3) |
| Ch.E. | 413 | Catalysis | (3) |
| C.E. | 410 | Prestressed Concrete | (3) |
| C.E. | 459 | Advanced Topics in Plastic Theory | (3) |
| E.E. | 404 | Solid State Device Theory | (3) |
| E.E. | 450 | Special Topics-Magnetic Device Theory | (3) |
| Geol. | 336 | Mineral Phase Relations | (3) |
| Geol. | 433 | Sulphide Phase Equilbria | (3) |
| Geol. | 435 | Advanced Mineralogy | (3) |
| I.E. | 344 | Metal Cutting Theory | (3) |
| M.E. | 441 | Stress Analysis in Design | (3) |
| M.E. | 444 | Experimental Stress Analysis in Design | (3) |
| Mech. | 404 | Advanced Vibrations Analysis | (3) |
| Mech. | 409 | Theory of Elasticity I | (3) |
| Mech. | 412 | Theory of Plasticity | (3) |
| Mech. | 413 | Fracture Mechanics | (3) |
| Mech. | 415 | Stability of Elastic Structures | (3) |
| Mech. | 451 | Non-linear Continuum Mechanics | (1-3) |
| (Phys. | 471) | | |
| Met. | 230 | Physical Metallurgy I | (4) |
| Met. | 358 | Selection of Materials | (3) |
| Met. | 406 | Solidification | (3) |
| Met. | 407 | Theory of Alloy Phases | (3) |
| Met. | 408 | Transformations | (3) |
| Met. | 410 | The Physical Chemistry of Metals I | (3) |
| Met. | 412 | Electrical and Magnetic Properties of Materials | (3) |
| Met. | 413 | Analysis of Metal Forming Processes | (3) |
| Met. | 416 | Atom Movements | (3) |
| Met. | 417 | Imperfections in Crystals | (3) |
| Met. | 418 | Deformation and Fracture | (3) |
| Met. | 433 | X-ray Metallography | (3) |
| Phys. | 340 | Heat, Thermodynamics | (3) |
| Phys. | 431 | Theory of Solids | (3) |
| Phys. | 442 | Statistical Mechanics | (3) |

# Curricula

## THE CURRICULUM IN CHEMICAL ENGINEERING

Chemical engineers play important roles in all activities bearing on the chemical process industry. These include the functions of research, development, design, plant construction, plant operation and management, corporate planning, technical sales, and market analysis. The industries that produce chemical and/or certain physical changes in fluids including petroleum and petrochemicals, rubbers and polymers, pharmaceuticals, metals, industrial and finee chemicals, foods, and industrial gases have found chemical engineers to be vital to their success. Chemical engineers are also important participants in pollution abatement, space exploration, and national defense programs.

Preparation for this broad field requires a sound background in the fundamental sciences of physics, chemistry, and mathematics plus a general background in engineering principles and intensive training in the application of these fundamentals to carrying forward into industrial production the new products and processes discovered in the laboratory. This latter training is directly called Chemical Engineering. In accord with this philosophy, the student is not trained for any specific industry, but the education is sufficiently broad that a graduate is competent to enter any of the chemical and allied industries.

The aim of the curriculum is to develop in the student understanding of the scientific fundamentals, an ability with mathematical tools, and the habits of precise analysis of process engineering problems that will allow him to function effectively in this broad field, and to grow into positions of responsibility. Of course these technical abilities must be coupled with an understanding of the economic, sociological, and cultural environment within which the engineer operates. The curriculum includes a relatively large commitment to education in these latter areas.

The program is also designed to prepare a student for graduate study in chemical engineering or in peripheral fields. Further study at the graduate level leading to advanced degrees is highly desirable in preparation for careers in the more highly technical aspects of manufacturing. The increasing complexity of modern manufacturing methods requires superior training for men working in the research, development, and design fields or for teaching.

(Effective for the Class of 1966)

| First Semester | | FRESHMAN YEAR<br>See Page 129<br>(34 hrs.) | | Second Semester | |
|---|---|---|---|---|---|
| | | **SOPHOMORE YEAR** | | | |
| Math. | 23 | Anal. Geom. and Calc. III | 4 | Math. 221 | Diff. Eqns. 3 |
| Phys. | 3 | Heat and Elect. | 4 | Phys. 4 | Phys. 4 Elect., Light & Atomic Phys. 4 |
| Mech. | 1 | Statics | 3 | | |
| Eco. | 4 | Economics | 3 | Chem. 91 | Phys. Chem. 3 |
| Ch. E. | 70 | Ind. Stoichiometry | 3 | Mech. 11 or Mech. 102 | Mech. of Matls. or Dynamics 3 |
| | | | 17 | Ch. E. 10 | Ch. E. Comp. 1 |
| | | | | Met. 63 or Met. 91 | Eng. Matls or El. of Matls. Sci. 3 |
| | | | | | 17 |
| | | **JUNIOR YEAR** | | | |
| Chem. | 51 | Organic Chem. | 3 | Chem. 52 | Organic Chem. 3 |
| Chem. | 53 | Org. Chem. Lab. | 2 | Chem. 193 | Phys. Chem. Lab. 1 |
| Chem. | 190 | Phys. Chem. | 3 | Ch. E. 164 | Unit Operations 4 |
| Chem. | 192 | Phys. Chem. Lab. | 1 | Math. 231 | Stat. Inf. 3 |
| Ch. E. | 163 | Unit Operations | 3 | Chem. 39 | Anal. Chem. 3 |
| E. E. | 160 | Elec. Circuits | 3 | | General Study 3 |
| E. E. | 161 | Elec. Probs. | 1 | | 17 |
| E. E. | 162 | Dynamo Lab | 1 | | |
| | | | 17 | | |
| | | **SENIOR YEAR** | | | |
| Ch. E. | 181 | Ch. E. Lab. | 3 | Ch. E. 182 | Ch. E. Lab. 3 |
| Ch. E. | 200 | Thermo. (Ch. E.) | 3 | Ch. E. 174 | Plant Design 3 |
| Ch. E. | 386 | Process Control & Dynamics | 3 | Ch. E. 302 | Ch. E. Kinetics 3 |
| | | General Study | 6 | | General Study 3 |
| | | Tech. Option[1] | 3 | | Tech. Options 6 |
| | | | 18 | | 18 |

[1]The technical options must represent a coherent group of approved courses such as: Any 200 or 300-level course in Ch.E. or Chem. (Students expecting to use organic chemistry are urged to include Chem. 54); Phys. 266, 340 or 363; Math. 208 or 221; I.E. 166; M.E. 322; Law 103; Acctg. 108; Mkt. 214 or 217.

## THE CURRICULUM IN CHEMISTRY

Chemists constitute nearly one-half of all professional research personnel in industry as shown by a report of the National Resources Planning Board. The American Chemical Society, which requires professional training and experience for eligibility, has a present membership of over 100,000. The consistently rapid increase in the membership of this society in recent years may be taken as an index of the expanding opportunities in the chemical profession.

The curriculum in chemistry provides a thorough grounding in the fundamentals of this science, with the requisite collateral training in physics

and mathematics, and gives some consideration to industrial and engineering principles. As a curriculum in the engineering school leading to a bachelor of science degree, the fundamentals of chemistry as well as engineering are stressed. In addition to the liberal allotment of time to courses in English, German, economics, history and other non-professional studies. provision is made for twelve semester hours (ordinarily four courses) of professional electives in a minor field of concentration. The tabulation below indicates some of the possibilities of this guided selection of elective courses.

| PREPARATION FOR | ELECTIVE SEQUENCE IN |
|---|---|
| Executive or sales departments of chemical industry | Business administration |
| Plant operation | Chemical engineering |
| Food and pharmaceutical industries | Biochemistry and bacteriology |

| PREPARATION FOR | ELECTIVE SEQUENCE IN |
|---|---|
| Medicine | Biology |
| Graduate study or research in chemistry | Physics and mathematics |
| Teaching, especially in public schools | Education |
| Metals industries and Polymer Science | Metallurgy |

Since the freshman year of this curriculum is identical with that of chemical engineering, and the sophomore years in the two curricula are nearly the same, it is possible, by a slight rearrangement, for the student to transfer from one curriculum to the other before the beginning of the junior year without a considerable sacrifice of credits. In a transfer from chemical engineering to chemistry, the chemical engineering courses may be utilized as electives.

A special program leading to a B.S. in Chemistry and an M.S. in Materials is available for interested students. See page 132.

Students interested in course offerings in the field of Materials should refer to section on B.S. Engineering—M.S. Materials Program on page 132.

**First Semester — FRESHMAN YEAR — Second Semester**

See Page 129

**First Semester — SOPHOMORE YEAR — Second Semester**

| Course No. | Course | Cr. Hrs. | Course No. | Course Title | Cr. Hrs. |
|---|---|---|---|---|---|
| Math. 23 | Anal. Geom. & Calc. III | 4 | Chem. 91 | Physical Chemistry | 3 |
| Phys. 3 | Heat & Electricity | 4 | Phys. 4 | Electricity, Light, & Atomic Physics | 4 |
| Chem. 51 | Organic Chemistry | 3 | Chem. 52 | Organic Chemistry | 3 |
| Chem. 53 | Organic Chem. Lab. | 2 | Chem. 54 | Organic Chem. Lab. | 2 |
| Ger. 1 | German | 3 | Ger. 2 | German | 3 |
| | | 16 | | | 15 |

**First Semester — JUNIOR YEAR — Second Semester**

| | | | | | |
|---|---|---|---|---|---|
| Chem. 190 | Phys. Chemistry | 3 | Chem. 193 | Phys. Chem. Lam. | 1 |
| Chem. 302 | Inorganic Chemistry | 3 | Chem. 235 | Analytical Chem. | 3 |
| Chem. 358 | Adv. Organic Chem. | 3 | Chem. 352 | Organic Chem. | 3 |
| Ger. 27 | Scientific German | 3 | Eco. 4 | Economics | 3 |
| | General Study[2] | 3 | | General Study[2] | 3 |
| Chem. 192 | Phys. Chem. Lab. | 1 | Chem. 305 | Or Elective | 3 |
| | | 16 | | | 16 |

**SUMMER**

**Chem. 100 Eight (8) weeks industrial employment with report.**

**SENIOR YEAR**

| | | | | | |
|---|---|---|---|---|---|
| Chem. 381 | | 4 | Chem. 382 | | 3 |
| Chem. 236 | | 3 | Chem. 375[1] | | 3 |
| GS | | 3 | GS | | 3 |
| | Electives | 6 | Chem. 305 | Or Elective | 3 |
| | | 16 | | | 15 |

[1]Optional—consent of chairman of Department required.
[2]For an elucidation of this requirement see page 126.

## THE CURRICULUM IN CIVIL ENGINEERING

Civil Engineering, the original stem from which have branched the other types of engineering, continues to meet the demands of those branches of business, industry and government which prefer a broad, fundamental education to a more specialized training. The curriculum, however, develops depth in the various professional areas of civil engineering.

Civil Engineers create the monuments of civilization. The professional practice of a civil engineer includes the conception, design, construction, operation, and maintenance of private and public projects, including bridges, buildings, highways, airports, railroads, harbors, docks, subways, tunnels, water supply and purification systems, sewage collection and treatment facilities, water power developments, the making of surveys, and research. Many civil engineers are associated with consulting engineering firms, contractors, industrial concerns, or various governmental subdivisions.

The work of the first three years deals chiefly with the scientific and mathematical basis of engineering practice, with emphasis upon the application of these principles during the fourth year. All students receive instruction in surveying, geology, fluid mechanics, soil mechanics, structural

theory and design, transportation engineering, foundation engineering, hydraulic engineering, and sanitary engineering. Opportunity is provided through an elective for a student to determine whether he has an interest in and aptitude for research. Development of abilities in self-expression is stressed throughout the curriculum.

Special five-year combined programs leading to the degrees B.S. in C.E. and either B.A. or B.S. in M.E. can be arranged. Also a combined program leading to the degree B.S. in C.E. and B.S. in Bus. Adm., (five and one-half years), M.B.A. in Management Science, or M.S. in Foreign Studies can be arranged.

Engineers, through their professional societies, have urged that the engineering student be trained as a professional man with a sound understanding of his place in society, so that he can direct the technician and tradesman as he creates the Monuments of Civilization. This training is provided through a well planned Civil Engineering program enriched by the humanistic-social courses taken during the four years, and selected with the advice and approval of the curriculum director.

**First Semester — FRESHMAN YEAR — Second Semester**

See Page 129

**First Semester — SOPHOMORE YEAR — Second Semester**

| Course No. | Course Title | Cr. Hrs. | Course No. | Course Title | Cr. Hrs. |
|---|---|---|---|---|---|
| C.E. 10 | Problem Comp. Lab. | 1 | C.E. 12 | Applied Engrg. Graphics | 2 |
| C.E. 11 | Engineering Graphics | 2 | | | |
| Math. 23 | Anal. Geom. & Cal. III | 4 | C.E. 40 | Principles of Surveying | 3 |
| Mech. 1 | Statics | 3 | Mech. 11 | Mech. of Materials | 3 |
| Phys. 3 | Heat & Electricity | 4 | Mech. 13 | Materials Testing Lab. | 1 |
| | General Studies | 3 | Phys. 4 | Electricity, Light & Atomic Physics | 4 |
| | | 17 | | Approved Math. Elect. | 3 |
| | | | | | 16 |

**SUMMER**
**C.E. 41 Engineering Surveys (3)**

**First Semester — JUNIOR YEAR — Second Semester**

| | | | | | | |
|---|---|---|---|---|---|---|
| C.E. | 121 | Mech. of Fluids | 3 | C.E. | 126 | Water Resources Engineering 3 |
| C.E. | 123 | Fluid Mechanics Lab | 1 | | | |
| C.E. | 150 | Structural Analysis I | 3 | C.E. | 154 | Structural Analysis II 3 |
| Mech. | 102 | Dynamics | 3 | C.E. | 162 | Sanitary Engineering 3 |
| Geol. | 1 | Principles of Geology | 3 | Met. 63 or | | Met. 91 |
| Met. 63 or | | Met. 91 | | | | Approved Elective 3 |
| | | Approved Elective | 3 | C.E. | 239 | Soil Mechanics 3 |
| | | | 16 | | | General Study[1] 3 |
| | | | | | | 18 |

**SUMMER**
**C.E. 100 Eight (8) Weeks Industrial Employment with Report (-)**

**First Semester — SENIOR YEAR — Second Semester**

| | | | | | | |
|---|---|---|---|---|---|---|
| C.E. | 102 | Proseminar | 1 | E.E. | 160 | Elec. Cir. & Appr. 3 |
| C.E. | 145 | Transport Engrg. I | 3 | E.E. | 161 | Elec. Problems 1 |
| C.E. | 151 | Structural Theory | 3 | E.E. | 162 | Dynamo Lab. 1 |
| C.E. | 153 | Reinf. Concrete Theory | 3 | M.E. | 160 | Thermodynamics 3 |
| C.E. | 157 | Concrete Laboratory | 1 | | | Approved Elective 6 |
| | | General Study[1] | 3 | | | General Study[1] 3 |
| | | Approved Elective | 3 | | | 17 |
| | | | 17 | | | |

[1]For an elucidation of this requirement see page 126.

## THE CURRICULUM IN ELECTRICAL ENGINEERING

The curriculum has been formulated to provide a foundation for competence and growth in the field of electrical engineering. Career opportunities identified with the field include research, development, design, operation, and administration in the areas of electrical communication, digital systems, information processing, electrical power systems. The latter includes conversion, transmission, and distribution of electric power, and its control.

The principles underlying these areas are derived from the basic sciences and mathematics. The physical sciences provide the basis for a theoretical and experimental approach to devices such as solid state devices, electron tubes, and electrical machines. Mathematics provides the basis for the analytical studies related to the models of the devices, to the analysis, design and use of analog and digital computers and to the synthesis of communication networks and control systems.

In addition to the requirements of the General Study Program, which deals with the humanities and social sciences, the electrical engineering program includes required courses in allied engineering fields. In terms of the engineering aspects of the program, the first three years are devoted to the study of science, mathematics, physical electronics, and introductory work in linear electric circuits, electronic circuits, and machines. During the fourth year elective courses provide opportunities for growth in those areas in which the student has interest and ability. Elective courses in other departments are encouraged, especially when such electives are chosen on the basis of an educational objective.

Irrespective of the specific area of engineering a student may eventually pursue as a career, his ultimate success will depend upon the amount of basic science and mathematics he has mastered and the effectiveness with which this knowledge has been integrated with his engineering work. This is the philosophy upon which the four-year curriculum is based.

Students interested in developing necessary background for graduate work in such areas as computing science, engineering materials, biomedical science, business administration, and others may do so through judicious choice of electives within the University as a whole. For example, a program in computing sciences might include Math. 219, Math. 331, Math. 362, I.S. 202, Phil. 364, in addition to departmental electives E.E. 141 and E.E. 201. Programs of this nature should be planned through conference with a departmental advisor, preferably as early as the sophomore year.

The experimental aspects of the program are supported by the following laboratory facilities: Circuits Laboratory, Electronics Laboratory, Electrical Machine and Transient Laboratories, Network Analyzer, Digital Systems Laboratory, and Microwave Laboratory.

A cooperative program combining academic work and industrial experience is available for those who are interested and can qualify.

**FRESHMAN YEAR** — See Page 129.

**SOPHOMORE YEAR**

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Course No. | | Course Title | Cr. Hrs. | Course No. | | Course Title | Cr. Hrs. |
| C.E. | 11 | Engineering Graphics | 2 | E.E. | 14 | Circuit Theory I | 3 |
| Math. | 23 | Anal. Geom. & Calc. III | 4 | Math. | 204 | Linear Analysis | 3 |
| Mech. | 1 | Statics | 3 | Mech. | 11 | Mech. of Materials | 3 |
| Met. | 63 or Met. 91 | | 3 | Mech. | 13 | Materials Testing Lab. | 1 |
| Phys. | 3 | Heat & Electricity | 4 | Phys. | 4 | Electricity, Light, & Atomic Physics | 4 |
| | | | 16 | | | General Study | 3 |
| | | | | | | | 17 |

**JUNIOR YEAR**

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| E.E. | 101 | Analog & Dig. Comp. | 2 | E.E. | 105 | Electronic Circuits | 4 |
| E.E. | 103 | Phys. Electronics | 3 | E.E. | 106 | Elect. Machines I | 5 |
| E.E. | 104 | Circuit Theory II | 4 | Math. | 231 | Statistical Inference | 3 |
| Math. | 208 | Applied Mathematics II | 3 | or | | | |
| Mech. | 102 | Dynamics | 3 | Math. | 309 | Theory of Probability | 3 |
| | | *General Study | 3 | E.E. | 231 | Elec. & Mag. Fields | 3 |
| | | | 18 | | | *General Study | 3 |
| | | | | | | | 18 |

**SUMMER**

E.E. 100 Summer Employment

**SENIOR YEAR**

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| **Electronics Option** | | | | | | | |
| E.E. | 111 | Proseminar | 1 | E.E. | 152 | Senior Lab. | 2 |
| E.E. | 151 | Senior Lab. | 2 | M.E. | 220 | Thermodynamics | 3 |
| E.E. | 245 | Electromagnetic Theory | 3 | | | Approved Electives | 9 |
| | | Approved Electives | 9 | | | *General Study | 3 |
| | | *General Study | 3 | | | | 17 |
| | | | 18 | | | | |
| **Power Option** | | | | | | | |
| E.E. | 212 | Control Systems | 3 | E.E. | 111 | Proseminar | 1 |
| E.E. | 233 | Power System Analysis I | 3 | E.E. | 234 | Power System Analysis II | 3 |
| M.E. | 220 | Thermodynamics | 3 | E.E. | 152 | Senior Laboratory | 2 |
| | | General Study | 3 | M.E. | 161 | M.E. Laboratory | 1 |
| | | Approved Electives | 6 | C.E. | 121 | Mechanics of Fluids | 3 |
| | | | 18 | C.E. | 123 | Fluid Mechanics Lab. | 1 |
| | | | | | | General Study | 3 |
| | | | | | | Approved Elective | 3 |
| | | | | | | | 17 |

## THE CURRICULUM IN INDUSTRIAL ENGINEERING

The curriculum is designed with the principal aim of industrial engineering in view, which is the design, improvement, and installation of integrated systems of men, materials, and equipment for operations by the application of the principles of the mathematical, physical, and behavioral sciences.

Thoughout the program there is an integrated series or sequence in the major field which includes not only basic and fundamental courses but specialized courses as well, in the fields of production planning and control, quality control, production engineering, information systems, methods engineering, operations research, and industrial manpower management. These specialized courses reflect the impact of recent developments in opera-

tions research, information processing, and automation, and considerable course work involves use of a high-speed digital computer.

There is a growing tendency on the part of industries to select young men from their engineering departments for managerial positions. Because of this the industrial engineering courses are oriented to the principles of scientific management to enable the industrial engineering graduate to accept and succeed in these opportunities.

It is the aim of the industrial engineering program to develop for industry a potential manager, a graduate well grounded in the fundamentals of science, trained in the principles and methods of engineering analysis and design, and adequately prepared to practice the profession of industrial engineering.

**FRESHMAN YEAR**

See Page 129.

**SOPHOMORE YEAR**

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Course | No. | Course Title | Cr. Hrs. | Course | No. | Course Title | Cr. Hrs. |
| C.E. | 11 | Engineering Graphics | 2 | Eco. | 4 | Economics | 3 |
| Math. | 23 | Anal. Geom. & Calc. III | 4 | Math. | 231 | Statistical Inference | 3 |
| Met. | 63 | Engr. Mat. and Proc. | 3 | Mech. | 11 | Mech. of Materials | 3 |
| Phys. | 3 | Heat & Electricity | 4 | Mech. | 13 | Mat. Testing Lab. | 1 |
| Mech. | 1 | Statics | 3 | Met. | 67 | Met. Lab. | 2 |
| I.E. | 10 | Prob. Comp. Lab. | 1 | Phys. | 4 | Elec. Light and Atomic Physics | 4 |
| | | | 17 | I.E. | 11 | Applied Prob. Lab. | 1 |
| | | | | | | | 17 |

**SUMMER**

I.E. 40 Machine Shop Practice (3)

**JUNIOR YEAR**

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| I.E. | 121 | Analysis & Design I | 5 | I.E. | 122 | Analysis & Design II | 4 |
| I.E. | 221 | Industrial Statistics | 4 | I.E. | 222 | Operations Analysis & Design | 4 |
| Mech. | 102 | Dynamics | 3 | Acctg. | 108 | Fund. Accounting | 3 |
| Math. | 204 | Linear Analysis | 3 | M.E. | 168 | Elem. Machine Design | 4 |
| Psych. | 1 | Elem. Psychology | 3 | | | Gen. Study | 3 |
| I.E. | 140 | Mfg. Processes Lab. | 1 | | | | 18 |
| | | | 19 | | | | |

**SUMMER**

I.E. 100 Industrial Employment

**SENIOR YEAR**

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| E.E. | 160 | Elec. Cir. & Appar. | 3 | I.E. | 152 | I.E. Project | 2 |
| E.E. | 161 | Elec. Problems | 1 | Ch.E. | 60 | Unit Oper. Survey | 3 |
| E.E. | 162 | Dynamo Lab. | 1 | M.E. | 161 | Engin. Lab. | 1 |
| M.E. | 160 | Thermodynamics | 3 | | | App. Tech. Elective | 9 |
| | | App. Tech. Electives | 6 | | | Gen. Study | 3 |
| | | Gen. Study | 3 | | | | 18 |
| | | | 17 | | | | |

## THE COMBINED FIVE-YEAR CURRICULUM IN ELECTRICAL ENGINEERING AND ENGINEERING PHYSICS

This curriculum is designed for a student who wants to make an early start on a career in electronics and electronic device research and development. It differs from the four-year programs in Electrical Engineering or Physics in that it provides additional opportunities for study of the fundamental principles of dialectric, magnetic and semiconductor materials along with a study of circuits in modern communications and control systems.

The E.E. degree is conferred on the successful completion of the fourth year, and the E.P. degree at the end of the fifth year.

FRESHMAN YEAR

See Page 129.

SOPHOMORE YEAR

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Course | No. | Course Title | Cr. Hrs. | Course | No. | Course Title | Cr. Hrs. |
| C.E. | 11 | Engineering Graphics | 2 | Math. | 204 | Linear Analysis | 3 |
| Math. | 23 | Anal. Geom. & Cal. III | 4 | Phys. | 32 | Electrostatics | 3 |
| Mech. | 1 | Statics | 3 | Phy. | 4 | Electricity, Light & Atomic Physics | 4 |
| Met. | 91 | El. of Materials Sci. | 3 | Phys. | 90 | Electrical Phenomena | 1 |
| Phys. | 3 | Heat and Electricity | 4 | E.E. | 11 | Circuit Theory I | 3 |
| | | | 16 | | | General Study | 3 |
| | | | | | | | 17 |

JUNIOR YEAR

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| E.E. | 101 | Analog & Digital Comp. | 2 | E.E. | 105 | Electronic Circuits | 4 |
| E.E. | 103 | Phys. Electronics | 3 | E.E. | 106 | Elec. Machines I | 5 |
| E.E. | 104 | Circuit Theory II | 4 | Math. | 221 | Differ. Equations | 3 |
| Math. | 208 | Applied Math. | 3 | E.E. | 231 | Elec. & Mag. Fields | 3 |
| Mech. | 102 | Dynamics | 3 | | | *General Study | 3 |
| | | *General Study | 3 | | | | 18 |
| | | | 18 | | | | |

SUMMER

E.E. 100 Summer Employment

SENIOR YEAR

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| E.E. | 151 | Senior Lab. | 2 | E.E. | 152 | Senior Lab. | 2 |
| E.E. | 111 | Proseminar | 1 | | | Appr. Electives | 9 |
| E.E. | 245 | Electromagnetic Theory | 3 | Phys. | 268 | Intr. Mod. Phys. Th. I | 3 |
| | | Appr. Elective | 3 | | | *General Study | 3 |
| Phys. | 213 | Electromagnetism | 3 | | | | 17 |
| Phys. | 215 | Particles & Fields | 3 | | | | |
| | | *General Study | 3 | | | | |
| | | | 18 | | | | |

FIFTH YEAR

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Phys. | 340 | Heat, Thermodynamics | 3 | Phys. | 252 | Optics | 3 |
| Phys. | 362 | Atom. & Mol. Struct. | 3 | Phys. | 254 | Optics Lab. | 2 |
| or | | | | Phys. | 363 | Phys. of Solids | 3 |
| Phys. | 364 | Nuclear Physics | 3 | Phys. | 171 | Proseminar | 1 |
| Phys. | 369 | Intr. Mod Phys. Th. II | 3 | Ger. | | German or Approved Elect.[1] | 3 |
| Phys. | 192 | Advanced Lab. | 1 | | | Electives | 6 |
| Phys. | 270 | Mod. Phys. Lab. | 1 | | | | 18 |
| Ger. | | German or Approved Elective[1] | 3 | | | | |
| | | Approved Elective | 3 | | | | |
| | | | 17 | | | | |

*For an elucidation of this requirement see page 126.
[1]Students planning graduate study should elect German. For others Math. 224 and Mech. 302 are suggested.

## THE CURRICULUM IN FUNDAMENTAL SCIENCES

The curriculum in Fundamental Sciences is designed to permit students to achieve a breadth of experience in the basic fields of modern science and at the same time, through an option, to acquire the discipline of one of them, about to the level of a minimum bachelors program. The options and electives offer the student the flexibility by which he may prepare himself for work in industry or government, requiring wide understanding of the basic

sciences but not the depth in a single field equalling that of a standard major, or he may approach adequacy for graduate study in a field.

The program offers excellent opportunity for a student who is uncertain of his firm desire for a career in a particular standard major to proceed on a broad program which can lead him to a bachelors degree. If his interest crystallizes in an established field in which he has been taking courses, transfer to that major will normally be possible with only a minimum of dislocation.

Fundamental Sciences majors are required to concentrate in an option or recognized hybrids of them: chemistry, physics and mathematics, biology, earth and space science, and science of living systems, materials.

Work in the major science subjects is continuous through all four years. The freshman year is identical with that required of all engineering students. The general studies requirements of the engineering college must also be completed. The discipline of a science will be provided by the inclusion of at least 15 semester hours in his option or from a combination which constitutes the core of one of the inter-disciplinary fields, for example, geophysics or biochemistry.

The details of the student's program will be worked out by the student with the advice of the curriculum advisor, and with the approval of the department heads concerned with the major field of his option.

**FRESHMAN YEAR**
**See Page 129.**

| First Semester | | | | SOPHOMORE YEAR | | Second Semester | |
|---|---|---|---|---|---|---|---|
| Math. | 23 | Anal. Geom. & Calc. III | 4 | Phys. | 4 | Electricity, Light & Atomic Physics | 4 |
| Phys. | 3 | Heat & Electricity | 4 | | | | |
| Chem. | 51 | Organic Chemistry | 3 | Eco. | 4 | Economics | 3 |
| Geol. | 1 | Principles of Geol. | 3 | Geol. | 2 | Principles of Geology | 3 |
| Biol. | 11 | General Biology | 4 | Elective[1] | | | 3 |
| | | | 14 or 15 | | | | 13 or 14 |

| First Semester | | | | JUNIOR YEAR | | Second Semester | |
|---|---|---|---|---|---|---|---|
| Math. | 221 | Differential Equations | 3 | Psych. | 1 | Intro. to Psychology | 3 |
| Biol. | 21 | General Biology | 4 | Astr. | 2 | General Astronomy | 3 |
| Geol. | 1 | Principles of Geology | 3 | Geol. | 2 | Principles of Geology | 3 |
| | | General Study | 3 | | | Elective | 6 |
| | | Elective | 6 | | | Option | 3 |
| | | Option | 3 | | | | 18 or 19 |
| | | | 18 or 19 | | | | |

**SUMMER: Industrial Employment**

| First Semester | | | | SENIOR YEAR | | Second Semester | |
|---|---|---|---|---|---|---|---|
| Math. | 231 | Statistical Inference | 3 | Phil. | 261 | Philosophy of the Natural Science | 3 |
| Math. | 204 | Linear Analysis | 3 | | | General Study | 3 |
| | | General Study | 3 | | | Option | 6 |
| | | Elective | 6 | | | Elective | 6 |
| | | Option | 3 | | | | 18 |
| | | | 18 | | | | |

**Power Option**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| E.E. | 212 | Control Systems | 3 | E.E. | 111 | Proseminar | 1 |
| E.E. | 233 | Power System Analysis I | 3 | E.E. | 234 | Power System Analysis II | 3 |
| M.E. | 220 | Thermodynamics | 3 | E.E. | 152 | Senior Lab. | 2 |
| | | *General Study | 3 | M.E. | 161 | M.E. Laboratory | 1 |
| | | Approved Elective | 6 | C.E. | 121 | Mechanics of Fluids | 3 |
| | | | 18 | C.E. | 123 | Fluid Mechanics Lab. | 1 |
| | | | | | | *General Study | 3 |
| | | | | | | Approved Elective | 3 |
| | | | | | | | 17 |

*For an elucidation of this requirement see page 126.

## THE CURRICULUM IN ENGINEERING MECHANICS

The curriculum in engineering mechanics is designed to prepare men for careers in engineering research and development. There is an increasing demand in industry and government service for men with a broad training in the fundamentals of engineering, rather than in a given specific field. Such a training, in which engineering mechanics and applied mathematics play an important part, is provided by this curriculum. It emphasizes the analytical approach to engineering problems and the application to their solution of the basic methods and principles of mechanics.

The first two years of work are the same as those in most of the other engineering curricula. During the junior and senior years, time is about equally divided among (1) engineering mechanics, (2) mathematics, (3) allied branches of engineering and general studies, and (4) technical electives. The major areas of study in engineering mechanics are statics and strength of materials, dynamics and vibrations analysis, elasticity, plasticity, and fluid mechanics. The technical electives should be used to form one of the suggested group options. Students electing the five year combined B.S. Engineering—M.S. Materials Program should take option C.

Only those men who have achieved high standing in mathematics, mechanics, and physics during the first two years of college and who have shown definite analytical ability are encouraged to proceed toward the degree of bachelor of science in engineering mechanics. Graduates in engineering mechanics are equipped for immediate work in research and development in government service or in aerospace, automotive, and similar industries. They are also eligible for admission to the Graduate School for advanced work in applied mechanics or in some related engineering field.

### FRESHMAN YEAR

See Page 129.

### SOPHOMORE YEAR

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Course No. | Course Title | Cr. Hrs. | | Course No. | Course Title | Cr. Hrs. | |
| Math. | 23 | Anal. Geom. & Calc. II | 4 | C.E. | 11 | Eng. Graphics | 2 |
| Mech. | 1 | Statics | 3 | Math. | 221 | Diff. Equations | 3 |
| Phys. | 3 | Heat & Electricity | 4 | Math. | 204 | Linear Analysis | 3 |
| Met. | 91 | El. of Mat. Science | 3 | Mech. | 11 | Mech. of Materials | 3 |
| | | *General Study | 3 | Mech. | 13 | Materials Testing Lab. | 1 |
| | | | | Phys. | 4 | Electricity, Light & Atomic Physics | 4 |
| | | | | Mech. | 10 | Prob. Computation Lab. | 1 |
| | | | 17 | | | | 17 |

### JUNIOR

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Math. | 208 | Complex Variables | 3 | Math. | 309 | Theory of Probability | 3 |
| Mech. | 102 | Dynamics | 3 | Mech. | 302 | Adv. Dynamics | 3 |
| Mech. | 301 | Adv. Mech. of Mat. | 3 | Mech. | 104 | Fluid Dynamics | 3 |
| E.E. | 14 | Circuit Theory I | 3 | C.E. | 123 | Fluid Mechanics Lab | 1 |
| | | Elective | 3 | | | Elective | 3 |
| | | *General Study | 3 | | | *General Study | 3 |
| | | | 18 | | | | 16 |

### SUMMER

Mech. 100 Summer Employment

| First Semester | | | | SENIOR YEAR | Second Semester | | | |
|---|---|---|---|---|---|---|---|---|
| Math. | 322 | Methods of Applied Analysis I | 3 | | Mech. | 304 | Mech. of Continua II | 3 |
| Mech. | 303 | Mech. of Continua I | 3 | | Mech. | 306 | Exper. Methods in Mech. | 6 |
| Mech. | 305 | System Dynamics | 3 | | | | Electives | 6 |
| Phys. | 340 | Heat, Thermo and Pyrometry | 3 | | | | *General Study | 6 |
| Phys. | 191 | Lab. Techniques | 2 | | | | | 18 |
| | | Elective | 3 | | | | | |
| | | | 17 | | | | | |

*Electives in junior and senior years consist of 14-15 hours and should include a group option, such as listed below. An approved technical elective or an approved foreign language will be used, when needed, to complete the total credit-hours requirement.

### Typical Group Options

**A. MATHEMATICS**

| | | | |
|---|---|---|---|
| Math. | 219. | Principles of Analysis | (3) |
| Math. | 220. | Principles of Analysis | (3) |
| Math. | 320. | Ordinary Diff. Equations | (3) |
| Math. | 323. | Methods of Applied Analysis II | (3) |
| | | | 12 |

**B. AERO- and THERMODYNAMICS**

| | | | |
|---|---|---|---|
| M.E. | 104. | Thermodynamics I | (4) |
| M.E. | 105. | Thermodynamics II | (4) |
| M.E. | 321. | Heat Transfer | (3) |
| M.E. | 322. | Gas Dynamics | (3) |
| Mech. | 326. | Aerodynamics | (3) |
| | | | 17 |

Note: Students electing this group option will not take Phys. 340.

**C. MATERIALS**

| | | | |
|---|---|---|---|
| Chem. | 95 | Physical Chemistry | (3) |
| Chem. | 195 | Physical Chemistry | (3) |
| Met. | 361 | Physics of Materials | (3) |
| Met. | 362 | Structure and Properties of Materials | (3) |
| | | | 12 |

Note: Students planning to obtain the M.S. in Materials should take this group option, as well as 6 additional hours of recommended electives. They will not take Phys. 340.

## THE CURRICULUM IN ENGINEERING PHYSICS

The curriculum in engineering physics is designed to prepare men for careers in scientific work. Emphasis on the principles of physics is carefully coordinated with laboratory training. The first two years of work are similar to those in the other engineering curricula, and some future engineering study is required in addition to the work in physics during the final two years. The training is thus consciously practical.

A sequence of courses in theory starting in the fourth semester with Physics 32 presents mechanics, electricity and light in a unified modern form. Thermodynamics and statistical mechanics in the senior year completes the intermediate level study of unified physical theory. At least two of four subject matter courses are taken in the senior year; the subject

matter courses comprise a concentrated look at four of the most currently active research areas in physics. A liberal number of electives in the senior year provides flexibility in allowing the curriculum to be adapted to the needs and interests of the individual student. Those whose interests lie in the theoretical or analytical aspects, or who are preparing for graduate study, elect additional courses in mathematics and physics. Others elect additional work in chemistry, engineering, geophysics, or business, or further studies in the social sciences and the humanities. The latter are equipped for work in business or applied science; they can undertake the solution of problems which have not yet been reduced to engineering practice.

Specialization within the curriculum permits the very capable student to embark on some graduate level work in the senior year, or to gain an early familiarity with research techniques. Such intensive study will reduce the number of years required for study to the Ph.D since the courses coordinate with the graduate program in physics.

**FRESHMAN YEAR**

See Page 129.

**SOPHOMORE YEAR**

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Course | No. | Course Title | Cr. Hrs. | | | | |
| Ger. or Met. | 91 | German<br>El. of Materials Science | 3<br>3 | Ger. or C.E. | 11 | German<br>Eng. Graphics | 3<br>2 |
| Phys. | 3 | Heat and Electricity | 4 | Phys. | 4 | Electricity, Light, Atomic Physics | 4 |
| Math. | 23 | Anal. Geom. & Cal. III | 4 | Math. | 221 | Differential Eq. | 3 |
| Mech. | 1 | Statics | 3 | Phys. | 32 | Electrostatics | 3 |
| Eco. | 4 | Economics | 3 | Phys. | 90 | Elect. Phenomena | 1 |
| | | | | | | *General Study | 3 |
| | | | 17 | | | | 16 or 17 |

**JUNIOR YEAR**

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| E.E. | 14 | Circuit Theory I | 3 | E.E. | 105 | Electronic Circuits | 4 |
| Phys. | 191 | Lab. Techniques | 2 | Mech. | 102 | Dynamics | 3 |
| Phys. | 213 | Electromagnetism | 3 | Phys. | 252 | Optics | 3 |
| Math. | 322 | Methods of Applied Analysis I | 3 | Phys. | 254 | Optics Lab. | 2 |
| Phys. | 215 | Particles and Fields | 3 | Phys. | 268 | Int. Mod. Th. I | 3 |
| | | *General Study | 3 | | | Elective | 3 |
| | | | 17 | | | | 18 |

**SUMMER**

Phys. 100 Industrial Employment

**SENIOR YEAR**

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Phys. | 369 | Int. Mod. Th. II | 3 | Phys. | 171 | Proseminar | 1 |
| Phys. | 340 | Thermodynamics | 3 | Phys. | 363 | Phys. of Solids[1] | 3 |
| Phys. | 270 | Mod. Phys. Lab. | 1 | or | | | |
| Phys. | 192 | Advanced Lab. | 1 | Phys. | 365 | Phys. of Fluids[1] | 3 |
| Phys. or | 362 | At. & Mol. Struct.[1] | 3 | | | Electives | 9 |
| Phys. | 364 | Nuclear Physics[1] | 3 | | | *General Study | 3 |
| | | Elective | 3 | | | | 16 |
| | | *General Study | 3 | | | | |
| | | | 17 | | | | |

*See page 126 for an elucidation of this requirement.
[1]Two of Phys. 362, Phys. 363, Phys. 364, Phys. 365 are to be elected during the senior year.

## THE COMBINED FIVE-YEAR CURRICULUM IN INDUSTRIAL ENGINEERING AND BUSINESS ADMINISTRATION

Students with definite objectives in mind which require more concentration in business administration may elect to pursue a five-year program which combines the two curricula of industrial engineering and business administration. This combined curriculum will lead to the degree B.S. in Industrial Engineering at the end of the fourth year and B.S. in Business Administration at the end of the fifth year. The first four years are essentially the standard industrial engineering curriculum. For the fifth year please see pages 122-124 under Business Administration.

SUMMER

I.E. 40 Machine Shop Practice (3)

JUNIOR YEAR

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| I.E. | 121 | Analysis & Design I | 5 | I.E. | 122 | Analysis & Design II | 4 |
| I.E. | 221 | Industrial Statistics | 4 | I.E. | 122 | Operations Analysis & Design | 4 |
| Mech. | 102 | Dynamics | 3 | | | | |
| Math | 204 | Linear Analysis | 3 | Acctg | 108 | Fundamental Accounting | 3 |
| Psych. | 1 | Elem. Psychology | 3 | M.E. | 168 | Elem. Machine Design | 4 |
| I.E. | 140 | Mfg. Processes Lab. | 1 | Eco. | 333 | Labor Problems | 3 |
| | | | 19 | | | | 18 |

Note A: Those students who will major in Accounting in the fifth year will take Accounting 1 and 2 in the junior year in place of Eco. 333 and Acctg. 108; and will take Eco. 333 in the senior year in place of Mkt. 11; and Acctg. 13 and Acctg. 14 will be taken in the senior year in place of Fin. 125 and an Approved Technical Elective; and Mkt. 11 and Fin. 125 will be taken in the fifth year.

SUMMER

I.E. 100 Industrial Employment

SENIOR YEAR

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| E.E. | 160 | Elec. Cir. & Appar. | 3 | I.E. | 152 | I.E. Project | 2 |
| E.E. | 161 | Elec. Problems | 1 | Ch.E. | 60 | Unit Oper. Survey | 3 |
| E.E. | 162 | Dynamo Lab. | 1 | M.E. | 161 | Enginering Lab. | 1 |
| M.E. | 160 | Thermodynamics | 3 | Fin. | 125 | Corp. Finance | 3 |
| Mkt. | 11 | Marketing | 3 | | | App. Tech. Elec. | 6 |
| | | Approved Tech. Elect. | 3 | | | English Elective | 3 |
| | | English Elective | 3 | | | | 18 |
| | | | 17 | | | | |

Note B: Those students who will major in Economics, Economic Statistics or Management in the fifth year will take Eco. 346 in the senior year in place of Fin. 125 and Fin. 125 will be taken in the fifth year.

## THE CURRICULUM IN MECHANICAL ENGINEERING

The field of mechanical engineering is wide and challenging. Conventionally mechanical engineering deals with the design and production of machines and their power sources, but the field has broadened to include many applications of the engineering sciences to a variety of engineering systems for the benefit of mankind.

The mechanical engineer has played an essential role in the exploitation of new engineering frontiers such as nuclear power, cryogenic systems, rocketry, satelite guidance systems, and systems at very high and very low pressures and temperatures.

Almost every manufactured product, including automobiles, airplanes, and missile systems, requires the services of the mechanical engineer either in the product design or in the design and manufacture of the machinery needed to produce the product. Engineering subjects such as thermody-

namics, strength of materials, dynamics, vibrations, heat transfer, aerodynamics, fluid mechanics, and automatic control systems build upon a foundation in physics, chemistry, and mathematics. A basic knowledge of the fundamentals of electricity, electronics, and metallurgy is also needed.

The curriculum is broad with several electives, which permits a student to go directly into an engineering position. It may also provide the essential background suitable for further studies at the graduate level, for those with ability and interest, for positions at the forefront of technology such as research and development or teaching activities.

Many managerial positions are being filled by men with mechanical engineering backgrounds.

First Semester — FRESHMAN YEAR — Second Semester

See Page 129.

First Semester — SOPHOMORE YEAR — Second Semester

| Course No. | Course Title | Cr. Hrs. | Course No. | Course Title | Cr. Hrs. |
|---|---|---|---|---|---|
| Eco. 4 | Economics | 3 | Math. 221 | Diff. Equations | 3 |
| Math. 23 | Anal. Geom. & Calc. III | 4 | Mech. 11 | Mech. of Materials | 3 |
| Mech. 1 | Statics | 3 | Mech. 13 | Materials Testing Lab. | 1 |
| Phys. 3 | Heat and Elec. | 4 | Phys. 4 | Elec., Light and Atom. Phys. | 4 |
| C.E. 11 | Engr. Graphics | 2 | | | |
| M.E. 10 | Anal. of Eng. Prob. I | 1 | Met. 63 | Engr. Mat. and Proc. | 3 |
| | | | | General Study[1] | 3 |
| | | 17 | | | 17 |

SUMMER

I.E. 40 Machine Shop Practice (3)

First Semester — JUNIOR YEAR — Second

| | | | | | |
|---|---|---|---|---|---|
| M.E. 104 | Thermodynamics I | 4 | M. E. 105 | Thermodynamics II | 4 |
| M.E. 101 | Mechanical Eng. Design I | 3 | M.E. 102 | Mechanical Eng. Design II | 3 |
| Mech. 102 | Dynamics | 3 | E.E. 160 | Elec. Circ. and Appar. | 3 |
| C.E. 121 | Mech. of Fluids | 3 | E.E. 161 | Elec. Probs. | 1 |
| C.E. 123 | Fluid Mech. Lab. | 1 | E.E. 162 | Dynamo Lab. | 1 |
| Met. 67 | Met. Lab. | 2 | Math. 208 | Complex Variables | 3 |
| M.E. 111 | Analysis of Eng. Prob. II | 2 | | General Study[1] | 3 |
| | | 18 | | | 18 |

SUMMER

M.E. 100 Summer Employment

First Semester — SENIOR YEAR — Second Semester

| | | | | | |
|---|---|---|---|---|---|
| M.E. 108 | Laboratory I | 2 | M. E. 109 | Laboratory II | 2 |
| M.E. 103 | Mechanical Eng. Design III | 5 | | Approved Tech. Elect.[2] | 6 |
| | M.E. Elective | 3 | | Business Elective | 3 |
| | Approved Tech. Elect.[2] | 3 | | M.E. Elective | 3 |
| | General Study[1] | 3 | | General Study[1] | 3 |
| | | 16 | | | 17 |

[1] For an elucidation of the General Study requirement see page 126.

[2] The Approved Technical Electives must represent a coherent group of approved courses such as 200 level courses in Mechanical Engineering, Mechanics, Mathematics, Physics and Chemistry, and a limited number of courses in other fields of engineering.

## THE COMBINED FIVE-YEAR CURRICULUM IN MECHANICAL-ELECTRICAL ENGINEERING

This curriculum is designed to meet the needs of the power engineer engaged in the operation of large public utilities for the generation and distribution of electrical energy, as well as for those concerned with the design

of electrical machines and apparatus. It is generally recognized that the engineering work of the electrical manufacturers and public utilities in the power field encounters as many mechanical as electrical problems. These two types of problems are equally important and equally interesting. In order to carry out the design of electrical machinery and power plants it is now generally necessary to employ both mechanical and electrical engineers on the same job because, with rare exceptions, one engineer is not proficient in both fields.

This combined five-year curriculum in M.E. and E.E. is intended to circumvent this deficiency in the present training of power engineers by offering a highly integrated, comprehensive, and balanced program which is devised to turn out graduates equally proficient in mechanical and electrical engineering and who in addition will have some grounding in those business courses which are deemed essential to the engineer when he eventually takes on executive and administrative responsibilities.

It is the intent of this curriculum that anyone undertaking it will make every effort to complete the five years. The B.S. (M.E.) degree will be conferred at the end of the fourth year and the B.S. (E.E.) at the end of the fifth year.

Frist Semester — **FRESHMAN YEAR** — Second Semester

See Page 129.

**SOPHOMORE YEAR**

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Course | No. | Course Title | Cr. Hrs. | Course | No. | Course Title | Cr. Hrs. |
| Eco. | 4 | Economics | 3 | Math. | 221 | Diff. Equations | 3 |
| Math. | 23 | Anal. Geom. & Calc. III | 4 | Mech. | 11 | Mech. of Materials | 3 |
| Mech. | 1 | Statics | 3 | Mech. | 13 | Materials Testing Lab. | 1 |
| Phys. | 3 | Heat and Elec. | 4 | Phys. | 4 | Elec., Light and Atom. Phys. | 4 |
| C.E. | 11 | Engr. Graphics | 2 | Met. | 63 | Engr. Mat. and Proc. | 3 |
| M.E. | 10 | Anal. of Engr. Prob. I | 1 | E.E. | 14 | Circuit Theory I | 3 |
| | | | 17 | | | | 17 |

**SUMMER**

I.E. 40 Machine Shop Practice (3)

**JUNIOR YEAR**

| First Semester | | | | Second Scmester | | | |
|---|---|---|---|---|---|---|---|
| M.E. | 104 | Thermodynamics I | 4 | M.E. | 105 | Thermodynamics II | 4 |
| E.E. | 104 | Circuit Theory II | 4 | E.E. | 106 | Elec. Machines I | 5 |
| Mech. | 102 | Dynamics | 3 | C.E. | 121 | Mech. of Fluids | 3 |
| M.E. | 111 | Anal. of Eng. Prob. II | 2 | C.E. | 123 | Fluid Mech. Lab. | 1 |
| Met. | 67 | Met. Lab. | 2 | Math. | 208 | Complex Variables | 3 |
| | | General Study* | 3 | | | General Study* | 3 |
| | | | 18 | | | | 19 |

**SUMMER**

M.E. 100 Summer Employment

**SENIOR YEAR**

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| M.E. | 101 | Mechanical Eng. Design I | 3 | M.E. | 102 | Mechanical Eng. Design II | 3 |
| M.E. | 108 | Laboratory I | 2 | M.E. | 109 | Laboratory II | 2 |
| M.E. | 321 | Heat Transfer | 3 | E.E. | 105 | Electronic Circuits | 4 |
| E.E. | 103 | Physical Electronics | 3 | Math. | 309 | Theory of Probability or | 3 |
| | | Technical Elective | 3 | Math. | 231 | Statistical Inference | 3 |
| | | General Study* | 3 | E.E. | 231 | Elec. & Mag. Fields | 3 |
| | | | 17 | | | General Study* | 3 |
| | | | | | | | 18 |

*For an elucidation of the General Study requirement see page 126.

| First Semester | | | | FIFTH YEAR | Second Semester | | | |
|---|---|---|---|---|---|---|---|---|
| M.E. | 103 | Mechanical Eng. Design III | 5 | | M.E. | 342 | Mech. Vibr. Anal. | 3 |
| E.E. | 107 | Elec. Machines II | 3 | | Mech. | 302 | Adv. Dynamics | 3 |
| E.E. | 133 | Power Systems Anal. I | 3 | | E.E. | 112 | Control Systems | 3 |
| E.E. | 111 | Proseminar | 1 | | E.E. | 134 | Power System Anal. II | 3 |
| E.E. | 151 | Senior Laboratory | 2 | | | | Elective | 6 |
| | | Elective | 3 | | | | | 18 |
| | | | 17 | | | | | |

## THE CURRICULUM IN METALLURGY AND MATERIALS SCIENCES

Progress in many fields of engineering depends upon discovery of new materials and a better understanding of the behavior of existing materials. Interest in new materials for solid-state devices, for application of nuclear energy and for space technology, as well as a better understanding of the behavior of materials in the design of structures, automobiles and aircraft, plant processing equipment, electrical machinery, etc., have increased the need for men trained in the science and technology of metals and other materials. The curriculum in metallurgy and materials sciences is designed to train graduates for research, development, operations, management and sales careers in industry or for graduate study in metallurgy and materials science.

Training for this field of engineering requires basic studies in mathematics, chemistry, physics, and mechanics, plus a general background in engineering principles, followed by intensive training in the application of scientific and engineering principles to the development and use of materials in a technological society. In addition, the curriculum offers an introduction to humanistic and social studies which broaden the student's outlook and enhance his professional development after graduation.

The objective of the program is to combine a fundamental understanding of the behavior of materials from the electronic, atomic, crystallographic, microstructural and macrostructural viewpoints with knowledge of the technology of materials preparation and processing. The metallurgical engineering student will thus receive a broad education with emphasis on the factors which govern the mechanical, physical and chemical properties of materials to aid him in the analysis, development, selection and use of materials for all types of industries. While some graduates go directly into metal producing companies, a larger proportion serve as metallurgists or materials engineers in the chemical, electrical, transportation, communications, space and other metal and materials consumer industries. A number of students pursue graduate study for university teaching and research careers.

In addition to the regular program, there are two options in the curriculum oriented to emphasize (1) industrial metallurgy, and (2) preparation for graduate research in materials.

### Industrial Metallurgy Option

The Industrial Metallurgy Option is designed to prepare men in a four-year program as a plant metallurgist or materials engineer. To assist in this objective, students electing the option take a special course, Met. 325, Industrial Metallurgy (8), in the first semester of the senior year in place

of an equivalent number of other specified courses. The emphasis in this course is a team approach to solution of actual plant problems. The course is conducted in cooperation with the Bethlehem Steel Company, and three days per week are spent in the Bethlehem plant for investigation of problems in plant operations. The option is limited to a small group of seniors selected by the department from among those who apply. Summer employment is provided for those students who elect to initiate the program during the summer preceding the senior year.

**Research Option**

For those students whose interests lie in the fields of theoretical metallurgy or materials science, and who intend to pursue graduate work, a Research Option is offered. In this option, students are required to take Met. 340, Research Techniques (2-3); and Met. 191, Experimental Metallurgy (3). Financial support is awarded to those students who elect to initiate a research program during the summer preceding the senior year. The option is limited to a small group of selected students.

**FRESHMAN YEAR**

See Page 129.

**SOPHOMORE YEAR**

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Course | No. | Course Title | Cr. Hrs. | Course | No. | Course Title | Cr. Hrs. |
| Eco. | 4 | Economics | 3 | Ch.E. | 60 | Unit Operations | 3 |
| Math. | 23 | Anal. Geom. & Calc. III | 4 | Mech. | 11 | Mech. of Materials | 3 |
| Mech. | 1 | Statics | 3 | Phys. | 4 | Electricity, Light, & Atomic Physics | 4 |
| Phys. | 3 | Heat & Electricity | 4 | Met. | 10 | Met. Laboratory | 2 |
| Met. | 91 | El. of Mat. Science | 3 | C.E. | 11 | Eng. Graphics | 2 |
| | | | | | | General Study | 3 |
| | | | 17 | | | | 17 |

**JUNIOR YEAR**

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Met. | 230 | Physical Met. I | 4 | Met. | 231 | Phys. Metallurgy II | 4 |
| Met. | 210 | Met. Thermodynamics | 3 | Met. | 304 | Extractive Met. I | 4 |
| Chem. | 95 | Physical Chem. | 3 | Chem. | 195 | Physical Chem. | 3 |
| M.E. | 166 | Proced. of Mech. Des. | 2 | Mech. | 102 | Dynamics | 3 |
| | | Approved Math. Elective | 3 | Met. | 101 | Professional Development | 1 |
| | | General Study* | 3 | | | Elective | 3 |
| | | | 18 | | | | 18 |

**SENIOR YEAR**

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Met. | 305 | Extractive Met. II | 3 | Met. | 278 | Metallurgical Reports | 3 |
| Met. | 323 | Mechanical Met. | 3 | Met. | 358 | Selection of Materials | 3 |
| Met. | 352 | Physical Met. III | 3 | E.E. | 160 | Elec. Cir. & Appar. | 3 |
| | | Approved Elective | 3 | E.E. | 161 | Elec. Problems | 1 |
| | | General Study* | 3 | E.E. | 162 | Dynamo Lab. | 1 |
| | | Approved Elective | 3 | | | General Study* | 3 |
| | | | | | | Approved Elective | 3 |
| | | | 18 | | | | 17 |

Research Option (Effective Class '69)

**JUNIOR YEAR**

| First Semester | | | | Second Semester | | | |
|---|---|---|---|---|---|---|---|
| Met. | 230 | Physical Met. I | 4 | Met. | 231 | Phys. Metallurgy II | 4 |
| Met. | 210 | Met. Thermodynamics | 3 | Met. | 304 | Extraction Met. I | 4 |
| Chem. | 95 | Physical Chem. | 3 | Met. | 340 | Research Techniques | 2 |
| M.E. | 166 | Proced. for Mech. Des. | 2 | Met. | 101 | Professional Dev. | 1 |
| | | Approved Math. Elective | 3 | Chem. | 195 | Physical Chem. | 3 |
| | | General Study | 3 | Mech. | 102 | Dynamics | 3 |
| | | | 18 | | | | 17 |

| First Semester | | SENIOR YEAR | | Second Semester | | |
|---|---|---|---|---|---|---|
| Met. | 191 | Experimental Met. ..... 3 | Met. | 338 | Met. Colloquium ..... | 2 |
| Met. | 305 | Extractive Metallurgy II ..... 3 | Met. | 358 | Selection of Materials .. | 3 |
| Met. | 323 | Mechanical Metallurgy ..... 3 | E.E. | 160 | Elec. Cir. and Apparatus ..... | 3 |
| Met. | 352 | Physical Met. III ..... 3 | E.E. | 161 | Elec. Problems ..... | 1 |
| | | General Study ..... 3 | E.E. | 162 | Dynamo Lab ..... | 1 |
| | | Approved Elective .... 3 | | | General Study ..... | 3 |
| | | 18 | | | Approved Elective .... | 3 |
| | | | | | Elective ..... | 3 |
| | | | | | | 19 |

Industrial Metallurgy Option (Effective Class '68)

| First Semester | | SENIOR YEAR | | Second Semester | | |
|---|---|---|---|---|---|---|
| Met. | 305 | Extractive Met. II .... 3 | Met. | 338 | Met. Colloquium ..... | 2 |
| Met. | 323 | Mechanical Met. ..... 3 | Met. | 358 | Selection of Materials .. | 3 |
| Met. | 325 | Industrial Met. ..... 8 | E.E. | 160 | Elec. Circ. and Apparatus ..... | 3 |
| Met. | 352 | Physical Met. III ..... 3 | E.E. | 161 | Elec. Problems ..... | 1 |
| | | 17 | E.E. | 162 | Dynamo Lab. ..... | 1 |
| | | | | | General Study ..... | 3 |
| | | | | | General Study ..... | 3 |
| | | | | | Approved Elective .... | 3 |
| | | | | | | 19 |

A special program leading to the B.S. in engineering and M.S. in materials is described on page 132.

# THE GRADUATE SCHOOL

Robert Daniel Stout, *Dean of the Graduate School*

Graduate study was a part of the original plan of the University and was announced in its first Register in 1866. More definite organization of the work along lines that are now generally accepted dates from 1883. Since that time the degrees of Master of Arts and Master of Science have been offered without interruption. The degree of Doctor of Philosophy was also announced for a time and twice conferred. In the middle nineties this degree was withdrawn and doctoral work was not again offered until 1936, when it was once more authorized by the trustees. In the same year the Graduate School was organized, with a Graduate Faculty which has full power to enact the necessary legislation governing the work of the school. In 1960 a program of studies leading to the degree of Doctor of Education was first offered.

The faculty is composed of the administrative officers of the Graduate School, the deans of the Colleges, and all professors, associate professors, and assistant professors who offer work for graduate credit. The rules and regulations of the faculty are administered by an Executive Committee composed of the President and Provost of the University, the Dean of the Graduate School, and five elected members of the Graduate Faculty.

The Graduate School, in certain areas, offers qualified students opportunity for intensive advanced study and for specialized training in methods of investigation and research, with a view to their development as scholars and independent investigators. The School also aims to serve the needs of teachers and prospective teachers in elementary and secondary schools by providing opportunities for advanced professional training, and by preparing them for administrative positions.

Major work leading to the master's degree may be taken in the following fields; applied mechanics, biology, business administration, chemical engineering, chemistry, civil engineering, economics, education, electrical engineering, English, geology, government, history, industrial engineering, information sciences, international relations, mathematics, materials, mechanical engineering, metallurgy and materials science, philosophy, physics, political science, psychology, and social relations. In the fields of Greek, Latin, German, French, and Spanish, advanced degrees are not offered; but

students majoring in other fields may take collateral work in these fields from the list of courses acceptable for graduate credit ("200" courses).

Work leading to the doctor's degree is offered in the following fields: applied mechanics, biology, business and industrial economics, chemical engineering, chemistry, civil engineering, education, electrical engineering, English, geology, history, industrial engineering, mathematics, mechanical engineering, metallurgy and materials science, philosophy, physics, and psychology.

**Admission to Graduate Standing**

A graduate of an accredited college, university, or technical institution is eligible for consideration for admission to the Graduate School at Lehigh University. Actual admission is subject to enrollment limitations in each department and is, therefore, competitive. An application for admission to the Graduate School may be secured from the Office of Admission. The candidate should file this application as far in advance as possible of the beginning of the semester when he wishes to undertake his graduate work. In addition to the application the candidate should also request that each institution of higher learning which he has attended send directly to the Office of Admission a transcript of his academic record. *An application fee of $5 will be charged.*

A prospective graduate student is invited to communicate directly with the chairman of the department in which he is interested. If it is convenient for him to visit the University prior to completing his admission or prior to registration, a consultation with the chairman of the department (or his representative) will assist the department in working out a program for the student and will aid the student by giving him a better understanding of the facilities and opportunities for graduate study at the University.

The submission of Graduate Record Examination scores by a student applying for admission is urged. (For information about this examination, write to the Educational Testing Service, 20 Nassau St., Princeton, New Jersey.) If a student is applying for admission to graduate work in education, scores may be submitted for either the Graduate Record Examination or the National Teachers Examination. Candidates for graduate work in business administration may submit scores for the Admissions Test for Graduate Students in Business. In all three instances, test scores may under certain circumstances be required.

Foreign students are required to submit evidence of competence in use of English. Tests such as those administered by the International Institute of Education or the Educational Testing Service are suitable for this purpose.

Admission to graduate standing permits the student to take any course for which he has the necessary qualifications. It does not imply admission to candidacy for a degree. Admission to candidacy for an advanced degree is granted in accordance with the provisions set forth below under "Degrees."

Women are admitted as graduate students on the same terms as men. Except during a summer session, however, they are not ordinarily permitted to attend, either as registered students or as listeners, courses intended only for undergraduates.

A graduate student who is absent from the University for a semester or more must obtain the written approval of the chairman of his major department in order to be readmitted to graduate standing. If the student has not established a major, he must obtain the approval of the Dean of the Graduate School.

Students of Lehigh University who are within a few hours of meeting the requirements for the bachelor's degree may, if given permission by the Graduate Faculty, enroll for a limited amount of work for graduate credit.

**Registration**

Several days are set aside for graduate registration just prior to the beginning of the semester as indicated in the calendar. However, a student, once admitted, can complete advance registration anytime in January, June, or September as the case may be, by obtaining a registration ticket in the office of the Registrar and arranging in advance for an interview with his advisor. Anyone who can register in advance is urged to do so. Normally students are expected to complete their registration before the close of the third day of instruction. Registration after the tenth day of instruction in a regular semester or the fifth day in a summer session is permitted only when the express consent of the Dean of the Graduate School has been obtained. A $10 Late Registration Fee will be charged.

It should be noted that graduate work itself starts promptly at the beginning of the term, and it is frequently true that graduate courses can be given only if there is a certain minimum demand for them. Delay in enrolling for a given course may therefore cause the course to be withdrawn.

A graduate student in residence must register each semester. A graduate student who is a degree candidate in absentia must register for that semester in which he expects to complete the degree requirements.

**Tuition and Fees**

Effective with the Fall Semester 1967 the tuition in the Graduate School is $850 per semester or $71 per semester hour, whichever amount is lower. The maximum full-time roster of graduate courses is 15 semester hours.

In an effort to help alleviate the existing shortage of fully qualified school teachers in the United States, the University will award educational grants to all qualified elementary and secondary school personnel enrolled in the Graduate School. By virtue of these grants, tuition for teachers either in full-time service or on leave is $540 a semester or $45 per semester hour.

A listener's fee of $35 is charged for each course audited, unless the student is already paying the full tuition fee. (See regulation on page 159.)

Where the major department requires a master's thesis, the student registers for the thesis and pays at the rate of the regular semester hour charge.

A graduate student in residence or using the facilities of the University must register and pay a minimum tuition or dissertation fee of $150 per semester.

For a doctoral dissertation prepared in absentia a reading fee of $150 is charged to a graduate student who has not paid a dissertation fee of at least $150 while in residence.

Identification cards, entitling the holder to attend various campus events, are issued to graduate students at a fee of $10 for the full academic year, and $5 for the period from January to June. Students registered for 9 credit hours or more are entitled to an identification card without charge.

**Transcripts**

Each student is entitled to one copy of his record free of charge. This can be an official or unofficial transcript. Unofficial copies are released to the student; official copies are sent directly to the educational institution, company, state board, etc., as the circumstances may require. After the first copy is released a fee of $1 is assessed for each subsequent copy.

**Housing**

Most resident graduate students live in rooms or apartments near the campus, although from time to time a limited number of living accommodations is available in the undergraduate Residence Halls on the University campus.

Inquiries in regard to accommodations for graduate students, either married or single, can be directed either to the Director of Admission or to the Bureau of Housing Information, Lehigh University.

**Parking Regulations**

Graduate students are expected to comply with campus parking regulations. They should register their automobiles, and secure instructions from the Superintendent of Buildings and Grounds in the Alumni Memorial Building. No fee is charged for this registration.

**Accident and Sickness Reimbursement Insurance**

The University requires all full time graduate students to carry the accident and sickness insurance coverage which is available at nominal cost at the Bursar's office, unless the student has approved coverage of his own.

All students are required to carry insurance for both accident and illness either through the University or by other approved policies.

**Refunds**

A graduate student who formally withdraws from the University or who, on the advice of his department chairman and with the approval of the dean, finds it necessary to reduce his roster below twelve hours in any regular semester, may qualify for a tuition refund. The amount of refund is equal to the tuition paid for the course or courses being dropped less 15 per cent of this tuition for each full or fractional week of the semester computed from the date of the beginning of instruction in courses open only to graduate students. There is no refund for semester hours dropped if the remaining roster totals 12 or more hours.

A summer session student who formally withdraws from the University is entitled to receive a refund of his total tuition less $5 for each credit hour for which he is registered and less a deduction for each day of regular instruction of 4 per cent of the total tuition paid computed from the first day of instruction in the session.

In the event of the death of a student or his involuntary induction into the armed forces, fees will be refunded in proportion to the fraction to the semester remaining at the time of the student's death or induction.

A student who is suspended or expelled from the University is not entitled to any refunds.

**Filing of Application for Degree**

Candidates for degrees to be conferred in June file with the Registrar, on a form provided for the purpose, on or before April 15, a written notice of their candidacy; candidates for degrees to be conferred in October file a similar notice on or before September 10. Failure to file such notice by the dates mentioned may bar the candidate from receiving the degree at the ensuing graduation exercises. If a late application can be accepted, the candidate is assessed a $10 fee to help cover the extra cost of processing.

In addition to the degree requirements set forth below, there may be departmental requirements in the field of the major. These requirements appear in the separate departmental statements in the section, "Description of Courses."

# Degrees

*In addition to the general regulations set forth below, more detailed instructions for procedures may be obtained from the Office of the Graduate School.*

Students desiring to qualify for graduate degrees in the minimum time should have pursued an undergraduate major in the subject equivalent to that offered at Lehigh. At the discretion of the chairman of the department, a limited number of credits in closely allied subjects may be accepted in lieu of courses in the undergraduate major. Those with undergraduate deficien-

cies who are admitted because they are otherwise well qualified will be expected to make up such deficiencies in addition to satisfying the minimum requirement for the degree sought.

## MASTER OF ARTS, MASTER OF EDUCATION, MASTER OF SCIENCE, AND MASTER OF BUSINESS ADMINISTRATION

The master's degree is granted to properly qualified students who complete satisfactorily at least two full semesters of advanced work. In meeting the requirements for the degree, the student must comply with the following regulations:

1. Each candidate for the master's degree must submit for the approval of the Graduate Committee the program of courses he proposes to take to satisfy the requirements. This program must have the approval of the chairman of the student's major department, and all courses included which are not offered by the student's major department must also be approved by the chairmen of the departments concerned. The program should be submitted as soon as possible after completion of 15 credits toward the degree. Approval of the program by the Graduate Committee signifies that the student has formally been admitted to candidacy for the degree.

2. The *minimum* program for the master's degree must include:
   a. Not less than thirty semester hours of graduate work.
   b. Not less than eighteen hours of "400" level course work (see page 33 for classification of courses).
   c. Not less than eighteen hours in the major field.
   d. Not less than fifteen hours of "400" courses in the major field.

3. The eighteen hours required in the major field are ordinarily taken in one department. Specific exceptions to this rule are mentioned in the departmental statements at the head of course listings. The remaining twelve hours of a *minimum* program, or any part of them, may also be taken in the major department; or they may be taken in any other field in which courses for graduate credit are offered, as the needs or interests of the student may indicate, subject to the approval of the chairman of the major department. In all cases, the work for the master's degree must be taken under at least two instructors.

4. Graduate students registered in "200" and "300" courses may be assigned additional work at the discretion of the instructor.

5. In order to qualify for the master's degree, candidates will be required (a) to submit a thesis or a report based on a research course of at least 3 credit hours, *or* (b) to pass a comprehensive examination given by the major department. The department will specify which of these require-

ments applies, and may specify both. If required, the thesis shall not count for more than six semester hours. The credit to be allowed shall be fixed by the chairman of the major department. One unbound typewritten copy of the thesis, approved by the faculty members under whom the work was done and by the chairman of the major department, shall be placed in the hands of the Dean of the Graduate School with a receipt for $10.00 to cover the fee to be conferred. Information as to the form in which the thesis must be presented may be obtained from the Office of the Graduate School.

6. The master's degree is not granted unless the candidate has earned the grades "A" or "B" in at least eighteen hours of the work on his program. No course in which the grade earned is less than "C" is credited toward the degree. A student who receives more than four grades below "B" in courses numbered "200" or higher will be allowed to qualify for the master's degree only by special petition to the chairman of the major department and to the dean of the graduate school.

7. All work which is to be credited toward a master's degree must be done in actual and regular attendance at Lehigh University.

8. All work on a program for the master's degree must be completed within a six-year period.

When all requirements have been met, the candidate is recommended by the faculty to the trustees for the master's degree appropriate to the work pursued.

**DOCTOR OF PHILOSOPHY**

The degree of Doctor of Philosophy is conferred on candidates who have demonstrated general proficiency and high attainment in a special field of knowledge and capacity to carry on independent investigation in that field as evidenced by the presentation of an acceptable dissertation embodying the results of original research. The requirements for the degrees are more specifically set forth in the following regulations.

1. Time Requirements. A candidate ordinarily is expected to devote three or more academic years to graduate study. In no case is the degree awarded to one who has spent less than two full academic years in graduate work. Study for any specified period of time, however, is not in itself regarded as sufficient ground for awarding of the degree.

Graduate work done in residence at other institutions will be accepted in partial fulfillment of the time requirements, provided such work is approved by the Graduate Committee and by the departments concerned.

Work of fragmentary character scattered over a long period of years, or work completed many years before the student becomes a candidate for the degree, is subject to special review by the Graduate Committee. The extent to which such work may be credited towards the fulfillment of the time requirements will be decided by the faculty. All work on a program for the Ph.D. degree must be completed within a ten-year period.

2. Residence Requirements. A candidate for the degree must complete at least one full academic year of resident graduate study at Lehigh University.

3. Admission to Candidacy. Candidates for the doctorate are accepted in a limited number of departments only, and a department may limit the number of candidates accepted in any year. In exceptional cases new students may be admitted to candidacy immediately upon registration in the Graduate School. Ordinarily, however, they are required to spend at least one semester in residence before they are accepted as candidates. Admission to candidacy is at the discretion of the Graduate Committee and is granted only upon written application by the student. The applicant must have the endorsement of the departments concerned. The proposed major department may require a qualifying examination. In passing upon a student's application, the Committee will take into consideration the applicant's general education, as well as his special qualifications for work in his chosen field. Each applicant is notified by the Dean of the Graduate School, in writing, of the action of the Committee upon his application.

The application of a foreign student must be accompanied by a statement from the department in which he intends to specialize, certifying that he has a satisfactory command of English.

At the time of admission to candidacy a special committee is appointed by the Graduate Committee to direct the work of the candidate.

4. Plan of Work. Preparation for the degree is based on the study of a major subject to which one or two minors may be added. The program of work, to be formulated by the candidate, his special committee, and the chairman of his major department, should be planned to lead to a general mastery of the major field and to a significant grasp of any minor that may be added. The program must be approved by the Graduate Committee.

While there is no definite requirement as to the number of courses to be taken, two years devoted to formal courses is customary.

5. Language Requirements. The candidate must give evidence, through examinations, of a reading knowledge, sufficient for the purposes of his special studies, of at least two foreign languages (in addition to any language which may constitute his major subject). In each case, the required

languages are designated by the candidate's major department and approved by the Graduate Committee. In certain fields, the candidate, with permission of the chairman of his major department and approval of the Dean of the Graduate School, may reduce the requirement to one language appropriate to his field.

The qualifying examination in one language must be passed at least twelve (12) months before the candidate applies for his degree.

Language examinations are in charge of a committee consisting of representatives of the language department concerned and of the candidate's major department.

Permission to take the language examinations does not imply admission to candidacy for the degree.

6. General Examination. The general examinations for the doctorate are designed to test both the student's capacity and his proficiency in his field of study. The examinations are not necessarily confined to the content of courses that have been taken at Lehigh University or elsewhere. They are not held later than seven months prior to the time when the candidate plans to receive the degree. The student's department is in charge of the examination, which may be both written and oral.

Should a candidate fail in any part of the general examinations he may be permitted by the Graduate Faculty to present himself for a second examination not earlier than five months after the first. If the results of the second trial are also unsatisfactory no further examination is set.

7. Dissertation. The candidate is required to present a dissertation prepared under the general direction of a professor at Lehigh University. The dissertation shall treat a topic related to the candidate's major subject, embody the results of original research, give evidence of high scholarship, and constitute a contribution to knowledge. It must be approved by the professor under whose direction it was written, by the candidate's special committee, and by the Graduate Committee. A copy bearing the written approval of the professor in charge must be presented to the Dean of the Graduate School for transmission to the student's special committee not later than May 1, if the degree is to be conferred in June; not later than September 1, if the degree is to be conferred in October.

The candidate shall deposit with the Dean of the Graduate School, at least two weeks before the degree is to be conferred: (1) the original typescript of the accepted dissertation, unbound, in standard form, and suitable for microfilming; (2) the first carbon copy of the accepted dissertation in standard form and binding; (3) three copies of an abstract, not exceeding 600 words, of the dissertation, accompanied by a letter from the dissertation supervisor stating that the abstract is acceptable and suitable for publication; (4) a receipt from the Bursar for the payment of the publication fee of thirty dollars ($30). The publication fee is used by the University to

defray the cost of publishing the dissertation on microfilm (through University Microfilms) and the abstract in *Dissertation Abstracts*. If the candidate wishes to copyright his dissertation, he may do so by paying the copyright fee of fifteen dollars ($15) to the Bursar at the time the publication fee is paid. Arrangements for the copyright in the author's name will then be made by the University through University Microfilms.

8. Final Examination. After the dissertation has been accepted by his special committee, the candidate will be examined orally by the officers of professorial rank in the departments concerned and such other persons as may be selected by the candidate's special committee.

9. Conferring of Degree in Absentia. The degree of Doctor of Philosophy will not be conferred in absentia unless the candidate is excused by the President of the University.

## DOCTOR OF EDUCATION

The degree of Doctor of Education is intended for a limited number of carefully selected students engaged in the fields of administration, counseling, and teaching. At least four years of successful professional experience is required for admission to candidacy for this degree. The plan for the Ed.D. degree includes a sixth-year program, with a certificate given for its successful completion, and the final work for the doctorate which will emphasize the application of knowledge to an educational problem.

In general, requirements for the Ed.D. degree parallel those already stated for the Ph.D. degree with the exception of the following: (a) language examinations are not required, (b) a statistics competency examination is required, (c) a residence requirement which may be satisfied by an academic year of full-time study or a semester of full-time study preceded or followed by a summer session in which 12 semester hours of credit are earned. There is enough flexibility in this program to permit certain modifications appropriate to the specific objectives and background of the doctoral student. For more detailed information, consult the Dean of the School of Education, and see the section on the School of Education on page 163 in this Catalog.

## POSTDOCTORAL WORK

Students who have completed the requirements for the doctorate may enroll for postdoctoral individualized study under the guidance of selected members of the faculty. Such a program of study contemplates a broad educational and research development at advanced and mature levels, and provides opportunities to prepare for specific positions. A formal certification of such work as may be accomplished by the student will be made.

## MISCELLANEOUS REGULATIONS

The maximum roster of a full-time graduate student is fifteen semester hours. Graduate students who are employed elsewhere and can give only part of their time to graduate work should restrict the size of their rosters accordingly.

Graduate students who hold University appointments of any kind are

permitted to enroll for only a limited amount of graduate work. Full-time employees of the University may not take more than six semester hours of graduate work in any one semester; half-time employees may not take more than ten semester hours.

With the consent of the chairman of his major department and of the chairman of the department concerned, a graduate student may be admitted as a regular listener in one or more courses which course or courses shall be outside his approved program of studies for the degree, provided that the total number of hours in which he is registered and in which he is a listener shall not exceed the limits set forth above. In no case shall a student who has attended a course as a listener be given an examination for credit in that course. A listener's fee is charged for each course audited.

# SCHOOL OF EDUCATION

John A. Stoops, B.A., M.A., Ed.D., *Dean*

The President and the Board of Trustees announced the establishment of the School of Education effective February 1, 1966. The School of Education operates in conjunction with the Graduate School. Its administrative procedures are identical or similar to those of the Graduate School in regard to admission, registration, tuition, fees, transcripts, and other related matters. Degree requirements are also consistent with those established by the Graduate School. The School of Education offers the Master of Arts in Education, the Master of Education, and the Doctor of Education. Details regarding the specific regulations and requirements can be found in that section of this catalog pertaining to the Graduate School (see pages 154-163). Course offerings and other pertinent data may be found under the list beginning on page 217.

The School is interested in the preparation of elementary teachers, secondary teachers, community college teachers, counselors, administrators, reading specialists, and curriculum specialists. Of particular interest are qualified persons holding B.A. degrees who wish to enter teaching and established teachers who wish to prepare for leadership responsibility in the school through preparation at the Master's and Doctorate levels.

Whereas graduate study in Education was once undertaken only by those preparing for leadership in the schools, it is now a part of the training required of every qualified teacher. In the face of this mounting trend, Lehigh is strengthening its graduate program in Education and has discontinued professional preparation of undergraduate students.

Accordingly, a fifth-year program is offered to qualified holders of B.A. degrees who wish to enter teaching. Those admitted to the program have the opportunity to accomplish their professional training and serve as salaried interns in the public schools. At the completion of a full year of full-time study, students can (1) meet the requirements to begin teaching, and (2) meet the requirements for the Master of Arts (secondary teachers) or the Master of Education (elementary teachers) degree.

For the benefit of in-service teachers many courses are offered in the evenings and on Saturday mornings. Teachers of the Lehigh Valley and surrounding regions are sent special bulletins on the offerings of the School of Education and various departments for the fall, spring, and summer sessions. Each bulletin is scheduled for mailing approximately one month before registration. All teachers are encouraged to participate in the life and work of the University.

The Graduate School, through the School of Education, offers the Master of Arts Degree, Major in Education. Candidates for this Degree must include in their program a minimum of twelve hours of graduate work in an academic specialty such as social studies or English. This is combined with a minimum of 18 hours in professional Education.

Lehigh's program of training for advanced professional responsibility

is planned in three stages. The first is represented in the M.Ed. or M.A.; the second exists in the several specialist programs. The final stage is the Doctorate in Education.

The Master of Education degree requires, in addition to broad study of the social foundations of education, specialization in a professional field. Special fields include elementary education, elementary administration, secondary administration, general administration, guidance and counseling, and reading. Although study at the Master's level is intense and specialized, the School recognizes that additional training is needed for professional leadership in most areas. Therefore, programs designed for these specialists are extended to the sixth-year certificate.

The Doctorate in Education program at present provides for major work in five areas: (1) administration, (2) reading, (3) educational foundations, (4) school psychology and (5) educational research. Students are screened for admission in the fall of each year and begin doctoral study the following spring semester. Formal admission to candidacy for the Ed.D. degree usually occurs after the completion of the equivalent of a semester of resident study and the submission of an approved outline for the dissertation.

**Examination Dates for Doctor of Education 1967-68 Academic Year**

| | | |
|---|---|---|
| Initial | Screening Examination | October 6, 1967 |
| Final | Written Examination | November 4, 1967 |
| Initial | Screening Exam | February 2, 1968 |
| Final | Written Examination | March 2, 1968 |

The School is organized in five divisions. Specific information regarding degree programs can be obtained from the director of the appropriate division.

**DIVISION OF EDUCATIONAL ADMINISTRATION**

John S. Cartwright, *Director*

Elementary School Principalship, Secondary School Principalship, School Business Managership, Curriculum Administration, School Superintendency.

**DIVISION OF COUNSELOR EDUCATION**

John A. Mierzwa, *Director*

Guidance Counselor, School Psychologists, Counseling Psychologist

**DIVISION OF ELEMENTARY EDUCATION**

Alfred J. Castaldi, *Director*

Elementary Teachers (Interns), and Elementary Master Teachers

**DIVISION OF SECONDARY EDUCATION**

Natt M. Burbank, *Director*

Secondary School Teachers (Interns), and Secondary Master Teachers

**DIVISION OF EDUCATION SPECIALISTS**

John A. Stoops, *Director*

Reading, *Charles Versacci;* Community College Teachers, *Charles Guditus;* Foundations, *John Stoops;* and Research, *Merle Tate.*

# Research Centers and Organizations

## INSTITUTE OF RESEARCH

The Lehigh Institute of Research was organized in 1924 to encourage and promote scientific research and scholarly achievement in every division of learning represented in the organization of the University, and in recognition of the need for further and more exact knowledge in science and in the application of science to the affairs of modern life. The Institute was reorganized in 1945 in recognition of the increasing role of government agencies and industry in sponsoring research.

Lehigh University cooperates with industrial concerns, technical associations, and government agencies in carrying on basic and applied research. A number of research assistantships are available to qualified graduate students, and provide stipends which vary from $150 to $550 per month, depending upon the qualifications and academic programs of the appointee and the time assigned to the project. Appointments are generally for one year and normally are continued upon satisfactory academic progress. Part- or full-time employment on research projects is frequently available during the summer and entering students who hold research appointments usually are encouraged to begin their employment in June or July before the commencement of formal graduate study in the fall. Applications for research assistantships should be accompanied by evidence of the candidate's qualifications for the appointment sought and sent to the Director of the Lehigh Institute of Research or to the chairman of the department concerned.

Sponsors of current research activities are as follows:

Abex Corporation
Air Products and Chemicals, Inc.
Air Reduction Company, Inc.
Aluminum Company of America
American Cancer Society
American Can Company
American Cyanamid Company
American Institute of Steel Construction
American Iron and Steel Institute
American Metal Climax, Inc.
Ashland Oil and Refining Co.
Atlas Chemical Industries, Inc.
Bell Telephone Laboratories
City of Bethlehem
Bethlehem Steel Corporation
Carpenter Steel Company
Climax Molybdenum Company
Louis Calder Foundation
Column Research Council
E. I. duPont de Nemours and Company
Esso Education Foundation
Fuller Company
General Electric Company
Gilbert Associates
Gregory Industries
Handy and Harmon Tube Company, Inc.
Heat Exchange Institute
Howmet Corporation
International Business Machines Corporation
International Nickel Company
M. W. Kellogg Company
Kentile, Incorporated
KSM Products, Inc.
Lepel High Frequency Laboratories, Inc.

National Council for Stream Improvement
National Printing Ink Research Institute
Newsprint Service Bureau
Olin Mathieson Corporation
Paint Research Institute
Commonwealth of Pennsylvania:
  Department of Highways
  General State Authority
Petroleum Research Fund of the American Chemical Society
Pressure Vessel Research Council
Reinforced Concrete Research Council
Research Council on Riveted and Bolted Structural Joints
Reynolds Metals Company
Rohm and Haas Company
Smith, Kline and French Foundation
St. Regis Paper Company
Scaife Foundation
The Boeing Company
Tru-Fit Screw Products Corporation
United States Government:
  Independent Offices:
    Atomic Energy Commission
    National Aeronautics and Space Administration
    National Science Foundation
  Department of Agriculture
  Department of Commerce
    Bureau of Public Roads
  Department of Defense
    Department of the Army
      Army Medical Research and Development Command
      Army Research Office — Durham
      Electronics Material Agency
      Corps of Engineers
      Munitions Command
    Department of the Navy
      Ships Systems Command
      Facilities Engineering Command
      Naval Applied Science Laboratory
      Office of Naval Research
    Department of the Air Force
      Aeronautical Systems Division
        Aerospace Research Laboratories
      Air Force Office of Scientific Research
    Department of Health, Education and Welfare
      Office of Education
      Public Health Service
        National Institutes of Health
        Division of Water Supply and Pollution Control
    Department of the Interior
      Office of Saline Water
      Federal Water Pollution Control Administration
U. S. Rubber Company
United States Steel Corporation
Warner-Lambert Pharmaceutical Company
Welding Research Council
West Virginia Pulp and Paper Company
Western Electric Company

## FRITZ ENGINEERING LABORATORY

Founded in 1909, the Fritz Engineering Laboratory serves for the advancement of knowledge and techniques in the fields of structures, structural mechanics, materials, hydraulics and fluid mechanics, structural model analysis, soil mechanics, and sanitation.

The Laboratory is associated primarily with the department of Civil Engineering. In addition, there are cooperative research efforts with other departments of the University and with other institutes and universities. Research projects are sponsored through the Institute of Research by national research councils, industrial corporations and associations, private companies, and by state and federal government agencies.

In 1955 the Laboratory was expanded and modernized to provide excellent facilities for research and instruction. Since then, the additional necessary equipment has been acquired to fill the needs of new research investigations.

Through the Laboratory organization, technical seminars and lectures are presented on current research findings and on new design applications

in the various fields of Civil Engineering and related disciplines.

The staff of the Laboratory consists of Lehigh University faculty members, research associates, research assistants, and supporting technical personnel. The Laboratory awards research assistantships and certain fellowships to competent research personnel who are candidates for advanced degrees. Through their work in research programs, men are trained for careers in teaching, in research, and in advanced engineering design.

As a result of the research studies conducted by the staff of the Laboratory, it has been possible to make basic changes to design procedures and specifications in numerous specialty fields. The Laboratory participates in a world-wide exchange of research information, maintains a special library of technical papers appropriate to its fields, and stimulates the publication of papers in technical journals both in this country and abroad.

## Interdisciplinary Centers

### CENTER FOR THE APPLICATION OF MATHEMATICS

The Center was established in the fall of 1965. The purpose of the Center is to foster interdisciplinary research related to the application of mathematics, to draw on other disciplines for pertinent mathematical problems, and to encourage the development of advanced courses in the application of mathematics.

In addition to the research and the support of teaching already described, the activities of the Center include the sponsorship of a colloquium, of lectures which report current research on the campus, and of expository lectures.

The Center serves in an advisory capacity on interdepartmental graduate programs, both in the design of programs to suit the interests of students and departments and in making recommendations on the award of fellowships and assistantships.

The Center surveys the need for courses in the application of mathematics and is concerned both with the design of new courses and the reorganization of existing courses so that these needs may be better served.

The Center sponsors institutes and conferences. It seeks support through contracts and grants for interdepartmental research related to the application of mathematics.

The Center is concerned with the imaginative use of computing facilities.

### BUSINESS ECONOMICS CENTER

The Business Economics Center was established in July, 1965 to (1) apply economic analysis to business problems and to (2) carry out research linking business behavior and policy with economic analysis and investigation. In the first case the goal is to test and make greater use of existing academic economic understanding, and in the second case to develop new ideas which will both be useful in the business world and will

contribute to academic advances in developing economic explanations and prediction in the real world.

The Center provides a focal point to which businessmen can turn in seeking solution to economic problems, which will benefit the professional economist by testing principles against applications and which will provide research training for students interested in business economics. The questions of businessmen, government officials and others in the field are invited and arrangements are provided to try to develop answers by organizing research where that appears appropriate and by making use of professional experts who desire to cooperate when that course appears promising. Research fellowships are available to a limited extent to attract students who are desirous of working on the research problems which arise. Additionally, we have found that many students wish to do research work in the Center for course credit even without financial remuneration because of the intellectual stimulation provided by practical research.

Lehigh University offers an M.S. in Business Economics which students working in the Center usually receive. A few students who work with the Center are working toward the Ph.D. degree.

The Center works closely with the National Association of Business Economists. The Clearinghouse Project, of that Association, which concentrates on possibilities of business and academic economists helping each other, is directed at Lehigh University.

## CENTER FOR SURFACE AND COATINGS RESEARCH

The purpose of the Center for Surface and Coatings Research, which was established at Lehigh University on February 1, 1966, is to encourage faculty and students from all pertinent disciplines to undertake research relevant to surface and coating phenomena.

The Center expects to fulfill its purpose by providing opportunities for research and education, for the most part at the graduate level. Personnel now engaged in its program include seven faculty members, four research associates, and 25 graduate students specializing in Physical Chemistry, Chemical Engineering, or Mechanics. Participation of other scientific fields is also being developed.

The research program currently emphasizes solid/gas and solid/liquid interactions. The major solid/gas effort is concerned with corrosion, particularly the mechanism whereby structurally important metals corrode, lose strength and fracture under stress. Advanced techniques such as electron spin resonance are being employed to determine physical, chemical and mechanical changes in surface states due to adsorption of elements from the atmospheric environment.

The solid/liquid studies are aimed principally at chemical coatings, most of which are based on colloidal dispersions of pigments in polymeric fluids. Aspects include the mechanism of de-aggregation and stabilization, effects of polymer orientation and other adsorbed species on interfacial properties, rheological response under stress, adhesion to and flow into porous substrates, and spectral characteristics of colorant layers.

Other research involves the surface properties of ice nucleants, metal alloys and semi-conductors; and the interfacial behavior of detergents, biogradable surfactants, protein structures, metal/oil/water systems, non-soap lubricants, and water impurities.

## CENTER FOR THE INFORMATION SCIENCES

The Center for the Information Sciences was established in 1962 as a division of the University Library and is now affiliated with the Center for the Application of Mathematics. It is designed to fulfill two general objectives. The first is the training of specialists who can analyze and organize information. The second is the investigation of the properties and behavior of recorded information, and the forces governing its flow.

In the last twenty years, technology, science, and the emerging social sciences have not only posed unforeseen demands on libraries, but have generated an entirely new complex of ideas about the processes of communication. The information sciences are a response to these needs and ideas. As science, they cut across such disciplines as psychology, logic, neurophysiology, linguistics, and mathematics. As technology, concerned with the processing of information for optimum accessibility, the information sciences utilize the techniques and concepts of computer technology, librarianship, operations research, and the management sciences.

In 1963, a Division of the Information Sciences was established within the College of Arts and Science, as the instructional section of the Center. A graduate program was initiated in 1964. Research in various aspects of the subject are presently being carried out in cooperation with the Departments of Industrial Engineering, Philosophy, Psychology, Social Relations, and the Computing Laboratory.

## MARINE SCIENCE CENTER

. . . we must look to the sea for the rule, to the land for the exceptions.
M. F. Maury, 1851

The Marine Science Center is an interdepartmental research institute with the purpose of encouraging interdisciplinary studies of oceanic problems. In the ocean, physical, chemical, biological and geological processes are so closely interrelated that it is often difficult or impossible to separate them. Thus in order to facilitate research on oceanographic problems the Center brings together faculty and graduate students from the Departments of Geology, Biology and Chemistry for discussion and research cooperation.

The laboratories in the Center are well equipped for field and laboratory oceanographic studies. In addition, cooperative projects are underway with marine stations in the Eastern U. S., Bermuda and the Caribbean.

Research activities of the staff and students include:
Air-sea interactions and surface water circulation;
Basic seawater chemistry and the carbonate cycle;
Marine microbiology and biochemistry of proteolytic bacteria;
Shallow-water sedimentation and organism-sediment interactions;
Zooplankton dynamics;
Algal and crustacean physiology.

## MATERIALS RESEARCH CENTER

The Materials Research Center was established in February 1962 to fulfill the need for a research and educational facility permitting intellectual stimulation of scientists and engineers dedicated to research in materials. The fundamental objectives of the Materials Research Center are to encourage interaction among the science and engineering disciplines with an interest in materials and to promote interdisciplinary research activity and interdepartmental education opportunities.

To achieve these objectives, the Center:

a. Coordinates and integrates all activities pertaining to materials science and technology at Lehigh University;
b. Seeks to establish a climate in which faculty members, post-doctoral associates, and graduate assistants develop an awareness of materials problems;
c. Arranges for physical facilities and space required to conduct interdisciplinary research;
d. Guides the search for new materials by encouraging fundamental research and new approaches to materials problems; and
e. Assists in developing educational opportunities in materials, in particular, interdisciplinary graduate programs devoted to training for research in materials.

Materials research has played an important role at Lehigh for the past two decades. Currently, approximately 160 persons, including graduate students and faculty members representing science and engineering departments, are engaged in research pertaining to materials science and engineering. These persons are distributed in departmental laboratories; in special University laboratories for Engineering Structure Analysis, Surface Chemistry, Stress Corrosion, Magnetic Materials, Crystal Growing and Zone Processing, Manufacturing Processes, Hydrothermal Synthesis and Fracture Mechanics; and in four interdisciplinary laboratories of the Center housed in Coxe Building i.e., Advanced Materials, Mechanical Behavior, Physical Ceramics, and Polymers. Government, industry, foundations, and technical societies support this work.

Organizationally the Materials Research Center is guided by a Materials Council composed of senior faculty members representing several departments of the University. The policies of the Council are implemented by the Director of the Center and his staff.

This Center facilitates interdisciplinary programs of study and research that cross the traditional boundaries of science and engineering curricula, providing a fundamental, broad approach to the field of materials science and technology. Graduate students participating in the Center's program usually receive M.S. or Ph.D. degrees in the traditional discipline of their choice, i.e., Chemistry, Physics, Metallurgy and Materials Science, Electrical Engineering, etc.; however, they may pursue course work related to a fundamental understanding of materials in several disciplines and conduct research on a broad materials problem involving several graduate students from different disciplines.

For further information concerning course offerings in Materials, see the description of the B.S. Engineering—M.S. Materials Program on page 132.

# DESCRIPTION OF COURSES

Following is a list of undergraduate and graduate courses offered by Lehigh University. For purposes of record, all approved courses are listed. It must be understood, however, that the offerings in any given semester are contingent upon a number of factors, including student needs as determined at the time of pre-registration.

### Credit Hours

The number in parentheses following each course title indicates the credit value of the course in terms of semester hours. Three hours of drawing, of work in the laboratory, or of practice in the field are regarded as the equivalent of a recitation or lecture of one hour's duration.

### Course Numbering

The course numbering system specifies which courses can be applied to the program of study as the student progresses toward his undergraduate or graduate degree. The numbering series is as follows:

**0-99** **Undergraduate courses, primarily for underclassmen. Not available for graduate credit.**

**100-199** **Advanced undergraduate courses. Not open to freshmen except on petition. Not open to sophomores except on petition, unless part of major program or curriculum. Not available for graduate credit.**

**200-299** **Courses open to advanced undergraduates and graduates. Not available for graduate credit in the major field.**

**300-399** **Courses open to advanced undergraduates and graduates. Available for graduate credit in the major field.**

**400-499** **Courses open to graduate students only.**

### Prerequisites

Academic preparation required for admission to courses is indicated under "Prerequisites" following course descriptions stated in most cases for purposes of convenience in terms of Lehigh courses. Status required for admission, where numbering does not fully describe this status, is also indicated under "Prerequisites."

A student who does not have the status or the academic preparation set forth as prerequisites must, in order to be admitted to a course, file with the Registrar at the time of registration and on a standard form provided by the Registrar a waiver of prerequisites signed by the instructor teaching or in charge of the course, the head of the teaching department, and the student's curriculum director. Academic work completed elsewhere must be attested in this manner as being substantially equivalent to prerequisites listed, unless the student's records in the Office of the Registrar show that the proper officers have so evaluated this preparation previously.

English 2 shall be prerequisite to all 100—or higher—level courses; exceptions may be made only by petition to the Committee on Standing of Students.

# ACCOUNTING

## ACCOUNTING

Professors Trumbull, Koch, Moore
Associate Professors Hobbs, Kubelius, Mills
Assistant Professors Brady, Brockway, Kraus, Lewis, Luh

**Acctg. 1. Accounting (3)**
Essentials of double-entry bookkeeping, transaction analysis, the accounting cycle, including presentation of operating results, funds flow, and financial position in formal financial statements. Controls and analysis for managerial decisions. Principles of financial accounting for corporations, partnerships, and other financial entities. **Prerequisite: Sophomore standing.** First and second semesters.

**Acctg. 2. Accounting (3)**
Continuation of Acctg. 1, including problems concerned with more specific areas such as inventories, plant assets and depreciation, manufacturing costs, long-term liabilities, and revenue and expense recognition. **Prerequisite: Acctg. 1.** First and second semesters.

**Acctg. 13. Intermediate Accounting (3)**
Intensive study of theory, generally accepted accounting principles, and problems concerned with presenting fairly the operating results and financial position of business entities; preparation, analysis, and interpretation of financial statements. **Prerequisite: Acctg. 2.** First semester.

**Acctg. 14. Intermediate Accounting (3)**
A continuation of Acctg. 13. **Prerequisite: Acctg. 2.** Second semester.

**Acctg. 108. Fundamentals of Accounting (3)**
A one-semester survey of accounting principles and practices, including an introduction to industrial cost systems. This course in combination with Acctg. 115 is designed for those planning industrial or engineering careers. (Students planning careers in business or professional accounting, perhaps after graduate work in business administration, should select the alternative two-semester sequence of **Acctg. 1** and **2.**) First and second semesters.

**Acctg. 111. Business Data Processing (3)**
An introduction to electronic data processing emphasizing general principles applicable to business data. The course includes (1) familiarization with a basic computer language, (2) uses of computers in processing information for the needs of business enterprises, and (3) the elements of integrated systems of financial information for business purposes. First and second semesters. Mr. Luh

**Acctg. 115. Cost Accounting (3)**
Principles and practices of industrial cost accounting, including cost planning and budgeting, cost controls, job-lot and standard and process systems, variance analysis, performance reports, costs in management decisions. **Prerequisite: Acctg. 2 or 108.** First and second semesters.

### For Advanced Undergraduates and Graduates

**Acctg. 203. Federal Tax Accounting (3)**
Survey of the Federal law and regulations for determining the income tax liability of individuals, partnerships, trusts, and corporations. **Prerequisite: Elementary accounting.** First semester. Mr. Koch

**Acctg. 304. Governmental and Institutional Accounting (3)**
Application of accounting principles and procedures to problems of budgets, appropriation, and funds in governmental units, educational institutions and hospitals. **Prerequisite: Intermediate accounting.** Not offered 1966-67.

**Acctg. 305. Financial Statements and Reports (3)**
Study of the features of accounting data essential to the interpretation and evaluation of business operations and financial position. Analysis of financial statements and reports from point of view of management, investors, creditors, and others. Not available to accounting majors. **Prerequisite: Acctg. 2 or 108.** Second semester. Mr. Trumbull

**Acctg. 308. Tax Planning and Research (3)**
Advanced course in Federal tax laws, regulations, and interpretations. Concerned with advance planning, timing of business transactions, and research on the rulings of the U. S. Treasury Department and the decisions of various Federal courts. **Prerequisite: Acctg. 203.** Second semester. Mr. Koch

**Acctg. 315. Advanced Accounting (3)**
Problems of partnerships, branches and agencies, consolidations and mergers. Accounting for estates, trusts, and insolvent concerns. **Prerequisite: Intermediate accounting.** Second semester. **Prerequisite: Intermediate Accounting.**

**Acctg. 318. Advanced Cost Budgeting and Analysis (3)**
Advanced problems in planning and controlling manufacturing and other operating costs; budgets, cost standards, analysis of cost data for output, price, and other decisions. **Prerequisite: three hours of cost accounting.** Second semester.

**Acctg. 320. Auditing (3)**
Survey of auditing theory, objectives, and practices relating largely to the responsibilities of independent professional accountants; ethics of the profession, generally accepted auditing standards, internal control, examination of various systems including EDP, statistical methods, report writing, etc. **Prerequisite: Intermediate Accounting.** First semester.

**Acctg. 325. Controllership (3)**
Analysis of the controllership function and of the controller's department as that phase of management responsible for the optimum use of accounting information, accounting facilities, and techniques of financial control in a business enterprise. **Prerequisites: Acctg. 13, 14, and 115.** Second semester. Mr. Moore

**For Graduates**

**Acctg. 422. Managerial Accounting (3)**
Survey course for non-accounting majors (related course for accounting majors is **Acctg. 325**); uses of accounting data for managerial planning and control; the interpretation of financial statements, including the price-level problem; cash-flow analysis; cost control; capital expenditure planning; product pricing decisions; operations research applications. **Prerequisite: Accounting background suitable to instructor.** First semester. Mr. Moore

**Acctg. 431. Accounting Theory and Thought (3)**
A critical and historical examination of modern accounting concepts. Concerned with measuring enterprise income and capital and related economic data, in

both simplified and realistic circumstances, and with communicating and interpreting such data effectively to interested parties. **Prerequisite: 15 hours of accounting.** First semester. Mr. Trumbull

**Acctg. 442. Professional Accounting Seminar (3)**
Survey of technical and professional accounting problems at the advanced level. Intensive review of CPA examination material and of management services performed by accountants. **Prerequisite: 15 hours of accounting.** Second semester. Mr. Mills

## LAW

**Law 1. Business Law (3)**
The law of contracts, agency, bailments, and sales; legal thought and the judicial process. First and second semesters. Messrs. Brockway, Lewis

**Law 102. Business Law (3)**
The law of negotiable instruments, partnership, corporations, real property, insurance, and security devices. **Prerequisite: Law 1.** Second semester.
Messrs. Brockway, Lewis

**Law 103. Business Law for Engineers (3)**
The law of contracts, agency, partnerships, corporations, and property rights with special emphasis upon the legal problems of the engineering profession. First semester. Messrs. Brockway, Kubelius

### For Advanced Undergraduates and Graduates

**Law 204. Wills, Estates, and Trusts (3)**
A study of the basic legal and management principles and practices involved in the planning and administration of wills, estates, and trusts. **Prerequisite: A course in business law.** Second semester. Mr. Kubelius

**Law 211. Legal Concepts (3)**
Study of legal reasoning, law as a process of resolving disputes, law as an instrument of social control; selected problems in ownership; provisions for the redress of harm; maintenance of law and order. Mr. Brockway

### For Graduates

**Law 401. Legal Problems in Business (3)**
A course designed to deal with specific legal problems involved in making business decisions. Emphasis is placed on preventive law and the tax consequences of business transactions. **Prerequisite: Law 1 or 103.** First semester. Mr. Kubelius

## ASTRONOMY

**See Mathematics and Astronomy (page 286).**

## ATHLETICS

**See Division of Athletics and Physical Education (page 341).**

# BIOLOGY

Professors Barber, Parker, Trembley, Malsberger
Adjunct Professors Benz, Wolf
Associate Professors Herman, Owen, Sutcliffe
Assistant Professor Pritchard

Students may not take for credit both **Biol. 21,** Principles of Biology (3) and **Biol. 13** Human Biology (3). Under special circumstances, a student may petition for an exception to this policy.

**Biol. 13. Human Biology (3)**
A lecture course in biological principles as illustrated by man. Man in relation to his environment, the organ systems of man, population biology, parasitism, elements of human inheritance, and human evolution. **Prerequisites: Chem. 1 and 11.** First and second semesters.

**Biol. 21. Principles of Biology (3)**
Introduction to biology by study of selected principles. Topics covered include cell structure and function, plant and animal structure and function, diversity and evolution of organisms. Three lectures per week. First and second semesters.

**Biol. 22. Introduction to Biology Laboratory (1)**
Laboratory observations and experiments to illustrate how biological information is acquired. Designed primarily as a laboratory to accompany Biology 21. **Prerequisite: Biology 21 previously or concurrently.** First and second semester. One 3-hour laboratory per week.

**Biol. 28. Genetics (3)**
A study of the basic laws governing inheritance in plants and animals, chromosome behaviour, nature of genes. The relation of environmental modifications, hybrid variation, and mutations to the mechanics of evolution. **Prerequisite: One semester of biology.** Second semester.

**Biol. 34. Comparative Vertebrate Anatomy (4)**
A course in vertebrate zoology with emphasis on the study of homologous body structures in the various vertebrate classes and their relationship to the functional demands of habit and environment in each class. Detailed dissections of representative vertebrates are made in the laboratory. Two lectures and two laboratory periods each week. **Prerequisite: Biol. 21 and 22, or equivalent; sophomore standing.** Second semester.

**Biol. 35. Microbiology (3)**
A basic course for students majoring in biology. A study of the physiology, biochemistry, and morphology, including staining methods, of representative heterotrophic microorganisms. Recitations, lectures, and laboratory work. **Prerequisite: A laboratory course in biology.** Second semester.

**For Advanced Undergraduates and Graduates**

**Biol. 221. Undergraduate Research (3)**
Laboratory work, field work, or both depending upon the interest and competence of the student. **Prerequisites: Senior standing and consent of the Chairman of the department.** First semester. Staff

**Biol. 231. Natural History and Ecology (3)**
A concentrated course in recognition of species of plants and animals and study of their interrelationships in natural and altered environments. Lectures

and seminars in use of keys and preservation of collections. Primarily designed for secondary school teachers in life sciences. **Prerequisites: Graduate standing or consent of instructor.** Summer Session. Mr. Trembley

**Biol. 252. Natural History and Ecology Workshop (3)**
Field and laboratory work in Natural History and Ecology. Must be taken concurrently with Biol. 331. Summer Session. Mr. Trembley

**Biol. 233. Modern Biology for Teachers (3)**
Lectures, demonstrations, and readings in frontier areas of biology. For secondary school teachers in biology and general science. Not available for undergraduate credit. First semester.

**Biol. 234. Modern Biology for Teachers (3)**
Continuation of Biology 233. Second semester.

**Biol. 261. Special Topics in Biology (1-3)**
Research, conferences, and reports on selected topics not covered in the general undergraduate offerings. May be taken more than once for credit. First semester.

**Biol. 262. Special Topics in Biology (1-3)**
Continuation of Biology 261. Second semester.

**Biol. 272. Senior Seminar (3)**
Seminar, for biology majors only, on advances in biology. Introduction to research literature on selected topics. One 3-hour seminar per week. Second semester.

**Biol. 303. Advanced Invertebrate Zoology (3)**
A detailed survey of representative invertebrates. Anatomical and histological examination of selected types. Concepts of evolution and speciation. **Prerequisite: Two semesters of biology, one with laboratory.** First semester. Mr. Herman

**Biol. 306. Ecology (3)**
The basic principles of ecological interrelationships; training in use of analytical keys and reference collections for the identification of plants and animals; field trips for the study of interrelationships of living organisms. Two lectures and one laboratory period or field trip per week. **Prerequisite: Consent of the chairman of the department.** Second semester. Mr. Trembley

**Biol. 313. General Histology (3)**
The techniques of preservation and preparation of animal and plant tissues, for microscopical study; comparative studies of fresh and preserved tissues. One lecture and two laboratory periods per week. **Prerequisite. Biol. 21 and 22, or equivalent, Biol. 34 or equivalent recommended.**
First semester. Mr. Owen

**Biol. 314. Vertebrate Embryology (3)**
A study of reproduction from germ cell formation through establishment of the principal organ systems of the vertebrate body. Various mechanical and physiological problems confronting the growing embryo are considered, and direct observation of whole mounts, sections, and living material are made in the laboratory. Two lectures and one laboratory period each week. **Prerequisite: Biol. 34 or equivalent.** Second semester. Mr. Owen

**Biol. 320. Physiology (3)**
Lectures and laboratory work covering the principles underlying the operation of life processes. The subject matter is not limited to any one group of organisms,

but is derived from living things in general. **Prerequisite. Two semesters of biology, one with laboratory; Chem. 52, or consent of the chairman of the department.** Two lectures and one laboratory period per week. First semester.

Mr. Barber

**Biol. 334. Growth and Development in Plants (3)**

A comparative study of life cycles and embryo growth and development in the plant kingdom, including the algae, bryophytes and tracheophytes. Emphasis is placed on morphology, physiology, and the role of macromolecular substances during growth and differentiation. **Prerequisites: Two semesters of biology with laboratory.** Second semester. Two lectures, one laboratory. Mr. Pritchard

**Biol. 336. Evolution of Land Plants (3)**

A comparative study of the ontogenetic and phylogenetic development of plants as they invaded the terrestrial environment. The algae are studied briefly, but stress is placed on the bryophytes and tracheophytes (land plants). The life cycles of representative plants are examined in detail. Two lectures and a laboratory. **Prerequisite: Biology 21 or its equivalent.** Second semester.

Mr. Pritchard

**Biol. 353. Virology (3)**

A lecture course on Rickettsiales, Virales, and bacterial viruses including taxonomy, physical and chemical properties, immunological characteristics, and evolution. **Prerequisite: A course in microbiology or bacteriology.** First semester.

Mr. Malsberger

**Biol. 361. Sanitary Microbiology (3)**

Laboratory, field work, and reports on the microbiology of water supplies, waste disposal, and food processing. **Prerequisite: One semester each of microbiology and analytical chemistry.** First or second semester as required.

Messrs. Parker, Malsberger

**For Graduates**

The prerequisite for graduate work in biology is preliminary work substantially equivalent to the amount of biology, mathematics, physics and chemistry usually taken by an undergraduate majoring in biology at Lehigh University. Minor deficiencies in these areas may be completed during the first year of graduate study, usually, however, without graduate credit. Ability to undertake graduate work must be demonstrated by previous scholastic record and examinations.

Candidates for admission to graduate study are required to submit their scores in the Graduate Record Examination in Verbal and Mathematical Aptitude and the Advanced Examination in Biology. Research training or thesis credit equivalent to six hours is required by the department for the master's degree.

Many of the following graduate courses are given irregularly upon demand. Consultation with the instructor is advised to assure suitable preparation.

**Biol. 402. Comparative Animal Physiology (3)**

Lectures and seminars on selected areas in the comparative physiology of animals. Introduction to the current literature of subjects studied. These include mechanisms of osmotic control, temperature effects, nerve and muscle physiology and others. **Prerequisite: Two years of college biology or consent of instructor.** Second semester. Mr. Barber

**Biol. 405. Special Topics in Biology (1-3)**
Research, conferences, and reports on selected topics not covered in the general graduate offerings. May be taken more than once for credit. Staff

**Biol. 406. Biological Seminar (1)**
An advanced seminar in current developments including departmental research. Required for candidates for graduate degrees. Second semester. Staff

**Biol. 407. Biological Research (3)**
Investigations in any phase of the biological sciences according to the student's preparation and interests. First semester. Staff

**Biol. 408. Biological Research (3)**
Continuation of Biol. 407. Second semester. Staff

**Biol. 409. Advanced Morphology (3)**
A laboratory course in special phases of morphology, such as comparative osteology, comparative morphology, or embryology of the vertebrates, etc., to meet the individual interest of the student. Mr. Owen

**Biol. 410. Topics in Modern Biology (3)**
A seminar in genetics, evolution, and current developments in biological sciences. Required of all candidates for advanced degrees in the department. First semester. Staff

**Biol. 411. General Cytology (3)**
Conferences, assigned readings, and laboratory work on the structural features of the cell in relation to cellular function and on modern methods of preparing living and fixed tissues for cytological study. Included are special studies of the cytology of microorganisms. **Prerequisite: Biol. 313 or its equivalent.** First semester Mr. Owen

**Biol. 412. Field Zoology (3)**
Methods of biological survey work; animal censuses; collection, preparation, and care of zoological specimens; use of keys; study of the interrelationships existing between the groups of local animals, especially the vertebrates, and of their habitat preferences. Lectures, laboratory work, and field trips. Mr. Trembley

**Biol. 413. Problems in Field Zoology (3)**
Concentrated work in the life history study of one or more local species. To be taken concurrently with or following Biol. 412 depending upon the previous experience and interest of each student. Mr. Trembley

**Biol. 414. Advanced Ecology (3)**
Conferences and field work with emphasis in such areas as aquatic ecology, limnology, and fisheries biology. Whenever possible this will include participation in research problems conducted by the Water Resources Council of the Lehigh Institute of Research. **Prerequisite: Consent of the instructor.** First and second semesters. Mr. Trembley

**Biol. 415. Cytochemistry (3)**
A study of morphological and biochemical events during cell growth and differentiation including lectures, labs. and student reports on current literature. Special emphasis is placed on plant developmental patterns and laboratory procedures of the cytochemist. **Prerequisite: Consent of the instructor.** First semester. Mr. Pritchard

**Biol. 416. Immunology (3)**
Consideration of antigen-antibody systems from theoretical and practical aspects. Lectures and reports on the structure and origins of antigens and antibodies and the mechanisms of agglutination, precipitation, complement fixation, anaphylaxis etc. Laboratory work on preparation, standardization, and assay of antigens and antigens and antibodies. **Prerequisite: Biol. 353, Chem. 371 or equivalent.** First semester. Mr. Malsberger

**Biol. 417. Marine Ecology (3)**
An advanced course in the ecology of the marine environment. Study of the physical and chemical factors, organisms and their interrelations. Ecological theory pertaining to population dynamics and energy flow. Two lectures and one laboratory period per week. **Prerequisite: Consent of chairman of department.** Second semester. Mr. Herman

**Biol. 418. Biological Oceanography (3)**
Surveys of marine plant and animal plankton, nekton and benthos. Composition of various groups, productivity, interrelationships of plants and animals and the role of microorganisms in the sea. Three lectures per week. **Prerequisite: Consent of chairman of department.** Second semester Mr. Herman

**Biol. 432. Laboratory Methods in Virology (3)**
Basic methods used in the isolation, identification, and handling of viruses. Practical exercises in the preservation of viruses, chick embryo techniques, tissue culture, staining methods, immunological techniques, and microscopy are included. **Prerequisite: Biol. 353. Second semester** Mr. Benz

**Biol. 462. Advanced Microbiology (3)**
A detailed consideration of algae, fungi, protozoa, and microorganisms other than the Eubacteriales of concern to the microbiologist or sanitarian. Two lectures and one laboratory period or field trip per week. First semester. Mr. Parker

**Biol. 480. Marine Science Seminar (1)**
An advanced interdisciplinary seminar on various problems of marine sciences, with visiting speakers and student presentations. May be substituted for Biol. 406. Second semester. Staff

# BUSINESS ADMINISTRATION

The College of Business Administration offers four degrees at the master's level, the M.B.A., the M.S. in Management Science, and the M.S. in Business Economics and Master of Arts in Economics. On a more advanced level the College offers a Ph.D. in Business and Industrial Economics, described on page 185.

## THE M.B.A. DEGREE

The M.B.A. degree is designed to give the candidate a working knowledge of the managerial problems involved in the various facets of business activity—marketing, finance, pricing, etc.—and is hence a fairly rigid program with required courses in the various areas and some opportunity for specialization.

A candidate who is a graduate, with a major in business administration, of an approved college or university, and who has had basic courses in accounting, business law, corporation finance, economics, marketing, money and banking, and statistics will usually have sufficient background work to enable him to complete the requirements for the degree in one year. For other candidates an additional semester or year devoted to prerequisite and basic courses may be necessary as indicated in the program outlined below.

All candidates for this program will be required to take the Admission Test for Graduate Study in Business.

### Program for the M.B.A. Degree

**Background Courses***

**Eco. 3**—Principles of Economics (3)
**Fin. 125**—Principles of Corporation Finance (3)
**Law 1**—Business Law (3)
**Eco. 45**—Statistical Method (3)
**Eco. 306**—Intermediate Economic Theory (3)
**Fin. 129**—Money and Banking (3)

**Acctg. 1**—Accouting and
**Acctg. 2**—Accounting (6)
*or*
**Acctg. 108**—Fundamentals of Accounting and
**Acctg. 115**—Cost Accounting (6)

**Mkt. 11**—Marketing (3)
**Fin. 326**—Problems in Financial Management (3)
or other 300-level course.

**Credit Courses**

Required Courses (18 hours)

**Acctg. 422** Managerial Accounting or
**Acctg. 431** Accounting Theory and Thought (for Accounting Majors) (3)

**Eco. 306** Intermediate Economic Theory or a 400-level course (3)
**Eco. 431** Managerial Economics (3)
**Fin. 421** Financial Management (3)
**Law 401** Legal Problems in Business (3)
**Mkt. 450** Marketing Management (3)

Elective Courses (12 hours)**

| Mgmt. Science | Forecasting | Labor Relations | Finance |
|---|---|---|---|
| **Eco. 313** (3) | **Eco. 346** (3) | **Eco. 333** (3) | **Fin. 323** (3) |
| **Eco. 415** (3) | **Eco. 454** (3) | **Eco. 433** (3) | **Fin. 331** (3) |
| **Eco. 416** (3) | **Eco. 471** (3) | **Eco. 471** (3) | **Fin. 431** (3) |
| | | | **Fin. 444** (3) |
| | | | **Fin. 471** (3) |

| Internat'l. Trade and Fin. | | Transportation | | Accounting | |
|---|---|---|---|---|---|
| **Fin.** | **341** (3) | **Eco.** | **337** (3) | **Acctg.** | **442** (3) |
| **Fin.** | **342** (3) | **Eco.** | **434** (3) | Two of following | |
| **Fin.** | **441** (3) | **Eco.** | **471** (3) | **Acctg. 308, 316, 318, 320, 325** | |

*The course numbers of the Background Courses refer to courses listed in the University Catalog. Equivalent courses completed at other approved institutions will be accepted in lieu of those indicated above.

## MASTER OF ARTS IN ECONOMICS

Admission to the Master of Arts program in Economics normally requires a major in economics or in one of the fields of business comparable to the Lehigh University offerings. Superior students in other majors with adequate background in economics and calculus may be admitted to the program. All candidates will be required to take the Graduate Record Examination with the advanced test in economics.

Candidates for the degree may qualify by completing thirty hours of approved course work or by completing twenty-four hours in approved courses and submitting a satisfactory thesis. A candidate not electing a thesis will be required to pass an examination covering the entire field of his graduate studies.

The program of study will include:

(1) six hours of required courses — Eco. 432 Micro-Economics and Eco. 436 Macro-Economics;

(2) at least eighteen hours of credit (twelve hours if a thesis is written) selected from the offerings in the departments of Economics and Finance excluding marketing, management, and private finance with six hours of course work in one sequence or field if a thesis is not written;

(3) six credit hours of optional courses may be elected from related fields in any department in the unversity with the consent of the director of the program.

**These major sequences are suggested for candidates interested in one of these areas of specialization, but the twelve elective credit hours may be selected from desired combinations of 300- and 400-level courses offered in the College of Business Administration, as described under the departments of Accounting, Economics and Finance.

Background courses other than Eco. 3 plus required and many elective courses are available in the evening or on Saturday morning to permit qualified candidates to obtain the degree on a part-time basis.

A comprehensive examination will be required of all candidates for the MBA degree.

## THE M.S. IN BUSINESS ECONOMICS

The College of Business Administration offers advanced work in Business Economics in recognition of the growing need for business and banking economists who have the training needed to interpret changes in general economic conditions. Emphasis is placed on the importance of estimation and forecasting in making business decisions. Since initiation of the program in 1962, it has come to be widely recognized in the business world. Suitable candidates will be admitted only if (a) they have had a thorough undergraduate training in economics, or (b) they have had substantial government or business experience in economic analysis, or (c) they are willing to take a substantial amount of background work in preparation. All candidates will be required to take the Graduate Record Examination with the advanced test in economics. The qualifications of each candidate will be considered on his particular merits. The great demands in industry, government, teaching, and research for trained and capable analysts necessitates a high degree of selectivity in accepting candidates.

A course of study is worked out for each student. Since the program centers on the use of futurity in interpreting general economic conditions, the following courses are recommended though substitutions are permitted.

| | | | | | |
|---|---|---|---|---|---|
| **Eco. 352** | Advanced Statistical Method | (3) | **Eco. 432** | Micro-Economics | (3) |
| **Eco. 447** | **Systems of National Accounts** | **(3)** | **Eco. 453** | **Time Series Econometrics** | **(3)** |
| | | | **Eco. 454** | Forecasting | (3) |
| | | | **Eco. 475** | **Business Economics Seminar** | **(3)** |

The remaining 12 hours required for the master's degree are fitted to the student's interest insofar as his set of courses clearly integrates into an oriented program. For instance, the student may wish to cover such areas as labor management, metropolitan market analysis, marketing management, computer programming, banking and monetary policy, accounting, or operations research.

## THE M.S. IN MANAGEMENT SCIENCE

This program is designed to provide a rigorous analytical preparation in business education emphasizing certain applied and behavioral aspects of economic theory. Management Science is an inter-disciplinary program and is given in cooperation with the departments of Industrial Engineering and Mathematics.

To be eligible for this program, the applicant must have had background preparation in mathematics embracing a thorough knowledge of calculus (equivalent to Math. 21, 22, and 23 at Lehigh University) plus basic courses in accounting, economics, finance and marketing. Candidates for this program will also be required to take the Admission Test for Graduate Study in Business.

Program for the M.S. in Management Science Degree

| | | | |
|---|---|---|---|
| **Eco.** | **415** | Operations Research | (3) |
| **Acctg.** | **422** | Managerial Accounting | (3) |
| **Eco.** | **432** | Micro-Economics | (3) |
| **Eco.** | **416** | Deterministic Models of Management Science | (3) |
| **I.E.** | **408** | Industrial Inf. Systems | (3) |
| **Math.** | **204** | Linear Analysis | (3) |

and
12 credit hours from the following:

| | | |
|---|---|---|
| **Eco.** | **313** | Quantitative Planning and Control |
| **Eco.** | **316** | Intermediate Macro-economics |
| **Eco.** | **433** | Labor Management Economics |
| **Eco.** | **454** | Forecasting |
| **Eco.** | **490** | Thesis |
| **E.E.** | **411** | Information Theory I |
| **E.E.** | **412** | Information Theory II |
| **Fin.** | **421** | Financial Management |
| **I.E.** | **308** | Data Processing |
| **I.E.** | **410** | Design of Experiments |
| **I.E.** | **416** | Dynamic Programming |
| **I.E.** | **417** | Mathematical Programming |
| **I.E.** | **418** | Simulation |
| **I.E.** | **420** | Analysis of Decision Process |
| **I.E.** | **425** | Production Systems |
| **I.E.** | **426** | Inventory Systems |
| **I.E.** | **427** | Queuing Theory |
| **I.E.** | **440** | Application of Automation |
| **Mkt.** | **450** | Marketing Management |
| **Math.** | **231** | Statistical Inference |
| **Math.** | **233** | Mathematical Statistics I |
| **Math.** | **234** | Mathematical Statistics II |
| **Math.** | **421** | Probability |

Descriptions of the above courses appear elsewhere in this catalog under the appropriate department headings.

Additional information on any of these programs may be obtained by writing to the College of Business Administration, Office of the Dean (Graduate Studies).

## THE PH.D. IN BUSINESS AND INDUSTRIAL ECONOMICS

Candidates for the Ph.D. degree may select advanced work in the fields of economic development, forecasting and business conditions, labor and population, economic systems, accounting and finance, and regional economics. Admission to the Ph.D. program is by committee action of the College of Business Administration and does not constitute admission to candidacy for the Ph.D. degree. Anyone planning to enter the program should have had a thorough grounding in calculus and economic theory at the undergraduate or master's level, or plan to make up any deficiencies in those areas. A student in the program who has met University doctoral requirements may apply to the Graduate Faculty for admission to candidacy

when he presents an approved dissertation plan and has passed satisfactorily qualifying examinations in the following fields:

a. Micro-economics
b. Macro-economics
c. Quantitative Analysis and Research Methodology, demonstrating competence in
    (1) Statistics
    (2) Accounting
    (3) Operations analysis
d. A major field
e. A minor field — either within or outside the College of Business Administration

A dissertation committee comprised of at least four faculty members including the candidate's major professor as Chairman and two other members as readers is established for each candidate passing the qualifying examinations. At least one member of the Committee shall be appointed from outside the College of Business Administration, and at least two departments within the College shall be represented on the committee.

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# CHEMICAL ENGINEERING

Professors Wenzel, Clump, Foust
Associate Professors Luyben, Scheisser, Stein
Assistant Professors Coughlin, Poehlein
Messrs. Geist, McKinley, Lapin, Fisher
Astorga, Ray, Kohler, Koko

**Ch.E. 10. Chemical Engineering Computation (1)**
Introduction to the role of computers in engineering. The techniques of programming high speed electronic computers are introduced. Applications to engineering problems such as optimization and data fitting are studied. First semester.

**Ch.E. 60. Unit Operations Survey (3)**
The theory of heat, mass, and momentum transport. Laminar and turbulent flow of real fluids. Heat transfer by conduction, convection, and radiation. Application to a wide range of operations in the chemical and metallurgical process industries.

**Ch.E. 70. Industrial Stoichiometry (3)**
Chemical and physical calculations upon which energy and material balances are based, and application of these balances to various industrial processes, involving vaporization and condensation, fuels and combustion. Applications are picked from a wide variety of chemical processes. **Prerequisites: Math. 22; Phys. 3 previously or concurrently.** Second semester.

**Ch.E. 100. Summer Employment (0)**
During the summer (preferably following the junior year) candidates for the degree of B.S. in Chemical Engineering are required to obtain industrial experience through employment for at least eight weeks in a plant or laboratory or engineering office and submit a report thereon.

**Ch.E. 163. Unit Operations I (3)**
Multistage mass transfer operations. Ideal stage concept and calculations. Principles of molecular and turbulent transport of heat, mass, and momentum. **Prerequisite: Ch.E. 70.** First semester.

**Ch.E. 164. Unit Operations II (4)**
Applications of heat, mass, and momentum transfer, and combination of these in simultaneous transport during chemical processing operation. **Prerequisite: Ch.E. 163.** Second semester.

**Ch.E. 174. Chemical Plant Design (3)**
A study of the technical and economic aspects of the design, location, and operation of chemical plants. **Prerequisite: Ch.E. 164.** Second semester.

**Ch.E. 181. Chemical Engineering Laboratory I (3)**
Laboratory experiences in the fields of unit operations, reaction kinetics, process control and dynamics, and thermodynamics. A research project leading to a final report will be a part of this course. Six hours in the laboratory per week. **Prerequisite: Ch.E. 164.** First Semester.

**Ch.E. 182. Chemical Engineering Laboratory II (3)**
A continuation of Ch.E. 181. Six hours in the laboratory per week. Second semester.

**For Advanced Undergraduates and Graduates**

**Ch.E. 200. Chemical Engineering Thermodynamics (3)**
Energy relations and their application to chemical engineering. Consideration of flow and non-flow processes, evaluation of the effect of temperature and pressure on thermodynamic properties of ideal and actual fluids: prediction of the heat effects accompanying phase changes and chemical reactions, application to industrial processes. **Prerequisites: Ch.E. 70, Chem. 91 or equivalents.** First semester.

**Ch.E. 301. Process Design (3)**
Intensive study of selected or proposed chemical processes with emphasis on optimum order of steps, flow diagrams, energy balances and recycle ratios and their effect on the balance sheet of the operation. Approximation methods of obtaining data. **Prerequisite: Ch.E. 200.** Second semester. Messrs. Foust, Poehlein

**Ch.E. 302. Chemical Engineering Kinetics (3)**
The application of chemical kinetics to the design and operation of reactors. Interrelations of kinetics, thermodynamics and unit operations in steady or unsteady states. **Prerequisites. Ch.E. 164, 200 or equivalent, previously or concurrently.** Second semester. Mr. Stein

**Ch.E. 315. Transport Processes (3)**
A combined study of the fundamentals of momentum transport, energy transport and mass transport and the analogies between them. Evaluation of transport coefficients for single and multicomponent systems. Analysis of transport phenomena through the equations of continuity, motion and energy. First semester.
Messrs. Clump, Schiesser

**Ch.E. 386. Engineering Process Control (3)**
Response characteristics of units of continuous processes; primary and final control elements for temperature, pressure, flow, and other process variables; modes of control; the closed loop and its equation; dynamic analysis and stability of processes. **Prerequisite: Senior standing in a curriculum of the Engineering College, or consent of the instructor.** First semester. Mr. Schiesser

**Ch.E. 390. Nuclear Reactor Engineering (4)**
A consideration of the engineering problems in nuclear reactor design and operation. Topics include instrumentation and control, reactor fuels and materials, thermal aspects, radiation protection and shielding, fuel processing, and reactor design. Three lectures, one laboratory period. **Prerequisite: Senior standing.** Second semester. Messrs. Clump, Coughlin

**Ch.E. 392. (Chem. 392) Polymer Science (3)**
Introduction to concepts of polymer science. Kinetics and mechanism of polymerization, synthesis and processing of polymers, characterization, relationship of molecular conformation, structure and morphology to physical and mechanical properties. Lectures and laboratory. **Prerequisite: Chem. 95 or equivalent.** Messrs. Manson, Poehlein

## For Graduates

The Chemical Engineering Department offers both the M.S. and Ph.D. degrees. Currently 48 graduate students are registered in the Department, of which 17 are beyond the M.S. degree.

Students expecting to take work towards the M.S. degree are required to present substantially the equivalent of the undergraduate curriculum of this University for unqualified admission. Minor deficiencies can be made up during graduate work, though course work beyond the specified minimum will probably be required. Students with major deficiencies are usually advised to enter the undergraduate curriculum in Chemical Engineering.

For a master's degree, Ch.E. 302, 315, and 386 or their equivalents, Ch.E. 400, and six hours of research with a suitable report are required. For students with experience beyond the B.S. degree, evidence of equivalent research may be substituted for the M.S. research required, but the student must pass a comprehensive examination. Collateral work can be taken in mathematics, chemistry, physics or other fields of engineering with emphasis in the direction of the student's interest. Candidates for the doctorate will be selected on the basis of their early graduate work and a qualifying examination. They will complete a dissertation, take additional courses in their area of specialization, and fulfill the general requirements of the Graduate School.

Subject to approval, a graduate major in Chemical Engineering may include 400-level courses selected from other Departments' offerings, such as chemistry, mechanical engineering, physics, and metallurgy.

The Chemical Engineering staff and laboratories provide support, facilities, and equipment suited to a wide range of research. Research in ex-

perimental thermodynamics, reaction kinetics, process dynamics and mathematical modeling, fluid mechanics, and transport processes is especially active. The fields of cryogenics, polymer properties and processes, chemical metallurgy, and water resources are involved, either through the direct interest of the Departmental faculty, or through coopeative efforts with other Departments and Centers. The program in Chemical Meallurgy is operated jointly with the Department of Metallurgy and Materials Science. A program in Water Resources is in operation in cooperation with the Civil Engineering and Biology Departments. The Polymers Research Laboratory of the Materials Research Center is the scene of research in polymer properties that is supervised by Chemical Engineering faculty. Research in catalysis, corrosion, and dispersion is done in cooperation with the Center for Surface and Coatings Research.

Financial support is available in the form of fellowships and traineeships supported by government and industry as well as through teaching and research assistantships. Conditions for these grants are given elsewhere in this Catalog.

**Ch.E. 400. Chemical Engineering Thermodynamics I (3)**
Applications of thermodynamics in Chemical Engineering. Topics include prediction of physical and chemical equilibria, heat effects accompanying solution, flow of compressible fluids, refrigeration including solution cycles, vaporization and condensation processes. **Prerequisite: An introductory course in thermodynamics.** First semester. Messrs. Wenzel, Stein

**Ch.E. 401. Chemical Engineering Thermodynamics II (3)**
A detailed study of the uses of thermodynamics in predicting phase equilibria in solid, liquid, and gaseous systems. The phase rule; solution theories; uses of equations of state. Theoretical basis and development of equations of state. Applications to azeotropic and extractive distillation, multicomponent separations, liquid extraction. Second semester, alternate years. Mr. Wenzel

**Ch.E. 410. Chemical Engineering Kinetics (3)**
The application of chemical kinetics to the engineering design and operation of reactors. Non-isothermal and adiabatic reactions. Homogeneous and heterogeneous catalysis. Residence time distribution in reactors. **Prerequisite: Ch.E. 302.** Second semester, alternate years. Mr. Stein

**Ch.E. 413. Heterogeneous Catalysis (3)**
Surface area, pore structure and pore-size distribution of catalysts. Influence of pore-diffusion on catalytic reactions and the design of catalytic reactors. Chemical adsorption and physical adsorption. Chemistry, energetics and kinetics of adsorption, desorption, and surface reaction. Electronic structure and catalysis; atomic orbital and bondstructure models. Mechanisms of catalytic reaction of industrial importance. Selection and classification of catalysts. Mr. Coughlin

**Ch.E. 421. Heat Transfer (3)**
Analysis of steady and unsteady state transfer. Radiation, vaporization, and condensation. Heat transfer in high velocity flow and in rarified gases. Applications. Second semester. Messrs. Foust, Clump

**Ch.E. 425. Momentum Transfer (3)**
The fundamentals of momentum transfer in chemical engineering systems. Applications of the equations of motion. Boundary layer theories. Modern theories of turbulence. Applications in high velocity flow, flow through porous media, flow of non-Newtonian fluids, two phase flow, equipment residence times. Second semester, alternate years. Mr. Pochlein

**Ch.E. 430. Mass Transfer (3)**
Equilibrium stage and continuous contact mass transfer operations with emphasis upon distillation, absorption, and extraction. Binary and multicomponent separations. Mr. Clump

**Ch.E. 435. Simultaneous Heat and Mass Transfer (3)**
Unit Operations involving simultaneous heat and mass transfer. Emphasis on drying, humidification, dehumidification, and condensation in the presence of non-condensable gases. First semester, alternate years. Mr. Clump

**Ch.E. 440. Process Design (3)**
Synthesis of flow sheets for various processes, investigation of contributions to overall economy of various alternatives. Evaluation of profitability of alternatives. Second semester, alternate years. Mr. Foust

**Ch.E. 441. System Dynamics and Control (3)**
Analysis of the dynamics of staged operations, and the interaction of dynamics of various operations as each contributes to the performance of a total system. First semester, alternate years. Messrs. Schiesser, Luyben

**Ch.E. 442. System Design (3)**
A study of the design and operation of chemical systems with emphasis upon optimization of both design and operation. Operations analysis. Second semester, alternate years. Messrs. Schiesser, Luyben

**Ch.E. 450. Special Topics (3-12)**
An intensive study of some field of chemical engineering not covered in the more general courses. Credit above 3 hours is granted only when different material is covered.

**Ch.E. 451. Problems in Research (1)**
Study and discussion of optimal planning of experiments and analysis of experimental data. Discussion of more common and more difficult techniques in the execution of chemical engineering research.

**Ch.E. 455. Seminar (1-3)**
Critical discussion of recent advances in chemical engineering. Credit above 1 hour is granted only when different material is covered.

**Ch.E. 461. Chemical Engineering Calculations I (3)**
Application of ordinary and partial differential equations to the solution of chemical engineering problems with emphasis on chemical reactions and transport processes as they occur in industrial chemical processing. Applications of

solution in series, separation of variables, and integral transforms. Analog computer solutions of differential equations. **Prerequisite: Math. 322.** First semester.
Messrs. Schiesser, Coughlin, Luyben

**Ch.E. 462. Chemical Engineering Calculations II (3)**
A continuation of Ch.E. 461 with emphasis on applications involving numerical methods. Second semester, alternate years. Messrs. Schiesser, Coughlin, Luyben

**Ch.E. 470. Cryogenic Engineering (3)**
Liquefaction and separation of gases, physical and chemical principles. Low temperature thermometry. Insulation. Properties of fluids and of structural materials. The behavior of helium. Ultra-low temperature phenomena and theories. First semester, alternate years. Messrs. Stein, Wenzel

**Ch.E. 471. Low Temperature Processes (3)**
The problems and design of plants operating in the cryogenic temperature range: Refrigeration demands. Distillation and heat exchange at low temperatures. Analysis of processes for thermodynamic and operating efficiency. Problems of safety, non-steady state behavior, and control. Second semester, alternate years.
Mr. Wenzel

**Ch.E. 480. Research (3-4)**
Investigation of a problem in chemical engineering. First semester.

**Ch.E. 481. Research (3-4)**
Continuation of Ch.E. 480. Second semester.

**Ch.E. 492. (Chem. 492) Polymer Science (3)**
Selected topics including reaction kinetics, thermodynamics and kinetics of crystallization, new analytical techniques, molecular weight distribution, morphology and processing, non-Newtonian flow behavior, second-order transition phenomena, novel polymer structures. **Prerequisite: Ch.E. 392 or Chem. 392 or equivalent.** Messrs. Manson, Poehlein

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# CHEMISTRY

Professors Amstutz, Zettlemoyer, Merkel
Associate Professors Daen, Diefenderfer, Fish, Kraihanzel, Manson, Ohnesorge, Sturm
Assistant Professors Heindel, Lovejoy, Ortolano
Assistant Research Professors Micale, Pravdic
(Miss) Clay, Messrs. Evans, Fink, Garett, Griswold, (Miss) Gyuricsek, Hamel, Herman, Klarman, Male, Molnar, McManemin, Powders, Reed, Romanik, Ryck, Stuart, Sunday

**Chem. 1. Chemical Principles I (3)**
An introduction to the important principles of chemistry. Topics include atomic structure and bonding, stoichiometry, kinetic molecular theory, states of matter,

solutions, and an introduction to chemical equilibrium. Math. 21 previously or concurrently. Two lectures, or recitation. First and Second semester Staff

**Chem. 11. Chemical Principles I Lab (1)**
A laboratory course to be taken concurrently with Chemistry 1. Emphasis is on quantitative methods. One three-hour laboratory period per week. First semester. Staff

**Chem. 3. Chemical Principles II (3)**
A continuation of Chemistry 1. Topics include further work in chemical equilibrium, and introductions to thermodynamics, kinetics, and electrochemistry. Selected descriptive chemistry of certain metallic and non-metallic elements. **Prerequisite: Chemistry 1.** Two lectures, one recitation. First and Second semesters. Staff

**Chem. 13. Chemical Principles II Lab (1)**
A laboratory course to be taken concurrently with Chemistry 3. Emphasis is on quantitative physico-chemical experiments. **Prerequisite: Chemistry 1.** One three hour laboratory period per week. Staff

**Chem. 39. Analytical Chemistry (3)**
The fundamentals, theory, and practice, of analytical chemistry for all students except chemistry majors. Selected topics in the areas of classical and instrumental analysis are discussed. Fundamental techniques are presented in the laboratory or by demonstration. Two lectures, one laboratory period. **Prerequisite: Chem. 3 or Chem. 2.** First semester. Messrs. Fish, Diefenderfer

**Chem. 51. Organic Chemistry (3)**
Systematic survey of the typical compounds of carbon, their classification and general relations; study of synthetic reactions. **Prerequisite: Chem. 3 or Chem. 2.** First semester. Mr. Amstutz

**Chem. 52. Organic Chemistry (3)**
Continuation of Chem. 51. **Prerequisite: Chem. 51.** Second semester. Mr. Amstutz

**Chem. 53. Organic Chemistry Laboratory (2)**
Preparation of pure organic compounds. **Prerequisite: Chem. 3 or Chem. 2.** First semester. Messrs. Amstutz, Young, Borowitz

**Chem. 54. Organic Chemistry Laboratory (2)**
Continuation of Chem. 53 with particular emphasis upon aromatic compounds and qualitative organic analysis. **Prerequisite: Chem. 53.** Second semester. Messrs. Amstutz, Young, Borowitz

**Chem. 55. Organic Chemistry Laboratory (2)**
A course in the preparation of pure organic compounds and the techniques of organic chemistry. Designed especially for chemical engineers. **Prerequisites: Chem. 51 and Chem. 52 concurrently.** Messrs. Young, Amstutz, Borowitz

**Chem. 91. Physical Chemistry (3)**
An introduction to physical chemistry which integrates the molecular and macroscopic viewpoints. The particulate structure of matter: nuclear and atomic structure, kinetic theory, elements of quantum chemistry. **Prerequisites: Chem. 3 preferably, or Chem. 2.** Second semester. Messrs. Daen, Sturm

**Chem. 95. Physical Chemistry (3)**
An introduction to physical chemistry primarily for students not majoring in chemistry. Classical thermodynamics; chemical kinetics; the kinetic theory of gases; applications of principles to problems of engineering interest. **Prerequisite: Chem. 3 or Chem. 2; Math 23, previously or concurrently.** First semester. Mr. Manson

**Chem. 100. Professional Training (0)**
During the summer following the sophomore or junior year candidates for the degree of B.S. or B.A. in Chemistry are expected to obtain professional experience through employment in a laboratory or plant and to submit a report thereon.

**Chem. 175. Research Chemistry Laboratory (3) (Optional)**
Advanced study or an investigation involving intensive work in laboratory and library. Topics in active research include absorption, analytical processes, drying oils, heterocyclic organic compounds, hydration of inorganic salts, kinetics of combustion, photomicrography, natural and synthetic resins, pigments, surface chemistry and X-ray technique. **Prerequisite: Consent of chairman of department.** Second semester. Staff

**Chem. 190. Physical Chemistry (3)**
A continuation of Chem. 91. Development of first, second, and third laws of thermodynamics with application to solids, liquids, and gases; solutions; chemical equilibria. Elements of statistical mechanics and statistical thermodynamics. Properties of the solid state. Mr. Lovejoy

**Chem. 192. Physical Chemistry Laboratory (1)**
This course, together with Chem. 193, provides a coordinated sequence of laboratory studies which illustrate the physico-chemical principles presented in Chem. 91. Emphasis is placed on both the quantitative interpretation of the data and the experimental method. **Prerequisite: Chem. 91.** First semester.
Mr. Micale

**Chem. 193. Physical Chemistry Laboratory (1)**
Physical chemical measurements. **Prerequisite: Chem. 91, previously or concurrently.** Second semester. Mr. Micale

**Chem. 195. Physical Chemistry (3)**
A continuation of Chem. 95 which integrates the molecular and macroscopic viewpoints. Nuclear, atomic and molecular structure; statistical thermoydnamics; the solid state; topics in surface chemistry. **Prerequisite: Chem. 95.** Second semester. Mr. Manson

**For Advanced Undergraduates and Graduates**

**Chem. 235. Analytical Chemistry (3)**

The theory and practice of chemical analysis. Selected volumetric and gravimetric procedures are used to illustrate fundamental and modern techniques and methods. One lecture and two laboratory periods. **Prerequisites: Chem. 51 and Chem. 91.** Second semester. Messrs. Diefenderfer, Fish, Ohnesorge

**Chem. 236. Analytical Chemistry (3)**

A continuation of Chem. 235. The determination of the structure and composition of suitable materials by methods which include modern instrumental techniques of separation and analysis. Messrs. Fish, Ohnesorge

**Chem. 302. Principles of Inorganic Chemistry (3)**

Application of the theory of atomic and molecular structure and of chemical bonding to the periodic relationships and selected descriptive chemistry of the elements of the first three periods. Introduction to complex ions and coordination compounds and to the theories of bonding in these substances. Introduction to organo-metallic chemistry. **Prerequisite: Chem. 91 previously or concurrently.** First semester. Mr. Kraihanzel

**Chem. 303. Nuclear and Radiochemistry (3)**

A broad survey of nuclear science with particular emphasis on aspects of importance to chemistry and biology. Elementary nuclear theory; production, separation and identification of radioactive and stable isotopes; use of isotopes in the study of chemical and biological systems; radiological safety; nuclear engineering. Two lectures and one lecture-laboratory. First semester. Mr. Sturm

**Chem. 305. Systematic Inorganic Chemistry (3)**

A survey of the descriptive chemistry of periods 4-7, based on the principles developed in Chem. 302. Special emphasis is placed on the chemistry of the transition metals. Introduction to acid-base behavior in non-aqueous solvents. **Prerequisite: Chem. 302 or its equivalent.** First or second semester. Mr. Sprague

**Chem. 306. Inorganic Preparations (1 or 2)**

A laboratory course illustrating a variety of techniques for the preparation and purification of inorganic compounds. One discussion period and approximately three hours of laboratory work per week. **Prerequisite: Chem. 302, previously or concurrently.** Messrs. Kraihanzel, Ortolano

**Chem. 310. Instrumentation Principles I (3)**

A study of electrical, electronic and optical principles in modern instrumentation for measurement and control. Principle and applications of vacuum tubes, transistors and phototubes with associated circuitry applied to modern instrumentation. Transducer application to fields of electrical, optical and mechanical measurement. Two lectures and one three hour laboratory. First semester.
Mr. Diefenderfer

**Chem. 311. Instrumentation Principles II (3)**

A continuation of Chem. 310 with emphasis upon mechanical principles, including kinematic design and mechanical computation. Development of the total instrumental concept integrating all facets of the problem. Two lectures and one three hour laboratory. **Prerequisites: Chem. 310 or equivalent.** Second semester.
Mr. Diefenderfer

**Chem. 352. Organic Chemistry, Heterocyclic Compounds (3)**
The chemistry of thiophene, pyrrole, furan, pyridine and their derivatives, considered from the viewpoint of recent theories of organic structure and reaction mechanisms. **Prerequisite: Chem. 358.** Mr. Young

**Chem. 356. Quantitative Organic Analysis (1)**
The practice of the common analytical procedures involving the quantitative estimation of carbon, hydrogen, halogen, nitrogen and sulphur; the iodine number method; the hydroxyl value; the acid value and the saponification number. One laboratory period per week. **Prerequisites: Three hours of analytical chemistry; a course in organic chemistry.** Second semester. Mr. Fish

**Chem. 358. Advanced Organic Chemistry (3)**
The study of modern theories of reaction mechanisms and their application to the problems of organic chemistry. **Prerequisite: One year of organic chemistry.** First semester. Mr. Heindel

**Chem. 368. Advanced Organic Laboratory (2 or 3)**
The synthesis and study of organic compounds illustrating the important techniques and special pieces of apparatus commonly used in organic chemical research. **Prerequisite: One year of organic chemistry and laboratory.** First or second semester. Messrs. Young, Heindel

**Chem. 371. Elements of Biochemistry (3)**
A general study of carbohydrates, proteins, lipids, nucleic acids and other biological substances and their importance in life processes. Protein and enzyme chemistry are emphasized. **Prerequisite: One year of organic chemistry.** First semester. Mr. Merkel

**Chem. 372. Advanced Biochemistry (3)**
Dynamic aspects of biochemistry: Enzyme reactions including energetics, kinetics, and mechanisms; Metabolism of carbohydrates, lipids, proteins, and nucleic acids; Photosynthesis, electron transport mechanisms, coupled reactions, phosphorylations, and the synthesis of biological macromolecules. **Prerequisite: Chem. 371.** Mr. Merkel

**Chem. 375. Research Chemistry Laboratory (3) (Optional)**
Advanced study or an investigation involving intensive work in laboratory and library. Topics in active research include adsorption, analytical processes, drying oils, heterocyclic organic compounds, hydration of inorganic salts, kinetics of combustion, natural and synthetic resins, pigments, surface chemistry and X-ray technique. **Prerequisite: Consent of chairman of department.** Second semester. Staff

**Chem. 377. Biochemistry Laboratory (1-3)**
Laboratory studies of the properties of chemicals of biological origin and the influence of chemical and physical factors on these properties. Laboratory techniques used for the isolation and identification of biochemicals. **Prerequisite: Chem. 371, previously or concurrently.** First semester.

**Chem. 378. Biochemical Preparations (1-3)**
A laboratory course involving the preparation or isolation, purification and identification of chemicals of biological origin. **Prerequisite: Chem. 377 and 372, previously or concurrently.** Second semester. Mr. Merkel

**Chem. 381. Radiation and Structure (4)**
A study of the method and theory of the development of chemical information from radiation-matter interactions; macroscopic optics, scattering phenomena, quantal phenomena. Applications to problems of analytical, inorganic, organic and physical chemical interest. Three one-hour lectures and one three-hour laboratory. **Prerequisites: Chem. 190 and 235.** Messrs. Daen, Diefenderfer

**Chem. 382. Structure, Electrochemistry and Kinetics (3)**
A unified study of matter in the process of change. Elements of irreversible thermodynamics; steady-state electro-chemistry; chemical kinetics, phenomenology and interpretation; non-steady-state electrochemistry; electrokinetic phenomena. Correlation with chemical structure. **Prerequisite: Chem. 381.** Second semester.
Messrs. Daen, Diefenderfer

**Chem. 392. (Ch.E. 392) Polymer Science (3)**
Introduction to concepts of polymer science. Kinetics and mechanism of polymerization, synthesis and processing of polymers, characterization, relationship of molecular conformation, structure and morphology to physical and mechanical properties. Lectures and laboratory. **Prerequisite: Chem. 95 or equivalent.**
Messrs. Manson, Poehlein

**Chem. 397. Colloid and Surface Chemistry (3)**
Introduction to concepts of colloid and surface chemistry. Classification of colloidal systems; determination of surface and interfacial tensions; spreading of films on liquids; types of emulsions; foams and aerosols; nature of the solid/gas and solid/liquid interface; causes of colloidal stability and determination of particle size; rheology of disperse systems. **Prerequisite: Chem. 95 or equivalent.**
Mr. Micale

## For Graduates

The Department of Chemistry offers work leading to both master's and doctor's degrees, and it provides facilities for graduate and post-doctoral research.

Minimum prerequisites for graduate study in Chemistry include full-year courses in general, analytical, organic and physical chemistry, in addition to thorough grounding in physics and in mathematics through the calculus. While minor deficiencies in preparation can frequently be removed during the course of graduate study, major deficiencies usually require course work in addition to the indicated minimum for the degree sought. As an aid to advising students on their programs, placement examinations in the four fields of chemistry are given to new students prior to their registration.

Admission to candidacy for an advanced degree is contingent on demonstrated ability in advanced courses and aptitude in research. Research training or thesis credit equivalent to six semester hours (see "Degrees", page 157) is required by the department for the master's degree. Further details may be obtained from the head of the Department.

The chemical laboratories are well equipped for work in analysis and

instrumentation, in organic synthesis and reaction mechanisms, and in several phases of physical and inorganic chemistry.

A substantial number of industrial and academic research appointments are available in the Department. They are described elsewhere in this catalog.

**Chem. 400. Inorganic Chemistry Research (1-4)**
Investigation of a problem in inorganic chemistry.
Messrs. Kraihanzel, Ortolano, Sprague

**Chem. 401. Inorganic Chemistry Research (1-4)**
Continuation of Chem. 400. Second semester.
Messrs. Kraihanzel, Ortolano, Sprague

**Chem. 402. Advanced Inorganic Chemistry (3)**
Theories of bonding. Group theoretical principles will be utilized in studies of molecular orbital and ligand field theories of bonding. **Prerequisite: Chem. 302 or equivalent.** Second semester. Mr. Ortolano

**Chem. 403. Advanced Topics in Inorganic Chemistry (3)**
Subjects of contemporary interest in inorganic chemistry, including quantitative treatment of acid-base chemistry in non-aqueous solvents, mechanisms of inorganic reactions and chemistry of organo-metallic compounds and metal carbonyls. **Prerequisite: Chem. 302 or its equivalent.** First or second semester.
Messrs. Sprague, Kraihanzel

**Chem. 429. Seminar in Inorganic Chemistry (1-6)**
Reports and discussions of recent developments in inorganic chemistry.
Messrs. Kraihanzel, Ortolano, Sprague

**Chem. 430. Analytical Research (1-4)**
Investigation of problems in analytical procedures. First semester.
Messrs. Diefenderfer, Fish, Ohnesorge

**Chem. 431. Analytical Research (1-4)**
Continuation of Chem. 430. Second semester.
Messrs. Diefenderfer, Fish, Ohnesorge

**Chem. 432. Advanced Analytical Chemistry (3)**
Theory of precipitation analysis; physico-chemical methods; micro-analysis; chromatography; organic-analytical reagents; accuracy and precision in analysis. **Prerequisite: Six hours of analytical chemistry.** First semester.
Messrs. Fish, Ohnesorge

**Chem. 433. Advanced Topics in Physico-Analytical Chemistry (3)**
Consideration of physico-chemical analytical techniques beyond those discussed in Chem. 337. Special topics in electro-chemical, statistical and optical methods such as electrode kinetics, diffusion phenomena, electronic emission spectroscopy.
Messrs. Diefenderfer, Fish, Ohnesorge

**Chem. 436. Advanced Methods of Analytical Chemistry (3)**
An examination of the theory and application of certain selected topics of modern instrumental analysis. The application of these techniques to the solution of chemical problems. Three lectures per week. **Prerequisite: Six hours of analytical chemistry.** Second semester. Messrs. Fish, Diefenderfer, Ohnesorge

**Chem. 439. Seminar in Physical Chemistry (1-6)**
Reports and discussions of recent developments in physical chemistry.
Messrs. Sturm, Daen, Lovejoy, Manson

**Chem. 440. Elements of Theoretical Chemistry II (3)**
Applications of chemical thermodynamics to gases, various types of equilibria, and chemical reactions with emphasis on real systems. Elementary statistical thermodynamics. Kinetic processes; rate laws and mechanisms; kinetic theory and transition state interpretations. **Prerequisite: Chem. 442 or consent of department head.** Second semester. Messrs. Lovejoy, Sturm

**Chem. 441. Chemical Kinetics (3)**
A study of kinetic processes. Phenomenological chemical kinetics; order, mechanism effect of external variables on rate. Theories of the rate constant. Relation between thermodynamics and kinetics. Applications to selected systems such as unimolecular decompositions, adsorption and catalysis. **Prerequisite: One year of physical chemistry.** First semester. Messrs. Daen, Sturm

**Chem. 442. Elements of Theoretical Chemistry I (3)**
An introduction to fundamental chemical physics. Quantum chemistry of simple systems; theories of chemical bonding; approximation methods. Molecular structure and spectroscopy. Principles of chemical thermodynamics including first, second and third law considerations; properties of state functions. **Prerequisite: One year of physical chemistry.** First semester. Messrs. Lovejoy

**Chem. 449. Seminar in Analytical Chemistry (1-6)**
Reports and discussions of recent developments in analytical chemistry.
Messrs. Fish, Diefenderfer, Ohnesorge

**Chem. 450. Theoretical Organic Chemistry (3)**
An advanced study of topics in theoretical and mechanistic organic chemistry: solvolyses, rearrangements, multi-center reactions, carbenes, photochemistry and the application of nuclear magnetic resonance to organic chemical problems.
Messrs. Young, Heindel

**Chem. 451. Theoretical Organic Chemistry (3)**
The chemistry of benzenoid aromatic compounds, quinones and non-benzenoid aromatic substances, including modern theories of structure, electrophilic, nucleophilic and homolytic aromatic substitution and the less familiar addition reactions of aromatic systems. **Prerequisite: Chem. 358.** Mr. Young

**Chem. 458. Topics in Organic Chemistry (3)**
An intensive study of limited areas in organic chemistry. Mr. Young

**Chem. 459. Seminar in Organic Chemistry (1-6)**
Reports and discussions of recent important developments in theoretical and applied organic chemistry. Messrs. Young, Heindel

**Chem. 460. Organic Chemistry Research (1-4)**
Investigation of a problem in organic chemistry. First semester.
Messrs. Amstutz, Young, Heindel

**Chem. 461. Organic Chemistry Research (1-4)**
Continuation of Chem. 460. Second semester.
Messrs. Amstutz, Young, Heindel

**Chem. 466. Advanced Organic Preparations (2 or 3)**
A laboratory course of instruction in advanced techniques of the preparation of organic compounds. First or second semester. Messrs. Young, Heindel

**Chem. 471. Natural Products (3)**
A survey of the chemistry of steroids, terpenes, alkaloids and antibiotics with emphasis on instrumental methods of analysis and structure proof, recent synthetic and bio-synthetic pathways. Mr. Heindel

**Chem. 473. Seminar in Biochemistry (1-4)**
Reports and discussions of current developments in the field of biochemistry.
Mr. Merkel

**Chem. 474. Biochemistry Research (1-4)**
Investigation of a problem in biochemistry.

**Chem. 475. Biochemistry Research (1-4)**
Continuation of Chem. 474.

**Chem. 476. Microbial Biochemistry (3)**
Composition, nutrition and metabolism of micro-organisms; with emphasis on microbial enzyme reactions and products of microbial metabolism. **Prerequisites: Chem. 372 and Biol. 35 or their equivalents.**

**Chem. 477. Topics in Biochemistry (3)**
Intensive study of selected areas of biochemistry, such as mechanisms of enzyme action, new developments in the chemistry of lipids, nucleic acids, carbohydrates and proteins. **Prerequisite: Consent of the chairman of the Department.**
Mr. Merkel

**Chem. 478. Advanced Biochemical Preparations (1-3)**
An advanced laboratory course in the preparation, isolation, purification and identification of biochemically produced materials. Emphasis is placed on materials and procedures of current interest in biochemistry. **Prerequisites: Consent of the head of department.**

**Chem. 490. Physical Chemistry Research (1-4)**
Investigation of a problem in physical chemistry. First semester.
Messrs. Zettlemoyer, Sturm, Daen, Lovejoy

**Chem. 491. Physical Chemistry Research (1-4)**
Continuation of Chem. 490. Second semester.
Messrs. Zettlemoyer, Sturm, Daen, Lovejoy

**Chem. 492. (Ch.E. 492) Polymer Science (3)**
Selected topics including reaction kinetics, thermodynamics and kinetics of crystallization, new analytical techniques, molecular weight distribution, morphology and processing, non-Newtonian flow behavior, second-order transition phenomena, novel polymer structures. **Prerequisite: Chem. 392 or equivalent.**
Messrs. Manson, Poehlein

**Chem. 494. Quantum Chemistry (3)**
Principles and applications of quantum mechanics to chemical problems. Applications to chemical bonding, molecular structure, reactivity and spectroscopy. **Prerequisite: Chem. 442 or consent of chairman of Department.**
Messrs. Daen, Lovejoy

**Chem. 495. Statistical Thermodynamics (3)**
Principles and applications of statistical mechanics to chemical problems. A study of the techniques for evaluating the properties of matter in bulk from the properties of molecules and their interactions. Messrs. Daen, Sturm

**Chem. 497. Surface Chemistry (3)**
Applications of colloid chemistry; special topics in surface chemistry. Lectures and seminar. **Prerequisite: Chem. 397 and Chem. 441.** Mr. Zettlemoyer

**Chem. 498. Advanced Physical Chemistry Seminar (3)**
An advanced study of some field of physical chemistry. Rotation-vibration spectroscopy; theory of solutions; photochemistry and radiation chemistry; irreversible thermodynamics or other topics of current interest.
Messrs. Daen, Sturm, Lovejoy

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# CIVIL ENGINEERING

Professors Beedle, Eney, Driscoll, Ostapenko, VanHorn
Associate Professors Liebig, Tall, Lu, Fisher, Huang
Assistant Professors Dinsmore, Yen, Brune, Slutter, Chen, Fang, Lopez
Messrs. Kostem, Yoshida, Amatangelo, Basco, Kerfoot,
Macias, Madison, McNamee, Mueller, Withrow,
Brewer, Carpenter, Christopher, Kattula,
Motarjemi, Munn, Scawthorn, Yu

**C.E. 10. Problem Computation Laboratory (1)**
Preparation of problems for computer programming with emphasis on problems in civil engineering; technique of programming for computers. First semester.

**C.E. 11. Engineering Graphics (2)**
Use of drawing instruments; freehand lettering and shape description; theory of orthographic projection, revolution, and pictorial representation; theoretical problems in space relationships between points, lines, and planes; surfaces as loci. Emphasis on visualization and geometric logic. First and second semesters.

**C.E. 12. Applied Engineering Graphics (2)**
Drawings for civil engineering projects; graphical solutions and representation of data. **Prerequisite: C.E. 11.** Second semester.

**C.E. 40. Principles of Surveying (3)**
Use of instruments for linear and angular measurements, astronomical observations; stadia, area, and traverse computations. Significance of errors in field and office work with emphasis on means of obtaining optimal precision. Elements of photogrammetry. **Prerequisites: C.E. 11.** Second semester.

**C.E. 41. Engineering Surveys (3)**
Applications of surveying to route location, topography, highways, construction. and boundaries. Daily recitation and field work for a three-week period. **Prerequisite: C.E. 40.** Summer session.

**C.E. 43. Advanced Surveying (3)**
Adjustment of instruments; investigation of systematic and observational errors; elements of least squares with application to surveying; adjustment of level nets and triangulation; celestial observation; precise leveling; photogrammetry. Office work, with some field exercises. **Prerequisite: C.E. 40.** Second semester.

**C.E. 100. Industrial Employment (0)**
During the summer following the junior year, students are required to spend at least eight weeks in approved office or shop work or on engineering construction. A written report on the shop work or project, outlining the experience obtained, is due on return from summer vacation.

**C.E. 102. Civil Engineering Proseminar (1)**
A study of current civil engineering projects and developments with written reports. At weekly meetings these reports are presented orally in abstract. **Prerequisite: Senior standing.** First semester.

**C.E. 103. Special Problems (1-6)**
Supervised individual research problems with report. **Prerequisite: Consent of instructor.** First and second semesters.

**C.E. 104. Readings in Civil Engineering (1-3)**
Study of selected technical papers, with abstracts and reports. **Prerequisite: Consent of instructor.** First and second semesters.

**C.E. 106. Structural Design (3)**
Elementary theory and design of structures in steel, wood, and concrete. An abridged course in stress analysis and design for students other than civil engineers. **Prerequisite: Mech. 11.** Second semester.

**C.E. 107. Structural Welding (1)**
The design of welded steel structures, together with a study of current literature. A few periods will be devoted to the manual operation of making welds. **Prerequisite: Senior standing in civil or mechanical engineering.** Second semester.

**C.E. 112. Advanced Mechanics of Materials (3)**
Further topics in column and beam theory, including unsymmetrical bending, combined stresses, conjugate beam methods; curved beams, impact loading, buckling. **Prerequisite: Mech. 11.** First semester.

**C.E. 121. Mechanics of Fluids (3)**
The behavior of real fluids and the more important physical laws; potential flow, boundary layer, lift, drag, and waves, with practical applications to flow through pipes, open channels, turbines, and pumps. Dimensional analysis and similitude. **Prerequisite: Mech. 102 previously or concurrently.** First and second semesters.

**C.E. 123. Fluid Mechanics Laboratory (1)**
Introduction to laboratory techniques, calibration principles, and fluid measurements. Closed conduit flow of water, oil, and air; open channel flow of water, wind tunnel studies; hydraulic machinery testing. **Prerequisite: C.E. 121 concurrently.** First and second semesters.

**C.E. 126. Water Resources Engineering (3)**
Water Resources Planning. The hydrologic cycle. Frequency, probability and duration analysis of precipitation and stream flow. Hydrographs and stream flow routing. Pressure conduit flow in pipe networks. Gradually-varied flow in open channels. Pump systems. Spillways and stilling basins. Costal engineering. Second semester.

**C.E. 145. Transportation Engineering I (3)**
Principles of the design, construction, and maintenance of transportation facilities with emphasis on highways and airports in the areas of geometric, drainage, and pavement design. Properties and performance of materials used. Field trips and design problems. **Prerequisites: C.E. 41; C.E. 239.** First semester.

**C.E. 146. Transportation Engineering II (3)**
Principles of planning for major forms of transportation facilities. Development, operation, coordination, and regulation of highway, rail, air, water, and pipeline transportation. Traffic studies, location analysis, and economic consideration. Mass transportation of freight and passengers. Studies of large transportation terminals. **Prerequisite: C.E. 145.** Second semester.

**C.E. 150. Structural Analysis I (3)**
Analysis of statically determinate frames and trusses; influence lines; deflections; statically indeterminate structures by method of deflections. Digital computer applications. **Prerequisite: Mech. 11, C. E. 12.** First semester.

**C.E. 151. Structural Theory (3)**
Introductory course in the theory of structural steel design, including bolted, riveted and welded connections, pins, tension members, columns, and beams. **Prerequisites: C.E. 150.** First semester.

**C.E. 153. Reinforced Concrete Theory (3)**
Analysis and design of reinforced concrete structural elements including beams, slabs and compression members by both the ultimate strength and working-stress methods. Analysis and design of footings and retaining walls. Introduction to prestressed concrete. **Prerequisite: C.E. 154.** First semester

**C.E. 154. Structural Analysis II (3)**
Elastic analysis of statically indeterminate beams, frames, and trusses by methods of energy, moment distribution, and slope deflection; influence lines; introduction to plastic analysis. **Prerequisite: C.E. 150.** Second semester.

**C.E. 155. Structural Design (3)**
Design of structures utilizing various structural materials. **Prerequisites: C.E. 151, 153, 154.** Second semester.

**C.E. 156. Plastic Design in Steel (3)**
Application of theory of plastic analysis to structural design. The behavior of steel structures beyond the elastic limit and up to formation of a failure mechanism. Plastic analysis and design of beams, columns, connections and rigid frames. **Prerequisite: C.E. 154. Second semester.**

**C.E. 157. Concrete Laboratory (1)**
Principles of the behavior of plain and reinforced concrete. Design and preparation of concrete mixtures, and tests of aggregates, control cylinders, and beams. **Prerequisite: C.E. 153 concurrently.** First semester

**C.E. 162. Sanitary Engineering (3)**
A systematic study of water and waste-water treatment employing the concept of unit-operations. Laboratory work includes field studies, examination of water and waste-water samples, batch and pilot plant experiments. **Prerequisites: Chem. 2, C.E. 121.** Second semester.

**For Advanced Undergraduates and Graduates**

**C.E. 201. Foundation Engineering (3)**
Application of soil engineering to foundation design. Site investigations and engineering tests to evaluate subsoil conditions. Procedures for choosing and proportioning foundation elements to meet specific structural requirements. The design and construction of temporary and permanent retaining structures. **Prerequisites: C.E. 239; C.E. 153 previously or concurrently; or consent of department chairman.** First semester. Mr. Fang

**C.E. 239. Soil Mechanics (3)**
Fundamental physical and mechanical properties affecting soil action in engineering projects: identification; classification; hydromechanical, deformation, shear and compaction properties. Applications of theories and principles in engineering practice. **Prerequisite: Mech. 11; or consent of department head.** Second semester. Mr. Fang

**C.E. 309. Analytical Methods in Structural Engineering (3)**
Analysis of redundant structures using matrix methods. Numerical and approximate methods of solution applied to various structural mechanics problems. Special methods including iteration, relaxation and finite differences. Introduction to theory of elasticity with application to engineering problems. Energy principles in structural analysis. **Prerequisite: Math. 204 or equivalent.** First semester. Messrs. Lu, Ostapenko

**C.E. 312. Ground Water Hydrology (3)**
Theory of ground water flow. Analysis of well production test data; ground water budgets; artificial recharge. Analog models. **Prerequisite: Consent of Instructor.** Messrs. Brune, J. Adams

**C.E. 320. Hydraulic Engineering Structures (3)**

Preparation and protection of foundations. Design of earth, gravity, arch, and buttressed dams. Wave forces. Design of seawalls, bulkheads and breakwaters. **Prerequisites: C.E. 127 previously or concurrently; or consent of department chairman.** First or second semester. Mr. Brune

**C.E. 321. Water Power and Pumping (3)**

Theory of hydraulic turbines. Study of penstocks, scroll cases, draft tubes, water hammer and cavitation. Theory and design of pumps. Performance and testing of turbines and pumps. **Prerequisites: C.E. 127 or consent of department chairman.** Second semester. Mr. Basco

**C.E. 322. Hydromechanics (3)**

Fundamental principles of fluid motion, with emphasis on hydraulic applications. Euler's, Bernoulli's and Laplace's equations, gradually varied open channel flow, wave motion, water hammer, sediment transportation, and cavitation. **Prerequisites: Math. 221, C.E. 121.** Second semester. Mr. J. Adams

**C.E. 323. Hydromechanics Laboratory (1)**

Study of instrumentation techniques on equipment commonly used in hydromechanics research. Stress on individual laboratory work. **Prerequisite: C.E. 322 previously or currently.** Staff

**C.E. 351. Structural Design: Timber (3)**

Analysis and design of timber columns, beams, tension members, trusses, connections, mechanical fasteners; study of allowable stresses, fire resistance, and preservation of timber structures; project and timber tests with reports. **Prerequisite: A course in structural design and theory.** Second semester.

Messrs. Liebig, Eney

**C.E. 352. Dynamics of Structures (3)**

Analysis and design of structures subjected to time-dependent loads. Behavior of lumped-mass and distributed-mass systems. Exact and approximate analyses of linear and non-linear systems. Applications to earthquake design, blast-resistant structures, wind effects, bridge vibration. **Prerequisite: Consent of Instructor.** Messrs. Van Horn, Yen, Huang

**C.E. 360. Sanitation (3)**

Study of those environmental factors having an influence upon public health, including food and milk sanitation; garbage and refuse collection and disposal; insect and rodent control; lighting, heating, and ventilation; plumbing, industrial hygiene, school sanitation; and swimming pools, but excluding water works and sewerage. **Prerequisite: C.E. 162 previously or concurrently.** Second semester.

Mr. Witherow

**C.E. 395. Civil Engineering Planning (3)**

Planning of civil engineering projects; selection of site; situation survey and data analysis; consideration of utilities; transportation; parking; architectural and structural features of structures; sub-surface exploration; air and water pollution control; landscaping; economic studies; estimates of costs; general plans and reports. **Prerequisite: Consent of chairman of department.** Second semester.

Mr. Eney and staff

**For Graduates**

The Department offers advanced work in structural engineering, soil and foundation engineering, hydraulic engineering, and water resources and water pollution, leading to the M.S. and Ph.D. degrees. A master's degree can also be earned in sanitary engineering.

Each candidate for a master's degree is expected to take at least one research course (C.E. 402, 404, 406, 407, 422, or 440), but a minimum of 24 hours of his program should consist of courses outside this group. Research Assistants and Fellows normally will prepare a thesis.

The following subjects, in addition to the C.E. courses listed below, may be considered a part of the major field in C.E.: Mech. 402, Advanced Analytical Mechanics; Mech. 404, Advanced Vibration Analysis; Mech. 409, 410, Theory of Elasticity; Mech. 412, Theory of Plasticity; Mech. 415, Structural Mechanics & Elastic Stability; Mech. 416, Theory of Plates & Shells; Mech. 421, Hydrodynamics; Mech. 422, Advanced Mechanics of Compressible Fluids; M.E. 342, Mechanical Vibration Analysis; M.E. 441, Stress Analysis in Design; M.E. 442, 443, Analytical Methods in Engineering. Subject to approval, courses from other departments may be included in the major.

**C.E. 400. Experimental Methods of Structural Research (3)**
Mechanical properties of structural materials and different procedures of evaluating these properties; experimental methods of stress analysis; statistical analysis of experimental data. Second semester. Mr. Yen

**C.E. 401. Experimental Methods of Structural Analysis (3)**
Analysis of structures using various experimental techniques; use of mechanical devices in investigation of special problems, such as temperature deformations, foundation displacements, and integral action of structures: moiré fringe method; theory of similitude and its application to model design; principles of structural analogies. First or second semester. Messrs. Eney, Lu

**C.E. 402. Structural Model Analysis (2-5)**
Individual structural research problems, with report. **Prerequisite: C.E. 401.** First and second semester. Messrs. Eney, Lu

**C.E. 404. Structural Research (2-5)**
Individual research problems with reports. First and second semester. May be repeated for credit. Staff

**C.E. 405. Advanced Design of Steel Structures (3)**
Analysis and design of welded structures and their components; residual stresses; brittle fracture; fatigue strength. Structural fasteners. Study of current research and related design practices. First semester of alternate years. (Offered Fall 1967). Mr. Tall

**C.E. 406. Special Problems in Civil Engineering (3)**
An intensive study, with report, of some special field of civil engineering. May be repeated for credit. First and second semesters. Staff

**C.E. 407. Thesis (1-6)** Staff

**C.E. 410. Prestressed Concrete (3)**
Analysis and design of prestressed concrete structures. Elastic and plastic properties of concrete. First semester. Mr. Van Horn

**C.E. 411. Selected Topics in Concrete Structures (3)**
Analysis and design of prestressed, folded plate, and thin shell structures. Principles and applications of ultimate strength, limit design, and yield line theories. Second semester. Mr. Van Horn

**C.E. 420. Hydrology and Open Channel Flow (3)**
Components of the hydrologic cycle. Analysis and prediction of basic quantities required for hydraulic engineering design and storage requirements. Non-uniform flow in open channels and reservoirs, backwater curves in natural and artificial channels, hydraulic jump surges, and waves, standing waves in supercritical flow. Sediment transportation. Supervised problems. First semester of alternate years. (Offered Fall 1968). Messrs. Adams, Brune

**C.E. 421. Hydraulic Laboratory Practice (1-5)**
Study of theory and method of hydraulic experimentation, simultaneously with laboratory work. **Prerequisite: C.E. 322 or consent of department chairman.** First or second semester. Mr. Brune

**C.E. 422. Hydraulic Research (2-5)**
Individual research problems with reports. First and second semesters. Staff

**C.E. 423. Advanced Hydraulic Engineering and Hydromechanics (3)**
Principles of irrotational flow. Laminar motion. Turbulence. Boundary Layer. Air entrainment. Wave Motion. Flow through non-prismatic channels. Rapidly varied unsteady flow. **Prerequisite: C.E. 322 or consent of department chairman.** First semester of alternate years. (Offered Fall 1967). Mr. Adams

**C.E. 440. Soils Research (2-5)**
Individual research problems relating to soil engineering, with report. **Prerequisite: A course in soil mechanics.** First or second semester. Staff

**C.E. 443. Advanced Soil Engineering I (3)**
The origin, composition, and physico-chemical properties of soils and their influence on the engineering properties and behavior of soils; transmission of water in saturated and unsaturated soils; theory of compaction; frost action; application of hydro-mechanics to soil engineering problems. **Prerequisite: An undergraduate course in soil engineering.** First semester. Mr. Fang

**C.E. 444. Advanced Soil Engineering II (3)**

Fundamental and advanced theories of soil mechanics applicable to earth structures and foundation design; stresses in wedges and in layered systems for ideal elastic, plastic and viscoelastic soils, theory of consolidation; vibrations and other dynamic forces. **Prerequisite: C.E. 443. Second semester.** Messrs. Fang, Chen

**C.E. 445. Advanced Foundation Engineering (3)**

Current theory and practice relating to the design of foundations for buildings and other rigid structures. Stress distribution due to loads on shallow and deep foundations; soil compression and rupture theories; analysis and limitations of settlement; structural design of foundations; construction problems; and site investigations. **Prerequisite: Consent of instructor.** First semester. Mr. Fang

**C.E. 446. Earth Structures (3)**

Current theory and practice relating to the design of large embankments, earth dams, and backfills. Slope analysis theories; theory of pavement design; loads on conduits and structures in embankments; evaluation of base courses; soil compaction; selection of material; and constructions. **Prerequisite: Consent of instructor.** Second semester. Mr. Fang

**C.E. 450. Advanced Structural Theory I (3)**

Deflections due to various causes. General force and deformation methods of analysis of statically indeterminate structures using matrix algebra. Specialized methods: column analogy, moment distribution, etc. First semester.
Messrs. Fisher, Ostapenko

**C.E. 451. Advanced Structural Theory II (3)**

Selected topics in structural theory: influence lines, multi-story building frames, space structures, suspension bridges (elastic and deformation methods), arches, relaxation, etc. **Prerequisite: C.E. 450.** Second semester.
Messrs. Fisher, Ostapenko

**C.E. 453. Structural Members and Frames (3)**

General torsion of thin-walled open, closed, and combined open and closed cross-sections; general instability of thin-walled members; in elastic instability; special problems in stability. Desirable preparation: C.E. 309 and Mech. 415. Second semester. Mr. Ostapenko

**C.E. 454. Plate and Shell Structures (3)**

Analysis and design of plates loaded transversely and in their plane. Shear lag; influence surfaces. Buckling and post-buckling behavior of elastic and inelastic plates. Membrane and bending analysis of cylindrical, rotational and hyperbolic-paraboloidal shells. Exact and approximate engineering methods. Design considerations. **Prerequisite: Consent of Instructor.** Mr. Ostapenko

**C.E. 456. Graduate Seminar (1-3)**

Study of current topics in the field of civil engineering. First or Second Semester.
Staff

**C.E. 458. Plastic Analysis and Design (3)**

Theory of plasticity and its applications to structural design. The behavior of steel structures beyond the elastic limit and up to collapse. Study of component parts of frames; methods of predicting strength and deformation in the plastic range. Studies of industrial type frames. Current research. Comparison of conventional design methods with plastic design techniques. First semester.
Messrs. Lu, Ostapenko, Chen

**C.E. 459. Advanced Topics in Plastic Theory (3)**
Advanced problems in plastic analysis and design: minimum weight design, composite design, deflections, shakedown, and arch analysis. Fundamentals of the mathematical theory of plasticity; the general theorems of limit analysis and their applications to beams under combined loading, space frames, plates and shells. Current developments. **Prerequisite: C.E. 458.** Second semester of alternate years (offered Spring 1967). Mr. Lu

**C.E. 460. Water Supply and Sewerage (3)**
Theory and design of facilities for the supply and distribution of water and for collection of waste water. First semester of alternate years. (Offered Fall 1967).

**C.E. 461. Treatment of Water and Waste Water (3)**
Theory and design of treatment facilities for water, sewage, and industrial waste; advanced topics of current practices, with reports. Second semester of alternate years. (Offered Spring, 1968).

# CLASSICAL LANGUAGES

Professors Maurer, Feaver
Assistant Professor de Angeli

## GREEK

**Gk. 1. Elementary Greek (3)**
For all students who desire to obtain a knowledge of the fundamentals of the Greek language. Early in the semester there will be reading in stories and legends in easy Greek. First semester.

**Gk. 2. Elementary Greek (3)**
Continued work in Greek vocabulary, forms, and syntax. Selected readings in Greek prose. **Prerequisite: Gk. 1.** Second semester.

**Gk. 3. Intermediate Greek (3)**
Xenophon: *Anabasis*, and other works. Grammar review. **Prerequisites: Gk. 1. and 2, or one year of entrance Greek.** First semester.

**Gk. 4. Intermediate Greek (3)**
Plato: *Euthyphro, Apology*, and *Crito*, or other dialogues. **Prerequisite: Gk. 3.** Second semester.

**Gk. 11. Greek Drama (3)**
Representative plays of Sophocles, Euripides, and Aristophanes. Literary study of the drama. **Prerequisite: Gk. 4.** First semester.

**Gk. 12. Greek Drama (3)**
Continuation of Gk. 11. **Prerequisite: Gk. 4.** Second semester.

**Gk. 13. Greek Historians (3)**
Selections from Herodotus, Thucydides, or Xenophon. A study of Greek historiography. **Prerequisite: Gk. 4.** First semester.

**Gk. 16. Greek Epic (3)**
Selections from the *Iliad*. A study of the epic as genre. **Prerequisite: Gk. 4.** Second semester.

**Gk. 21. Ancient History (3)**
The development of civilization from palaeolithic times to the world empire of Alexander the Great. The social, economic, religious, philosophic, artistic, and literary development of the ancient world; the origin of political institutions. First semester.

**Gk. 50. Greek Literature in English Translation (3)**
The development of the major departments of Greek literature; required readings in English translations, with special attention to the epic, drama, and lyric poetry. No knowledge of the Greek language is required. First or second semester.

**For Advanced Undergraduates and Graduates**

**Gk. 202. Greek Archaeology (3)**
Aims and methods. A chronological presentation of prehistoric civilizations including the neolithic, Minoan, Helladic, and Mycenaean periods. A study of extant ancient monuments, buildings, and city plans of important sites of the classical and Hellenistic periods. Lectures, collateral readings, and reports. First semester. Mr. Feaver

**Gk. 311. Homer (3)**
Rapid reading of considerable portions of the *Iliad* or the *Odyssey*. Homeric language, syntax, and metre. **Prerequisites: Gk. 4 and consent of chairman of department.** First semester.

**Gk. 316. Plato (3)**
*The Republic*, and other dialogues. Lectures on classical philosophy. **Prerequisites: Gk. 4 and consent of chairman of department.** Second semester.

**LATIN**

**Lat. 22. Ancient History (3)**
Continuation of Gk. 21. The Hellenistic Age. Rome from its origin to 395 A.D. Second semester.

**Lat. 51. Latin Literature in English Translation (3)**
A study of Latin literature by means of the best English translations. The lives of the most important authors are studied and their works read according to the major departments of literature—history, comedy, epic, lyric, etc. Emphasis is placed on the chronological development of the literature and historical background necessary to the interpretation of the author's works. Lectures and readings with special reports. No knowledge of the Latin language is required. First or second semester.

**Lat. 61. Elementary Latin (3)**
For all students who desire to obtain a knowledge of the fundamentals of the Latin language. Special emphasis on English derivations and the principles of grammar. First semester.

**Lat. 62. Caesar (3)**
Selections from Caesar: *The Gallic War*. Prose composition and syntax. **Prerequisite: Lat. 61 or 2 entrance units.** Second semester.

**Lat. 63. Nepos and Cicero (3)**
Nepos: *de Viris illustribus;* Cicero's orations and either *de Senectute* or *de Amicitia*. **Prerequisite: Lat. 62 or 3 entrance units.** First semester.

**Lat. 65. Vergil (3)**
Vergil: *Aeneid*, selections from the entire work; study of the aesthetic, political, and philosophical values of Vergil's poetry. **Prerequisite: Lat. 63 or at least 3 entrance units.** Second semester.

**Lat. 166. Horace (3)**
Selected Odes. Lectures on the history and development of lyric poetry; constant practice in reading the more important metres; memorization of stanzas and passages. **Prerequisite: Lat 65 or at least 4 entrance units.** First semester.

**Lat. 167. Roman Prose Writers (3)**
Selections from Cicero, Tacitus, and Seneca. **Prerequisite: Lat. 65 or at least 4 entrance units.** Second semester.

**Lat. 168. Latin Drama (3)**
Readings of selected plays of Plautus, Terence, and Seneca. **Prerequisite: Lat. 65 or at least 4 entrance units.** First semester.

**Lat. 169. Satire (3)**
Selected satires of Horace and Juvenal. Lectures on the history of Roman satire and its influence on modern literature; study of social conditions under the empire. **Prerequisite: Lat. 65 or at least 4 entrance units.** Second semester.

**For Advanced Undergraduates and Graduates**

**Lat. 203. Archaeology of Italy (3)**
Neolithic, Terramara, Villanovan, and Etruscan cultures. Rome the city: its buildings, monuments, and streets, its destruction and rediscovery through excavation; origin and growth of the city; the three periods, empire, republic, and kingdom; methods of identifying and dating monuments. A survey of Pompeii, Herculaneum, and Ostia. Lectures, readings, and reports. First or second semester.
Mr. Feaver

**Lat. 211. Readings (3)**
Intensive reading in one author or in a selected genre. **Prerequisites: Six hours of courses at the "100" level and consent of chairman of department.** First semester.
Mr. Maurer

**Lat. 212. Readings (3)**
Intensive reading in one author or in a selected genre. **Prerequisites: Six hours of courses at the "100" level and consent of chairman of department.** Second semester. Mr. Maurer

**Lat. 301. The Roman Republic (3)**
The final century of the Roman Republic (133-44 B.C.) studied through a close examination of the original sources in translation. The course gives a broad comprehension of the historical background to the Latin authors of the Roman Republic normally read in secondary school. First semester.

**Lat. 302. The Roman Empire (3)**
A continuation of Latin 301. The principate of Augustus and the first century of the Roman Empire (44 B.C.-70 A.D.). The course gives a broad comprehension of the historical background to the Latin authors of the Augustan and Silver Age normally read in secondary school. Second semester.

**Lat. 303. The Roman Epic (3)**
The epic in Latin literature with lectures on the Greek models; early Latin translations of Greek epics; later minor writers of epic. Passages from Lucretius, Vergil, and Ovid; a study of the *Aeneid* in its entirety. **Prerequisites: Six hours of courses at the "100" level and consent of chairman of department.** First or second semester.

**Lat. 304. Latin Historical Grammar (3)**
The development of Latin syntax with survey of early Latin. Syntactical analysis of Caesar, Cicero, and Vergil. The development of classical prosody and metrics with emphasis on changes in the hexameter from Catullus and Lucretius to Vergil. The course is designed primarily for teachers of Latin in secondary schools and for majors in Classical Languages planning to teach. **Prerequisites: Six hours of courses at the "100" level and consent of chairman of department.** First or second semester.

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# ECONOMICS

Professors Jensen, Tripp, Bratt, Balabkins, Loomba, Unterberger
Associate Professors Cohen, Hobbs, Pillsbury, Snider, Rosenbaum
Assistant Professors Butkys, Gonce, Hall, Shen, Turban, Weintraub
Messrs. Corkhill, Gross, Hunt, Innes, Power, Reilly, Splane, Snyder, Winch

**Eco. 3. Economics (3)**
A general course in the principles of economics, covering the organization of production, problems of concentration and efficiency, principles of value and price, income distribution and labor problems. First and second semester.

**Eco. 4. Economics (3)**
A continuation of Eco. 3 in which the work deals with the basic institutions of economic life, money and banking, the general price level, national income, income determination, business cycles, monetary policy, and public finance. **Prerequisite: Eco. 3.** First and second semester.

**Eco. 11. Introduction to Political-Economic Thought (3)**
An evaluative study of key problems in political economy and in the organization of economic power and function. Involved are thoughtful and parallel reading of contemporary and classical writers and effective essays and research papers. First semester.

**Eco. 12. Introduction to Political-Economic Thought (3)**
Continuation of Eco. 11. Second semester.

**Eco. 45. Statistical Method (3)**
An introduction to quantitative method: descriptive statistics, elementary probability and sampling, estimation and testing of population parameters, simple correlation and regression. **Prerequisite: A course in college-level mathematics.**

**Eco. 160. Insurance (3)**
A non-mathematical course in the economic principles and business practice of insurance, particularly life, fire, and casualty insurance. **Prerequisite: Eco. 4.** Second semester.

**For Advanced Undergraduates and Graduates**

*All of the following courses in economics have as a prerequisite a one-year course in the principles of economics.*

**Eco. 302. Survey of Management Science Applications (3)**
Survey course of the various operations research models: Inventory, waiting line (Queuing), replacement, simulation, PERT, competitive models and dynamic programming. **Prerequisite: Eco. 45 or equivalent.** Second semester.

**Eco. 303. Economic Development (3)**
The principal determinants of economic development; economic development in advanced and underdeveloped countries. First or second semester.
Mr. Cohen

**Eco. 305. The Economic Development of Latin America (3)**
Forces at work in the changing economies in Latin America: in addition to the economic variables, social and political factors are considered and related to technological change and the development process. Second semester.
Mr. Cohen

**Eco. 306. Intermediate Economic Theory (3)**
Determination of prices in terms of the equilibrium of the business enterprise and consumer choices in markets of varying degrees of competition; determination of wages, rent, interest, and profits. First and second semesters.
Messrs. Cohen, Pillsbury, Power, Weintraub, Winch

**Eco. 307. History of Economic Thought (3)**
Traces development of economic doctrines. Discusses views of mercantilists, classical economists, socialists, and neo-classical economists on value, distribution, money, and national economic policy. Relates economics to social issues of a period. Mr. Gonce

**Eco. 308. History of Economic Thought (3)**
Continuation of Eco. 307. Mr. Gonce

**Eco. 309. Comparative Economic Systems (3)**
A comprehensive examination of the philosophical, economic, and political tenets of American Capitalism, Soviet Socialism, and Nazi Fascism. Analysis of economic planning under various socio-economic systems: study of comparable economic growth of the U. S. and the Soviet Union. First semester.
Mr. Balabkins

**Eco. 310. Economic Evolution (3)**
A study of the causes and effects of changes in the economic organization of Western society. Oriented by the examination of special problems. Second semester.

**Eco. 311. Economics Resource Use (3)**
Problems of the economic use and development of human and natural resources, with particular reference to the future and to relationships within and between regions. **Prerequisite: Eco. 306 or consent of chairman of department.** First semester. Staff

**Eco. 313. Introduction to Management Science (3)**
Introduction to the analytic techniques and mathematical models of Operations Research and management science and their application to business problems. Deterministic decision models; Linear Programming. **Prerequisite: Eco. 45 or equivalent.** First and second semester.

**Eco. 316. Intermediate Macro-economic Theory (3)**
Introduction to the theory of income, employment, and growth. Provides tools of analysis necessary for dealing with aggregate economic problems. Second semester.

**Eco. 321. Business and Organization Behavior (3)**
An analysis of various theories of business and managerial behavior emphasizing the business organization and its internal processes. Economic analysis, hierarchical management, modern organization theory, human relations, conflict—are the main frameworks examined. First and second semester.

**Eco. 333. Labor Problems (3)**
The economics of labor; the history of labor movements in the United States, forms of labor organizations, and the methods and policies of trade unions. First and second semesters. Messrs. Hunt, Rosenbaum, Weintraub

**Eco. 334. Labor Legislation (3)**
State and federal labor legislation. Background, experience, and economic impact. Second semester. Mr. Rosenbaum

**Eco. 336. Business and Government (3)**
A general survey of the economic aspects of the relation of government and business in the United States, with considerable emphasis on problems of public utility rate making, finance, public ownership and operation, and related issues. Second semester. Mr. Pillsbury

**Eco. 337. Transportation and Spatial Economics (3)**
The principles of transportation in theory and practice are integrated with traditional and spatial economics. Transport models and location theories are reviewed for varying conditions of spatial separation of economic activity. Transportation policies are analyzed and evaluated in terms of their efficiency in the allocation of resources for the firm and the economy at the local, regional and national levels. **Prerequisite: Economics 306 or Consent of the Instructor.** First semester.
Mr. Pillsbury

**Eco. 346. Business Cycles and Forecasting (3)**
A study of economic conditions, involving short-term fluctuations, growth, forecasting and stabilization proposals. **Prerequisite: A course in statistics.** First and second semesters.
Mr. Bratt and Staff

**Eco. 347. National Income Analysis (3)**
Analysis of income and product aggregates for the point of view of development and structural breakdown, emphasizing sector accounts, savings and investments; and integrated with broad macroeconomic theory. **Prerequisite: Eco. 346.** First semester.
Messrs. Bratt, Shen

**Eco. 348. Advanced Business Cycles (3)**
Recent business cycle theories; the evolution of the theories, and the problems of economic change which the theories attempt to explain. **Prerequisite: Eco. 346.** Second semester.
Mr. Bratt

**Eco. 352. Advanced Statistical Method (3)**
A further course in quantitative method: sampling design, probability distributions including the analysis of variance, and multiple correlation and their application to common situations. **Prerequisite: Eco. 45 or equivalent.** First semester.
Mr. Shen

**Eco. 371. Readings in Economics (3)**
Readings in various fields of economics, designed for the student who has a special interest in some field of economics not covered by the regularly rostered courses. **Prerequisite: Preparation in economics acceptable to the department chairman.** First semester.
Messrs. Jensen, Bratt, Loomba, Firestone, Pillsbury, Shen

**Eco. 372. Readings in Economics (3)**
Continuation of Eco. 371. Second semester.
Messrs. Jensen, Bratt, Loomba, Firestone, Pillsbury, Shen

**For Graduates**

**Eco. 404. Developmental Theory and Problems (3)**
The evolution of growth doctrines and the analysis of such developmental problems as: structural versus monetary reform, ideological controversy of the appropriate economic system, balanced investment programs as opposed to unbalanced plans, the nature and changes in the aggregate production function, and dependence upon domestic as opposed to foreign source of savings. **Prerequisite: Eco. 303.** Second semester.
Mr. Cohen

**Eco. 417. Deterministic Models of Management Science (3)**
Theory and applications of the extensions of linear programming: Integer programming, quadratic programming, decomposition, dynamic Linear Programming. **Prerequisite: Eco. 313.** First semester.

**Eco. 418. Seminar in Management Science (3)**
Theory and applications of inventory, waiting line theory, stochastic programming, simulation, net-work theory, dynamic programming. **Prerequisite: Eco. 417.** Second semester.

**Eco. 431. Managerial Economics (3)**
Problems of business enterprise: price and output determination analysis of cost and demand functions in markets of various types and under various conditions of general business. Emphasis will be on the application of economic theory to business practice. **Prerequisite: Economics 306 or Consent of the instructor.** First and second semesters. Mr. Hobbs

**Eco. 432. Micro-Economics (3)**
A survey of methods of decision making at the micro-economic level utilizing concepts developed in price theory and econometrics. **Prerequisite: Eco. 306 or equivalent.** Mr. Pillsbury

**Eco. 433. Labor Management Economics (3)**
A study of modern industrial relations including problems of the labor force, hiring policies, the social aspects of modern industry, collective bargaining practices and policies of management and labor organizations, structure, policy and tactics of contemporary unions, problems and policies of United States labor legislation. **Prerequisite: Eco. 333 or equivalent.** First and second semesters.
Messrs. Rosenbaum, Tripp, Unterberger

**Eco. 434. Metropolitan Market Analysis**
A study of regional markets from a forecasting point of view. The structure of the metropolis; metropolitan systems; location factors in market analysis; metropolitan economic analysis. Mr. Pillsbury

**Eco. 435. Micro-economic Analysis (3)**
Topics in resource allocation and price determination. Theories of choice of consumers, firms, and resource owners under monopoly, monopsony, competition, and alternative market forms. **Prerequisites: Eco. 432 or equivalent and consent of instructor.** Messrs. Balabkins, Weintraub

**Eco. 436. Macro-Economics (3)**
Theory of employment, income, and growth. Role of money in theory of output. Policies for economic stability and growth. **Prerequisite: Consent of the instructor.** Messrs. Innes, Shen

**Eco. 447. Systems of National Accounts (3)**
A study of American National Accounts, relating the theoretical analysis to actual and potential measurements; also relation to National Accounts of other countries. Coverage includes national income, input-output, flow of funds, national balance sheet and other systems of aggregation. First semester.

**Eco. 453. Time Series Econometrics (3)**
Statistical measurement of economic change and its economic significance. Second semester. Mr. Shen

**Eco. 454. Forecasting (3)**
A study of the methods of business forecasting and its relation to planning with emphasis on the prediction of growth and short-term movements. **Prerequisite: Eco. 346 or equivalent.** Second semester. Mr. Bratt

**Eco. 455. Econometric Methods (3)**
The development of economic models. The statistical estimation of economic parameters, and the testing of hypotheses suggested by economic theory. The development of production, cost, demand, and consumption functions; aggregate cyclical and growth models. **Prerequisites: Background in statistics and calculus.** Second semester. Mr. Shen

**Eco. 461. Methodology in Theory and Research**
Foundations of theory construction and empirical research in economics and related subject matter. Theory, hypothesis formation and empirical study in the business firm, organizations, industrial relations, and micro-macro research.

**Eco. 471. Special Topic Study (3)**
An extended study of an approved topic in the field of business economics. Staff

**Eco. 472. Special Topics (3)**
Selected topics not covered in scheduled courses in the Department. May be repeated for credit with the consent of the Head of the Department. Second semester. Staff

**Eco. 475. Business Economics Seminar (3)**
Independent research for M.S. in Business Economics candidates. Second semester. Messrs. Bratt, Jensen, Snyder

**Eco. 490. Thesis in Business Administration (6)**
Subjects for theses may be in the fields of accounting, economics, economic statistics, finance or marketing. First and second semester. Staff

## MARKETING

**Mkt. 11. Marketing (3)**
A detailed and critical analysis of the principles of marketing, designed to acquaint the student with the institutions and functions involved in the distribution of goods and services, and with the problems of marketing management. **Prerequisite: Eco. 3.** First and second semester.

**Mkt. 113. Advertising (3)**
The principles, practices, and problems of advertising. Evaluation of techniques utilized in its management and control, with special reference to economic and social aspects. **Prerequisite: Mkt. 11.** Second semester.

**Mkt. 115. Retailing (3)**
A study of modern retail institutions; principles and methods of retail organization and management; economic, social, and legislative aspects of the retailing structure. **Prerequisite: Mkt. 11.** Second semester.

### For Advanced Undergraduates and Graduates

**Mkt. 214. Selling and Sales Management (3)**
Principles and practices of modern selling and sales management; product planning, policy and research; distribution channels, sales planning and promotion;

sales force management; and control of sales operations. **Prerequisite: Mkt. 11 or consent of head of department.** Second semester. Mr. Butkys

**Mkt. 217. Industrial Marketing (3)**

Problems in the marketing of industrial as differentiated from consumer goods; product planning and development; industrial marketing research; marketing channels; management of the sales force; industrial advertising; and government regulations. **Prerequisite: Mkt. 11 or consent of chairman of department.** First semester. Mr. Butkys

**Mkt. 312. Marketing and Distribution Research (3)**

Analysis of the techniques of marketing research; determination of research objectives; procedures involved in the conduct of marketing investigations. **Prerequisite: Two courses in marketing.** Second semester. Mr. Gross

**For Graduates**

**Mkt. 450. Marketing Management (3)**

A study of the factors affecting consumer demand and methods of satisfying it; the structure of the market; marketing methods and problems of various agencies; competitive practices; the management of the selling activities of a business, distribution policies, pricing, and the planning of marketing operation. Second semester. Mr. Snider

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# EDUCATION

Professors Stoops, Cartwright, Tate
Associate Professors, Ashby, Burbank, Burket, Castaldi
Mierzwa, Millon, Sam
Assistant Professors Guditus, McCormick, Miller, Reddin,
Versacci, Warfel
Messrs. Bell, Douris, Duelfer, Dungan, Fleck, Garis
Gibboney, Howard, Iacono, Kuklentz, Lamana
Leight, Liddicoat, McHugh, Montgomery, Nancarrow
Nisbet, Oswalt, Ray, Schafer, Siles, Sutton
Mesdames Beidler, Deitz, Grandovic, Johnson, Kemmerer,
Larrick, Leyton, Mauriz, Moyle, Rinehart, Rutkoff
Seylar, Smith, Szwed, Tepper, Veatch

**For Advanced Undergraduates and Graduates**

**(For further information see the School of Education, page 164)**

**Educ. 391-392. Workshop (3, 5, or 6)**

Cooperative study of current educational problems. Designed to provide elementary and secondary school teachers an opportunity to work at their own teaching levels and in their own fields. Students will be limited to six credits during

a summer session but may register for more than one workshop provided there is no duplication in subject matter. First or second semester.

Messrs. Sam, Stoops and Staff

**Educ. 393. Instructional Media (3)**

Study of principles underlying the use of graphic and sound projection in teaching. Utilization of commercial, student, and teacher made materials. Applications of new instructional media such as television, teaching machines, and computer assisted instruction to classroom teaching. First semester.

## For Graduates

**Educ. 400. Psychological Foundations of Education (3)**

Study and practice of methods involved in making a psychological analysis of pupils or classroom situations particularly in relation to school problems. First semester. Mr. Mierzwa

**Educ. 401. Sociological Foundation of Education (3)**

An analysis of the school as a social institution. This includes a consideration of man's cultural heritage and the function of education in preserving and improving it; group behavior relating to school problems; the integration of education with the life and institutions of the community and society; the social role of the teacher; social change and the school. First or second semester.

Mr. Williamson

**Educ. 402. Anthropological Foundations of Education (3)**

Emerging uses of anthropological analysis in the study of the educative process in our own society and in other societies. Particular emphasis is placed upon relevance of a particular cultural or sub-cultural value pattern to the structure of educational institutions. First semester. Mr. Szwed

**Educ. 403. Teaching in the Two Year College (3)**

Major theories of teaching, learning, and measurement are studied with particular reference to the problems of instruction in the two year college. The characteristics of students in two year colleges are examined. Participants undertake research in the field. First or second semester. Mr. Guditus

**Educ. 406. Historical Foundations of Education (3)**

The developments of primary, secondary, and higher education; the aims, curricula, methods, and systems of education from early times to the present, in relation to the social conditions and processes. First semester. Mr. Burkett

**Educ. 407. Philosophical Foundations of Education (3)**

Comparative philosophical analysis of the aims of education in the social order; the nature, needs, and adjustments of modern industrial society; the conflicting demands upon education by a changing civilization as represented by modern social points of views; the implications of contemporary educational philosophy for social progress. First and Second semester. Mr. Stopps

**Educ. 408. Comparative Education (3)**

A survey of educational practices abroad including all programs from nursery to graduate education. Major emphasis is placed upon systems of articulation, social foundations, legal foundations, and structure in government. The nature and

purposes of the schools are considered with particular reference to cultural patterns. Focus is also placed upon major problems and trends. Second semester.
Mr. Ashby

**Educ. 409. The Two-Year College (3)**
Historical and philsophical analysis of the two-year college as an institutional mode in American higher education. The unique nature of the two-year college is considered in relation to its service functions and the values in American higher education. Participants undertake research in the field. First or second semester. Mr. Guditus

**Educ. 410. Structure and Syntax of the Academic Disciplines (3)**
Professors from other departments of the University are presented in discussions coordinated by the School of Education. The patterns which organize and identify the academic disciplines are emphasized. Study is given the nature and significance of the conceptual structures which guide inquiry or research in certain major fields of scholarship. Implications for planning of curricula and preparations of teaching materials are considered. Mr. Stoops and Staff

**Educ. 411. Personality and Adjustment (3)**
The theory of individual and social adjustments and the individual and cultural factors in learning of motives and adjustments with particular reference to the educative processes and the work of educational institutions. Relationships to the typical varieties of adjustive behavior and determinents of personality are shown. Mental life, conduct, personal, and social adjustment are analysed with regard to changing conceptions of self and the interplay of emotion and intellect. Fall semester; alternate years. **Prerequisite: Permission of instructor.**
Messrs. Millon, Mierzwa

**Educ. 412. Individual Assessment and Interviewing (3)**
A study of the appraisal process and the data used to understand and predict educational, vocational, and social behavior. Surveys of advanced methods and instruments in appraisal including comparison of diagnostic approaches, interpretation of research, preparation of written reports, and application in practice are included. Spring semester; alternate years. **Prerequisite: Permission of instructor.** Mr. Millon, Mrs. Grandovic

**Educ. 413. Theories of Psychological Counseling (3)**
A historical analysis and synthesis of concepts drawn from Jung, Rank, Freud, Adler, and neo-analysts with particular reference to the educative process and the work of educational institutions. The research and current trends in counseling on educational, social, and vocational problems are studied. Precepts and practices in mental health screening are examined. Fall semester; alternate years. **Prerequisite: Permission of instructor.** Messrs. Millon, Mierzwa

**Educ. 414. Child Development (3)**
A study of physical, intellectual, emotional, and social aspects of child development as they relate to the elementary schools. Second semester. Mr. Castaldi

**Educ. 416. Classroom Didactics (3-6)**
Initial preparation of interns for classroom teaching. Secondary interns are trained in special methods of subject fields and the reading problems of secondary students. Elementary interns study the place of subjects in the elementary school. Open to interns only. Second semester. Messrs. Burbank and Castaldi

**Educ. 422. Education of Exceptional Children (3)**

Methods of instruction and provision of materials for children who differ markedly from the normal, i.e., gifted, subnormal and maladjusted; the problems of the teacher in a system that makes little provision for the exceptional child. Actual case studies of pupils are required. First or second semester.

Mrs. Grandovic

**Educ. 423. Diagnostic and Remedial Teaching (3)**

The analysis and treatment of difficulties in the various subjects. The student may select any subject in which he has adequate background as his field of work. Practice is given in the development of materials, and actual work with failing pupils is expected. First semester. Mr. Oswalt

**Educ. 424. Linguistics in Education (3)**

Emphasis on the nature of language, phonetic applications, and the relationships of linguistics to instruction in the language arts. Second semester.

Miss Reddin

**Educ. 425. The Diagnosis and Adjustment of Reading Difficulties (3)**

A survey of problems in diagnosing and adjusting reading difficulties. The psychology of reading as related to learning difficulties; the measurement and diagnosis of reading difficulties; the development of informal tests for identifying reading difficulties; materials for corrective and/or remedial instruction. Second semester.

Mr. Versacci

**Educ. 426. Independent Study and Research (3-9)**

Individual or small group study in the field of specialization. Approved and supervised by the major advisor. Not more than three (3) credits may be earned in a semester. First and second semester. Mr. Tate and Staff

**Educ. 427. Observation of Teaching (3)**

Study, directed observation of, and initial practice in the various phases of teaching in a campus laboratory-demonstration school or in elementary and secondary schools in the area. First or second semester.

Messrs. Burbank, Guditus, Warfel

**Educ. 428. Intern Teaching (6)**

Intensive practice in the application of the principles of teaching. Each intern is appointed to a full-time teaching position for one semester. Supervision is provided both by the employing school district or community college and by the University. **Prerequisite: Ed. 427.** First and second semester.

Messrs. Burbank, Guditus, Warfel

**Educ. 429. Intern Teaching Seminar (3)**

Critical Analysis and discussion of classroom instructional practices. Discussion and illustration will be based on the experiences of participants as they engage in intern teaching. **Education 428 required concurrently.** First and second semester.

**Educ. 433. Reading in Elementary Education (3)** Mr. Versacci

**Educ. 434. Mathematics in Elementary Education (3)** Mr. Sam

**Educ. 435. Social Studies in Elementary Education (3)** Mr. Warfel

**Educ. 436. Science in Elementary Education (3)** Mr. Castaldi

**Educ. 437. Language Arts in Elementary Education (3)** Mr. Sam

**Educ. 438. Fine Arts in Elementary Education (3)** Mrs. Rutkoff, Mr. Douris

**Educ. 443. Elementary School Administration (3)**
The major problems of organization and administration of elementary schools; types of organization, pupil promotion, time allotment, service agencies, and plant and equipment. Required for a principal's certificate. First semester.
Miss McCormick

**Educ. 444. The Elementary School Curriculum (3)**
Problems of curriculum development in the first six grades; subject matter jects, articulation, and similar problems. Second semester.
Mesdames McCormick, Reddin

**Educ. 448. Reading in Secondary Education (3)**
Principles and practices in reading instruction for secondary education, emphasizing identification of reading needs, approaches to reading instruction, and reading problems in content courses. **Prerequisite: Educ. 447A or consent of instructor.** First or second semester. Mr. Howard

**Educ. 449. Children's Literature in Reading Instruction**
placement, program-making for difficult types of schools, regular vs. special sub-
A consideration of the role of literature in the instructional program of the elementary schools. Emphasis is given the use of trade books for individual instruction in reading. Miss Larrick

**Educ. 453. Secondary School Administration (3)**
The major problems of organization and administration of secondary schools; program of studies, teaching staff, pupil personnel, plant and equipment, and community relationships. Required for a principal's certificate. First semester.
Messrs. Ashby, Nancarrow

**Educ. 454. The Secondary School Curriculum (3)**
Methods of study of curriculum problems, selection of subject matter in various fields, principles of program construction, and similar problems. First semester.
Messrs. Ashby, Cartwright

**Educ. 455. Statistics I (3)**
Reduction and description of data. Characteristics of the frequency distribution. Types of distributions. Simple correlation and regression. Score transformations. Statistical inference: tests of hypotheses and estimation of parameters. Uses of the normal, $t$, and chi-square sampling distributions. First or second semester.
Miss Reddin, Messrs. Tate and Miller

**Educ. 456. Statistics II (3)**
Review of descriptive statistics. Movements of the frequency distribution. Errors of inference and their control. Power of a statistical test. Extended applications of the binominal, normal, *t*, and chi-square sampling distributions. The F distribution. Simple analysis of variance and covariance. Special methods of correlation. Multiple linear correlation and regression through the four-variable case. **Prerequisite: Statistics I.** First semester. Messrs. Tate and Miller

**Educ. 457. Statistics III (3)**
Selected topics including complex designs in analysis of variance and covariance, multiple correlation and regression factor analysis, and nonparametric methods. Emphasis on experimental design. **Prerequisite: Statistics II and consent of instructor.** Second semester. Mr. Tate

**Educ. 458. Statistics IV (1)**
Theory and practice of handling mass data in research studies. Use of data-processing equipment in school systems. **Prerequisite: Statistics II.** First or second semester. Mr. Tate

**Educ. 460. Group Processes and Group Guidance (3)**
Analysis of group dynamics as related to attitude and behavior change. Procedures and resources for promoting individual and group development. Emphasis on group processes as related to guidance and counseling. Second semester.
Mr. Mierzwa

**Educ. 463. Public School Administration (3)**
A systematic treatment of the problems of administration, local, state and national. The newer developments which are modifying educational administration; state authorization and organization, the board of education, the superintendent of schools, personnel management, business administration, financial support, and public relations. Second semester. Mr. Cartwright

**Educ. 464. Foundations of Curriculum Construction (3)**
Principles of curriculum construction which underlie the reorganization of the program of studies for elementary and secondary schools: origin and background of the curriculum; methods of organization; curriculum planning and development; and pertinent applications. K-12. First or second semester. Miss McCormick

**Educ. 465. Administration of Higher Education (3)**
Analysis of legal foundations, administrative controls, and operational patterns of the various types of higher institutions with special emphasis on the two-year college. Coverage of traditions which establish duties, responsibilities, and rights of faculty, administration, and board of control in American colleges and universities. Second semester. Mr. Guditus

**Educ. 466. Supervision of Instruction (3)**
Analysis of the principles underlying the organization and supervision of instruction; application to specific teaching situations. No lines will be drawn between the elementary and the secondary school. First or second semester.
Mr. Cartwright

**Educ. 467. Extra-Class Activities (3)**

A cooperative study in the philosophy and psychology supporting activity programs; their organization and administration. Emphasis will be given to the teacher's part in the program, e.g., clubs, student councils, homeroom and class organization, assemblies, publications, finance. First semester.

Mr. Liddicoat

**Educ. 470. Practicum in Analysis of Reading Difficulties**

An investigation of research as it relates to analysis of reading difficulties; practice in administration of test materials and the analysis of reading difficulties. First or second semester. Mr. Versacci

**Educ. 471. Evaluation in Education (3)**

Primarily for classroom teachers. Construction and evaluation of the teacher-made test. Selection of published tests and interpretation of individual and group results. Reliability and validity, school marks, emphasis on evaluation of student achievement. Second semester. Messrs. Burkett and Castaldi

**Educ. 472. Educational Tests and Measurements (3)**

Primarily for specialists in measurements and research. Theory of measurement as applied to various kinds of tests and scales. Item analysis; pre-testing, scaling and equating; errors of measurement; reliability and validity; prediction; factor analysis in test development. **Prerequisite: Educ. 455 or permission of the instructor.** First or second semester. Mr. Miller

**Educ. 474. Seminars in School Building (3)** Messrs. Burbank, Cartwright

**Educ. 475. Seminar in Business Management (3)** Mr. Cartwright

**Educ. 476. Seminar in School Finance (3)** Messrs Abbott, Cartwright

**Educ. 477. Seminar in School-Community Relations (3)**

Messrs. Burbank, Cartwright

**Educ. 478. Seminar in School Personnel Problems (3)**

Messrs. Burbank, Cartwright

**Educ. 479. Seminar in School Law (3)** Messrs. Abbot, Cartwright

**Educ. 480. Elementary School Guidance (3)**

Study of child development as related to guidance in elementary schools. Emphasis on assessment and counseling. Analysis of the roles of counselors, teachers, parents, and other specialists and their influence upon the child in the elementary school. Second semester. **Prerequisite: Education 482 and permission of the instructor.** Mr. Mierzwa

**Educ. 482. Philosophy and Principles of Guidance (3)**

Introduction to the guidance of children and youth in elementary and secondary school and to the guidance of adults in school, business, and industry. Theoretical foundations, principles and ethics of guidance are considered together with implications for school and extra-school experience. Guidance functions such as identification, appraisal, placement, orientation, motivation, support, curriculum design, and resource development are surveyed. Organizations of school personnel programs are analyzed. First or second semester. Mrs. Tepper

**Educ. 483 Counseling (3)**

An intensive examination of theories and techniques of counseling. Critical study of the counseling process through lectures, case histories, and demonstrations. Case studies by students are required. First or second semester.

Mr. Mierzwa

**Educ. 484. Career Development (3)**
Study of the process of selecting and pursuing educational and vocational goals with an emphasis upon decision making. Career development is examined as a facet of general human development. Evaluating and using occupational, educational, and related information. First or second semester. Mr. Guditus

**Educ. 485. Elementary School Principal's Clinic (3-6)** Mr. Sam

**Educ. 486. Secondary School Principal's Clinic (3-6)** Mr. Ashby

**Educ. 487. School Psychologist's Clinic (3-12)** Mr. Scanlan

**Educ. 488. School Superintendent's Clinic (3-6)** Messrs. Burbank, Cartwright

**Educ. 489. Reading Specialists Clinic (3-12)** Mr. Versacci

**Educ. 491-492. Advanced Seminars in Education (3)** Mr. Stoops and Staff

**Educ. 493. Research (3)**
Basic principles of research and techniques of gathering and analyzing data. Students will review relevant research reports and prepare a research proposal on an educational problem. Recommended to be taken before approval for candidacy. First and second semester. Miss Reddin, Mr. Tate

**Educ. 494. Field Work (3-6)**
Identification of significant problem(s) in an educational environment, review of the literature, and development of appropriate research plans. No more than 3 credits may be earned in a semester. First and second semester. Mr. Miller

**Educ. 496 Seminar in Research Methods (3-6)**
For specialists in measurements and research. Research designs and application to various kinds of educational problems; data collection and analysis. Seminar will include criticism and evaluation of student proposals. First or second semester. Mr. Miller and Staff

**Educ. 498. Internship (3)**
Designed to give advanced students an opportunity to obtain practical experience in selected school systems. Conference hours for students and staff members will be devoted to discussion of work and problems encountered in the schools. Students will be sectioned as follows: Section A, elementary school principals; Section B, secondary school principals; Section C, guidance counselors, Section D, superintendent of schools, Section E, reading specialists; and Section F, specialists in measurements and research. First or second semester: Mr. Stoops and Staff

# ELECTRICAL ENGINEERING

Professors Karakash, Dahlke, Larky
Associate Professors Eberhardt, Leenov, McCracken
Assistant Professors Holzinger, Hollabaugh, Barrett
Messrs. Knerr, Juvet, Nehf, Sacks, Talhelm

**E.E. 14. Circuit Theory I (3)**
Energy relations and voltage-current characteristics of idealized electrical circuit elements. Singularity functions. Response of linear circuits. Formulation of network equations. Network theorems and applications. Sinusoidal forcing functions. **Prerequisite: Phys. 4, Math. 204, previously or concurrently.**

**E.E. 100. Summer Work**
During the vacation following the junior year, each student is expected to spend at least eight weeks getting experience in some industrial organization. A written report on the experience gained therein, is due on or before February 1.

**E.E. 101. Analog and Digital Computation (2)**
Concepts of analog and digital computation. Introduction to compiler language programming, assembly language programming, computer organization, analog computer programming. Solution of electrical problems by analog and digital techniques. Includes one three-hour problem session. **Prerequisite: E.E. 104 concurrently.**

**E.E. 103. Physical Electronics (3)**
Physical phenomena basic to vacuum, gaseous, and solid-state electronic devices. Kinetic theory of gases; atomic structure; electron emission. Electronic conduction through solids, vacua, and gases. **Prerequisite: Phys. 4.**

**E.E. 104. Circuit Theory II (4)**
Continuation of E.E. 14. Fourier series, Fourier integral, and Laplace transform. Operational methods applied to electric networks. Poles and zeros. Includes one-three laboratory. **Prerequisite: E.E. 14.**

**E.E. 105. Electronic Circuits (4)**
Transistor and vacuum tube amplifiers. Linear and piecewise linear circuit models. Frequency response, feedback, and oscillation. Includes one three-hour laboratory. **Prerequisite: E.E. 14.**

**E.E. 106. Electrical Machinery (5)**
Analysis of transformers. General analysis of rotating machines including direct current machines, induction motors, synchronous machines, and special machines. Includes one 3-hour laboratory. **Prerequisite: E.E. 104.** Second semester.

**E.E. 107. Alternating Current Machines (3)***
Continuation of E.E. 106. Steady state and transient theories of machines. Balanced and unbalanced conditions; time constants; rigorous and approximate solutions. This course includes one 3-hour laboratory. **Prerequisite: E.E. 106.** First semester.

**E.E. 111. Electrical Engineering Proseminar (1)**
A weekly seminar to acquaint students with developments in research and industry which are outside the scope of the undergraduate courses. Students are required to present oral and written reports on topics relevant to all phases of electrical engineering. **Prerequisite: Senior Standing.**

**E.E. 151. Senior Laboratory (2)**
Senior projects. Two three-hour sessions. **Prerequisites: E.E. 105 and 106.** First semester.

**E.E. 152. Senior Laboratory (2)**
Senior projects. Two three-hour sessions. **Prerequisites: E.E. 105 and 106.** Second semester.

**E.E. 160. Electrical Circuits and Apparatus (3)**
Theory and applications of electrical circuits, machines. Electronic devices and circuits. **Prerequisites: Math. 23, Phys. 4.** First or second semester.

**E.E. 161. Electrical Problems (1)**
A three-hour problem period to accompany E.E. 160. **Prerequisite: E.E. 160 concurrently.** First or second semester.

**E.E. 162. Electrical Laboratory (1)**
Experiments on circuits, machines, and electronic devices. **Prerequisite: E.E. 160 concurrently.** First or second semester.

**For Advanced Undergraduates and Graduates**

**E.E. 201. Introduction to Digital Systems (3)***
Number representation and coding. Serial and parallel arithmetic operations; memory devices and their characteristics; input-output devices; instruction decoding; digital differential analyzers; logical implementation of the above.

**E.E. 205. Pulse and Digital Circuitry (3)***
Wave shaping and pulse generation. Models of electron tubes, semiconductor devices and circuits. Timing and switching circuits. Feedback, negative resistance, and non-linear circuits.

**E.E. 212. Control Systems (3)**
Introduction to feedback control systems. Transfer functions. Trial and error synthesis of time invariant linear controls. Root loci and frequency-response methods. Servomechanism transducers. Non-linear controls. **Prerequisite: E.E. 104.** Second semester.

**E.E. 231. Electric and Magnetic Fields (3)**
Electrostatics and magnetostatics. Three-dimensional field solutions of elementary geometries. Two-dimensional solutions and conformal mapping. Free-hand field plotting and numerical techniques.

**E.E. 233. Power System Analysis I (3)**
Determination of transmission line constants; transmission line equations. General circuit constants. Regulation, efficiency. Symmetrical components. System faults. Sequence impedances of transmission lines, transformer banks; metering. **Prerequisite: E.E. 106.** First semester.

**E.E. 234. Power System Analysis II (3)**
Steady state and transient power limits of transmission systems; electro-mechanical characteristics of electrical machines and networks. **Prerequisite: E.E. 233** Second semester.

**E.E. 241. Logis and Switching Theory (3).***
Switching algebra; n-variable theorems and related active, semi-conductor and magnetic embodiments. Combinational logic; minimization methods using algebra, tables, hypercubes, maps. Symmetric functions, decompositions, and sequential networks. Linear binary machines. **Prerequisites: E.E. 101, 104, and 105.** First semester.

**E.E. 244. Communication Networks (3)***
Introductory theory of two-terminal and four-terminal network synthesis. Matrix representation of networks. Filter theory. **Prerequisites: E.E. 104 and 105.** Second semester.

**E.E. 245. Electromagnetic Theory (3)**
Maxwell's equations: Poynting's theorem; transmission; reflection, and refraction of waves. Transmission lines; rectangular and cylindrical waveguides.

**E.E. 304. Semiconductor Electronics (3)***
Introduction to solid state physics and quantum statistics; band theory; conduction mechanism in solids. Intrinsic and extrinsic semiconductors; junctions. Theory of diodes and transistors. Equivalent circuits.

**E.E. 306. Solid State Magnetic and Dielectric Devices (3)***
Origin of magnetic and dielectric properties. Electrostrictive and magnetostrictive systems. Nonlinear magnetic and dielectric materials. Magnetic and dielectric amplifiers. Digital techniques employing square loop materials. Magnetic recording. Magnetic and dielectric measurements. Ferrites at microwave frequencies.

**E.E. 342. Communication Theory (3)***
Transmission theory for unilateral, active, multi-port networks using Fourier series and integrals. Modulation, the analog and digital coding of information. The demodulation process with noise present. System performance measures. Second semester.

**E.E. 346. Microwave Circuits and Techniques (3)***
Application of Maxwell's equations to obtain the external characteristics of distributed parameter networks. Principles of microwave measurements.

**E.E. 350. Special Topics (3)**
Selected topics in the field of electrical engineering not included in other courses. In 1966-67 topics related to Pattern Recognition and signal detection are considered.

*Departmental Electives

**For Graduates**

A student who wishes to qualify for an advanced degree with a major in electrical engineering should have as preparation for his graduate work background equivalent to that required for the B.S. in E.E. at Lehigh University. Research training or thesis credit equivalent to six semester hours is required by the department for the master's degree. Subject to approval by the departmental advisor. Masters degree programs may include as part of the "major," courses chosen from the 300- and 400-level offerings of other departments.

The laboratories of the Department are located in the James Ward Packard Laboratory of Electrical and Mechanical Engineering. Facilities for experimental work in electronics and communication include low-, medium-, high-, and microwave-frequency components; special research facilities are available for the study of semiconductor networks and digital functions. Students interested in power generation, transmission, and distribution have at their disposal equipment suitable for the study of high and low voltage transients on transmission lines and in machines. Power distribution problems may be studied on a 6-generator, a.c. network analyzer.

**E.E. 401. Digital Systems (3)**
Principles of machine organization; macro- and micro-programming. Modern concepts and practices in logical design.

**E.E. 404. Solid State Device Theory (3)**
Quantum-mechanical concepts, band theory, electron-phonon interactions, statistical transport theory, semiconductor surfaces; special devices, p-i-n and tunnel diodes; avalanche, transit time, and bulk effects. (Can be repeated for credit.)
Messrs. Dahlke, Leenov

**E.E. 410. Electronics of Microwave Tubes (3)**
Optics of electron beams. Ballistic theory of transit time tubes. Space charge waves. Interaction of space charge waves with slow electromagnetic waves. Thermal noise in electron streams with basic introduction to mathematical treatment of random noise. Latest devices using free electrons. First semester.
Mr. Eberhardt

**E.E. 411. Information Theory I (3)**
Topological spaces; metric spaces; measure; probability theory. Information measure, self- and mutual; maximization and inequalities; channels, transmission criteria, and control of redundancy including feedback and fading. First semester.
Mr. McCracken

**E.E. 412 Information Theory II (3)**
Continuous channels without memory, coordinate transformation and noise whitening, Gaussian channels. Band limited signals, sampling, normed linear multi-dimensional spaces, character recognition with criteria. Transitional entropy, cylinder sets, shift translations, sequential processes, networks, and automata.
Mr. McCracken.

**E.E. 413. Active Networks (3)**

Synthesis of active networks to proscribed frequency characteristics, stability and realizability criteria, parameter drift effects. (Offered alternate years.)

Mr. Larky

**E.E. 423. Power System Transients I (3)**

Traveling waves; free and forced oscillations; reflections; transition points; multi-conductor systems; multi-velocity waves. Attenuation and distortion; lighting surges; switching surges; arcing grounds; protective devices. Surges in transformer and machine windings. First semester. (Offered alternate years.)

**E.E. 424. Power System Transients II (3)**

Transient stability problems, including machine inertias, unbalanced system conditions, and switching operations. Economic operation of combined systems. Second semester. (Offered alternate years.)

**E.E. 433. Tensor Analysis of Electric Circuits and Machines (3)**

The application of dyadics, matrices, and tensors to the theory of electric circuits and machinery, static networks, network theorems, vacuum tube circuits, transformers, and transmission lines. (Offered alternate years.)

**E.E. 435. Power System Stability (3)**

Power flow in electric circuits, steady state power limits of systems having synchronous and asynchronous machines with salient poles or round rotors, stability criteria, and other related topics. First semester. (Offered alternate years.)

**E.E. 437. Advanced A.C. Machine Theory (3)**

The two-reaction theory of synchronous machines; harmonic analysis; field and armature time constants; direct and quadrature synchronous, transient, and subtransient reactances; electrical and mechanical transients; calculation of voltage, current, mechanical oscillations, hunting, forces and torques; operation of machines under unbalanced conditions and faults; effect of variable excitation. Two lectures and one laboratory period per week. Second semester. (Offered alternate years.)

**E.E. 441. Automatic Control Systems I (3)**

Logical synthesis of continuous and discrete, linear and non-linear, time-invariant control systems using Wiener methods. Generalized harmonic analysis; probability functions, averaging, stationary processes, correlation, spectra, and Campbell's theorems. Error minimization and functional minimization using Lagrangian multipliers. Error integral equation formulation, reduction to factorization solutions, and compensation network realizations. Control of bandwidth, saturation, dead-zone, sampling, and quantization in system design. First semester. (Offered alternate years.)

Mr. McCracken

**E.E. 442. Automatic Control Systems II (3)**

Fourier integral treatment of linear, multipole, time-invariant systems. Double Fourier integral analysis of time-varying systems. Vectors, matrices, and linear transformations; eigenvalues, eigenvectors, and canonical forms; calculus of matrices and linear differential equations. Autonomous systems analysis; stability, phase-planes. Poincare index, Lyapunov functions. Discrete systems analysis; stability, responses, Nyquist sampling; adaptive switching for terminal control, minimum-time and maximum range. Second semester. (Offered alternate years.)

Mr. McCracken

**E.E. 443. Network Theory (3)**
Properties of driving-point and transfer functions; synthesis; realizability and positive-real functions. First semester. Mr. Larky

**E.E. 444. Microwave Devices (3)**
Devices using paramagnetic resonance: isolators, circulators, digital phase shifters, modulators, limiters. Cavity and traveling wave maser. Optical masers. Cavity and traveling wave parametric amplifiers. Tunnel diode amplifiers. Application of perturbation theory to microwave devices. Second semester.
Mr. Eberhardt

**E.E. 450. Special Topics (3)**
Selected topics in the field of electrical engineering not covered in other courses.

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# ENGLISH

Professors Severs, Strauch, Hook
Associate Professors Armstrong, Dilworth, Hartung, Frakes, Greene
Assistant Professors Criswell, Vickrey, DeBellis, James, Marx, Harson
Messrs. Baker, Digel, Cunningham, Brown, Johnstone,
Keiser, Moisiades, Beidler, MacDonald, Dullea, Bentone,
Corey, Miss Cote, Messrs. Kowalski, Ness, Santore, Zak

### English Composition

All students must meet the requirements of six semester hours in freshman composition. This may be done through satisfactory performance in (a) the regular freshman courses, Engl. 1 and 2, (b) the Engl. 11 and 12 program as outlined below, or (c) the Advanced Placement Tests administered by the College Entrance Examination Board.

First semester freshmen are divided, on the basis of preliminary tests, into two groups: (1) those whose preparation appears to have been adequate but who do not give evidence of outstanding ability, and (2) those who give evidence of outstanding ability. Students in Group 1 are required to take Engl. 1 and 2; those in Group 2 are given the option of taking either Engl. 11 or 12 (an advanced course in World Literature) or Engl. 1 and 2.

So that superior students may be enabled to satisfy their requirements more rapidly and thus accelerate their progress, those students of Group 2 who elect to take Engl. 11 and 12 will be given credit for Engl. 1 and 2 upon satisfactory performance in Engl. 11 and 12. Thus the superior student can receive twelve credit hours for taking six credit hours of Engl. 11 and 12. If the student does not perform satisfactorily in Engl. 11 and 12 he will not receive credit for Engl. 1 and 2.

A student whose classwork shows that he has been placed in the wrong group may be transferred to a higher or lower group at any time during the year, if his instructor recommends and the head of the department approves the transfer.

**Engl. 1. Composition and Literature (3)**
Practice in expository writing and the application of rhetorical principles; readings in expository prose; a rapid review of functional grammar. First and second semesters.

**Engl. 2. Composition and Literature (3)**
Continuation of Engl. 1. Further practice in expository writing in conjunction with readings in literature. **Prerequisite: Engl. 1.** First and second semester.

**Engl. 1X. English for Foreign Students (3)**
Practice in reading, writing, and speaking the English language, with exercise in listening and note taking. A substitute for Engl. 1 for foreign students who demonstrate a need. Open also to transfer and graduate students. **Prerequisite: Consent of chairman of department.** First semester.

**Engl. 2X. English for Foreign Students (3)**
Continuation of Engl. 1X. A substitute for Engl. 2 for foreign students who demonstrate a need. **Prerequisites: Engl. 1X or its equivalent and consent of chairman of department.** Second semester.

**Engl. 11. Types of World Literature (3)**
A course in composition and literature for superior students who do not need or who have had the basic training of Engl. 1 and 2. In addition to wide and thoughtful reading in world masterpieces, the course requires correct and effective writing of critical essays, original sketches, and documented research papers. Not open to students who have taken Engl. 36. First semester.

**Engl. 12. Types of World Literature (3)**
Continuation of Engl. 11. Not open to students who have taken Engl. 36. May be taken independently of Engl. 11. Second semester.

### English Literature and Advanced Composition

Students wishing to major in English literature should take as preliminary work Engl. 8 and 9, or such equivalent courses as may be recommended by the chairman of the department. They should then elect a total of ten advanced English courses in the junior and senior years. Students working for honors take a course in which they prepare a thesis as part of the honors requirement.

**Engl. 4. A Study of the Drama (3)**
Reading and critical study of the drama; theories of the drama; the drama and the stage; the drama as a criticism of life. **Prerequisite: Engl. 2 or 12.** First semester.

**Engl. 5. A Study of the Drama (3)**
Continuation of Engl. 4. **Prerequisite: Engl. 2 or 12.** Second semester.

**Engl. 7. A Study of the Short Story (3)**
A critical study of the short story, English, American, and Continental. Class discussions, extensive collateral reading, and reports. **Prerequisite: Engl. 2 or 12.** First and second semesters.

**Engl. 8. English Literature (3)**
A survey of English literature from *Beowulf* through the Pre-Romantics, with selected readings. **Prerequisite: Engl. 2 or 12.** First semester.

**Engl. 9. English Literature (3)**
A survey of English literature from Wordsworth to Housman. **Prerequisite: Engl. 2 or 12.** Second semester.

**Engl. 18. The Novel (3)**
A study of a selection of novels as noteworthy works of literature. **Prerequisite: Engl. 2 or 12.** First semester.

**Engl. 19. The Novel (3)**
Chronological continuation of Engl. 18. **Prerequisite: Engl. 2 or 12.** Second semester.

**Engl. 20. American Literature, 1607-1855 (3)**
A survey of the major writers from the settlement of America to the Civil War. Lectures and class discussions. **Prerequisite: Engl. 2 or 12.** First semester.

**Engl. 21. Modern American Literature (3)**
A study of the development of American literature from Whitman to the present day. Lectures and class discussions. **Prerequisite: Engl. 2 or 12.** Second semester.

**Engl. 35. Poetry (3)**
The analytical and critical reading of poetry, to provide such acquaintance with idiom and technique that poetry may be read with pleasure and understanding. **Prerequisite: Engl. 2 or 12.** Second semester.

**Engl. 36. Masterpieces of World Literature (3)**
A study of great works selected from the literature of epic poetry, the drama, the romance, philosophy, and the essay to illustrate the humanistic traditions of Western civilization. Not open to students who have taken Engl. 11 or 12. **Prerequisite: Engl. 2.** First and second semesters.

**Engl. 142. Technical Writing (3)**
Study and practice in forms and methods of technical exposition, description, definition, classification; the technical report, abstract. **Prerequisite: Engl. 2 or 12.** First and second semesters.

**Engl. 181. Undergraduate Thesis (3)**
Open to advanced undergraduates who wish to submit theses in English. **Prerequisite: Consent of chairman of department.** First semester.

**Engl. 182. Undergraduate Thesis (3)**
Continuation of Engl. 181. **Prerequisite: Consent of chairman of department.** Second semester.

**Engl. 183. Readings in English Literature (3)**
Open to advanced students who wish to pursue special courses of reading in English literature. **Prerequisite: Consent of chairman of department.** First semester.

**Engl. 184. Readings in English Literature (3)**
Continuation of Engl. 183. **Prerequisite: Consent of chairman of department.** Second semester.

## ENGLISH LITERATURE

### For Advanced Undergraduates and Graduates

Advanced degrees may be obtained in all areas of English and American literature. Members of the Department are particularly interested in advanced work in the following areas: Chaucer and medieval literature, Shakespeare and Elizabethan drama, twentieth-century literature, and American literature.

Students desiring to qualify for graduate degrees in this Department should have taken as part of their undergraduate work at least twelve semester hours of advanced courses in English literature. Those with undergraduate deficiencies who are admitted because otherwise well qualified will be expected to make up such deficiencies in addition to satisfying the minimum requirements for the degree sought.

Candidates for the master's degree majoring in English may qualify for the degree under either of two plans offered by the Department. Under Plan I the candidate is required to complete successfully eight semester courses (twenty-four semester hours) and to write a thesis representing the equivalent of six hours of course work, but he is not required to take an examination covering the entire field. Under Plan II no thesis is required; but the student, in addition to completing successfully ten semester courses (thirty semester hours), must pass an examination, usually oral, covering the entire field of English literature. The candidate selects the plan better suited to his needs and abilities, upon the advice and with the approval of the Head of the Department.

If his needs and interests make it desirable for him to do so, the candidate for the master's degree is permitted to take collateral work in other departments to the extent of six semester hours in lieu of an equivalent amount in the major field.

Candidates for the doctor's degree are accepted in English only after a consultation among the graduate professors concerning the candidate's qualifications. A reading knowledge of two foreign languages is required, usually Latin, French, or German; and the candidate must give evidence of such knowledge, through examination, either before, or soon after, he is accepted.

For the purposes of the general examination for the doctorate in English, each candidate will select the following fields to be examined upon:

1. Major field, in which primary materials (literature) and secondary materials (scholarship and criticism) will be examined.

2. Two minor fields, in which primary materials only will be examined.

3. Three major figures, concerning whom primary and secondary materials will be examined. The three major figures must be chosen outside the major and minor fields in 1 and 2 above, and at least two of them must be figures not studied in a graduate seminar. They may not be figures already treated by the candidate in a master's thesis or to be treated in the doctoral dissertation.

The three fields (one major and two minor) must be chosen from the following list, one from each group; and the fields may not be contiguous.

Group I
Middle English (1050-1500)
Renaissance (1500-1600)
Elizabethan and Jacobean Drama (1500-1642)

Group II
Seventeenth Century to Restoration (1600-1660)
Restoration and Augustan (1600-1740)
Age of Johnson (1740-1800)

Group III
Romantic (1800-1835)
Victorian (1835-1900)
American Literature to 1900
English and American Literature 1900 to World War II

**Engl. 317. The Contemporary Drama (3)**
A course in contemporary American and European drama with particular emphasis upon the development of social and philosophical conflicts of the present day. Summer session. Mr. Cunningham

**Engl. 318. American Literature (3)**
Movements that have shaped American thought and feelings as expressed in the national literature: Puritanism, Americanism, Romanticism, Transcendentalism, Individualism, the Civil War, Democracy, the West, Realism, Internationalism, and Skepticism, as presented by Jonathan Edwards, Franklin, Paine, Longfellow, Poe, Emerson, Thoreau, Mark Twain, Henry James, and Henry Adams. Summer session. Mr. Strauch

**Engl. 320. The Novel (3)**
The great masterpieces of prose fiction produced in England, in America, and on the Continent during the nineteenth and twentieth centuries; development of types of the novel; the theory and technique of the novel. Summer session.
Mr. James

**Engl. 321. Twentieth-Century American Literature (3)**
American literature before World War II. Lectures and class discussion of major fiction and poetry. First semester. Messrs. Strauch, Frakes

**Engl. 322. Twentieth-Century European Literature (3)**
English and Continental literature before World War II. Lectures and class discussion of major fiction and poetry. Second semester.
Messrs. Strauch, Frakes

**Engl. 323. Shakespeare and the Elizabethan Drama (3)**
The development of the English drama, including the important plays of Shakespeare. First semester. Mr. Hook

**Engl. 324. Shakespeare and the Elizabethan Drama (3)**
Continuation of Engl. 323. Second semester. Mr. Hook

**Engl. 325. English Literature of the Romantic Era (3)**
Poetry and prose of the chief romantic writers—Wordsworth, Coleridge, Scott, Byron, Shelley, Keats, Lamb, Hazlitt, De Quincey—with consideration of the political, religious, and social problems of the period as they are exhibited in the literature. Readings and class discussions. First semester. Messrs. Severs, Harson

**Engl. 326. English Literature of the Victorian Era (3)**
Poetry and prose of the chief Victorian writers—Tennyson, Browning, Arnold, Clough, Rossetti, Morris, Swinburne, Macaulay, Carlyle, Mill, Newman, Ruskin—with consideration of the political, religious and social problems of the period as they are exhibited in the literature. Readings and class discussions. Second semester. Messrs. Severs, Marx

**Engl. 331. Milton (3)**
The life and works of John Milton in connection with the history of his times and the chief sources of his inspiration. First or second semester. Mr. Greene

**Engl. 333. Restoration and Augustan Literature (3)**
Prose and poetry from 1660 to 1745, with special emphasis upon the works of Dryden, Pope, and Swift. First or second semester. Mr. Dilworth

**Engl. 334. Age of Johnson (3)**
English prose and poetry from 1745 to 1798. Dr. Johnson and his circle and the Pre-Romantics, including Burns and Blake. First or second semester.
Mr. Dilworth

**Engl. 335. History of the English Language (3)**
A survey of the development of the English language, in vocabulary, pronunciation, and structure, beginning with its relation to the other Germanic languages and coming down to modern English usage. First or second semester.
Mr. Vickrey

**Engl. 336. Writing for Publication (3)**

Comprehensive study of the short story and practice in the various techniques of writing short stories, essays, and poems with a view to publication. First or second semester. Mr. Criswell

**Engl. 337. The Renaissance (3)**

The growth of English non-dramatic literature in the sixteenth century and the stimulus of the Italian Renaissance and northern humanism. Readings in and class discussions of the works of the chief writers—Petrarch, Erasmus, More, Wyatt, Surrey, Lyly, Sidney, and Spenser. First semester. Mr. Greene

**Engl. 338. The Seventeenth Century (3)**

The rich variety of English literature from Donne to Dryden—Donne and the "Metaphysical School"; Jonson and "The Tribe of Ben"; Cavalier and religious poetry; the prose of Bacon, Brown, Burton, Walton, and Bunyan. Second semester. Mr. Armstrong

**Engl. 339. Chaucer (3)**

Reading and critical study of the chief works of Geoffrey Chaucer, with attention to his language and the backgrounds of his works. First or second semester. Mr. Hartung

**Engl. 340. Principles of Advanced Composition (3)**

A study of the principles and rhetorical forms of non-narrative prose with intensive practice in writing at an advanced level. Attention to the theory of language and grammar. Corollary readings, conferences, and class discussions. **Prerequisite: English major standing or 2.5 average in freshman English.** First or second secester. Mr. Digel

**Engl. 341. Contemporary American Literature (3)**

American literature since World War II. Lectures and class discussion of new writers and of recent works by established writers. First semester. Messrs. Frakes, De Bellis, James

**Engl. 342. Contemporary European Literature (3)**

English and Continental literature since World War II. Lectures and class discussions of new writers and of recent works by established writers. Second semester. Messrs. Frakes, De Bellis, James

**Engl. 343. American Romanticism (3)**

A study of the chief American Romantics, Emerson, Thoreau, Whitman, Hawthorne, Melville, and Emily Dickinson. The European and American philosophical, historical, and social background as well as the formal aesthetic study of romantic masterpieces. First or second semester. Mr. Strauch

**Engl. 344. American Realism (3)**

The rise of realism in prose and poetry in the period roughly from the 1870's to 1914: Twain, Howells, James, Robinson, Norris, Crane, Dreiser and others. First or second semester. Mr. Frakes

**Engl. 345. Themes in American Literature (3)**
A study of important themes in American literature, illustrating historical, regional, and social conditions and drawn from works of authors from the colonial period to the present.

**Engl. 346. Middle English Literature (3)**
A study of the major literary works of the Middle English period by authors other than Chaucer. Some works will be dealt with in translation, some in the original. In addition to such major figures as Langland, Gower, and the Pearl Poet, the metrical romances will be emphasized. First or second semester.
Mr. Hartung

**For Graduates**

**Engl. 400. Old English (3)**
A study of the Old English language and literature. First or second semester.
Mr. Vickrey

**Engl. 401. Beowulf (3)**
A study of the Beowulf poem and some of the pertinent scholarship. Second semester. Mr. Vickrey

**Engl. 404. Literature of the Fourteenth Century (3)**
Types of medieval literature, with special attention to Langland, Gower, and Chaucer. Mr. Severs

**Engl. 405. Chaucer (3)**
A study of the life and works of Chaucer. Readings, reports, and class discussions. First semester. Mr. Severs

**Engl. 406. Chaucer (3)**
Continuation of Engl. 405. Second semester. Mr. Severs

**Engl. 412. Shakespeare's History Plays (3)**
A study of the English history plays as an introduction to advanced work in Shakespeare. First or second semester. Mr. Hook

**Engl. 413. Shakespeare's Roman Plays (3)**
An intensive critical study of *Julius Caesar, Antony and Cleopatra,* and *Coriolanus.*
Mr. Hook

**Engl. 414. Sixteenth-Century Drama (3)**
A study of plays representing the development of English drama before Shakespeare. Mr. Hook

**Engl. 418. Donne (3)**
A study of the complete body of Donne's verse, with especial concern for its meanings. Mr. Armstrong

**Engl. 444. Pope (3)**
A study of the works of Pope and their literary background. First or second semester. Mr. Dilworth

**Engl. 447. Eighteenth-Century Prose (3)**
Studies in periodical prose (Addison and Steele) and in the satire and comic moralism of Swift, Fielding, Johnson, and Goldsmith. Mr. James

**Engl. 448. Studies in the Eighteenth Century (3)**
Studies in, and reports on, one or more authors or issues in eighteenth-century English literature. Mr. Dilworth

**Engl. 452. Keats (3)**
A study of the life and works of John Keats. Readings, reports, and class discussions. Mr. Severs

**Engl. 457. Carlyle and Arnold (3)**
The major works of Carlyle and Arnold contrasted and compared in terms of Romanticism and Victorian social and religious problems. Mr. Strauch

**Engl. 461. Conrad (3)**
A study of Conrad's major novels and tales, with emphasis on the author's style, technique, and attitude. Mr. Greene

**Engl. 465. Joyce (3)**
A sequential study of the works of James Joyce, their place in Irish and world literature, and their influence on twentieth-century prose. Mr. Frakes

**Engl. 472. Transcendentalism, Hawthorne, and Emerson (3)**
Representative works of the Transcendentalist movement; the major works of Hawthorne and Emerson contrasted and compared in terms of Transcendentalism and Romanticism. First or second semester. Mr. Strauch

**Engl. 473. Melville and Whitman (3)**
The major works of Melville and Whitman contrasted and compared in terms of Romantic doctrine. First or second semester. Mr. Strauch

**Engl. 477. Twain and James (3)**
Selected works of Twain and James representing the development of American fiction after the Civil War. Mr. Strauch

**Engl. 480. Hemingway and Faulkner (3)**
A thematic and stylistic examination of the major works of Hemingway and Faulkner. Mr. Frakes

**Engl. 486. Literary Criticism (3)**
A course aimed to correlate and unify the student's previous work in literature by means of wide reading in critical literature and discussions of theories and schools of criticisms. First semester.

**Engl. 487. Literary Criticism (3)**
Continuation of Engl. 486. Second semester.

**Engl. 492. Bibliography and Methods of Research (3)**

A study of the bibliographical tools essential to an advanced student of English literature. Survey of historical, or critical bibliography, of both printed books and manuscripts; of practical bibliography, including direction in the compilation of a list of books and articles on an assigned subject and in the procedures of thesis writing; and of enumerative bibliographies of English language and literature. First or second semester. Mr. Severs

**Engl. 493. The Teaching of College English (2)**

The principles and practice of teaching composition, prose, and other literature on the college level. A consideration of standards, organization, grammar, diction, and style in student writing and the adaptation of a student writing program to readings in prose and other literature. Class discussions, actual teaching, and reports. First semester. Mr. Hartung

**Engl. 494. The Teaching of College English (1)**

Continuation of Engl. 493. Second semester. Mr. Hartung

**Engl. 495. Graduate Seminar (3)**

An intensive study of the works of one or more English or American authors or of a type of literature. Summer session. Messrs. Dilworth, Frakes, Greene, Hartung, Hertz, Hook, Severs

**Engl. 496. Graduate Seminar (3)**

An intensive study of the works of one or more English or American authors, or a type of literature. Subject and instructor vary from semester to semester according to the needs of the students and the wishes of the department. Courses available are Johnson's Literary Criticism (Mr. Dilworth), Approaches to the Short Story (Mr. Frakes), Approaches to Poetry (Mr. Greene), Approaches to Composition (Mr. Hartung), Approaches to Literary Criticism (Mr. Hertz), Shakespeare for Teachers (Mr. Hook), Seventeenth-Century Drama (Mr. Hook), Studies in Victorian Literature (Mr. Marx), Wordsworth (Mr. Severs). First semester.

**Engl. 497. Graduate Seminar (3)**

Same as Engl. 496. Second semester.

**Engl. 498. Graduate Thesis (3)**

First semester. Mr. Severs and others

**Engl. 499. Graduate Thesis (3)**

Second semester. Mr. Severs and others

## SPEECH — RADIO — THEATRE

Professor Davis
Associate Professor Barker
Mr. Hess

**Speech Clinic**

For the purpose of diagnosis and treatment of speech defects. Individual instruction provided for students with minor disturbances of voice and speech, as well as those with more serious handicaps. Open to all students in need of corrective treatment and to those desiring speech tests. By appointment. No credit.

**Speech 11-13. Principles of Theatre Art (1)**
The aesthetic process by which plays are translated into theatrical terms for the appreciation and enjoyment of all forms of dramatic art. Students enrolling for their first semester register for Speech 11; for their second semester, Speech 12, etc. First and second semesters.

**Speech 21-23. Impromptu Speaking (1)**
The organization and presentation of short expository speeches and of speeches for special occasions. Content drawn from contemporary events. Students enrolling for their first semester register for Speech 21; for their second semester, Speech 22, etc. First and second semesters.

**Speech 30. Fundamentals of Speech (3)**
A foundation course designed to develop knowledge of the basic principles of speech and ability to speak effectively on the platform. First and second semesters.

**Speech 31. Business and Professional Speaking (3)**
Development of speech for business and professional problems: technique of expository speaking; use of visual graphics; persuasive speaking applied to the emotional or analytical approach in selling; methods of interviewing; techniques of conference. First and second semesters.

**Speech 32. Conference and Discussion (3)**
The technique of investigation, analysis, evidence, inference, briefmaking, and refutation in oral argument; participation in the various forms of discussion—conference table, panel, and symposium—and in various types of debate—conventional, cross-examination, and direct clash. First and second semesters.

**Speech 33. Parliamentary Procedure (1)**
Study and drill in modern rules and methods of conducting organized group-deliberation. First and second semesters.

**Speech 34-36. Debate (1)**
A study of the principles and techniques of debate, analysis, evidence, reasoning, refutation, briefing, speech composition, and delivery skills. Members required to participate in the activities of the Debate Society. Students enrolling for their first semester register for Speech 34; for their second semester, Speech 35, etc. First and second semesters.

**Speech 61. Dramatics (3)**
The practical technique and production of plays; acting, stage-lighting, scenic design and execution, and student direction of plays. Each member must write either an original one-act play or a thesis upon any practical problems of the modern theatre. One play is presented each semester.

**Speech 62. Dramatics (3)**
Continuation of Speech 61. **Prerequisite: Speech 61.**

**For Advanced Undergraduates and Graduates**

**Speech 260. Speech for the Teacher (3)**
An orientation course in the field of speech for those engaged in classroom teaching or in directing extra-curricular speech activities. Discussion as a teaching device; integration of speech with other subjects; recognition of common defects of speech; modern emphases in speech contests. Individual investigations, reports, and conferences. Summer session. Mr. Davis

## JOURNALISM

Professor McFadden
Associate Professor Sullivan

Journalism majors must successfully complete at least four semesters of Journ. 1-10, *Brown and White*, taking it during each semester of residence following the declaration of their major. They must also take Journ. 11, 12, 17, 113, 115, 120, 121 and 122 and the following courses: Gk. 21 or Lat. 22, and Phil. 15.

**Journ. 1-10. Brown and White (1 or 2)**
Enrollment constitutes membership on the staff of the semi-weekly paper. Students enrolling for their first semester register for Journ. 1; for their second semester, Journ. 2, etc. **Prerequisite: Consent of chairman of department.** First and second semesters.

**Journ. 11. News Writing (3)**
Definition, determinants, and components of news; news story structure and style; sources; interviewing; practice in gathering and writing news. First semester.

**Journ. 12. Reporting of Public Affairs (3)**
Reporting and writing news of government on the local, county, state, and federal levels; civil and criminal courts; labor, science, and entertainment news. **Prerequisite: Journ. 11.** Second semester.

**Journ. 17. Magazine Article Writing (3)**
Writing and marketing non-fiction magazine articles. First or second semester.

**Journ. 21. Creative Writing (3)**
The study and writing of fiction, short-stories, especially with a view to developing each student's particular talent. **Prerequisite: Engl. 2.** First semester.

**Journ. 22. Creative Writing (3)**
Continuation of Journ. 21. **Prerequisite: Engl. 2.** Second semester.

**Journ. 111. Problems in Advanced Reportage (3)**
Intensive practice in the reporting of complex events. First semester.

**Journ. 112. Problems in Advanced Reportage (3)**
Continuation of Journ. 111. Second semester.

**Journ. 113. Editing (3)**
Study of and practice in newspaper desk work; headline writing, make-up, and typography; selecting, editing, and rewriting news and feature copy; use of reference works and morgue. **Prerequisite: Journ. 11.** First semester.

**Journ. 115. Interpretive Writing (3)**
Editorial interpretation of current events; practice in interpretive writing, including editorials. **Prerequisite: Journ. 12.** Second semester.

**Journ. 118. History of American Journalism (3)**
English background of the American newspaper; development of press from Colonial days to the present; influence of newspaper on American life; contributions of outstanding journalists. Second semester.

**Journ. 120. Journalism Proseminar (3)**
Survey of the press in its relation to public affairs. Extensive research and reports. **Prerequisite: Consent of chairman of department.** First semester.

**Journ. 121. Law of the Press (3)**
Constitutional development of freedom of the press; rights and responsibilities of the press. First semester.

**Journ. 122. Law of the Press II (3)**
Law of and defenses in libel; privacy; contempt; copyright; obscenity. Second semester.

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# FINANCE

Professors Jensen, Schwartz
Associate Professor Krouse
Assistant Professor Aronson
Mr. Petrakis

**Fin. 125. Principles of Corporation Finance (3)**
An intensive course covering the fundamentals of corporation finance in one semester. **Prerequisite: Eco. 3, Acctg. 2 or 104.** First and second semesters.

**Fin. 129. Money and Banking (3)**
A general course dealing with the nature and functions of money and commercial banking, monetary and banking development in the United States, the value of money, foreign exchange, and monetary, credit and fiscal policies. **Prerequisite: Eco. 4.** First and second semesters.

**Fin. 130. Money and Banking (3)**
A course dealing with specific monetary and banking problems with suggested actions to resolve these problems. **Prerequisite: Fin. 129.** Second semester.

The courses listed below have as prerequisite a one-year course in the principles of economics, in addition to such other prerequisites as may be specified in the descriptions of individual courses.

**For Advanced Undergraduates and Graduates**

**Fin. 323. Investments (3)**
A study, from the standpoint of the investor, of the various types of corporation and government securities, with special reference to owners equities, comparative yields, and the machinery of investment, including stock exchange operations. **Prerequisite: A course in corporation finance.** First semester. Mr. Krouse

**Fin. 324. Investments (3)**
A project course in investment analysis for advanced students who are already familiar with investment principles. Sources of data and analysis procedures: the securities of industrials, railroads, public utilities, and municipalities. **Prerequisite: Fin. 323.** Second semester. Mr. Krouse

**Fin. 326. Problems in Financial Management (3)**
Consideration is given to the financial policies of management, with considerable emphasis placed on the corporation's relationship to government and the general economy. **Prerequisite: A course in corporation finance.** Second semester. Messrs, Krouse, Schwartz

**Fin. 331. Bank Credit Management (3)**
Problems surrounding the extension of loans to customers and the purchase of open-market paper by the individual banker; detailed consideration of legal regulations and restrictions, instruments of bank credit extension, and analysis of the bank borrower's credit position treated in detail. **Prerequisite: A course in money and banking.** Second semester. Mr. Krouse

**Fin. 332. Monetary-Fiscal Policy (3)**
A course devoted to the study of monetary, credit, and fiscal policies of governments and central banks with particular reference to the policies of the United States Treasury and the Federal Reserve System. Current problems will receive special emphasis. **Prerequisite: A course in money and banking.** First semester. Messrs. Aronson, Jensen, Schwartz

**Fin. 337. International Economics (3)**
The theory of international trade; the theory of tariffs; United States Commercial policies; the impact of growth and development on the world economy. First semester. Mr. Jensen

**Fin. 338. International Economics (3)**
The balance of payments and the theory of disturbances and adjustment in the international economy; international monetary policies. Second semester. Mr. Jensen

**Fin. 343. European Economic Integration (3)**
Analysis of the problems of economic integration with special emphasis on the development of economic cooperation and integration in Western Europe. The methods and the problems of economic planning in the Common Market. United States trade and investments and European economic integration. First or second semester. Mr. Jensen

**Fin. 351. Public Finance: Federal (3)**
A course dealing with government expenditures and revenues, the economics of taxation, and government administration. First semester. Messrs. Aronson, Jensen, Schwartz

**Fin. 352. Public Finance: State and Local (3)**
The major issues regarding revenues, expenditures, debt, and budgeting policy will be examined in the light of fiscal principles and economic effects. Particular attention will be given to current practices in Pennsylvania and contiguous states. **Prerequisite: Fin. 351.** Second semester. Mr. Aronson

**Fin. 371. Readings in Finance (3)**
A course of readings in various fields of finance, designed for the student who has a special interest in some field of finance not covered in schedule courses. **Prerequisite: Preparation in finance acceptable to the department chairman.** First semester. Staff

**Fin. 372. Readings in Finance (3)**
Continuation of Fin. 371. Second semester. Staff

## For Graduates

**Fin. 421. Financial Management (3)**
A case study of financial management problems of business. Attention is given to the control of current funds, working capital operations, and estimating the need for funds; the problem of long-term capital funds and expansion, and the choice between risk and profitability in the capital structure are also considered. **Prerequisite: Preparation in finance acceptable to the instructor.** First and second semesters. Messrs. Krouse, Schwartz

**Fin. 425. Public Finance (3)**
Major issues in taxation of income, consumption, and capital; principles of government debt management; budgeting and fiscal planning for economic stability and growth. Mr. Schwartz

**Fin. 431. Advanced Investment Analysis and Portfolio Management (3)**
This course is designed to integrate the theoretical and empirical aspects of the economic environment with the investment analysis associated with portfolio management program of financial intermediaries and individuals. Particular emphasis will be given in the course to the current impingements of the economic environment upon portfolio management decisions. Krouse, Rosenbaum

**Fin. 441. Foreign Trade Management (3)**
Current problems of foreign operations: including channels of export in foreign markets, management of exports at home and abroad, export and import financing, foreign investments, policies of government and international agencies as they affect foreign operations. Second semester. Mr. Jensen

**Fin. 444. Banking and Monetary Policy (3)**
Description and analysis of the U. S. monetary and banking structure. The supply and demand for funds. Financial markets. Central bank controls; monetary theory and policy. **Prerequisite: A course in Money and Banking.** First and second semesters. Messrs. Aronson, Jensen, Schwartz

**Fin. 471. Special Topics (3)**
Selected topics not covered in scheduled courses in the Department. First semester. (Offered as required.) Staff

**Fin. 472. Special Topics (3)**
Similar to Fin. 471. May be elected separately. Second semester. (Offered as required.) Staff

# FINE ARTS

Professor Quirk
Associate Professor Redd

**F.A. 1. Survey of Painting and Sculpture (3)**
A basic history of man's artistic expression in painting and sculpture from prehistoric times through the High Renaissance. Lectures. First semester.

**F.A. 2. Survey of Painting and Sculpture (3)**
Manneristic, baroque, rococco, Nineteenth Century and Contemporary expression. Lectures. Second semester.

**F.A. 3. Pre-Renaissance Architecture (3)**
A study of man's expression through architecture from the prehistoric through the Romanesque period. Conditioning influences, evolution of styles, the development of organic and inorganic types, in relation to structural purposes. Lectures. First semester.

**F.A. 4. Architects and Architecture (3)**
Factors determining the development and spread of Gothic, Renaissance, and succeeding styles, the effects of discovery and exploration, the rise of romantic, classic, functional, international, and contemporary movements are examined as periodic expression. Principles of appreciation and aesthetic character in the scientific age. Lectures. Second semester.

**F.A. 15. Italian Renaissance Art (3)**
Painting and sculpture are examined as the outgrowth of conditions in Italy during the fourteenth, fifteenth, and sixteenth centuries: the influence of medieval thought and tradition, the awakening interest in nature, the effect of antiquity, especially the stimulus it gave to individual effort. Lectures. First semester, alternate years.

**F.A. 31. Elements of Art (3)**
Elementary techniques in representation, color theory, composition, surface anatomy, design theory are taught with the use of various media preliminary to the practice of guided creative expression. Portrait models, casts, still life precede landscape study. For beginners and trained students. Evaluation based on individual advancement in the sequential, assigned projects. Studio. First semester.

**F.A. 32. Elements of Art (3)**
Essentially the same as F.A. 31 for beginners. Advanced students extend experience and range of media. Emphasis is placed on more effective control of basics, the establishment of individual style, and the incorporation of aesthetic principles in assigned as well as original projects. Studio. Second semester.

**F.A. 33. Painting Practices and Principles (3)**
Focus is on the broader aspects of creative expression and the effective production of paintings accenting an area of optional specialization. Assignments in complimentary areas, research and experimentation in combined media. **Prerequisites: F. A. 31 or 32, or consent of chairman of department.** Studio. First semester.

**F.A. 34. Painting Practices and Principles (3)**
Similar to F.A. 33. Further penetration of manners and means of expression in chosen area and style. Easel and mural painting. Assigned projects. **Prerequisites: F. A. 31 or 32, or consent of chairman of department.** Studio. Second semester.

**F.A. 41. Basics in Architecture (3)**
An introduction to rendering, three-dimensional forms, utility, organization of space. Perspective, color, textures of materials, site, and light. Emphasis on contemporary design. Plans. For beginners and trained students. **Prerequisites: Either engineering drawing, architectural drawing, or field experience; or consent of chairman of department.** First semester.

**F.A. 42. Contemporary Architectural Design (3)**
Further study in techniques. Plans and details, models, design problems. Integration of function and aesthetic satisfaction. For beginners and trained students. **Prerequisites: Either engineering drawing, architectural drawing, or field experience; or consent of chairman of department.** First semester.

**F.A. 131. Advanced Studio Practice (3)**
Primarily for students with thorough art foundation. Painting, drawing, graphics. Industrial projects. Woodblock, etching, oil painting, silver-point, tempera. **Prerequisite: Consent of chairman of department.** First semester.

**F.A. 132. Advanced Studio Practice (3)**
Continuation of F.A. 131. Familiarization with variety of media and techniques. **Prerequisite: Consent of chairman of department.** Second semester.

**F.A. 216. Art in the U. S. (3)**
A study of phases of American expression. Painting, sculpture, architecture in relation to cultural progress from Colonial to present time. The analogical and synthetic approaches to art as an index of changing environment. Museum Research. Reports. Second semester. Mr. Quirk

**F.A. 219. 19th Century Painting (3)**
From Neoclassicism through the development of Naturalism. Emphasis on Impressionism from Manet to Cezanne. Written reports. Discussions. The analytical and appreciative approaches. First semester. Alternate years. Mr. Redd

**F.A. 220. Form and Milieu in 20th Century Art (3)**
Sequential movements in contemporary painting and sculpture. Their interrelations as cultural expression. Museum reports and critical interpretation. Second semester. Mr. Redd

# Art Galleries

The North and South Galleries of the Alumni Memorial Building are the scene of teas and receptions marking the opening of the monthly exhibitions held there. This "Meet the Artists" series presents contemporary American and foreign artists and their work. Prints, drawings, paintings, and sculpture are consecutively shown in original exhibitions.

In the Central Gallery cases are periodic displays of Chinese porcelains from the Franklin Baker Colection, Etruscan Bronzes or Roman coins on indefinite loan.

Prints from the Mr. and Mrs. Charles G. Prasse Memorial Collection are shown as groups in the gallery cases.

In the University Center contemporary American paintings from the collection of Mr. and Mrs. Ralph L. Wilson are shown. This expanding collection is located in the Tom Girdler Gallery Lounge and adjacent areas. The multi-purpose rooms house the oriental prints, a group on indefinite loan from the Muriel and Phillip Berman Collection.

The Faculty Lounge houses the Marian Brown Grace Collection of English, Dutch, French, Spanish, and American paintings. Here students,

faculty, and friends are afforded contact with excellent examples of such masters as Gainsborough, Romney, Raeburn, Hoppner, Reynolds, Hobbema, Van Ruysdael, Corot, Daubigny, Goya, Inness, and others whose paintings admirably accent the decor of the area, provide pleasure and inspiration, and serve as fine reference for scholastic pursuits.

The Cort Room houses framed original contemporary prints. This display, a series of "miniature exhibitions," was made possible by the freshmen of the Class of 1962.

Admission Offices, Drown Hall gallery, Education Offices and public areas of Whitaker Laboratory present examples from the Permanent Collection of Student Paintings.

In the Grace Lounge and Snack Bar are presented examples of student paintings, including the annual award-winning oils and watercolors, and recent acquisitions.

The music room and student card rooms are hung with prints and paintings appropriate to these areas. Numerous other paintings, either loans or gifts, decorate other major Center rooms.

The Kenneth L. Isaacs gift of American and European prints and paintings depicting the early development of life along the Lehigh River is situated in Drown Hall where it decoratively presents a picture of the sociological and industrial growth of our community of Colonial times to the mid-nineteenth century.

The Offices of the Dean of Arts and Science is hung with oils, watercolors and prints from the Anonymous Loan Collection.

The departmental offices and study areas in Coppee Hall house the collection of etchings, drypoints, lithographs, and engravings, providing basic study material for research. Here, too, is located the collection of more than ten thousand lantern slides and numerous viewers which permit further study or reference. From here are rented more than five hundred framed reproductions for student and faculty use.

Gallery talks, discussions, and lectures are frequently scheduled for on-campus or visiting groups. A continuing reflection of current tendencies in American contemporary expression is presented through the permanent and rotating collections. Guide service may be obtained for groups of ten or more as a Department of Fine Arts service.

**FOREIGN CAREERS**

**See pages 93 and 118**

**FRENCH**

**See Romance Languages, page 333**

# GEOLOGY

Professor Ryan, Gallagher, Chave, Simpson
Associate Professor Myers
Assistant Professors Daetwyler, McLeroy
Adjunct Professor Kullerud
Messrs. Eby, Layton, Dygas, Force, Mrs. Force

**Geol. 1. Principles of Geology (3)**
Fundamental concepts of geology; the composition, structure, and development of the earth; processes of geologic change. Lectures, laboratory work, and field trip. First and second semesters.

**Geol. 2. Principles of Geology (3)**
A continuation of Geol. 1. **Prerequisite: Geol. 1.** First and second semesters.

**Geol. 13. Sedimentation (3)**
The characteristics of sediments, the processes that control deposition, environments of deposition. Techniques of collection, preparation, and analysis. Lecture and laboratory work. **Prerequisite: Geol. 2.** First semester.
Mr. Daetwyler

**Geol. 23. Structural Geology (3)**
The major and minor rock structures of the earth's crust. Problems of the type encountered in geological, geophysical, and mining work are studied in the laboratory and field. **Prerequisite: Geol. 1.** Second semester. Mr. Myers

**Geol. 141. Field Geology (3)**
Principles and methods of geologic mapping and field work. Preparation of a report and geologic map based on field work by each student in a specific area. **Prerequisites: Geol. 14, 23.** Staff

**For Advanced Undergraduates and Graduates**

**Geol. 201. Earth Sciences I — Geology (3)**
Fundamental concepts of geology; composition and structure of the earth, dynamics of natural processes, evolution and development of the earth. Must be taken concurrently with Geol. 203. Designed for secondary school science teachers. **Prerequisites: Graduate standing or consent of chairman of department.** Summer Session.

**Geol. 202. Earth Sciences II — Meteorology and Astronomy (3)**
Comprehensive treatment of the place of the earth in the cosmos; the solar system; and the consequence of solar energy and terrestrial influences on the behavior of the atmosphere. **Prerequisite: Graduate standing or consent of chairman of department.**

**Geol. 203. Geology Workshop (3)**
Field and laboratory exercises in geology. Must be taken concurrently with Geol. 201. Summer Session.

**Geol. 281. Geological Research (1-3)**
Independent investigation of a special problem in the field, laboratory, or library. **Prerequisite: Consent of chairman of department.** First semester. Staff

**Geol. 282. Geological Research (1-3)**
Similar to Geol. 281. May be elected as a continuation or separately. **Prerequisite: Consent of chairman of department.** Second semester. Staff

**Geol. 301. Introduction to Geophysics (3)**
The application of the principles and practices of physics to the solution of problems related to the earth. The origin of the earth; geochronology; temperature of the earth; seismology, gravitation; geomagnetism, terrestrial electricity. **Prerequisite: Senior standing or consent of chairman of department.** First semester. Mr. Gallagher

**Geol. 302. Geophysical Prospecting (3)**
The application of the principles of geophysics to the problems of prospecting. Geophysical instrumentation. Physical and electrical properties of rocks and formations. **Prerequisite: Geol. 301.** Second semester, alternate years. Mr. Gallagher

**Geol. 310. Computer Applications (1)**
The use of computers in the solution of geological problems. **Prerequisite: Consent of chairman of department.** Second semester.

**Geol. 311. Paleontology (3)**
Morphology of invertebrate fossils, their use in interpreting geologic history; evolution of the faunas and floras. Lectures and laboratory work. **Prerequisite: Biol. 21.** First semester. Mr. Chave

**Geol. 315. Regional Stratigraphy (3)**
Studies of sedimentary rock sequences in North America illustrating principles of correlation, facies change, methods of environmental and paleogeographic reconstruction. **Prerequisite: Senior standing or consent of chairman of department.** First semester. Mr. Ryan

**Geol. 333. Crystallography (3)**
Fundamentals of crystallography and crystal structure; patterns and symmetries, symmetry notations, crystal morphologies and internal structure, principles of crystal chemistry. The anisotropy of crystalline materials with special reference to crystal optics. Lectures and laboratory. **Prerequisite: Chem. 5.** First semester. Mr. Simpson

**Geol. 334. Petrology and Petrography (4)**
Evolution of crystalline rocks and their distribution in space and time; physical and chemical factors in igneous and metamorphic processes. Microscopic study of rocks. Lectures, laboratory work, and field trips. **Prerequisite: Geol. 333.** First semester. Mr. McLeroy

**Geol. 336. Mineral Phase Relations (3)**
Principles of phase equilibria; unicomponent and multicomponent condensed systems and multicomponent systems with volatile phases. The application of phase relation studies to mineralogical and geological problems. **Prerequisites: Chem. 5, Geol. 333.** Lectures and laboratory. Second semester. Mr. Simpson

**Geol. 337. Sedimentary Geochemistry (3)**
Processes controlling the distribution of the elements in the lithosphere, hydrosphere, atmosphere, and biosphere with particular reference to sediments and sedimentary rocks. **Prerequisite: Geol. 315 or consent of chairman of department.** Mr. Chave

**Geol. 339. Techniques in Geochemistry (1-2)**
Study of chemical and physical analytical techniques as applied to sedimentary materials and waters; problems of sampling. Laboratory work. **Prerequisite: Geol. 337, previously or concurrently.** Mr. Chave

**Geol. 351. Geology of Fuels (2)**
The geology and geochemistry of oil, gas, and coal. **Prerequisite: Geol. 315 or consent of chairman of department.** Mr. Chave

**Geol. 354. Elements of Mining (4)**
Methods of prospecting and exploration; drilling and blasting; development openings; methods of mining; support of workings. Lectures, recitation, and laboratory. **Prerequisite: Geol. 23. Second semester.** Alternate years.
Mr. Gallagher

**Geol. 357. Economic Geology (3)**
The formation of mineral deposits and the occurrence and characteristics of deposits of economic importance. Includes metals, non-metals, and fuels. Lectures, laboratory work, and inspection trips. First or second semester. Mr. McLeroy

**Geol. 363. Introduction to Oceanography (3)**
A survey of the physical, chemical, biological, and geological nature of the oceans. Two lectures, one recitation. **Prerequisite: One year of science (Biol., Chem., Geol., or Phys.)** Mr. Daetwyler

**Geol. 390. Problems of Geology (3)**
History and present status of controversial basic geologic problems. **Prerequisite: Geol. 312 or consent of chairman of department.** Staff

**Geol. 391. Field Seminar (1)**
Study of geological problems using field methods of analysis. Field trips, reading, reports, and discussion. **Prerequisites: Geol. 23, 312.** First or second semester.
Staff

## For Graduates

The graduate program in Geology is mainly directed toward the study of geologic processes. Candidates for the master's degree receive instruction in most fields of geology and are expected to take courses in appropriate collateral fields of science. Advanced graduate students, working toward the doctorate, specialize in one field of geology.

Research is an important part of the graduate program. In general, students are encouraged to choose research problems which for their solution require the use of integrated laboratory and field studies. Research training or thesis credit equivalent to six semester hours is required by the department for the master's degree.

Candidates for the master's degree are required to take a comprehensive examination during the semester in which they expect to take their degree. The examination also serves as a qualifying examination for admission to candidacy for the doctoral degree. Students entering with the master's degree take the comprehensive examination at the end of their first semester of residence.

Candidates for the Ph.D. degree must demonstrate through examination a thorough reading knowledge of one foreign language, generally French, German, or Russian.

Other requirements for graduate degrees are listed in the section of this catalog headed "Degrees," page 157.

**Geol. 401. Seismic Methods (3)**
The elements and theory of elastic deformations and wave propagation; refraction and reflection; theory and description of seismographs. **Prerequisites: Mathematics through calculus and consent of the instructor.** First semester, alternate years. Mr. Gallagher

**Geol. 402. Electrical Methods (3)**
Electrical properties of rocks and minerals; the principles of potential distribution in DC and AC fields. **Prerequisites: Mathematics through calculus and consent of the instructor.** Second semester, alternate years. Mr. Gallagher

**Geol. 403. Magnetics and Gravity (4)**
Terrestrial magnetism; magnetic properties of rocks and minerals; magnetic instruments. Shape of the earth; gravitational principles and instruments. **Prerequisites: Mathematics through calculus and consent of the instructor.** First semester, alternate years. Mr. Gallagher

**Geol. 411. Advanced Paleontology (4)**
Classification, evolution, biometrics, and paleoecology; study of fossil and modern populations and assemblages. Lectures and laboratories. **Prerequisite: Geol. 311.** First or second semester. Mr. Chave

**Geol. 414. History of Geology (2)**
The growth of geologic thought from the Greeks to the present; the great geologists, their theories, controversies, and contributions. Reading, conferences, preparation of reports. Second semester.

**Geol. 417. Sedimentary Petrography (3)**
The theory and application of petrographic methods in the study and classification of sedimentary rocks. **Prerequisites: Geol. 312, 334.** First semester. (Offered alternate years.) Mr. Ryan

**Geol. 418. Sedimentary Petrogenesis (3)**
The origin and development of sedimentary rock types; mineral provenance, environment of deposition, diagenesis, sediments in time, stratigraphic synthesis. **Prerequisite: Geol. 417.** Second semester. (Offered alternate years.) Mr. Ryan

**Geol. 421. Tectonics (3)**
The major structural features of the earth's crust and the problems of crustal instability; the relationships between major and minor structures; distribution of rock types as related to crustal deformation. First semester. (Offered alternate years.) Mr. Myers

**Geol. 422. Tectonics (3)**
Continuation of Geol. 421. Second semester. (Offered alternate years.)
Mr. Myers

**Geol. 424. Advanced Structural Geology (3)**
The theory and application of analytical methods in the study of rock deformation; experimental deformation, petrofabric analysis; statistical field methods. Second semester. (Offered alternate years.) Mr. Myers

**Geol. 433. Sulfide Phase Equilibria (3)**
The thermodynamics of sulfide type ores based on experiments in laboratory systems. First semester. Mr. Kullerud

**Geol. 435. Advanced Mineralogy (3)**
Topics of contemporary interest in mineralogy. **Prerequisite: Chem. 302 or equivalent.** First semester. (Offered as required.) Mr. Simpson

**Geol. 436. Advanced Mineralogy (3)**
Similar to Geol. 435. **Prerequisite: Chem. 302 or equivalent.** May be elected separately. Second semester. (Offered as required.) Mr. Simpson

**Geol. 437. Igneous and Metamorphic Processes (3)**
Selected problems on crystalline rocks. Lectures, conferences, assigned reading, field trips. First semester. (Offered alternate years.) Mr. Simpson or Mr. Myers

**Geol. 438. Igneous and Metamorphic Processes (3)**
Continuation of Geol. 437. Second semester. (Offered alternate years.)
Mr. Simpson or Mr. Myers

**Geol. 439. Ore Microscopy (3)**
Microscopic study of selected ore mineral suites with special attention toward applications of phase equilibria. **Prerequisite: Geol. 433.** First semester.
Mr. Kullerud

**Geol. 451. Examination of Mineral Deposits (3)**
Systematic exploration and examination; theory of sampling; statistical analysis. Second semester, alternate years. Mr. Gallagher

**Geol. 461. Marine Geology (3)**
Chemical and physical oceanography; marine ecology; modern sediments. First semester. (Offered alternate years). Mr. Chave and Mr. Daetwyler

**Geol. 462. Paleoecology (3)**
Reconstruction of paleoenvironments based on principles of paleoecology and sedimentary petrology. **Prerequisite: Geol. 461.** Second semester. (Offered alternate years.) Mr. Chave

**Geol. 481. Geological Investigation (1-6)**
Research on a special problem; field, laboratory, or library study; report required. Credit above three hours granted only when a different problem is undertaken. First semester. Staff

**Geol. 482. Geological Investigation (1-6)**
Similar to Geol. 481. Credit above three hours granted only when a different problem is undertaken. Second semester. Staff

**Geol. 483. Thesis (3)**
May be elected only by master's degree candidates. First semester. Staff

**Geol. 484. Thesis (3)**
Continuation of Geol. 483. Second semester. Staff

**Geol. 490. Special Topics (3)**
An extensive study of selected topics not covered in more general courses. First semester. (Offered as required.) Staff

**Geol. 491. Special Topics (3)**
Similar to Geol. 490. May be elected separately. Second semester. (Offered as required.) Staff

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# GERMAN

Associate Professors Tremper, Ubben, Gardner, Herz
Mr. Gougher

**Ger. 1. Elementary German (3)**
Drill in the fundamentals of German grammar; pronunciation; simple conversation and composition; extensive outside reading of simple vocabulary-building texts. No previous study of German required. First semester.

**Ger. 2. Elementary German (3)**
Continuation of Ger. 1. **Prerequisite: Ger. 1.** Second semester.

**Ger. 11. Intermediate German (3)**
German prose and poetry; outside reading; composition. **Prerequisite: One year of college German or two units of entrance German.** First semester.

**Ger. 12. Intermediate German (3)**
Continuation of German 11. **Prerequisite: Ger. 11.** Second semester.

**Ger. 27. Scientific German (3)**
Reading of material with stress on chemistry and physics. **Prerequisites: Ger. 2, or three units of entrance German; sophomore standing or consent of the chairman of the department.** First semester.

**Ger. 31. Conversation and Composition (3)**
Remedial exercises in grammar; phonetics; conversation and composition stressing situations taken from daily life. **Prerequisites: Ger. 12, or three units of entrance German.** First semester.

**Ger. 32. Conversation and Composition (3)**
Continuation of Ger. 31. Oral and written reports, personal and business letters, fundamentals of good style. **Prerequisite: Ger. 31.** Second semester.

**Ger. 41. Survey of German Literature (3)**
From the beginnings through Classicism, Lectures and collateral reading. **Prerequisites: Ger. 12, or three units of entrance German, or consent of chairman of department.** First semester.

**Ger. 42. Survey of German Literature (3)**
Continuation of Ger. 41. From Classicism through Expressionism. Lectures and collateral reading. **Prerequisities: Ger. 12, or three units of entrance German, or consent of chairman of department.** Second semester.

**For Advanced Undergraduates and Graduates**

*The prerequisite for all "200"-level courses is three years of college German or the equivalent.*

**Ger. 202. The German Novelle (3)**
Study of the origin and history of the *Novelle* and of contributions by outstanding writers. Mr. Ubben

**Ger. 203. Nineteenth Century German Drama (3)**
Survey of developments and reading of outstanding dramatic works in German literature from the end of the Classical Period through the Age of Naturalism. Mr. Tremper

**Ger. 205. Twentieth Century German Literature (3)**
Study of developments since the downfall of Naturalism; reading of works illustrative of trends and authors. Mr. Gardner

**Ger. 211. Nineteenth Century German Lyric Poets (3)**
A study of selected poems by lyricists from Heine to Conrad Ferdinand Meyer. Discussion and analysis. **Prerequisite: Three years of college German (or equivalent) or consent of the chairman of the department.**

**Ger. 212. Modern German Lyric Poetry (3)**
A study of selected poems by German Lyricists from Nietzsche to Brecht. Discussion and analysis. **Prerequisite: Three years of college German (or equivalent) or consent of the chairman of the department.**

**Ger. 250. Special Topics (3)**
Study of literary and linguistic topics not covered in regular courses, or continuation of study of topics begun in regular courses. May be repeated for credit.

**Ger. 251. Geothe's Faust (3)**
Lectures on the origin and development of the Faust story and collateral reading. **Prerequisites: Ger. 31, 32, 41, or 42, or consent of chairman of department.**

**Ger. 301. The Age of Goethe (3)**
Selected works of Klopstock, Herder, Lessing, Wieland and the early works of Goethe and Schiller. **Prerequisites: Ger. 31, 32, 41, or 42, or consent of chairman of department.** First semester.

**Ger. 302. The Age of Goethe (3)**
The Classical **Prerequisites: Ger. 31, 32, 41, or 42, or consent of chairman of department.** Second semester.

**Ger. 303. German Romanticism (3)**
Early and late Romanticists. **Prerequisites: Ger. 31, 32, 41, or 42, or consent of chairman of department.**

**Ger. 321. Middle High German (3)**
Medieval German and its relationship to the development of modern German. Selected works by the great German poets of the period. **Prerequisites: Ger. 31, 32, 41, 42, or consent of chairman of department.**

**Ger. 322. History of the German Language (3)**
The development of the language and its present structure. **Prerequisites: Ger. 31, 32, 41, or 42, or consent of chairman of department.**

**Ger. 331. Methods of Teaching German (3)**
A course designed for prospective teachers and teachers of German. **Prerequisites: Ger. 31, 32, 41, or 42, or consent of chairman of department.**

**Ger. 335. German Poetry (3)**
A study of selected lyric and narrative verse. **Prerequisites: Ger. 31, 32, 41, or 42, or consent of chairman of department.**

**Ger. 341. Advanced Conversation and Composition (3)**
For undergraduates and teachers. **Prerequisites: Ger. 31 or 32, or consent of chairman of department.**

## RUSSIAN

Associate Professor Herz

**Russ. 1. Elementary Russian (3)**
Drill in the fundamentals of Russian grammar; pronunciation and dictation; extensive exercises in written translation; simple conversation; outside reading of graded texts. First semester.

**Russ. 2. Elementary Russian (3)**
Continuation of Russ. 1. **Prerequisite: Russ 1.** Second semester.

**Russ. 11. Intermediate Russian (3)**
Reading in class of portions of literary works by nineteenth and twentieth century Russian writers and of selected materials dealing with Russian history, politics, and other phases of Russian culture, and of scientific articles; outside reading; practice in conversation and composition. **Prerequisite: One year of college Russian or two units of entrance Russian.** First semester.

**Russ. 12. Intermediate Russian (3)**
Continuation of Russ. 11. **Prerequisite: Russ. 11.** Second semester.

**Russ. 31. Survey of Russian Literature (3)**
Reading of selected works through the Golden Age. Oral and written reports. **Prerequisites: Russ. 12, or three units of entrance Russian, or consent of chairman of department.** First semester.

**Russ. 32. Survey of Russian Literature (3)**
From the Golden Age to the present. Oral and written reports. **Prerequisites: Russ. 31, or consent of chairman of the department.** Second semester.

# GOVERNMENT

Professors Tresolini, Yates
Associate Professor Barry
Assistant Professors Patterson, Colon
Mr. Washburn
Mr. Winters, Miss Platner

**Govt. 1. American National Government (3)**
Constitutional principles; organization and operation of the national government; the party system, citizenship, and civil rights. First and second semester.

**Govt. 2. American State and Local Government (3)**
The position of the states in the union; machinery and functions of state governments; nominations and elections; the various systems of local government. Second semester.

**Govt. 3. Foreign Governments (3)**
The governmental systems of foreign countries: the parliamentary systems of Great Britain and France; authoritarian government in the U.S.S.R.; democratic and authoritarian regimes in various other countries of Europe and the Americas. First and second semester.

**Govt. 4. American Political Ideas (3)**
A survey of the ideas underlying and associated with the political institutions and practices of the United States. Second semester.

**Govt. 6. Democracy (3)**
An analysis of the theory and the practice of democratic government in selected countries. **Prerequisite: Sophomore standing.** Second semester.

**Govt. 101. History of Political Thought (3)**
History of leading political ideas. Analysis of the views of representative ancient, medieval, and modern political philosophers of the western world. First semester.

**For Advanced Undergraduates and Graduates**

**Govt. 304. Political Parties (3)**
The organization, functions and techniques of political parties and pressure groups; nomination and election methods, voting behavior and public opinion; government and politics. Second semester. Mr. Patterson

**Govt. 311. Teaching Civil Liberties (3)**
Consideration of fundamental civil liberties issues in constitutional perspective. Designed for improving the teaching of constitutional freedom in public and private schools. Freedom of speech, religious freedom, racial equality, censorship. Materials and methods for teaching the Constitution and the Bill of Rights. Not open to students who have taken Govt. 352 or Govt. 453 and 454. First semester and summer session. Mr. Tresolini

**Govt. 312. Workshop in Teaching Civil Liberties (3)**
Research and library work, outside lectures, observation of court and administrative procedures pertaining to civil liberties. Must be taken concurrently with Govt. 311 when courses are offered together. Mr. Tresolini.

**Govt. 321. Scope and Methods of Political Science (3)**
Introduction to the philosophy of the social sciences; approaches to the study of politics; the limits of political analysis; research design and techniques; political biblography; field study. First semester. Mr. Patterson

**Govt. 351. Constitutional Law (3)**
The law of the Constitution as expounded by the Supreme Court of the United States. First semester. Mr. Tresolini

**Govt. 352. Civil Rights (3)**
A study of constitutional guarantees designed to protect the individual against arbitrary, unreasonable, and oppressive government. Freedom of speech and of the press, religious freedom, freedom of assembly, property rights. Constitutional problems concerning crime and its punishment. Second semester.
Mr. Tresolini

**Govt. 354. Administrative Law (3)**
Consideration of the authority, procedures, and methods utilized by executive agencies in the administration of public policy. Analysis of the general problem of adjusting the administrative process to traditional constitutional principles. Second semester. Mr. Barry

**Govt. 357. Urban Politics (3)**
The structure and processes of city government in the United States; city-state and federal-city relationships; the problems of Metropolitan areas; political machines and community power structures; the politics of municipal reform; city planning and urban renewal. First semester. Mr. Patterson

**Govt. 359. Law-making (3)**
Organization and procedure of legislative and constituent assemblies. Legislative leadership. Role of administrative and judicial agencies in law-making. Pressure groups, parties, and policy determination. Direct legislation. First semester.
Mr. Patterson

**Govt. 360. Public Administration (3)**
The nature of administration; problems of organization and management; public personnel policies; budgeting and budgetary systems; forms of administrative responsibility. Second semester. Mr. Colon

**Govt. 361. Comparative Administrative Systems (3)**
Problems concerning governmental organization and administration; the implementation of public services in selected countries. Comparison of administrative procedures in various jurisdictions or bodies politic with those in the U. S. **Prerequisite: Govt. 3 or consent of head of department.** Second semester.
Mr. Colon

**Govt. 362. The Soviet System of Government (3)**
An examination of the roles of the Communist Party, the Council of Ministers, the Supreme Soviet and other governmental and social organizations in governing the U.S.S.R. Second semester. Mr. Barry

**Govt. 363. Contemporary Political Thought (3)**
Analysis of the fundamental concepts of political science. The nature of the state, nationalism, sovereignty, law and liberty. Constitutions; unitary and federal systems of government; authoritarianism and democracy. First semester.
Mr. Washburn

**Govt. 364. Contemporary Political Thought (3)**
Recent thought concerning the ethical basis of political authority and the proper role of the state in society. Analysis and appraisal of anarchism, individualism, socialism, communism, syndicalism, fascism, and other doctrines. Second semester.
Mr. Washburn

**Govt. 371. Readings (3)**
Readings in political science assigned to properly qualified students in consideration of their special interest in particular political institutions and practices. **Prerequisite: Consent of head of the department.** First semester.

**Govt. 372. Readings (3)**
Continuation of Govt. 371. **Prerequisite: Consent of head of the department.** Second semester.

**For Graduates**

Graduate students desiring to major in political science should have had at least twelve semester hours of undergraduate work bearing on this field or should in other ways satisfy the department that they are qualified to pursue the required program of study.

Candidates for the master's degree in political science may qualify by completing thirty hours of approved course work and passing an examination covering the entire field or by completing twenty-four hours in approved courses and submitting a satisfactory thesis. The choice between these plans shall be made by each candidate upon the advice and with the approval of the chairman of the Department.

All graduate students seeking the master's degree in political science shall enroll for a minimum of eighteen hours of courses in the political science field. International relations courses fall in the political science category. Appropriate courses in other fields, among them economics, history, philosophy, social relations, and public finance may be selected to meet the total of hours required for the master's degree.

**Govt. 441. Public Administration (3)**
Administrative theory and practice in the public sphere in the United States; problems of public organization and management; executive leadership; personnel, budgeting, and regulatory administration. First semester. Mr. Colon

**Govt. 442. Comparative Administration (3)**
Theory and practice in the administrative systems of developing nations; comparative comparison of public administrative systems with non-public systems; cultural influences on administration. Second semester. Mr. Colon

**Govt. 451. American Political Institutions (3)**
The federal and state constitutions; congress and state legislatures; the presidency and state governors; federal and state judicial systems. First semester.
Mr. Patterson

**Govt. 452. American Political Institutions (3)**
Political parties and pressure groups; nomination and election methods; voting behavior and public opinion. Second semester. Mr. Patterson

**Govt. 453. Public Law (3)**
Origins and basic principles of American constitutionalism; distribution and scope of governmental powers; constitutional limitations; individual freedoms; problems of due process; administrative powers and procedures. First semester.
Mr. Tresolini

**Govt. 454. Public Law (3)**
Continuation of Govt. 453. Second semester. Mr. Tresolini

**Govt. 463. Political Theory (3)**
Theories pertaining to the nature of the political system and its organization: the local community, state, nation, empire, federalism. Theories and doctrines of the governing process; legitimate objectives of government; proper spheres of political authority. First semester. Mr. Washburn

**Govt. 464. Political Theory (3)**
Theories and doctrines pertaining to the political person and to the dimensions of power, justice, equality and freedom. Second semester Mr. Washburn

**Govt. 471. Foreign Governments (3)**
Governmental and political institutions of the Western and Western-type democracies. Approaches to the study of comparative politics. First semester.
Mr. Barry

**Govt. 472. Foreign Governments (3)**
Governmental and political institutions of the USSR and other communist states. Approaches to the study of comparative politics. Second semester.
Mr. Barry

**Govt. 481. Special Topics (3)**
Individual inquiry into some problems of government other than the subject of the master's thesis. Reading, field, work, and other appropriate techniques of investigation. Conferences and reports. First semester. Staff

**Govt. 482. Special Topics (3)**
Continuation of Govt. 481. Second semester. Staff

## GREEK

**See Classical Languages, page 208**

# HISTORY

Professors Cary, Cowherd
Associate Professors Dowling, Haight
Assistant Professors Fischman, Tipton
Messrs. Amidon, Cody, Neamand, Vadasz, Shade
Miss Stauffer

**Hist. 11. Western Civilization (3)**
The roots of Western Civilization; the evolution of economic, social, and political institutions; the impact of religious and philosophical ideas upon European Culture. First semester.

**Hist. 12. Western Civilization (3)**
The modern Western World; the rise of nationalism and imperialism; the growth of science and industrialism; modern thought and ideologies. Second semester.

**Hist. 13. American Civilization (3)**
History of American civilization to 1865, emphasizing the development of our cultural heritage. Puritanism; Deism; American Revolution; Constitution; Jeffersonian and Jacksonian Democracy; Abolitionism and Civil War. First semester.

**Hist. 14. American Civilization (3)**
American civilization since 1865. Industrialism; Urbanization; Social Darwinism; Pragmatism; the Frontier; Progressivism and the New Deal; the two World Wars. Second semester.

**Hist. 15. English History (3)**
An introduction to the history of England to 1688. The origins of representative government, the development of English social institutions, the unification of England, and the Renaissance and Reformation in England will be examined. First semester.

**Hist. 16. English History (3)**
The development of English political and social institutions from 1688 to the present. The evolution of parliamentary government, the rise of modern parties, the Industrial Revolution, and recent social philosophies will be studied. Second semester.

**Hist. 25. European History (3)**
A survey of some of the major historic forces in Europe from the collapse of the Roman Empire to the end of the seventeenth century. First semester.

**Hist. 26. European History (3)**
Continuation of Hist. 25. A survey of major developments in European history from about the year 1700 to the middle of the twentieth century. Second semester.

**Hist. 49. History of Latin America (3)**
A survey of the Spanish and Portuguese colonization of America and the struggles for independence, preceded by a brief view of the ancient American civilizations and the Iberian backgrounds. First semester.

**Hist. 50. History of Latin America (3)**
Continuation of History 49. The development of the Latin American nations in the nineteenth and twentieth centuries. Second semester.

Attention is called also to the following courses in history offered by other departments: Gk. 21, Ancient History; Lat. 22, Ancient History.

**For Advanced Undergraduates and Graduates**

**Hist. 319. Seventeenth Century America (3)**
A study of the founding and growth of English, French, and Dutch colonies in North America. Attention will be paid to motives behind European expansion as well as to developments in the colonies. Messrs. Shade, Cary

**Hist. 320. Eighteenth Century America (3)**
Continuation of Hist. 319. A study of American political, economic, and cultural developments including the War for American Independence and the founding of a new nation. Messrs. Shade, Cary

**Hist. 321. United States History, 1789 to 1877 (3)**
The development of the American people from the establishment of the Republic to the end of Reconstruction in the South. Consideration will be given to political, economic, and social developments with special emphasis on westward expansion, Jacksonian democracy, and the Civil War crisis. Mr. Dowling

**Hist. 322. United States History since 1877 (3)**
The urbanization and industrialization of American society and the political, social, and economic effects thereof. Mr. Dowling

**Hist. 323. American Constitutional History (3)**
The development of American constitutional thought and practice from the colonial period to the Civil War. Consideration of governmental institutions, political parties, and legal thought in the context of American history; special emphasis upon the Confederation, the Constitution, and the states-rights controversy. Staff

**Hist. 324. American Constitutional History (3)**
Constitutional thought and practice from the Civil War to the present. Consideration of the new role of government, problems caused by the Industrial Revolution, and modern issues relating to personal liberties and federal-state relations. Staff

**Hist. 325. American Immigrant History (3)**
Immigration in American history. The changing sources of American immigration; successive "first generations" and the process of ethno-cultural transfer; cultural stability and change through post-immigrant generations; "minority groups" in American political history. Mr. Amidon

**Hist. 326. American Urban History (3)**
The city in American history from the colonial period to the present. Colonial maritime centers; changing transportation patterns and the diffusion of urban sites; industrialization and urban social structure; urban imperialism and regional rivalries; urban technology; "reformers" vs. "the machine"; suburbanization and nationalization. Mr. Amidon

**Hist. 327. American Intellectual History (3)**
A study of the development of political, social, and religious ideas in America from the colonial period to the Civil War. **Prerequisite: Consent of chairman of department.** Mr. Dowling

**Hist. 328. American Intellectual History (3)**
A study of economic, political, and religious thought in industrial America, 1860 to the present. **Prerequisite: Consent of chairman of department.** Mr. Dowling

**Hist. 329. American Foreign Policy (3)**
The French alliance; independence and boundaries; commercial restrictions; French Revolution and neutrality; purchase of Louisiana; War of 1812: acquisition of Florida; Monroe Doctrine; relations with France and Great Britain; Oregon and Texas; the Mexican War; Civil War diplomacy. Mr. Amidon

**Hist. 330. American Foreign Policy (3)**
Maximilian in Mexico; Seward and expansion; Alaska boundary; War with Spain; the new Caribbean policies; the World War of 1914-1918 and its aftermath; diplomatic events preceding Pearl Harbor; outbreak and prosecution of the war; plans for peace; the "Cold War"; diplomacy since 1945. Mr. Amidon

**Hist. 347. The British Empire (3)**
The expansion of the English-speaking people from 1603 to 1848; the origins of self-government; the founding of the Empire in Asia and Africa; the role of Great Britain in world affairs. Mr. Cowherd

**Hist. 348. The British Empire and Commonwealth (3)**
The expansion of the Empire in Asia and Africa since 1848; the growth of federalism and self-government; the independence movements in Ireland and India; the formation of the Commonwealth; the impact of two World Wars; the decline of the Empire since the Second World War. Mr. Cowherd

**Hist. 349. The Early Middle Ages (3)**
An analysis of European institutions and cultural developments from 284 A.D. to the mid-eleventh century. Emphasis upon the evolution of the Church, feudalism and manorialism, the foundations of the Byzantine, Carolingian, and Holy Roman Empires, and the literary and artistic achievements of the period. Mr. Tipton

**Hist. 350. The High Middle Ages (3)**
A continuation of Hist. 349 to about 1400 A.D. Rise of the universities and towns; legal developments and the origins of representative government; rise of

the nation-state; the crusades; Scholasticism and the decline of the medieval church; expansion of trade; and literary and artistic developments in late medieval society. Mr. Tipton

**Hist. 355. European Intellectual History (3)**
A study of political and religious thought and other aspects of the history of ideas in Europe from the Middle Ages to about 1700. **Prerequisite: Consent of chairman of department.** Mr. Haight

**Hist. 356. European Intellectual History (3)**
A continuation of Hist. 355, with special attention given to the impact of the Industrial Revolution upon thought and to the development of nineteenth and twentieth-century ideologies. **Prerequisite: Consent of chairman of department.** Mr. Haight

**Hist. 357. The Renaissance and Reformation (3)**
An analysis of the transition from medieval to modern society. Consideration will be given to political, economic, and social forces produced by the Renaissance and the influence of these upon the dominant religious theme of the Reformation era. Mr. Tipton

**Hist. 358. Age of the Baroque (3)**
A study of Europe from 1648 to 1789. The course will treat the growth of absolutism in France, the rise of Prussia, and the social and political and economic conditions in the eighteenth century. Staff

**Hist. 359. Modern Europe (3)**
The study of revolutions and reactions in Western Europe from 1789 to 1870. Emphasis is placed on rise and spread of liberalism and the origins of socialism. Mr. Haight

**Hist. 360. Modern Europe (3)**
A study of contemporary Europe; the origins and consequences of two World Wars; the rise of revolutionary governments in Italy, Germany, and Russia. Mr. Haight

**Hist. 365. Modern Latin America (3)**
Individual investigation and reports on selected nineteenth and twentieth century topics valuable for an understanding of present Latin American culture. **Prerequisite: Hist. 49, 50, or consent of chairman of department.** Mr. Fischman

**Hist. 366. Modern Latin America (3)**
Continuation of Hist. 365. **Prerequisite: Hist. 49, 50, or consent of chairman of department.** Mr. Fischman

**Hist. 367. The Iberian Peninsula (3)**
A study of Spain and Portugal from the eighth century to the present, emphasizing the historical influence of Iberian culture on the development of colonial institutions. **Prerequisite: One year of college Spanish or its equivalent and consent of chairman of department.** Mr. Fischman

**Hist. 368. The Caribbean (3)**
A study of political and social developments from pre-Columbian times to the present with primary emphasis upon the growth of liberalism and nationalism in the twentieth century. Mr. Fischman

**Hist. 371. Special Topics in History (3)**
Intensive study in an area of history not adequately covered in currently listed offerings. The field of research may be varied from time to time and the course may be administered as a reading program or otherwise as may seem best to meet the needs of students of unusual ability and adequate preparation. **Prerequisite: Consent of chairman of department.** First semester.

**Hist. 372. Special Topics in History (3)**
Continuation of Hist. 371. **Prerequisite: Consent of chairman of department.** Second semester.

**Hist. 374. Themes in American History (3)**
An intensive study of a selected topic in American history primarily for American studies majors. The topic may vary from time to time as the needs of the American Studies program dictate. The aim of the seminar will be to allow study of an aspect of American history in greater depth than is generally the case. **Prerequisite: Permission of director of American Studies.**

## For Graduates

The Lehigh Library is especially rich in materials for advanced study and research in history, and the Department of History offers programs leading to the Master of Arts and Doctor of Philosophy degrees. The graduate programs are designed to provide more intensive and specialized study than is possible at the undergraduate level. Graduate enrollment is limited so that close relations can be maintained between faculty and students. Admission to graduate study in History is competitive and dependent upon the applicant's undergraduate preparation and record.

Besides the general requirements for degrees set forth in the Graduate School section of this catalog, the following special requirements apply to graduate study in History. History 401 is required of all graduate majors. There are two master's programs. Under Plan I, a candidate may earn the degree by successfully completing twenty-four hours of approved course work and submitting a satisfactory thesis. Candidates declaring Plan II take thirty hours of course work without thesis. Candidates for the master's degree under both plans must take course work in, and pass examinations on, at least two fields, chosen from American, British, European, and Latin-American history. Each candidate will select the plan better suited to his needs and abilities, upon the advice and with the approval of the head of the Department.

Candidates for the degree of Doctor of Philosophy in History must prepare themselves in four history fields and one outside minor, pass written and oral examinations on these fields, and submit an original dissertation. The four history fields offered by the candidate are chosen upon the advice and with the approval of the head of the Department from the seven fields listed below. Dissertations may be written only in the primary fields.

| *Primary* | *Secondary* |
|---|---|
| Britain | Medieval-Renaissance |
| Colonial America | Modern Europe to 1815 |
| United States | Modern Europe since 1815 |
| | Latin-America |

**Hist. 401. Methods in Historical Research (3)**
Techniques of research in history: training in the critical handling of documentary materials, in measuring the value of evidence, and in formal presentation of the results of research. Required of all graduate students in history. First semester. Staff

**Hist. 402. Historiography (3)**
A continuation of Hist. 401. A study of the aims, methods, and accomplishments of some of the most renowned historians of Europe and America. Second semester. Mr. Kyte

**Hist. 405. Early Modern Europe (3)**
Research in selected topics in European history from the Reformation to the Wars of Religion. Staff

**Hist. 406. Age of Absolutism (3)**
Research in selected topics in political, social, and intellectual history of Europe from the Peace of Westphalia to the eve of the French Revolution.
Staff

**Hist. 407. Modern Europe, 1789-1870 (3)**
The French Revolution; Era of Metternich; Congress of Vienna and reconstruction of Europe; industrial revolution and subsequent social reforms; democracy and nationalism; Second French Empire; unification of Italy and Germany. First semester. Mr. Haight

**Hist. 408. Modern Europe since 1870 (3)**
Latin and Teutonic Europe; nationalism and the new imperialism; World War I and the Treaty of Versailles; League of Nations; national socialism vs. democracy; World War II and its aftermath. Second semester. Mr. Haight

**Hist. 410. Historical Literature: Europe (3)**
This course is designed to familiarize teachers with the important literature in the field. Students will analyze the major interpretations of the most significant movements in modern European history. Staff

**Hist. 415. Tudor and Stuart England (3)**
Selected topics in the religious, political, social, and intellectual history of England from 1485 to 1688. First semester. Mr. Cowherd

**Hist. 416. Hanoverian England (3)**
Selected topics in political, social, and intellectual history from 1688 to 1815. Second semester. Mr. Cowherd

**Hist. 417. England: The Age of Reform (3)**
An intensive study of English industrial history, 1815-1870, emphasizing the liberal and humanitarian reforms. First semester. Mr. Cowherd

**Hist. 418. England: The Age of Conflict (3)**
An intensive study of English history since 1870, including the growth of socialism, the rise of the Labor Party, the formation of the Commonwealth, and the origins and consequences of two World Wars. Second semester.
Mr. Cowherd

**Hist. 420. Historical Literature: America (3)**
This course is designed to familiarize teachers with the important literature in

the field. Students will analyze the major interpretations of the most significant movements in American history. Staff

**Hist. 421. America in the Seventeenth Century (3)**
An advanced research seminar in British-American colonial history. Varied topics such as the settlement of the English colonies, the growth of colonial institutions, Puritanism and other intellectual currents. First semester.
Mr. Cary

**Hist. 422. America in the Eighteenth Century (3)**
A continuation of Hist. 421. Varied topics, such as the workings of the mercantile system, the evolution of colonial institutions, the development of imperial administration, and the causes, events, and results of the wars with France and the War for American Independence, the Confederation and Constitution. Second semester. Mr. Cary

**Hist. 426. The United States, 1800-1850 (3)**
Research in selected topics related to Jefferson, the War of 1812 and the Era of Good Feelings, nationalism and sectionalism, the Age of Jackson, and Manifest Destiny. First semester. Mr. Shade

**Hist. 427. The United States, 1850-1877 (3)**
Research in selected topics related to the Civil War and Reconstruction, politics and foreign affairs, and post-war industrialism. Second semester. Mr. Shade

**Hist. 428. The United States, 1877-1914 (3)**
Research in selected topics of the period, including late nineteenth-century industrialism, the growth of labor unions, agricultural discontent, and the rise of reform movements. First semester. Mr. Dowling

**Hist. 429. The United States Since 1914 (3)**
Research in selected topics related to World War I, the 1920's, the depression and New Deal, World War II, and post-war America. Second semester.
Mr. Dowling

**Hist. 431. America as a World Power (3)**
The results of the Spanish-American War; the United States' Pacific possessions; Theodore Roosevelt and world affairs; Knox and "Dollar Diplomacy"; World War I; American neutrality; the United States as a belligerent; the Treaty of Versailles. First semester. Mr. Dowling

**Hist. 432. America as a World Power (3)**
The United States and the League, the reconstruction of Europe; the rise of Hitler; World War II; the Monroe Doctrine; the Good Neighbor Policy; the problems of the Pacific; China and Japan; Japan and the United States; the War with Japan; the aftermath of World War II. Second semester Mr. Dowling

**Hist. 481. Graduate Seminar (3)**
An intensive study of the history of Latin America, the United States, England, or one or more of the leading countries of Europe. Subject and instructor may vary from semester to semester according to the needs of the students and the availability of faculty members. First semester. Staff

**Hist. 482. Graduate Seminar (3)**
A continuation of Hist. 481. Second semester. Staff

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# HONORS SEMINARS

Honors Seminars are open to students admitted to the Interdepartmental Honors Program (see page 74), and occasionally to special students approved by the Honors Council. Enrollment is limited.

Seminars are conducted with a combination of lectures, student reports, and discussion. Emphasis is placed on the development of the student's ability to conduct, report on, and defend independent research. In addition to the scheduled seminar hours, there will be personal conferences with the instructor.

Course titles indicate only the general area in which a seminar will be conducted. The particular concepts to be considered and the material to be studied will be determined by the instructor with the concurrence of the Honors Council.

**Creative Concepts 101. The Humanities (3)**
A study of concepts significant in man's attempts to understand himself as an individual, his place in and his relation to the universe, the meaning of his existence, and the way in which he should live. Material is drawn chiefly from literature, philosophy, religion, and the fine arts and music.

**Creative Concepts 102. The Life Sciences (3)**
A study of concepts significant in man's efforts to understand and to control the living world of which he is a part. Material is drawn primarily from biology, psychology, and geology, but also, because of the ultimate inseparability of the natural sciences, from chemistry and physics.

**Creative Concepts 103. The Physical Sciences (3)**
A study of concepts significant in man's efforts to understand and use the physical universe in which he lives. Material is drawn primarily from chemistry, physics, mathematics, and astronomy, but also, because of the ultimate inseparability of the natural sciences, from biology and geology.

**Creative Concepts 104. The Social Sciences (3)**
A study of concepts significant in man's attempts to understand himself as a social being, his beliefs as to how men should live together and the means he has used to achieve social order. Material is drawn, depending on the orientation of individual seminars, from the political and social sciences.

**Creative Concepts 190. Honors Thesis (3-6)**
Independent work and thesis on an approved subject in a form appropriate to the field of study. The work is directed throughout by the thesis adviser.

# INDUSTRIAL ENGINEERING

Professors Gould, Richardson, Kane, Monro, Loomba
Associate Professors W. A. Smith, Carroll, Adams
Assistant Professor Whitehouse
Messrs. G. L. Smith, Burbridge, Landis, Huddart, White, Groover, Saure, Jackson

**I.E. 10. Problem Computation Laboratory (1)**
Preparation of problems for computer programming with emphasis on industrial engineering problems; techniques of programming for computers. **Prerequisite: Consent of chairman of department.** First semester.

**I.E. 11. Applied Probability Laboratory (1)**
Experimental sampling to approximate the different common models of probability distributions, including distributions of both data and related estimators. **Prerequisite: Math. 231 concurrently.** Second semester.

**I.E. 40. Metal Processing Practice (3)**
Study of metal processing theory and equipment. Practice in the operation of metal processing equipment at the Bethlehem Vocational High School including use of hand tools and operation of machine tools and welding equipment. Full-time daily schedule of lectures and practice for three weeks. **Prerequisite: Met. 63.** Summer Session.

**I.E. 100. Industrial Employment (0)**
Usually following the junior year, students in the industrial engineering curriculum are required to do a minimum of eight weeks of practical work, preferably in the field they plan to follow after graduation. A report is required. **Prerequisite: Sophomore standing.**

**I.E. 105. Thesis (3-6)**
Candidates for the bachelor's degree in industrial engineering may, with the approval of the department staff, undertake a thesis as a portion of the work of the senior year. **Prerequisite: Senior standing.**

**I.E. 121. Analysis and Design I (5)**
An intensive study of the planning activities of industrial engineering, including manufacturing planning, product design analysis, process selection, operation planning, material handling, plant layout, production control. **Prerequisites: I.E. 40, Math. 231.** First semester.

**I.E. 122. Analysis and Design II (4)**
Techniques for analysis and design of man and machine work systems and application to typical problems in work measurement. Time study, predetermined time systems, work sampling, and development of standard data. Control of methods and standards. **Prerequisites: I.E. 121 and 221.** Second semester.

**I.E. 140. Mfg. Processes Laboratory (1)**
Experiments in application of metal cutting theory with emphasis on the economics of metal removal. Testing of tool life, tool materials, cutting fluids, and determination of machinability of materials. **Prerequisite: I.E. 40.**

**I.E. 152. Project (2)**
Special study of a particular problem involving laboratory work and/or work in local industrial plants. **Prerequisite: Senior standing in Industrial Engineering.**

**I.E. 166. Production Management (3)**
A course for the student not majoring in I.E. Study of functions involved in manufacturing planning and control, including production scheduling, inventory control, quality control, work measurement, methods analysis, and production systems analysis. **Prerequisites: Math. 21, Eco. 3.** First and second semesters.

**For Advanced Undergraduates and Graduates**

**I.E. 210. Elementary Design of Experiments (3)**
An introduction to the structure of experiments, the analysis of experimental data, and their inter-relation. Measurement error, randomization, pairing, complete blocks, Latin squares, analysis of variance. **Prerequisite: Graduate standing or consent of instructor.** Mr. Monro

**I.E. 221. Industrial Statistics (4)**
Techniques of hypothesis testing, including analysis of variance and distribution free methods; estimation, including regression and prediction. Elementary principles of planning samples. Design of experiments and construction of decision rules. **Prerequisite: Math. 231.** First semester. Staff

**I.E. 222. Operations Analysis and Design (4)**
Use of economic models of interest to industrial engineers. Specific topics include depreciation, replacement economy, break-even analysis, marginal analysis, queing, and linear programming. **Prerequisite: Math. 231.** Second semester.
Staff

**I.E. 308. Data Processing (3)**
Introduction to punched card and electronic data processing. Effects on organizational relationships; preparation of computer applications. Lectures, demonstrations, tours, student projects on computer. **Prerequisite: I.E. 122 or I.E. 166.**
Messrs. Richardson, Carroll

**I.E. 310. File Structure and Processing (3)**
Organizing data files for effective processing by computer. Coverage in depth of coding and filing; list processing; search strategy; sorting techniques; randomizing and chaining; use of decision tables; coordinate indices. Demonstrations, student projects on computer. **Prerequisite: I.E. 308.** Mr. Carroll

**I.E. 321. Experimental Industrial Engineering (3)**
Experimental projects in selected fields of industrial engineering, approved by the instructor. A written report is required. Staff

**I.E. 322. Experimental Industrial Engineering (3)**
Continuation of I.E. 321. Staff

**I.E. 325. Production Control (3)**
A study of the decision rules, and mathematical and economic models of pro-

duction forecasting, scheduling, order control, and inventory control. Case problems and laboratory. **Prerequisites: I.E. 121 and 222.** Mr. Gould

**I.E. 326. Quality Control (3)**
Problems involving inspection and test of product and check of process. Study of effect of design and inspection specifications upon cost and value. Problems and project. **Prerequisite: I.E. 221.** Messrs. Monro, Richardson

**I.E. 333. Industrial Engineering Administration (3)**
The policies, organization, and procedures for the industrial engineering function in industry; influence of labor relations, grievance procedures and arbitration. Lectures, case problems, guest lecturers, term project. **Prerequisite: I.E. 122 or I.E. 166.** Mr. W. A. Smith

**I.E. 339. Industrial Manpower Management (3)**
A study of policies and procedures involved in analysis and design of manpower planning and control; study of utilization of human resources on the job with emphasis on wage administration. Lectures, case problems, projects. **Prerequisite: I.E. 122 or I.E. 121.** Mr. G. L. Smith

**I.E. 340. Production Engineering (3)**
Introduction to mechanization and automation of product manufacturing. Partial mechanization, engineering materials utilization, product design analysis, special processing methods, economic analysis of processing design alternatives. Term project. **Prerequisite: I.E. 121.** Mr. Kane

**I.E. 344. Metal Cutting Theory (3)**
Intensive study of metal cutting, emphasizing temperature and energy relationships and their effect on tool life, power requirements and surface finish. Economic balancing of metal cutting variables from application of theory. Lectures and laboratory experiments including designing and conducting an original experiment. **Prerequisites: I.E. 140, Math. 231.** Mr. Kane

**I.E. 350. Industrial Engineering Problems (3)**
Comprehensive study of problems encountered in manufacturing with special attention to quantitative methods of problem analysis including such topics as sampling controls, queueing theory, mathematical programming, probability theory, design of experiments. **Prerequisite: Senior standing in industrial engineering.**
Messrs. Gould, Whitehouse

A program leading to the Ph.D. degree is offered by the Department of Industrial Engineering. The fields of concentration are Operations Research, Manufacturing Engineering, and Information Systems.

A student who wishes to complete his work for the M.S. in Industrial Engineering in one year of full-time study must have completed a course of study equivalent to that required for the B.S. in Industrial Engineering at Lehigh University.

The minimum program consists of twenty-four hours of approved course work and completion of a satisfactory thesis. Students with less than

the required undergraduate program may be required to devote additional time to prerequisite and basic courses. In any event, a satisfactory thesis must be completed by all candidates.

An M.S. program is selected to meet the interests and needs of the student, and courses in other departments for which the student has the prerequisites may be integrated into the major field. Subject to proper approval, the courses required in the major field may include a maximum of nine hours from the following two groups with no more than six hours from each group: (1) "400" level courses in other branches of engineering; (2) Eco. 431, Managerial Economics; Eco. 433, Labor Management Economics; Acctg. 422, Managerial Accounting; Psych. 455. Engineering Psychology; I.S. 421 Analysis of Information. As part of a purposeful major program, collateral courses may be taken in other branches of engineering, mathematics, economics, psychology and Information Science.

The laboratories of the department are located in the James Ward Packard Laboratory and available for graduate work are a modern metal processing research laboratory, a General Electric 225 computer, and a work measurement laboratory.

The department offers courses during the late afternoons for the convenience of students who are employed in local industry and are taking graduate work on a part-time basis. There is no evening program, however, and courses are not scheduled during evening hours.

**For Graduates**

**I.E. 405. Special Topics in Industrial Engineering (3)**
An intensive study of some special field of industrial engineering. Staff

**I.E. 407. Techniques of Operations Analysis (3)**
Techniques for quantitative analysis of operational problems; operational gaming and Monte Carlo methods; application of theory of queues; linear programming; renewal theory; probability theory. Mr. Whitehouse

**I.E. 408. Management Information Systems (3)**
Integrated and total systems concept for information processing. Real-time, on-line computing systems. Implementation and evaluation of management information systems. **Prerequisite: I.E. 308 or consent of the department chairman.** Mr. W. A. Smith, Jr.

**I.E. 409. Industrial Engineering Standardization (3)**
Identification of the basic variables that exist in industrial engineering, problem-solving techniques, and investigation of the means for standardization of these variables. Techniques analyzed for standardization include motion and time study, metal process planning, statistical quality control, and production planning and control. Mr. Kane

**I.E. 410. Design of Experiments (3)**
Fixed designs for testing hypotheses, including incomplete blocks and fractional factorials. Sequential designs for estimation and optimization. Desirable preparation: Math. 234. Mr. Monro, Adams

**I.E. 415. Manufacturing Management (3)**
Analysis of the factors entering into the development of manufacturing management philosophy; decision-making process in areas of organization, planning, operation, and control of manufacturing. Influence of the social, technical, and economic environment upon manufacturing management decisions.
Mr. Richardson

**I.E. 416. Dynamic Programming (3)**
The principle of optimality; one-dimensional processes, multi-dimensional processes, lagrange multiplier technique; markovian decision processes; applications. Mr. Adams

**I.E. 417. Mathematical Programming (3)**
Theory and application of methods for determining the maximum and minimum of functions of many variables subject to constraints. Topics include the algebra of linear inequalities, the algebra of duality, the theory of graphs, parametric linear programming, discrete linear programming, stochastic linear programming, non-linear programming, and dynamic programming.
Mr. Whitehouse

**I.E. 418. Simulation (3)**
Random number generation, sources of bias, tests of randomness, transformations, estimating run length, clocked and unclocked simulation programs, evaluation of results, applications of simulation to industrial problems. Mr. Carroll

**I.E. 420. Analysis of Decision Processes (3)**
Methods of making optimum decisions, including decisions under certainty, decisions under risk, decisions under uncertainty, statistical decisions, and simulated decision making. Application to such areas as inventory theory, maintenance policy, and purchasing policy. Mr. Whitehouse

**I.E. 425. Production Systems (3)**
Mathematical models of production systems; dynamic simulation by digital computers for analysis and evaluation; optimization of production systems; interaction of physical system and information system; significance of system parameters. Mr. Carroll

**I.E. 426. Inventory Theory (3)**
Optimal policies in deterministic inventory processes; optimal policies in stochastic inventory processes; operating characteristics of inventory policies.
Mr. Adams

**I.E. 427. Queueing Theory (3)**
Single server queueing processes, Poisson input and exponential service times, Poisson input and general service times, derivation of busy period distributions; many server queueing processes; applications. Mr. Adams

**I.E. 428. Advanced Work Systems (3)**
A critical evaluation of methods improvement and work measurement techniques. Emphasis on the design of complex work systems, and reporting systems to control work. Work sampling, construction of standard data, mathematical models of work systems. Student projects. Mr. Richardson

**I.E. 440. Application of Automation (3)**
Study of concepts and principles of design in fully automatic production lines; influence of economic factors; partial automation; integration into existing production systems. Case histories with emphasis on problems involved in application of principles. Plant visits and guest lecturers. Mr. Kane

**I.E. 450. Manufacturing Problems (3)**
Discussion and solution of manufacturing problems involving several subfunctions, with emphasis on problem identification and definition; selection of techniques of analysis; procedures for evaluation of proposed solutions.
Mr. Gould

**I.E. 490. Research Methods Seminar (3)**
Research methods in industrial engineering; discussion and critical analysis of current industrial engineering research; practice in preparation of research proposals. Mr. W. A. Smith, Jr.

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# INTERNATIONAL RELATIONS

Professor Joynt
Adjunct Professor Corbett
Associate Professors Dunlap, Braddick, Smolansky
Mr. Gladeck

**I.R. 1. World Politics (3)**
An introductory analysis of the major concepts and principles involved in an understanding of international politics. The main focus will be upon nationalism, the balance of power, alliances, the nature of conflict, and the limits of peaceful change. First semester. Mr. Dunlap

**I.R. 2. World Politics (3)**
An introduction to the foreign policies of the great powers: United States Soviet Union, Britain, France, Germany, Japan, India, and China. Second semester. Mr. Dunlap

**I.R. 11. European International Relations 1815-1919 (3)**
Politics of the Great Powers; clashes of interests and international crises; development of alliances and other associations of states; wars and peace settlements; unification of Germany and Italy; European imperialism; World War I and the peace treaties. Mr. Braddick

**I.R. 12. European International Relations Since 1919 (3)**
The political and strategic structure of Europe in the 1920's; the rise of Germany under Hitler; the politics of international crises, 1935-39; World War II and the new distribution of power in Europe; development of the Cold War; European functional integration; contemporary European international problems; European relations with the United States. Mr. Braddick

**I.R. 21. The Diplomacy of the Far East to 1919 (3)**
The opening of China and Japan; the transformation of Japan; the partition of

China; international rivalries in Korea, Manchuria, the Philippines, Southeastern Asia, and the Indies; economic and territorial imperialism. First semester.
Mr. Gladeck

**I.R. 22. The Diplomacy of the Far East Since 1919 (3)**
An analysis of recent and contemporary political and economic problems confronting not only the countries of the Orient but the Western powers with interests in that region; Japan's aspirations to establish a New Order in Greater East Asia; frustration and remotivation of Japan; the spread of communism and its consequences; prerequisites for peace and security in the Far East and the Pacific region. Second semester. Mr. Gladeck

**I.R. 31. The Middle East in World Affairs**
An analysis of the political, economic and social forces which have led to the rise of the modern states in the Middle East. Emphasis will be placed upon the role of the area in international politics from the invasion of Egypt by Napoleon to 1918. First semester. Mr. Smolansky

**I.R. 32. The Middle East in World Affairs (3)**
The mandates system and the Palestine problem; movements of modernization in Turkey and Iran; the rise of Arab Nationalism; the impact of the Second World War upon the position of Britain and France; the growth in influence of the United States and the Soviet Union; the emergence of Israel and its impact on the Arab states; the rise of Nasserism and the Suez Crisis; the growth of neutralism. Second semester. Mr. Smolansky

**I.R. 133. The Diplomacy of Russia to 1917 (3)**
Development and expansion of the Russian Empire; principles of Russian foreign policy and their specific applications under the Tsarist and Provisional Governments, treated partially as backgrounds of Soviet policy; interaction between Russian domestic and foreign affairs. First semester. Mr. Smolansky

**I.R. 134. The Diplomacy of Russia Since 1917 (3)**
A topical and chronological survey of Russian foreign relations in the Soviet period; philosophical, psychological, economic, social, and other factors influencing the formulation and execution of foreign policy; interaction between Soviet domestic and foreign affairs. First and second semester. Mr. Smolansky

**For Advanced Undergraduates and Graduates**

**I.R. 311. World Affairs, 1919-1945 (3)**
The structure and politics of the state system after World War I; ideals and realities of the League of Nations; rise of Germany, Japan and Italy to challenge the established order; analysis of the political and strategic background to appeasement; the international crises of the 1930's; the Second World War.
Mr. Braddick

**I.R. 312. World Affairs Since 1945 (3)**
The impact of World War II upon the State system; the Cold War and the development of bipolar international politics; the United Nations as an instrument for international order and security; the decline of the colonial system and the emergence of new states; development of Communist China and Western Europe as new power centers; contemporary problems in international relations. Mr. Braddick

**I.R. 321. The Far East in World Affairs (3)**
Analysis of the major forces which have made for conflict in the Far East

with particular emphasis upon the rise of communism in China, the struggle between China and Japan, and the events leading up to the outbreak of the Second World War in the Far East. **Prerequisite: I.R. 22.** Mr. Gladeck

**I.R. 322. The Far East in World Affairs (3)**
Analysis of the period since the Second World War with special studies of the occupation of Japan, the defeat of the Kuomintang and the victory of the Chinese Communists, the Korean War and recent international crises. **Prerequisite: I.R. 22.** Mr. Gladeck

**I.R. 334. The Soviet Union in World Affairs (3)**
An appraisal of the objectives and tactics of Soviet diplomacy, with particular emphasis upon Russia's status as one of the great powers, and upon contemporary Soviet-American relations and their backgrounds. **Prerequisite: I.R. 134 or consent of chairman of department.**

**I.R. 341. International Relations (3)**
An examination of contemporary theories and basic concepts in world politics, with application to historic and current issues of international politics. Consent of head of department. First semester. Mr. Joynt

**I.R. 342. International Relations (3)**
Continuation of I.R. 341. **Prerequisite: Consent of chairman of department.** Second semester. Mr. Joynt

**I.R. 351. International Institutions (3)**
Theory and functioning of the League of Nations and the United Nations with particular reference to the problems of collective security, enforcement, and the pacific settlement of disputes; functional and regional organizations; diplomacy by conference; state sovereignty and inter-state organizations.
Mr. Braddick

**I.R. 352. International Institutions (3)**
Continuation of I.R. 351, with emphasis upon the United Nations. Second semester. Mr. Braddick

**I.R. 361. International Law (3)**
General theories of law and their application to international law; international lawmaking, adjudication and enforcement; personality of states, international organizations, corporations and persons; state succession; title to territory; jurisdiction over territory, waters, airspace, outer space and persons; the state and the foreign corporation. Mr. Dunlap

**I.R. 362. International Law (3)**
Privileges and immunities of diplomatic and consular officers and of international organizations; treaties and agreements; pacific settlement; measures short of war; collective security; the legal status of war and the laws of war; war crimes trials and international criminal jurisdiction. Mr. Dunlap

**I.R. 371. Readings in International Relations (3)**
Directed studies and readings in the several fields of international relations, designed for the student who has a special competence or interest in some area not covered by regularly rostered courses. **Prerequisite: Consent of chairman of department.** First semester. Staff

**I.R. 372. Readings in International Relations (3)**
Continuation of I.R. 371. **Prerequisite: Consent of chairman of department.** Second semester. Staff

**I.R. 381. Special Topics (3)**
An intensive study of some aspects of international politics not covered in another course. **Prerequisite: Consent of chairman of department.** Staff

**I.R. 382. Special Topics (3)**
A continuation of I.R. 381. **Prerequisite: Consent of chairman of department.** Staff

**I.R. 391. The Teaching of International Relations (3)**
Lectures, readings and discussion of fundamental concepts, principles and problems of international relations, with current applications. Open only to present and prospective junior and senior high school teachers. Mr. Dunlap

**For Graduates**

Each student's program is planned on an individual basis to take advantage of his previous academic work and his career goals.

A thorough understanding is required of basic theoretical issues and, unless the student comes prepared, he will be expected to undertake a course in theoretical analysis. Emphasis throughout the Department is upon the fundamentals of international politics as they affect international law and institutions and the policies and activities of the great powers.

Candidates for the master's degree may qualify either by completing successfully thirty hours of approved course work and passing an examination covering the entire field or by completing twenty-four hours in approved courses and submitting a satisfactory thesis. Each candidate will select the plan better suited to his needs and abilities, upon the advice and with the approval of the head of the Department, and will be required to take a comprehensive oral examination. In addition, each candidate is normally expected to possess an adequate reading knowledge of one modern foreign language.

Students will be encouraged to include in their programs appropriate courses in Economics, Government, History, Psychology, and Social Relations.

**I.R. 441. Seminar in International Relations (3)**
Intensive analysis of selected forces and problems of world politics. First semester. Mr. Joynt

**I.R. 442. Seminar in International Relations (3)**
Continuation of I.R. 441. Second semester. Mr. Joynt

**I.R. 451. Seminar in International Organization (3)**
Intensive analysis of selected agencies and activities of the League of Nations and affiliated institutions. First semester.

**I.R. 452. Seminar in International Organization (3)**
Continuation of I.R. 451, with emphasis upon the United Nations. Second semester.

**I.R. 461. Seminar in International Law (3)**
Intensive analysis of the principal theories concerning the nature of international law and its fundamental conceptions, with special studies of their application and significance in contemporary international society. First semester.

**I.R. 462. Seminar in International Law (3)**
Continuation of I.R. 461. Second semester.

**I.R. 471. Special Topics (3)**
Selected topics in the field of international politics not covered in other courses. May be repeated for credit. **Prerequisite: Consent of chairman of department.**
Staff

**I.R. 472. Special Topics (3)**
Continuation of I.R. 471. May be repeated for credit. **Prerequisite: Consent of chairman of department.** Second semester.
Staff

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# MATHEMATICS

Professors Pitcher, Wilansky, Hsiung, Hailperin
Associate Professors Assmus, Cutler, Ghosh, Khabbaz, King, Latshaw, McAllister, Stengle, Van Arnam
Assistant Professors Byrd, Friend, Gulden, Lloyd, McCluskey, Otto, Rayna, Richetta, Ruckle, Schechter, D. H. Taylor, Trutt, Mrs. Gravez
Messrs. Kirch, Laison, Rhodes, Rogers, Subramanian, Frey, Miss Braidi, Messrs. Eisenberg, Fiore, Fleischman, Fleming, Guyker, Jessup, Leonard, Levko, Narayan, Schneller, Stephens, Stern, Stills, Swope, Mrs. J. G. Taylor, Messrs. J. W. Taylor, R. W. W. Taylor, Weston, Williams, Cossey, Koch, Michaels, Pell, Sabotka, Miss Sprague, Messrs. Thompson, Wood

**Math. 6. Finite Mathematics (3)**
Compound statements; intuitive ideas of set with elementary techniques of union, intersection, complement; combinatorial algebra; probability measures and

applications to probability theory; matrices and linear equations; finite Markov chains; linear programming; game theory; and applications to behavioral sciences. First and second semesters.

**Math. 8. Elementary Statistics (3)**
Collection and representation of statistical data; measures of location, dispersion, skewness and kurtosis; sampling distributions studied empirically; fundamental theorems on probability; binomial, Poisson and hypergeometric laws; normal curve; statistical estimation and tests of significance; correlation and regression, least square theorems; the bivariate normal surface; the chi-square tests; analysis of variance and elementary ideas on the design of experiments. **Prerequisite: Math. 21.** Second semester.

**Math. 21. Analytic Geometry and Calculus I (4)**
Functions and graphs; limits and continuity; derivative and differential; indefinite and definite integral; logarithm and exponential. First and second semesters.

**Math. 22. Analytic Geometry and Calculus II (4)**
Trigonometric and hyperbolic functions; integration; vector algebra and calculus; solid analytic geometry. **Prerequisite: Math. 21.** First and second semesters.

**Math. 23. Analytic Geometry and Calculus III (4)**
Series: Taylor's Theorem; approximations; partial derivatives, multiple integrals; line and surface integrals; differential equations. **Prerequisite: Math. 22.** First and second semesters.

**Math. 54. Advanced Geometry (3)**
An introductory course in projective geometry and non-euclidean geometry. **Prerequisite: Math. 22 or consent of chairman of department.** First semester.

**Math. 105. Computer Programming (3)**
The translation of simple mathematical and logical problems into forms permitting their solution by each of certain typical commercially available electronic digital computers, with illustrations from scientific computation and from commercial data processing. Programs will be tested on a computer during hours to be arranged. First and second semesters. Mr. Rayna

**Math. 171. Reading Course in Mathematics (1)**
Credit not to exceed one hour per semester, total credit not to exceed three hours; approval of program and written report required. **Prerequisite: Consent of chairman of department.** First and second semesters.

**For Advanced Undergraduates and Graduates**

*For students who have not taken their elementary mathematics at Lehigh, the prerequisites for certain advanced courses are stated in terms of the number of semester-hours of calculus.*

**Math. 204. Linear Analysis (3)**
Matrices, determinants, elementary transformations, canonical forms; quadratic functions and principal axes, orthogonal families, characteristic roots; Sturm-Liouville systems, expansions in orthogonal functions including Fourier series, boundary value problems. **Prerequisite: Math. 23 or nine semester-hours of differential and integral calculus.** First and second semesters. Staff

**Math. 208. Complex Variables (3)**

Functions of a complex variable; calculus of residues; contour integration; applications to conformal mapping and Laplace transforms. **Prerequisite: Math. 23, or nine semester hours of differential and integral calculus.** First and second semesters. Staff

**Math. 219. Principles of Analysis I (3)**

The real number system; limits; continuous functions; differentiation; integration; infinite series; absolute and uniform convergence. **Prerequisite: Math. 23 or nine semester-hours of differential and integral calculus.** First and second semesters. Staff

**Math. 220. Principles of Analysis II (3)**

Continuation of Math. 219. Functions of several variables; line and surface integrals; implicit functions; Fourier series. **Prerequisite: Math. 219.** First and Second semesters. Staff

**Math. 221. Differential Equations (3)**

Techniques for solving first order and higher order linear differential equations, Laplace transform methods; method of successive approximations, fundamental existence theorem, properties of linear equations; solutions in series, Legendre Polynomials. **Prerequisite: Math. 23 or nine semester-hours of differential and integral calculus.** First and second semesters. Staff

**Math. 224. Probability and Numerical Analysis (3)**

Probability; least squares and its application in the study of errors; formation of empirical formulas; numerical methods. Designed for students engaged in experimental or observational work. **Prerequisite: Math. 23 or nine semester-hours of differential and integral calculus.** First and second semesters.

Mr. Latshaw

**Math. 230. Numerical Methods (3)**

Numerical solution of non-linear equations and systems; linear systems and the algebraic eigenvalue problem; difference calculus and interpolation; numerical differentiation and quadrature; numerical solution of ordinary differential equations. Students will use the digital computer. **Prerequisite: Math. 204.** First or second semester.

**Math. 231. Statistical Inference (3)**

Probability, distribution of random variables; hypergeometric, binomial, Poisson, normal, gamma and beta distributions, moments, samples, populations, classification of data, random sampling; sampling distributions of mean and variance; chi-square, $t$, $F$; testing of hypotheses and estimation, Neyman-Pearson Lemma and likelihood ratio tests, methods of maximum likelihood and moments; application of chi-square, $t$ and $F$; correlation and regression theory of two variables; brief introduction to non-parametric methods and analysis of variance. **Prerequisite: Math. 23 or nine semester-hours of calculus.** First and second semesters. Staff

**Math. 241. Matrices and Vector Spaces (3)**

Number systems; theory of polynomial functions and equations; systems of lin-

ear equations; theory of matrices and linear transformations; linear spaces; bilinear and quadratic forms. **Prerequisite: Consent of the chairman of the department.** First semester. Mr. Otto

**Math. 242. Modern Algebra (3)**

The basic concepts of higher algebra: group theory including the Sylow theorems; ring theory with emphasis on Euclidean rings; field theory including an introduction to Galois theory. **Prerequisite: Math. 241.** Second semester. Mr. Otto

**Math. 251. Mathematical Methods (1-4)**

An introductory survey of topics in analysis for graduate students in fields other than mathematics. Topics may include: differential equations, techniques of series expansion, numerical methods, matrix and vector analysis, complex variables, calculus of vector fields. Formal applications are emphasized. **Prerequisites: graduate standing and consent of the instructor. With consent of the department chairman, may be repeated for credit.** First semester.

**Math. 252. Mathematical Methods (1-4)**

A survey of topics in analysis for graduate students in fields other than mathematics, either continuing topics treated in Math. 251 or introducing new topics. **Prerequisites: Graduate standing and consent of the instructor. With consent of the department chairman, may be repeated for credit.** Second semester.

**Math. 284. Number Theory (3)**

Divisibility, congruences, quadratic residues, primitive roots, diophantine equation.

**Math. 301. Vector and Tensor Analysis (3)**

Theory and techniques of vector and tensor analysis with geometrical and physical applications. **Prerequisite: Math. 23 or nine semester-hours of differential and integral calculus.**

**Math. 303. Mathematical Logic (3)**

A course, on a mathematically mature level, designed not only to acquaint the student with the logical techniques used in mathematics but also to present symbolic logic as an important adjunct in the study of the foundations of mathematics. First semester.

**Math. 304. Axiomatic Set Theory (3)**

A development of set theory from axioms; relations and functions; ordinal and cardinal arithmetic; recursion theorem; axiom of choice; independence questions. **Prerequisite: Math. 219 or consent of the instructor.** Second semester.

**Math. 307. General Topology I (3)**

An introductory study of topological spaces, particularly metric spaces, including such topics as separation axioms, maps, connectedness, compactness, arcs. **Prerequisite: Math. 219.** First semester. Messrs. Gulden, Ruckle

**Math. 308. Algebraic Topology I (3)**

The simplicial and singular cohomology theories, homotopy groups and the

exact homotopy sequence, the Mayer-Vietoris sequence of a triad, cup products, covering spaces. The course will emphasize examples and applications of the theory to the problem of classifying compact two dimensional manifolds. **Prerequisite: Math. 307.** Second semester. Messrs. Khabbaz, D. Taylor

**Math. 309. Theory of Probability (3)**

Probabilities on discrete and continuous sample spaces; events on a discrete sample space; random variables and probability distributions; transformations; simplest kind of law of large numbers and central limit theorem. The theory will be applied to problems in physical and biological sciences. **Prerequisite: Math. 23 or nine semester hours of differential and integral calculus.** First or second semester.

**Math. 315. Theory of Functions of a Complex Variable I (3)**

Algebra of complex numbers; analytic functions. Cauchy-Riemann equations; Laplace's equation; conformal mapping; integrals of complex functions; Cauchy's theorem; power series; Taylor's theorem; Laurent's theorem, residues. **Prerequisite: Math. 219.** First or second semetser. Messrs. Hsiung, King, Trutt

**Math. 320. Ordinary Differential Equations (3)**

The analytical and geometric theory of ordinary differential equations, including such topics as linear systems, systems in the complex plane, oscillation theory, stability theory, geometric theory of non-linear systems, finite difference methods, general dynamical systems. **Prerequisite: Math. 220 previously or concurrently and Math. 221.** First or second semester. Messrs. Schechter, Stengle

**Math. 322. Methods of Applied Analysis I (3)**

Fourier series, eigenfunction expansions, Sturm Liouville problems, Fourier integrals and their application to partial differential equations; special functions. Emphasis is on a wide variety of formal applications rather than logical development. **Prerequisite: Math. 221 or consent of chairman of department.** First and second semester. Staff

**Math. 323. Methods of Applied Analysis II (3)**

Green's functions; integral equations; variational methods; asymptotic expansions, method of saddle points; calculus of vector fields, exterior differential calculus. **Prerequisite: Math. 322.** Second semester. Mr. Stengle

**Math. 327. Groups and Rings (3)**

An intensive study of the concept of group theory including the Sylow theorems, and of ring theory including unique factorization domains and polynomial rings. First semester.

**Math. 328. Fields and Modules (3)**

Field theory, including an introduction to Galois Theory; the theory of modules, including tensor products and classical algebras. **Prerequisite: Math. 327.** Second semester.

**Math. 331. Numerical Analysis (3)**

The construction of polynomial approximations and application to numerical quadrature and differentiation; solution of systems of equations with emphasis on linear systems; discrete variable methods for the solution of ordinary differential equations. Students will have the opportunity to use a digital computer in the solution of problems. **Prerequisite: Math. 219.** First semester.

Messrs. McAllister, Schechter

**Math. 334. Mathematical Statistics (3)**
Populations and random sampling; sampling distributions; theory of statistical estimation; criteria and methods of point and interval estimation; theory of testing statistical hypothesis; analysis of variance; non-parametric methods. **Prerequisite: Math. 309 or, with the consent of the instructor, Math. 231.** First or second semester. Messrs. McAllister, Schechter

**Math. 345. Theory of Groups (3)**
Some basic structure theorems for Abelian groups including the concepts of divisibility, purity, and height; solvable groups; nilpotent groups; composition series. **Prerequisite: Math. 327.** First semester.

**Math. 350. Special Topics (3)**
A course covering special topics not sufficiently covered in the general courses. **Prerequisite: Consent of the chairman of department.** First or second semester. May be repeated for credit. Staff

**Math. 362. Computer Languages (3)**
An examination of a number of high-level computer programming languages, and of the concepts and techniques which are used in the design of the compilers which translate them. **Prerequisite: Math. 105 or consent of the instructor.** First or second semester. Mr. Rayna

**Math. 371. Readings in Mathematics (3)**
The study of a topic in mathematics under appropriate supervision; designed for the individual student who has studied extensively and whose interests lie in areas not covered in the listed courses. **Prerequisite: Consent of the chairman of the department.** First or second semester. May be repeated for credit.

**Math. 381. Probability and Statistics (3)**
Combinatorial problems, theory of probability, various frequency distributions, standard deviation, sampling, correlation. **Prerequisite: Open to secondary school teachers who present at least eighteen hours of undergraduate mathematics.**

**Math. 382. Algebra (3)**
Fundamentals of algebra, axiomatic method, set theory, notions of group, ring, integral domain, and field. **Prerequisite: Same as Math. 381.**

**Math. 385. Higher Geometry I (3)**
Logical systems, postulates, synthetic projective geometry, analytic projective geometry, affine, euclidean and non-euclidean geometry. **Prerequisite: Same as Math. 381.**

**Math. 387. Intermediate Analysis (3)**
The real number system, functions, limits, continuity, derivative, law of the mean, Taylor's formula, definite integral. **Prerequisite: Open only to secondary school teachers of mathematics who present at least 18 semester-hours of undergraduate mathematics including a course in analysis.**

## For Graduates

In order to begin the work required for an M.S. degree in Mathematics, a graduate student must present evidence of having completed an adequate undergraduate major program in mathematics. Such a major is understood

to consist of at least 36 semester hours of mathematics, of which at least 12 hours required the elementary calculus sequence as prerequisite. A year of advanced calculus and a year of algebra should be included.

The 30 semester hours required for the M.S. degree must include (with the exceptions noted below) the following courses: four of the six courses Math. 307, 308, 315, 322, 345, 346, selected with the approval of the department chairman; also, Math. 401, 423, and 443. A student with unusually strong background may be permitted to substitute a more advanced course for a required course, or may have covered the work of a required course, thereby gaining greater feedom of election of courses within the required 30 semester hours. The M.S. degree requires either a thesis or a comprehensive examination at the discretion of the chairman of the department.

The plan of work for the Ph.D. degree will ordinarily include courses in algebra, analysis, geometry, and topology at the 400 level and several courses including seminars in the field in which the dissertation is to be written. The Department accepts candidates for the Ph.D. who wish to specialize in and to write a dissertation on some aspect of any of the following areas of advanced work: analysis with emphasis on pure mathematics or applied mathematics, algebra, functional analysis, differential geometry, mathematical logic, probability, statistics, and topology.

**Math. 401. Theory of Functions of a Real Variable (3)**
A study of significant classes of real valued functions, distinguished by such properties as continuity, semi-continuity, bounded variation, absolute continuity, differentability, integrability. **Prerequisite: Math. 307.** Second semester.
Messrs. Pitcher, Ruckle

**Math. 402. Measure and Integration (3)**
The general theory of measure and integration, with Lebesgue measure and integration as a significant example. **Prerequisite: Math. 401.** First semester.
Messrs. Laison, Pitcher

**Math. 404. Mathematical Logic (3)**
Advanced topics in quantification theory relevant to formalized theories, recursive functions, Godel's incompleteness theorem; algorithms and computability. **Prerequisite: Math. 303.** First semester. Mr. Hailperin

**Math. 405. Partial Differential Equations (3)**
Classification and transformation of equations; theory of characteristics; initial and boundary value problems; Cauchy's problem for hyperbolic equations; Dirichlet's problem for elliptic equations; potential theory; Green's function; harmonic and sub-harmonic functions; difference equations; applications to equations of physics. **Prerequisite: Math. 220 and Math. 221.** First semester.
Messrs. McAllister, Stengle

**Math. 406. Partial Differential Equations (3)**
Continuation of Math. 405. **Prerequisite: Math. 405.** Second semester.
Messrs. McAllister, Stengle

**Math. 407. Transforms (3)**
The properties and use of the Fourier transform, the Laplace transform, the finite transform and generalized functions. **Prerequisites Math. 220, Math. 221, and either Math. 208 or Math. 315.** Messrs. Gulden, Schechter

**Math. 408. Boundary Value Problems (3)**
The study of boundary value problems with attention to integral equations, special functions, variational methods, and eigenvalue problems. **Prerequisites: Math. 220, Math. 221, and either Math. 208 or Math. 315.** Mr. Schechter

**Math. 409. Mathematics Seminar (3 or 6)**
An intensive study of some field of mathematics not offered in another course. **Prerequisite: Consent of chairman of department.** First or second semester. Staff

**Math. 410. Mathematics Seminar (3 or 6)**
Continuation of the field of study in Math. 409 or the intensive study of a different field. **Prerequisite: Consent of chairman of department.** First or second semester. Staff

**Math. 416. Theory of Functions of a Complex Variable II (3)**
Continuation of Math. 315, with more advanced topics, such as theory of conformal mapping, bilinear transformations, analytic continuation, summability of series, multiple-valued functions, Riemann surfaces, infinite products, Weierstrass's factor theorem. Mittag-Leffler's theorem, special classes of functions. **Prerequisite: Math. 315.** Second semester. Mr. King

**Math. 421. Probability (3)**
Continuation of Math. 309. Algebra of sets, theorems on addition and multiplication of probabilities, conditional probability and independence; random variables of discrete and continuous types, compound and multidimensional distributions; probability generating functions, characteristic functions, uniqueness theorem, central limit theorem (Liapunov form), strong and weak law of large numbers; Markov chains, random walk problems, the ergodic theorem; stochastic processes with discrete and continuous states, birth and death process, Kolmogorov equations, Wiener process. **Prerequisite: Math. 309 or Math. 234.** Second semester. Mr. Ghosh

**Math. 423. Differential Geometry I (3)**
The differential geometry of curves and surfaces in Euclidean space, including problems in the large. First semester. Mr. Hsiung

**Math. 424. Differential Geometry II (3)**
Multilinear algebra; differentiable manifolds; tensor bundles; exterior differential forms; theorems of Stokes and Frobenius; imbedding theorem; affine connections; holonomy groups; Riemannian manifolds. **Prerequisite: Math. 423 and Math. 308.** Mr. Hsiung

**Math. 425. Differential Geometry III (3)**
Continuation of Math. 424 Curvature tensor; manifolds of constant curvature; Gauss-Bonnet formula; completeness; harmonic forms; curvature and homology; infinitesimal transformations: conjugate points and Morse index theorem; Lie groups and Lie algebras. **Prerequisite: Math. 424.** Mr. Hsiung

**Math. 431. Calculus of Variations (3)**
Fundamental existence theorems; necessary conditions and sufficient conditions for relative minima of single integrals; the index theorem; application to boundary value problems. **Prerequisite: Math. 401.** First semester. Mr. Pitcher

**Math. 435. Functional Analysis I (3)**
Transfinite induction; linear space; convex sets, separation theorems; linear topology; Frechet, Banach, Hilbert and Minkowski spaces, and Banach algebra; ordered spaces; reflexivity, weak and product topologies; open mapping, uniform boundedness; basis and orthogonal series: representation theorem; applications to classical analysis. **Prerequisite: Math. 307.** First semester. Mr. Wilansky

**Math. 436. Functional Analysis II (3)**
Continuation of Math. 435. **Prerequisite: Math. 435.** Second semester.
Mr. Wilansky

**Math. 443. General Topology II (3)**
A continuation of Math. 307, with such topics as filters and nets, topological products, local compactness, paracompactness, metrizability, uniformity, function spaces, dimension theory. **Prerequisite: Math. 307.** Second semester.
Mr. Gulden

**Math. 444. Algebraic Topology II (3)**
Cross products, cup and cap products, duality theorems, universal coefficient theorems, the Kunneth theorem. **Prerequisite: Math. 308.** First semester.
Mr. Khabbaz

**Math. 445. Algebraic Topology III (3)**
Fibre bundles, obstruction theory, spectral sequences. **Prerequisite: Math. 444.** Second semester. Mr. Khabbaz

**Math. 449. Advanced Topics in Algebra (3)**
An intensive study of some topic in algebra with emphasis on recent developments. May be repeated for credit. **Prerequisite: Math. 344.** First or second semester. Mr. Lloyd

**Math. 453. Topics in Function Theory (3)**
The development of one or more topics in function theory, such as analytic continuation, maximum modulus principle, conformal representation, Taylor series analysis, integral functions, Dirichlet series, functions of several complex variables. **Prerequisite: Math. 416.** First semester. Messrs. Gulden, King

**Math. 471. Homological algebra (3)**
Modules, tensor products, categories and functors, homology functors, projective and injective modules. **Prerequisite: Math. 346.** First or second semester.
Mr. Lloyd

**Math. 472. Finite Groups (3)**
An intensive study of the structure of finite groups and their automophisms. **Prerequisite: Math. 346.** First or second semester. Mr. Otto

**Math. 473. Ordered algebraic systems (3)**
Partially ordered groups and rings with emphasis on representation theory. **Prerequisite: Math. 346.** First or second semester. Mr. Lloyd

## ASTRONOMY

**Astr. 1. Descriptive Astronomy (3)**
The earth as an astronomical body; the solar system; a brief introduction to sidereal astronomy. First and second semesters.

**Astr. 2. General Astronomy (3)**
The solar system; the sidereal system, with an introduction to celestial mechanics and astrophysics. **Prerequisite: Math. 21. Not open to Freshmen.** First or second semester.

**Astr. 104. Stellar Astronomy and Astrophysics (3)**
Introduction to astrophysics; the sun considered as a star; physical characteristics of the stars; stellar motions; binary stars; theory of binary star orbits; stellar aggregations; cosmogony. **Prerequisites: Math. 22, and Phys. 16 or Phys. 3.** First or second semester. Mr. Van Arnam

**Astr. 250. Topics in Astronomy (3)**
A course covering one or more topics not covered in other courses. **Prerequisite: Consent of the chairman of department.** First or second semester. May be repeated for credit.

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# MECHANICAL ENGINEERING

Professors Long, Owczarek, Stenning
Associate Professors Benner, Eppes, Jackson
Assistant Professors Lucas, Nevis, Roberts, Terry
Messrs. Golan, Paul, Pujol

**M.E. 10. Analysis of Engineering Problems I (1)**
Elementary analyses of problems in the field of mechanical engineering. Methods and techniques of solution. Use of digital computers. **Prerequisite: Consent of chairman of department.**

**M.E. 100. Industrial Employment (0)**
Usually following the junior year, students in the mechanical engineering curriculum are expected to do a minimum of eight weeks of practical work, preferably in the field they plan to follow after graduation. A report is required. **Prerequisite: Sophomore standing.**

**M.E. 101. Mechanical Engineering Design I (3)**
Application of the principles of mechanics to the design of machine elements. Introduction to kinematic principles in mechanisms. **Prerequisites: C.E. 11; Mech. 11; Mech. 102, previously or concurrently.**

**M.E. 102. Mechanical Engineering Design II (3)**
Continuation of M.E. 101. **Prerequisite: M.E. 101.**

**M.E. 103. Mechanical Engineering Design III (5)**
Consideration of dynamic loading on design of machines. Vibration and balancing. Attention to logical methods of investigating unfamiliar problems. **Prerequisites: M.E. 102; Math. 221.**

**M.E. 104. Thermodynamics I (4)**
Basic concepts and principles of thermodynamics with emphasis on universal applications. First and Second Law development. Energy equations. Reversibility and irreversibility. Entropy and probability. Thermodynamic functions. Properties of pure substances. **Prerequisite: Math. 23, Phys. 3.**

**M.E. 105. Thermodynamics II (4)**
Thermodynamics applications. Reversible and irreversible processes and cycles with various fluids. Gas and vapor mixtures. Compressible and incompressible fluid flow. **Prerequisite: M.E. 104.**

**M.E. 108. Laboratory I (2)**
Lectures and laboratory exercises relating to various phases of engineering laboratory technique and procedures. Includes planning, execution, and analysis of tests and writing of reports. **Prerequisite: M.E. 105.**

**M.E. 109. Laboratory II (2)**
Continuation of M.E. 108 with emphasis on project investigations.

**M.E. 110. Thesis (1-3)**
Candidates for the degree of B.S. in M.E. may, with the approval of the director of the curriculum, undertake a thesis as a portion of the work during the senior year.

**M.E. 111. Analysis of Engineering Problems II (2)**
Formulation of equations, analysis, and modeling of engineering systems. Elements of numerical and analog methods of solution. **Prerequisites: M.E. 10, Math. 221.**

**M.E. 160. Thermodynamics (3)**
Fuels; combustion; principles of engineering thermodynamics; properties of steam; steam power plant equipment and cycles; internal combustion engines. **Prerequisites: Math. 23; Phys. 3.**

**M.E. 161. Mechanical Engineering Laboratory (1)**
Testing of mechanical engineering equipment. **Prerequisite: M.E. 160, or M.E. 104.**

**M.E. 166. Procedures for Mechanical Design (2)**
General design procedures, motion analysis, force analysis, static, repeated and impact types of loading, modes of failure, stress analysis, failure theories. Applications to the design of typical machine elements. **Prerequisite: Mech. 11.**

**M.E. 168. Elements of Mechanical Design (4)**
Elements of mechanical design: motion and force analysis, sizing of members, selection of materials for failure prevention, production requirements. Selected examples of mechanical component and system design. **Prerequisites: Mech. 11, Mech. 102 previously or concurrently.**

**For Advanced Undergraduates and Graduates**

**M.E. 220. Thermodynamics (3)**
Principles of classical thermodynamics with applications to engineering problems. Introduction to statistical thermodynamics. **Prerequisites: Phys. 3 and Math. 23.**

**M.E. 310. Projects (3-6)**
Analysis and synthesis of selected mechanical engineering systems and devices. Case studies chosen from topics such as design of fluid machinery, power plants, internal combustion engines. Consideration of mechanical design and thermodynamic influences, with emphasis on the creative phase of design. **Prerequisites: Consent of chairman of department.** Staff

**M.E. 320. Thermodynamics III (3)**
Kinetic theory of gases, statistical thermodynamics. Advanced and specialized topics in thermodynamics. **Prerequisite: M.E. 105.** Second semester.
Mr. Owczarek

**M.E. 321. Heat Transfer (3)**
Conduction, free and forced convection, radiation, evaporation and condensation, mass transfer. Application to design of heat exchangers in power plant, air conditioning, and refrigeration apparatus. **Prerequisites: Math. 221; C.E. 121; M.E. 105.** Mr. Nevis

**M.E. 322. Gas Dynamics (3)**
Dynamics and thermodynamics of compressible flow; subsonic and supersonic flow in nozzles and ducts, heat addition, compressible flow with friction, linearized analysis of subsonic and supersonic flow, similarity rules, normal and oblique shocks, method of characteristics, applications to design of wind tunnels, rockets, ram-jets, turbines. **Prerequisites: C.E. 121; M.E. 105; Math. 221.** First semester.
Mr. Owczarek

**M.E. 324. Space Propulsion Systems (3)**
Cycle analysis of air-breathing engines. Optimum configurations for different flight regimes. Chemical and nuclear rocket engines. Electrical propulsion devices. Rankine and Brayton cycles for space power plants. Component design. **Prerequisite: M.E. 105.** Mr. Stenning

**M.E. 331. Fluid Mechanics (3)**
Kinematics of fluid flow, equations of flow in integral form, and two dimensional potential flow theory of incompressible fluids with applications. Navier-Stokes equations, dynamic similarity, laminar flows, turbulence, and boundary layers. Introduction to flow of compressible fluids. Measurement techniques. Flows in and performance analysis of turbomachinery; introduction to the design of cascades. Flow of non-Newtonian fluids. Hydrodynamic lubrication. **Prerequisites: C.E. 121 and C.E. 123.** Mr. Owczarek

**M.E. 340. Advanced Mechanical Engineering Design (3)**
Design of mechanical systems and components requiring applications of advanced principles of mechanics and material behavior. Advanced design topics, including optimization, reliability and sensitivity analysis. **Prerequisite: M.E. 103.** Second semester. Messrs. Benner, Terry

**M.E. 342. Mechanical Vibration Analysis (3)**
Analysis of physical systems and setting up equations: development of significant engineering relationships. Emphasis on engineering application. **Prerequisite: Math. 221.** Second semester. Messrs. Terry, Long

**M.E. 343. Instrumentation and Automatic Control (3)**
Selection, design and operation of measuring instruments. Analysis of automatic control systems for thermal, hydraulic and mechanical processes. Stability and response criteria. **Prerequisite: Math. 221.** Messrs. Benner, Long

## For Graduates

For the master's degree a thesis will be required. The taking of mathematics courses which are required in the undergraduate mechanical engineering curriculum may be considered as making up a deficiency so that a larger number of credits than the minimum may be necessary.

Subject to proper approval "400" level courses from other engineering curricula, such as mechanics and chemical engineering, may be included in the major.

A student who plans to work for the doctor's degree should submit during his first year a general plan to the head of the department and arrange for the qualifying examination.

The department offers courses during the late afternoon for the convenience of students who are employed locally and taking graduate work on a part-time basis.

**M.E. 420. Advanced Thermodynamics (3)**
Critical review of first and second laws, entropy, and general thermodynamic equations and relations; applications to current problems in technology and research. Messrs. Owczarek, Stenning

**M.E. 421. Topics in Thermodynamics (3)**

Emphasis on theoretical and experimental treatment of combustion processes including dissociation, flame temperature calculations, diffusion flames, stability and propagation; related problems in compressible flow involving one-dimensional, oblique shock waves and detonation waves. Methods of measurement and instrumentation. Mr. Owczarek

**M.E. 423. Boundary Layer Analysis (3)**

Navier-Stokes equations, laminar boundary layer theory, analysis of friction drag, heat transfer and separation; transition from laminar to turbulent flow. Turbulent boundary layer theory, Karman integral equations, Prandtl mixing length, turbulent friction drag, heat transfer and layer thickness. Flow in ducts, waves and jets. Messrs. Owczarek, Stenning

**M.E. 424. Advanced Mechanical Vibrations (3)**

Comprehensive study of vibrating systems; non-linear vibrations; aeroelasticity; study of current literature. **Prerequisite: M.E. 440.** Mr. Long

**M.E. 431. Advanced Gas Dynamics (3)**

Continuation of M.E. 322. Small perturbation theory. Methods of solution of two-dimensional subsonic steady flows. The supersonic blunt body problem. Similarity rules of high-speed flow. Transonic flow. Hypersonic flow. Introduction to magnetogasdynamics. **Prerequisite: M.E. 322.** Mr. Owczarek

**M.E. 432. Topics in Gas Dynamics (3)**

The equilibrium thermodynamic properties of a dissociating mixture of gases. Equilibrium flow of dissociating gases. Vibrational and chemical nonequilibrium. Criteria for thermodynamic equilibrium of gas flow. Chemical kinetics of gaseous reactions. Equations of flow of a reacting gas mixture. Nonequilibrium flows. Application to design of ram-jets and rocket nozzles and of re-entry vehicles. **Prerequisites: M.E. 320, M.E. 322.** Mr. Owczarek

**M.E. 439. Fluid Mechanics of Turbo-machinery (3)**

Hodograph methods in potential flow. Solution of direct and indirect cascade design problems using the methods of singularities and conformal transformation. Real fluid effects in two-dimensional cascade flow. Secondary flow in cascades. Three-dimensional flow. Messrs. Owczarek, Stenning

**M.E. 440. Dynamics of Machinery (3)**

Fundamental principles of dynamics; variational dynamics; variable mass systems; gyroscopic theory and devices; applications to mechanical systems.
Messrs. Benner, Long

**M.E. 441. Stress Analysis in Design (3)**

Application of methods of the theory of elasticity to mechanical design problems. Direct, approximate, and numerical methods of analysis applied to problems in plane stress, plane strain, torsion, thermal stresses, and residual stresses. First semester. Messrs. Benner, Long

**M.E. 442. Analytical Methods in Engineering I (3)**

Analytical Methods of Solution for Discrete and Continuous engineering systems. Theoretical, numerical and approximate methods of solution applied to equilibrium, characteristic value and propagation types of engineering problems. First semester. Mr. Erdogan

**M.E. 443. Analytical Methods in Engineering II (3)**
Continuation of M.E. 442. Second semester. Mr. Erdogan

**M.E. 444. Experimental Stress Analysis in Design (3)**
Applications of experimental stress analysis to mechanical design problems. Second semester. Mr. Benner

**M.E. 445. Advanced Engineering Design (3)**
The application to mechanical systems of the systems engineering process, environmental and needs research, the economic theory of demand and value, decision making, systems analysis and synthesis techniques. Computer-aided design including simulation, optimum seeking methods, and design-logic programming. **Prerequisite: Math 231, previously or concurrently.** Mr. Benner

**M.E. 446. Advanced Engineering Design (3)**
Continuation of M.E. 445. Reliability engineering for mechanical systems and components including system effectiveness, data collection and analysis procedures, redundancy, reliability allocation, prediction and testing. Maintainability analysis. Mr. Benner

**M.E. 450. Special Topics (3)**
An intensive study of some field of mechanical engineering not covered in more general courses. Staff

**M.E. 451. Seminar (1-3)**
Critical discussion of recent advances in mechanical engineering. Staff

**M.E. 460. Design Project (1-6)**
Selected design project in an area of student and faculty interest where the need for creative design work is recognized. Economic as well as physical and functional aspects are considered. Laboratory testing and data acquisition is carried out as needed to promote design development. Prototypes are constructed and tested, when practical. Messrs. Benner, Terry

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# MECHANICS

Professors Beer, Erdogan, Paris, Sih, G. F. Smith
Associate Professors Kalnins, Osborn, Wei
Assistant Professors Hartranft, Karna, Perlman, Updike
Messrs. Bhandari, Perna, Ravera
Creager, Landes, Leonesio, Lewis, Loeber, MacDonald, Regl, Robertson, Seitz, Trevino, Tseng

**Mech. 1. Statics (3)**
Composition and resolution of forces; equivalent force systems; equilibrium of particles and rigid bodies; centroids and centers of gravity; analysis of simple struc-

tures; internal forces in beams; friction; moments and products of inertia; method of virtual work. **Prerequisites: Math. 22 and Phys. 1.** First and second semesters.

**Mech. 10. Problem Computation Laboratory (1)**
Techniques of programming for computers; preparation of problems in mechanics for computer programming. **Prerequisite: Mech. 1.**

**Mech. 11. Mechanics of Materials (3)**
Strength and elasticity of materials; theory of stresses and strains; deflection of beams and shafts; torsion; buckling of struts. **Prerequisites: Mech. 1; Math. 23, previously or concurrently.** First and second semesters.

**Mech. 13. Materials Testing Laboratory (1)**
Experiments to study the mechanical properties of engineering materials; correlation of the properties of different materials, of their behavior under different types of load application, and of mechanical properties to design criteria. Verification of certain assumptions used in Mech. 11. **Prerequisite: Mech. 11, preferably concurrently.** First and second semesters.

**Mech. 100. Industrial Employment (0)**
During the summer following the junior year, students in engineering mechanics are required to spend at least eight weeks getting practical experience in some approved industrial or research organization, preferably in the field they plan to enter after graduation. A written report on the work done is due within two months of the termination of their employment.

**Mech. 102. Dynamics (3)**
Kinematics and kinetics of particles and rigid bodies; relative motion; dynamic equilibrium; work and energy; impulse and momentum; mechanical vibrations. **Prerequisites: Mech. 1; Math. 23.** First and second semesters.

**Mech. 104. Fluid Dynamics (3)**
Equations of continuity, energy, momentum with basic applications. Viscous effects. Introductory fluid kinematics. Two-dimensional potential flow problems using conformal mapping; foils; free streamline theory. Vortex formation. **Prerequisites: Mech. 102, Math. 208 and 221.** Second semester.

**For Advanced Undergraduates and Graduates**

**Mech. 2XX. Elements of Continuum Mechanics (3)**
Stress and strain at a point, invariants, and generalized stress strain relations; basic equations of motion of a continuum, energy principles and reduction of equations for special areas; application to materials behavior phenomena. **Prerequisite: Math. 221. or equivalent.** Second semester. Mr. Paris

**Mech. 301. Advanced Mechanics of Materials (3)**
Introduction to two-dimensional theory of elasticity; theories of failure; bending and torsion of prismatic bars; principles of indeterminate analysis; instability. **Prerequisite: Mech. 11; 221, previously or concurrently.** First semester.
Messrs. Paris, Sih, Wei

**Mech. 302. Advanced Dynamics (3)**

Fundamental dynamical theorems and their application to the study of the motion of particles and rigid bodies, with particular emphasis on three-dimensional motion. Use of generalized coordinates; Lagrange's equations and their applications. **Prerequisites: Mech. 102; Math. 204.** Second semester.

Messrs. Beer, Osborn, Paris

**Mech. 303. Mechanics of Continua I (3)**

Fundamental principles of the mechanics of deformable bodies. Study of stress, strain, velocity and acceleration fields. Compatibility equations, conservation laws. Applications to viscous and non-newtonian fluids, perfectly plastic and perfectly elastic materials. **Prerequisites: Mech. 104 and Mech. 301.** First semester. Messrs. Sih, G. F. Smith

**Mech. 304. Mechanics of Continua II (3)**

Formulation of constitutive equations; invariance principles. Large elastic deformations; theory of dislocations; couple-stress theory; hereditary materials and viscoelasticity; elements of crystal physics and continuum physics. **Prerequisite: Mech. 303.** Second semester. Messrs. Sih, G. F. Smith

**Mech. 305. System Dynamics (3)**

Application of Lagrange equations to the dynamics of linear systems; total energy, Rayleigh's principle, disippation function, structural damping. Use of convolution integrals and Laplace transforms in the study of transient response. Nonlinear discrete systems; introduction to the response of systems to random inputs. **Prerequisites: Mech. 302; Math. 204, 208 and 221.** First semester. Mr. Erdogan

**Mech. 306. Experimental Methods in Mechanics (3)**

Study of loading, sensing and recording devices pertinent to applied mechanics. Application to the determination of the time-dependent properties of materials and systems with emphasis on research. Lectures, laboratory, and individual projects. **Prerequisites: Mech. 301 and 305.** Second semester.

Messrs. Osborn, Warnock

**Mech. 326. Aerodynamics (3)**

Fundamentals of fluid dynamics applied to aircraft; the Prandtl theory of lift and drag; performance calculations; theory of stability and control. **Prerequisite: Mech. 104 or M.E. 331.** Second semester.

**Mech. 350. Special Topics (3)**

A study of some field of Engineering Mechanics not covered in the general courses. **Prerequisite: Consent of chairman of department.** First or second semester. Staff

## For Graduates

The graduate courses in Mechanics are open in general to students who have been graduated from a curriculum in engineering mechanics, engineering mathematics, engineering physics, civil engineering, or mechanical engineering at a recognized institution.

A candidate for the M.S. degree in Applied Mechanics is expected to possess a thorough knowledge of undergraduate mathematics and mechanics. Math. 204, 208 and 322, and Mech. 301 and 302, or their equivalents, are

considered prerequisites for graduate work in Applied Mechanics. Any of these courses which have not been taken by the student as an undergraduate should be included in his graduate program. He may then be required to present a larger number of credits than the minimum required for graduation. A thesis carrying 3 to 6 credit hours is required of all candidates for the M. S. degree.

**Mech. 402. Advanced Analytical Mechanics (3)**

Fundamental dynamical theorems and their application to advanced problems; generalized coordinates; Lagrange's equations; fixed and moving constraints; nonholonomic systems; Hamilton's principle; Hamilton's canonical equations; contact transformations; Hamilton-Jacobi partial differential equation. **Prerequisite: Mech. 302 or consent of chairman of department.** First semester. Mr. Beer

**Mech. 404. Advanced Vibrations Analysis (3)**

Sturm-Liouville theory; variational problems for deformable bodies; methods for estimating the natural frequencies and their bounds for continuous elastic systems. Wave propagation in a continuous elastic medium; Rayleigh waves; viscoelastic waves. **Prerequisites: Math. 221; Mech. 305, or equivalent introductory course in vibrations analysis.** Second semester. Mr. Erdogan

**Mech. 405. Response of Systems to Random Loads (3)**

Stochastic processes; correlation functions and power spectra; response of mechanical systems to one-dimensional and multidimensional random load fields; probability theory for several random variables; statistical properties of the random vibrations of mechanical systems; application to failure prediction. **Prerequisite: Consent of chairman of department.** Second semester. Mr. Beer

**Mech. 409. Theory of Elasticity I (3)**

Theoretical foundations of the mechanics of linear elasticity theory. Kinematics of deformation; analysis of stress, stress-strain relations; strain-energy. Reciprocal and uniqueness theorems; St. Venant's principle; minimum and variational principles and their applications. Methods for boundary value problems; theory of biharmonic functions; Galerkin, Papkovich, Neuber functions; integral transforms. Fundamental problems in two-and three-dimensions; singular solutions; torsion, bending and plane problems. **Prerequisites: Math. 221; Mech. 301, or C.E. 309, or equivalent introductory course in theory of elasticity.** First semester Messrs. Sih, G. F. Smith

**Mech. 410. Theory of Elasticity II (3)**

Advanced topics in the theory of elasticity. The subject matter may vary from year to year and may include, e.g., theory of potential functions, linear thermoelasticity, dynamics of deformable media, integral transforms and complex-variable methods in classical elasticity. Problems of boundary layer type in elasticity; current developments on the micro-structure theory of elasticity. **Prerequisites: Mech. 409, Math. 208, or consent of chairman of department.** Second semester. Messrs. Sih, G. F. Smith

**Mech. 412. Theory of Plasticity (3)**

Mechanical behavior in the plastic range; foundations of the theory of plasticity; axisymmetric problems; limit analysis theorems; plane strain and slip line theory; applications to metal forming; introduction to plastic analysis of structures. **Prerequisites: Math. 221; Mech. 301, or C.E. 309, or equivalent course in theory of elasticity.** First semester. Mr. Updike

**Mech. 413. Fracture Mechanics (3)**

Introduction to the Griffith-Irwin theory of static strength of bodies containing cracks; stress-intensity-factor methods; application to fatigue crack growth; com-

plex variable methods of stress analysis of cracks for extension and bending of plates, for torsion and flexure of bars, and for thermal stress problems; viscoelastic, anisotropic, and non-homogenous effects. **Prerequisites: Mech. 301, Math.**

**Mech. 415. Stability of Elastic Structures (3)**

Basic concepts of instability of a structure: bifurcation, energy increment, snap-through, dynamic instability. Analytical and numerical methods of finding buckling loads of columns. Postbuckling deformation of cantilever column. Dynamic buckling with nonconservative forces. Buckling of columns on elastic foundation. Effects of initial imperfections. Inelastic buckling. Buckling by torsion and flexure. Variational methods. Buckling of frames. Instability problems of thin plates and shells. **Prerequisite: Math 221.** First semester. Mr. Kalnins

**Mech. 416. Theory of Plates and Shells (3)**

Governing equations of classical theory of plates. Solutions for rectangular and circular plates. Reissner's theory of plates. Vibration of circular plates. Nonlinear theories of plates. Differential geometry of surfaces. Governing equations of bending of thin elastic shells. Methods of solution for cylindrical, spherical, and arbitrary shells of revolution. Shallow shells. Approximate theories of shells. **Prerequisites: Math. 221; Mech. 301, or C.E. 309, or equivalent introductory course in theory of elasticity.** Second semester. Mr. Kalnins

**Mech. 421. Hydrodynamics (3)**

Mathematical theory of fluids; potential; two-and three-dimensional flow problems. **Prerequisite: Mech. 104. or consent of chairman of department.** Mr. Hartranft

**Mech. 422. Advanced Mechanics of Compressible Fluids (3)**

Study of subsonic and supersonic flows of compressible fluids by analytical methods. Steady and unsteady flows in ducts and around immersed bodies. **Prerequisite: Consent of chairman of department.** Second semester. Mr. Owczarek

**Mech. 450. Special Problems (3)**

An intensive study of some field of applied mechanics not covered in more general courses. First or second semester. Staff

**Mech. 451. Phys. 471 Nonlinear Continuum Mechanics (1-3)**

An introduction will be given to the nonlinear continuum theories of the mechanics of solids and fluids. This will include a discussion of the mechanical and thermodynamical bases of the subject, as well as the use of invariance principles in formulating constitutive equations. Applications of the nonlinear theories to specific problems will be given. Mr. Rivlin

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# METALLURGY AND MATERIALS SCIENCE

Professors Libsch, Conard, Kraft, Stout
Associate Professors Avitzur, Pense, Krauss, Spriggs, Wood
Assistant Professors Tarby, Hahn, Hertzberg, Tauber, Runk
Messrs. DeBardillo, Robinson, Bratspies, Sheffler, Weber, Smith, Koop, Begley, Zimmerman

**Met. 10. Metallurgy Laboratory (1-2)**

Elementary analysis of metallurgical problems for programming in computer solution; application of equipment for laboratory study of structure and properties

of metals. **Prerequisite: Met. 63 or 91 previously or concurrently.** Second semester.

**Met. 63. Engineering Materials and Processes (3)**
A study of engineering materials and properties. Methods and effect of fabrication and treatment. Application and use of materials in engineering. Primarily metals, but including plastics, ceramics, and other engineering materials. **Prerequisites: or Chem. 3, 13; Phys. 16 or 1.** First and second semesters.

**Met. 67. Engineering Materials Laboratory (2)**
Laboratory study and discussion of the processing, structure and properties of engineering materials. Analysis of thermal and mechanical means of controlling the properties of materials with emphasis on quantitative approaches to metallurgical design. **Prerequisites: Met. 63 or Met. 91, Phys. 3.**

**Met. 91. Elements of Materials Science (3)**
Introductory study of the relationship between structure (on the atomic, crystallographic or molecular, micro and macro scales) and physical and mechanical properties of metallic, ceramic, and polymeric materials. Influence of processing variables on structure and properties. Lectures and recitation. **Prerequisites: Chem. 3, 13 and Phys. 3 or 16 previously or concurrently.** First and second semesters.

**Met. 100. Industrial Employment**
In the summer following the junior year students in the curriculum of metallurgy and materials science are required to secure at least eight weeks of experience in industrial plants or research organizations.

**Met. 101. Professional Development (1)**
Meetings with the department staff for the purpose of developing a professional outlook of the engineering student. Required reading, oral reports and term papers. **Prerequisite: Junior standing.** Second semester.

**Met. 191. Experimental Metallurgy (3)**
Application of research techniques to a project in metallurgy or materials science selected in consultation with the senior staff. **Prerequisite: Met. 340.**

## For Advanced Undergraduates and Graduates

**Met. 2XX. Structure and Behavior of Materials (3)**

Correlation of electronic, crystal and microstructure with electrical, magnetic and mechanical properties of crystalline materials, primarily metals. Solidification, equilibrium and non-equilibrium structures, deformation and fracture, transformation mechanisms. **Prerequisites: Met. 91 or equivalent; Phys. 4.** First semester.

**Met. 210. Metallurgical Thermodynamics (3)**
The application of thermodynamic relations to metallurgical processes with emphasis on solving specific problems for processes such as the open hearth for steel, heat treating atmospheres, alloy equilibrium diagrams, and others. Lectures and problem sections. **Prerequisites: Met. 10, Math. 23, Chem 91 or 95 concurrently.** First semester. Mr. Hahn

**Met. 230. Physical Metallurgy I (4)**
Structure, metallic bonding, and properties of metals. Solidification, alloying, and constitution diagrams. Metallography. Deformation and annealing. Fracture. Lectures and laboratory. **Prerequisites: Met. 91 or 63; Phys. 4.** Mr. Libsch

**Met. 231. Physical Metallurgy II (4)**
Atomic mobility, kinetics, and mechanisms of transformation. Heat treatment. Corrosion. Surface treatment. Mechanical behavior. Properties and uses of metals and alloys. Sources of metallurgical failures. Lectures, laboratory. **Prerequisite: Met. 230** Messrs. Libsch, Pense

**Met. 278. Metallurgical Reports (3)**
An opportunity for the advanced student to develop familiarity with current metallurgical literature and to present oral reports and a comprehensive written survey. **Prerequisite: Senior standing.**

**Met. 304. Extractive Metallurgy I (4)**
A unit process study of extractive metallurgy techniques. Includes chemical principles, thermochemistry, and kinetics; also phases in pyrometallurgical systems, combustion of fuels, and refractories. The preparation, treatment, and handling of materials for primary crude metal production. Lectures plus laboratory. **Prerequisite: Ch.E. 60, Met. 210.** Second semester. Mr. Hahn

**Met. 305. Extractive Metallurgy II (3)**
Continuation of Met. 304. Refining primary metals and scrap. Instrumentation and control of processes, flow sheets, and program analysis. Lectures and laboratory, plant trips. A three day inspection trip is required. **Prerequisite: Met. 304.** First semester. Mr. Tarby

**Met. 315. Physical Ceramics (3)**
Correlation of internal structure with physical and mechanical behavior of ceramic materials. Effect of processing variables. Sintering, grain growth, vitrification. **Prerequisite: Met. 2XX or equivalent.** Mr. Spriggs

**Met. 316. Physical Properties of Materials (3)**
Consideration of the observed electrical, magnetic, thermal and optical properties of crystalline materials with emphasis on their relationship to electron configuration and crystal structure. **Prerequisite: Met. 2XX or equivalent.**
Messrs. Conard and Tauber

**Met. 318. Theoretical Physical Metallurgy (3)**
Atomic structure. Theories of alloying and transformation. Dislocations. **Prerequisites: Met. 231 or equivalent.** First semester. Mr. Conard or Mr. Krauss

**Met. 323. Mechanical Metallurgy (3)**
Deformation and fracture of metals. Theoretical considerations and their application to service. Analysis of metal forming operations. Lectures and laboratory exercises. **Prerequisites: Mech. 11; Met. 231; M.E. 166 and Met. 352 previously or concurrently.** First semester. Mr. Avitzur

**Met. 325. Industrial Metallurgy (8)**
This course is restricted to a small group of seniors and graduate students selected by the department from those who apply. Three full days per week are spent at the plant of the Bethlehem Steel Company for research in plant operations. Application by a graduate student for admission to this course must be made prior to March 1 of the previous semester. First semester. Mr. Tarby

**Met. 333. X-ray Methods (3)**
Introduction to the fundamentals and experimental methods of X-ray techniques. Application to various materials problems including diffraction, radiography, fluorescent analysis. Lectures and laboratory work. **Prerequisite: Physics 4, Met. 91 or equivalent.** Mr. Kraft

**Met. 334. Electron Microscopy (3)**
Study of theory and application of electron diffraction and microscopy methods for investigation of the structure ot matter. Specific topics include electron optics and replica and transmission electron microscopy. Special laboratories will be given in cooperation with other departments as required. **Prerequisite: Consent of chairman of department.** Messrs. Krauss and Wood

**Met. 338. Metallurgical Colloquium (2)**
An opportunity for the student to develop an acquaintance with the current metallurgical literature, the ability to interpret such literature clearly, and skill in presenting oral engineering reports. **Prerequisite: Consent of chairman of department.**

**Met. 340. Research Techniques (2-3)**
Study, analysis, and application of experimental techniques in metallurgical and materials research. Analysis of experimental data and methods of presentation. Design of experimental programs. Recitations and laboratory.

**Met. 352. Physical Metallurgy III (3)**
Structure and properties of ferrous and non-ferrous alloys as influenced by metallurgical processing and heat treatment. Lectures and project laboratory. **Prerequisite: Met. 231.** First semester. Mr. Pense

**Met. 358. Selection of Materials (3)**
Study of problems relating to design and service requirements of metal components, failure of metal components, and selection of materials and processes. Discussion of specific examples to develop approach to and judgement of engineering problems involving metallurgy. Lectures, problems. **Prerequisite: Met. 352 or consent of chairman of department.** Second semester. Messrs. Libsch, Wood

**Met. 361. Physics of Materials (3)**
Consideration of the principles of quantum mechanics, statistical thermodynamics, and continuum mechanics. Intended to provide a basic understanding of the principles underlying the study of structure and properties of materials. **Prerequisites: Met. 91, Math. 221.**

**Met. 362. Structure and Properties of Materials (3)**
Study of transformations in materials and correlation of structure with the electrical, magnetic, optical and mechanical properties of materials. Intended, in conjunction with Met. 361, to provide an integrated background sequence for further studies in the science of materials. **Prerequisite: Met. 361.**

## For Graduates

The foundation for successful graduate work in Metallurgy or Materials Science includes sound basic preparation in chemistry, physics, and mathematics, and adequate breadth of general education. Two years of college chemistry, physics, and mathematics usually will suffice. Candidates entering

upon graduate study who have obtained their bachelor's degree in fields of science or engineering other than metallurgy will be required to take certain undergraduate courses in physical and chemical metallurgy, without credit toward the graduate degree, or else to pass an examination demonstrating a satisfactory foundation for advanced work in metallurgy and materials science.

Programs of graduate study may lead to the Master of Science or Doctor of Philosphy degrees with prime concentration in the fields of Physical, Mechanical, or Chemical Metallurgy, and, in cooperation with the Materials Research Center, in the broader field of Materials Science. The Center facilitates interdisciplinary programs of study and research that cross the traditional boundaries of the various science and engineering curricula, providing an opportunity for the study of the fundamental behavior of materials (see page 171).

A candidate for the degree of Master of Science must include a thesis in his program. This may not count for more than six of the 30 semester hours required for that degree. Typical recent master's thesis programs include: age hardening studies, analysis of embrittlement behavior in steels, studies of electronic and magnetic properties, preferred orientation determination and control, production of metallic thin films, production of single crystals of thermoelectric and laser materials, investigation of the kinetics of high temperature liquid metal reactions, measurements of high temperature fatigue behavior, and studies relating to welding, induction heating, and powder metallurgy.

A candidate for the degree of Doctor of Philosophy must pass a qualifying examination and submit a general plan to the head of the Department at the beginning of the first year of the doctoral work, preliminary to formulation of the doctoral program by his special committee at the time of his formal admission to candidacy. The plan will provide for specialization in some phase of theoretical metallurgy, to be effected mainly through research; in addition to collateral course work. Special fields of metallurgy and materials science included in recent doctoral research include: kinetics of solid state transformations, design of magnetic alloys, thermodynamic properties of liquids, controlled solidification, environmental crack propagation, correlation of deformation and recrystallization textures with magnetic and mechanical behavior, elevated temperature deformation and fracture mechanisms, fine structure of martensite, analysis of gross plastic deformation in metal-forming procesess, magnetic, electronic and mechanical behavior of unidirectionally solidified eutectic alloys, structure and properties of sputtered and evaporated thin films, pressure sintered ceramic oxides and strengthening mechanisms in high density ceramic materials.

The Department of Metallurgy and Materials Science has joined with the Department of Chemical Engineering to provide a graduate program in the field of chemical metallurgy. The program, leading to the degree of

Master of Science or Doctor of Philosophy, offers opportunity for research and instruction in a broad spectrum of topics relating to the understanding, design and control of high-temperature processes.

A number of research fellowships and assistantships are available to aid students of outstanding promise, either through the Department or through the Materials Research Center. Opportunities for part-time teaching are available for qualified Ph.D. candidates.

**Met. 401. Metallurgical Investigation and Thesis (3)**
Experimental investigation of some problem in the areas of mechanical, chemical, and physical metallurgy or materials science. The study must be embodied in a written report. **Prerequisite: Undergraduate metallurgical courses in the field of investigation.** First and second semesters. Staff

**Met. 402. Metallurgical Investigation and Thesis (3)**
Continuation of Met. 401. First and second semesters. Staff

**Met. 404. Materials for Modern Technology (3)**
Detailed study of the chemical, mechanical and physical behavior of one or more of the materials in modern technology, such as cryogenic, nuclear, or aerospace technologies. This course may be repeated for credit beyond three hours with permission of the instructor. **Prerequisites: Met. 231 and Met. 210, Met. 305 or consent of chairman of department.** Staff

**Met. 406. Solidification (3)**
Structure, theory and properties of liquids. Homogeneous and heterogeneous nucleation, theory and experimental results. Solidification phenomena in pure, single and multi-phase materials including the nature of the freezing interface, segregation, constitutional super-cooling, dendritic growth, crystallographic effects, the origin of defects, crystal growing. Zone processes. **Prerequisite: Consent of chairman of department.** Mr. Kraft

**Met. 407. Theory of Alloy Phases (3)**
Consideration of the application of the principles of thermodynamics, physics, and crystallography to the explanation of structure, physical properties and behavior of crystalline materials. **Prerequisite: Met. 231. Desirable preparation: Physics 363.** Mr. Conard

**Met. 408. Transformations (3)**
A description of phase equilibria and phase transformations with emphasis on the solid state. Phase diagrams and their thermodynamic basis. Physical and kinetic aspects of various types of phase transformations. **Prerequisites: Met. 231, Met. 210.** Mr. Krauss

**Met. 409. Recent Developments in the Theory of Metals (3)**
Current topics and new developments in metallurgy. This course may be repeated for credit with permission of the instructor. **Prerequisite: Consent of chairman of department.** Staff

**Met. 410. Physical Chemistry of Metals (3)**
Discussion of the thermodynamic properties of solid and liquid metals and alloy systems. Treatment of solution laws, methods of determining thermodynamic properties by experimentation and computation, changing standard states, and interaction parameters developed for liquid ferrous alloys. **Prerequisite: Met. 210 or equivalent.** Mr. Tarby

**Met. 411. The Principles of Modern Welding (3)**
The foundations upon which the welding processes rest; the present limitations of the various processes; the trends in new developments; the engineering and metallurgical aspects of welding. **Prerequisite: Met. 231.** Mr. Stout

**Met. 412. Electrical and Magnetic Properties of Materials (3)**
The study of semiconducting, dielectric, magnetic and similar materials and their properties. Brief discussion of band theory, conduction and emission mechanisms and related topics. The relation between structure (including imperfections) and physical properties. **Prerequisites: Met. 316 or Physics 363; Chem. 195; or Consent of chairman of department.** Messrs. Conard and Tauber

**Met. 413. Analysis of Metal Forming Processes (3)**
Three dimensional stress and strain analysis. Yield criteria, plastic flow and the upper and lower bound theorems. Analysis of metal forming processes, including drawing and extrusion, press work, rolling and spinning. The emphasis is on presenting several approaches to each problem. Mr. Avitzur

**Met. 414. Physical Chemistry of Metallurgical Reactions (3)**
A study of the thermodynamic and kinetic aspects of process metallurgy reactions. Mr. Tarby

**Met. 416. Atom Movements (3)**
Phenomenological and atomistic development of the laws of diffusion and their solution. Influence of gradients of concentration, potential, temperature and pressure. Effects of structural defects on diffusion in metals and non-metals. **Prerequisite: Math. 23 and Chem. 195 or the equivalent.** Mr. Hahn

**Met. 417. Imperfections in Crystals (3)**
Study of the types of imperfections in crystals and their effects on the behavior of materials, with particular emphasis on dislocation concepts. **Prerequisite: Met. 231 or equivalent.** Mr. Conard

**Met. 418. Deformation and Fracture (3)**
Mechanisms involved in deformation and annealing of crystalline materials. Development of preferred orientation during deformation and annealing. Theories of fracture. **Prerequisite: Met. 231.** Mr. Hertzberg

**Met. 419. Alloy Steels (3)**
Alloy steels with nickel, chromium, manganese, silicon, molybdenum, vanadium, tungsten; tool steels; stainless steel; ternary and quaternary alloy steels for heat treating. **Prerequisites: Met. 231, 352.** Mr. Pense

**Met. 421. Surface Treatment of Metals (3)**

Study of metallic surfaces. Preparation of surfaces by machining, grinding, polishing; methods of surface hardening; corrosion and surface protection of metals; analysis of surface stresses as related to fatigue life. **Prerequisite: Met. 231.**
Mr. Libsch

**Met. 423. Powder Metallurgy (3)**

Study of powder metallurgy processes for forming metal parts; discussion of metal powder production and characteristics, plastic deformation and bonding associated with pressing, the mechanism of sintering, and the nature of the sintered product; preparation of sintered alloy compacts; application of the process to special industries. **Prerequisite: Met. 231.** Mr. Libsch

**Met. 433. X-ray Metallography (3)**

Scattering theory using the interference function and reciprocal lattice concepts. Diffuse scattering of X-rays and the radial distribution method, including applications. Brief treatment of crystal structure determination. Structural evaluation of materials by X-ray topographic, X-ray microscopic, and microradiographic methods. **Prerequisite: Met. 333.** Mr. Kraft

**Met. 458. Metallurgical Design (3)**

Analysis of design requirements for metal components. Selection of materials and processes. Study of failures in process and service and application of recent metallurgical knowledge for improved design. Solution and discussion of industrial problems, and outline of experimental approach. **Prerequisite: Consent of chairman of department.** Messrs. Libsch, Wood

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# MUSIC

Professors Cutler, Elkus

**Mus. 1-4. Instrumental Music (1)**

Study and performance of instrumental music. Participation in the appropriate ensemble, as determined by the Department of Music, is an integral part of the course. Students enrolling for their first semester register for Mus. 1; for their second, Mus. 2, etc. **Prerequisite: Consent of chairman of department.** Mus. 1 and 3, first semester only.

**Mus. 5-8. Choral Music (1)**

Study and performance of choral music. Participation in the appropriate vocal ensemble, as determined by the Department of Music, is an integral part of the course. Students enrolling for their first semester register for Mus. 5; for their second, Mus. 6, etc. **Prerequisite: Consent of chairman of department.**

**Mus. 20. Introduction to Musical Literature (3)**
An approach to musical style through the study of works by representative composers from 1600 to the present.

**Mus. 22. Sacred Choral Music (3)**
The functional aspects of choral music and its relationship to the church, beginning with Gregorian Chant. Compositions of the Renaissance and Baroque masters are studied, with special attention given to the works of Bach. A survey is made of the outstanding sacred choral works of the 18th, 19th, and 20th centuries, observing the shift in emphasis from the church to the concert hall. **Prerequisite: Consent of chairman of department.**

**Mus. 23. Chamber Music (3)**
A survey of works for smaller instrumental ensembles from the forerunners of Haydn to Stravinsky. **Prerequisite: Consent of chairman of department.**

**Mus. 25. Keyboard Music (3)**
Study of keyboard music with particular reference to the styles of Scarlatti, Bach, Mozart, Beethoven, Chopin, and Bartok; demonstration of performance techniques on the various instruments; description of the mechanics of keyboard instruments, such as the organ, harpsichord, and piano. **Prerequisite: Consent of chairman of department.**

**Mus. 30. Aesthetics and Criticism of Music (3)**
An analytical approach to writings of Berlioz, Hanslick, Oscar Weil, Stravinsky, Langer, and others with particular attention to the questions of meaning, intent, and expressive values in music. **Prerequisite: Consent of chairman of department.**

**Mus. 31. The Viennese Classic Period (3)**
Exercises in tonal harmony and study of forms and procedures in western music 1750-1825. **Prerequisite: Consent of chairman of department.** Fall semester.

**Mus. 32. The Viennese Classic Period (3)**
Intensive study of works for various media of Haydn, Mozart and Beethoven, with emphasis on form and style. **Prerequisite: Mus. 31 or consent of chairman of department.** Alternating spring semesters.

## THE LEHIGH UNIVERSITY BAND

Band may be elected by suitably qualified undergraduates.

The Band will consist of a concert, varsity, and marching band and will perform music, as specified by the director, for concerts, convocations, and athletic events.

Except during the fall season, rehearsals will be held twice weekly and, in addition, provision may be made for required section rehearsals.

Band uniforms and certain musical instruments are furnished by the University. A deposit of $25 is required from each member of the band for the uniform issued him.

Students serving in the band receive the following awards: a sweater for two years of satisfactory service; for three years, $20 in cash; and four years, an additional $20 in cash.

### THE LEHIGH UNIVERSITY GLEE CLUB

Glee Club may be elected by suitably qualified undergraduates.

The Glee Club will perform at concerts on the campus and away, and will collaborate with choruses of women's colleges in performing major works with orchestra.

Rehearsals will be held twice weekly, and, in addition, provisions may be made for required additional section rehearsals.

Members will purchase their own blazers and trousers which are worn for all performances.

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# PHILOSOPHY

Professor Hillman
Associate Professors Barnes, Haynes, Taylor
Assistant Professors Lindgren, Melchert
Mr. LaPara

**Phil. 14. Logic (3)**

An introductory study of the methods used in clear thinking and in the detection of fallacies. Examination of the principles used in testing scientific hypotheses and in the discovery of causes. Illustrations are drawn from the problems of everyday life. First and second semesters.

**Phil. 15. Ethics (3)**

A critical study of classic and contemporary ethical theories as analyses of moral life. Special attention is given to problems concerning the nature of moral responsibility and moral judgment, the relation of man to his world, and the scientific status of moral theory. First and second semesters. Mr. Haynes

**Phil. 100. Philosophy of Contemporary Civilization (3)**

A philosophical analysis of the theoretical foundations of our culture, providing a useful method for formulating policies in private and public life. Special attention is given to the nature and integration of ideals of family, industry, education, art, science, religion, law, and politics. First and second semesters. Mr. Haynes

**For Advanced Undergraduates and Graduates**

**Phil. 261. Philosophy of the Natural Sciences (3)**

An analysis of the logical structure and significance of modern scientific knowledge. Critical comparison of rival theories of scientific explanation. Formal systems

and physical theory. Geometry and experience. Space, time and motion in classical mechanics. The logical structure of the Special Theory of Relativity. Fact, theory, law, determinism and causality. The nature of mathematical truth. First and second semesters. Messrs. Hillman, LaPara

**Phil. 271. Readings in Philosophy (2 or 3)**

A course of readings designed primarily for undergraduate philosophy majors. **Prerequisite: Consent of chairman of the department.** First semester. Staff

**Phil. 272. Readings in Philosophy (2 or 3)**

A course of readings designed primarily for undergraduate philosophy majors. **Prerequisite: Consent of chairman of the department.** Second semester. Staff

**Phil. 301. Philosophy of the Social Sciences (3)**

An analysis of the social sciences considered as programs for achieving understanding and control of man and society. Study is made of assumptions basic to, and problems incurred in, scientific methodology in general; the implications of these for the various social sciences is stressed. First or second semester.

Mr. Haynes

**Phil. 316. Contemporary Ethics (3)**

The course includes a preliminary survey of major types of ethical theory, but consists essentially of a critical reading of contemporary books and journal articles which reflect current concerns and philosophic methods in ethics. Topics dealt with include analysis of various types of meaning (descriptive, evaluative, directive, emotive, etc.) embodied in moral language, and a study of the logic of moral discourse. The relations of the latter to social sciences will be studied. **Prerequisite: Phil. 15 or consent of the instructor.** Second semester. Mr. Haynes

**Phil. 331. Ancient Philosophy (3)**

A history of philosophy from the origins of scientific and philosophical thought in Ionia to the flowering of learning in Alexandria. Particular emphasis on the philosophical writings of Plato, Aristotle, Lucretius, Marcus Aurelius, and Plotinus. The influence of the sciences, particularly mathematics and astronomy, upon the development of philosophy in antiquity will be considered. First semester.

Staff

**Phil. 335. Modern Philosophy (3)**

An historical study of the major philosophies from the Renaissance to the end of the 18th Century; the work of Descartes, Spinoza, Leibniz, Locke, Berkeley, Hume, and Kant. Special attention will be given to the interaction of scientific and philosophical thought during the period. Second semester. Staff

**Phil. 337. Nineteenth Century Philosophy (3)**

A study of major philosophers — Hegel, Schopenhauer, Marx, Comte, Kierkegaard, Mill, Spencer, and Nietzsche — with emphasis on central issues of the century, such as social philosophy, the philosophy of history, evolution, the theory of knowledge, and scientific method. First semester. Mr. Melchert

**Phil. 339. Twentieth Century Philosophy (3)**

A study of major contemporary philosophic movements in the West, including pragmatism, idealism, realism, existentialism, logical positivism, and linguistic analysis. Special emphasis is given to the positions of the various schools regarding the problems of meaning, method, and the philosophic role of scientific knowledge. Second semester. Mr. Melchert

**Phil. 341. The Evolution of Scientific Ideas (3)**
A study of the leading concepts, theories and revolutions in the history of science, and the changing conceptions of the nature of the scientific enterprise. Topics to be treated include: ancient cosmology and physics; late medieval and renaissance developments, from alchemy to chemistry; theories of evolution; classical mechanics and astronomy; philosophical aspects of relativity and quantum theory. First semester. Mr. LaPara

**Phil. 351. Analytical Philosophy and Religion (3)**
A critical look from the viewpoint of contemporary analytic philosophy at some of the main problems of religion: the nature of religious belief and language, the meaning and justification of religious symbols, and the problems of evil, the meaning of "God", the existence of God, and religious truth. First or second semester. Messrs. Melchert, LaPara

**Phil. 362. Issues in the Philosophy of Science (3)**
Critical study and review of crucial philosophical problems arising from research into the logical and epistemological foundations of science, with attention directed at alternative approaches to their resolution. **Prerequisite: Phil. 261 or consent of chairman of the department.** Second semester. Mr. LaPara

**Phil. 364. Logic and Language (3)**
A study of the properties of natural and formal languages and an investigation of the logical and semantical problems which arise. Special attention will be given to the following topics: the construction of logical models of language and their role in the analysis of communication; logico-linguistic grammars for the generation of language; the use of contemporary logical theories of language to examine the problems of meaning and reference; the function of linguistic models in theories of information storage and retrieval; theories of mechanical translation and processing of natural language text by computers. Second semester. Staff

**Phil. 381. Theory of Formal Grammars (3)**
The study of the structure of formal languages as determined by their formation-rule grammars. Comparison of grammars of differing strengths (finite-state, context-free, context-sensitive, etc.); considerations of applications in logic (Turing machines, decidability) and in linguistics (phrase-structure and transformational grammars). First semester. Mr. Barnes

**Phil. 388. Philosophy of Mathematics (3)**
An investigation of the philosophical foundations of mathematics, with special emphasis on the "classical" views of the nature of mathematics — logicism, formalism, and intuitionism — and on their contemporary counterparts. Second semester. Mr. Barnes

**Phil. 391. Information Retrieval Theory (3)**
An introduction to the problems of theory-construction for information storage and retrieval systems. Special attention is given to the logical and mathematical foundations of retrieval operations, content analysis, the measurement of relevance, automatic document characterization, and the methodology of evaluation. Computer applications will be discussed. First semester. Mr. Hillman

## For Graduates

The Department of Philosophy offers advanced programs in two maior areas of concentration, in each of which it is possible to proceed to the M.A. or M.S. degree and the Ph.D. degree.

The first field of concentration is that of the information sciences, embracing such topics as mathematical logic, combinatorics, logical algebras, topology, graph theory, computers and control languages, information systems, scientific methodology, epistemology, philosophy of science, philosophical analysis, computational linguistics, syntactic structures and model theory. The Department of Philosophy has strong research interests in these fields, and offers opportunities for well-qualified graduate students to participate in sponsored research programs.

In these research activities, the Department cooperates with the Center for the Information Sciences, which fosters interdisciplinary programs of study and research. The Division of the Information Sciences offers a graduate program leading to the M.S. degree (see p. 310). This program is separate from, but very closely related to, the M.A. offered by the Philosophy Department in the foundations of the information sciences. The Ph.D. in the information sciences is offered as an advanced degree in philosophy.

The second area of concentration for graduate study in philosophy is of a more traditional character, emphasizing work in the history of philosophy, ethics, value theory, contemporary philosophical issues, logic, epistemology and the philosophy and history of science. This program is designed primarily for the student who wishes to pursue a career in philosophy as one of the liberal arts.

Adequate preparation for graduate study in either of these programs will normally include undergraduate courses in basic logic. Additional course work for the program in the information sciences should include training in mathematics and methodology. However, students with a sound background in a systematic discipline may also be admitted to this program. Additional preparation for the program in traditional philosophy should include undergraduate courses in ethics and the history of philosophy.

A candidate for the M.A. degree may qualify for the degree either by completing successfully twenty-four hours of approved course work and submitting a satisfactory dissertation, or by completing thirty hours in approved courses and passing an examination covering his chosen area of concentration. Each candidate will select the plan better suited to his needs and abilities with the advice and approval of the Chairman of the Department.

A candidate for the Ph.D. degree is required to submit a general plan to the Chairman of the Department at the beginning of the first year of doctoral studies. This plan must be approved by the candidate's special committee at the time of his admission to candidacy.

The doctoral program in the information sciences will be based on the candidate's approved plan of original and specialized research. A program of courses and seminars at the 400 level will also be formulated in the field in which the dissertation is to be written.

The doctoral program in traditional philosophy is also based on original research and collateral course work. In this area of concentration, the Department accepts candidates who wish to specialize in one of the following fields; history of philosophy; contemporary philosophy; ethics and value theory; logic and methodology; philosophical analysis; philosophy of science.

The doctorate in the information sciences serves to qualify students for careers in universities, government, industry and research.

Support in the form of fellowships, research assistantships and graduate assistantships is provided for a restricted number of well-qualified students.

**Phil. 401. Philosophy of Mind (3)**
An examination of several problems in the philosophy of mind: the current status of the mind-body problem, knowledge of other minds, the "logical geography" of mind-talk, the scientific status of psychoanalysis, and problems of mind and machine. First semester (offered alternate years). Mr. Melchert

**Phil. 416. Value Theory (3)**
A review of major types of practical problems deriving from conflict and confusion in evaluation is followed by a critical study of value theory, with emphasis on such topics as these: types of value and modes of value judgment; evidence and authority of value judgments; the logic of normative discourse; techniques of normative analysis; the relation of value judgments to science. Exemplification will be made largely in the fields of morality and law, with some references to politics, economics, art and religion. **Prerequisite: Consent of the instructor.** Second Semester. Mr. Haynes

**Phil. 421. Plato (3)**
Intensive study of the mature thought of Plato, dealing with both the epistemological and moral issues in the later *Dialogues*. First semester (offered alternate years). Mr. Lindgren

**Phil. 423. Aristotle (3)**
Advanced study of selected themes which appear throughout the Aristotelian Corpus. Students will read widely in the *Organon, Physics, De Anima, Metaphysics, Nic. Ethics* and *Politics*. First semester (offered alternate years). Mr. Lindgren

**Phil. 424. The Rationalists (3)**
Detailed study of the principal works of Descartes, Spinoza and Leibniz. Second semester (offered as required). Staff

**Phil. 426. The Empiricists (3)**
Detailed study of the principal works of Locke, Berkeley and Hume. Second semester (offered as required). Staff

**Phil. 428. Kant (3)**
Intensive analysis of Kant's metaphysic of human experience as set forth in the *Critique of Pure Reason*. Second semester (offered as required). Mr. Lindgren

**Phil. 430. Nineteenth Century German Philosophers (3)**
A study of the writings of major figures in German philosophy of the last century, focusing principally upon Hegel, Schopenhauer, and Nietzsche. Second semester (offered as required). Staff

**Phil. 432. Nineteenth Century English Philosophers (3)**
A detailed study of the principal works of Bentham, Mill and Bradley. Second semester (offered as required). Staff

**Phil. 439. Epistemology (3)**
Selected topics in the theory of knowledge, such as the phenomenalism-realism debate, the *a priori* and empirical knowledge, and the development of alternative epistemological systems. First Semester. Mr. Melchert

**Phil. 443. The Analysts (3)**
A detailed and critical study of the main works of one or more recent analytical philosophers, e.g., Russell, Moore, Wittgenstein, or the schools of logical positivism or ordinary language philosophy. First semester (offered as required). Mr. Melchert

**Phil. 445. The Phenomenologists (3)**
An examination of phenomenology as found in the writings of Husserl, with study of the tradition after him, e.g., Merleau-Ponty, Sartre or Heidegger. First semester (offered as required). Mr. Melchert

**Phil. 447. The Pragmatists (3)**
A critical examination of the principal writings of one or more philosophers usually placed in the pragmatic tradition: Peirce, James, Dewey, or Lewis. First semester (offered as required). Staff

**Phil. 451. Logical Investigations (3)**
A study of formal and natural languages for the problem of content analysis. Topics to be treated include: theory of representation; logical analysis; linguistic correlates of syntactic, semantic and pragmatic features; applications to retrieval theory. First Semester. Staff

**Phil. 461. Special Topics in Philosophy of Science (3)**
Intensive study and research on certain selected topics, such as the philosophical assumptions and implications of recent physical science; the foundations of probability; the meaning and status of laws and theories; the concepts of space and time. **Prerequisite: Phil. 261 or consent of chairman of department.** First or Second Semester. Staff

**Phil. 464. Semantics (3)**
An investigation into problems of meaning and reference, including disputes about analyticity and the *a priori*, making use of recent literature on the subject. Second semester. Mr. Melchert

**Phil. 471. Graduate Thesis (3)**
First semester

**Phil. 472. Graduate Thesis (3)**
Second semester.

**Phil. 482. Retrieval Languages (3)**
The study of formal indexing and retrieval languages, with special attention to the interaction between syntactic structure and retrieval properties. Examples

will be drawn from actual and experimental systems to show the effect of syntactic structure upon system capabilities. Second semester. Mr. Barnes

**Phil. 485. Model Theory (3)**
Metamathematical investigations of the relationships between formal properties of logics and structural properties of their models. Attention will center upon such topics as: topological aspects of completeness theorems; model-theoretic separation theorems; hierarchies of definability; mathematical vs. metamathematical properties of structures; applications of models in the non-formal sciences. **Prerequisite: Math. 404 or consent of the instructor.** First or second semester.
Mr. Barnes

**Phil. 490. Special Topics (3)**
An intensive study of selected topics not covered in more general courses. Second semester. Staff

**Phil. 492. Retrieval Structures (3)**
Advanced study of the application of mathematics and mathematical logic to the problems of model construction in retrieval system design. Attention will be given to the applications of: graph theory; point-set topology; set-theory; linear transformations; Markov processes; computational linguistics. **Prerequisite: Phil. 391 or consent of chairman of department.** Second semester. Mr. Hillman

## DIVISION OF THE INFORMATION SCIENCES

Associate Professor Taylor

The rate of change in information technology demands that the practitioner have the conceptual background necessary to participate in and contribute to existing and developing systems. Within this framework, the master's degree program offered by the Division of the Information Sciences is designed to fulfill several objectives. The program provides a broad base of both theory and application. Emphasis is on fundamentals, rather than techniques. Basic to the program of the Information Sciences at Lehigh University is the concept that research and instruction reinforce one another. Consequently whenever possible, students are expected to participate in research and operations on a part-time basis.

The curriculum in the Information Sciences is based on a B.S. degree in an engineering or scientific discipline. Desirable preparation consists of at least 12 hours of mathematics, including 9 hours of differential and integral calculus and one course beyond the calculus. In recognition of the flexibility and cross-disciplinary nature of the subject, exception to this requirement may be granted to those students with training in a systematic

science. A course in computer programming or programming experience is desirable. Mathematics 105, Computer Programming, is available, without graduate credit, for those without computer background.

A candidate for the degree of Master of Science in the Information Sciences is required to complete at least twenty-four hours of approved course work and to submit a dissertation. Each student's schedule will be chosen in consultation with the head of the Division. Three core areas are at the heart of the M.S. program: information processing systems; information retrieval theory, and analysis of information. Beyond this basic core, student schedules are planned on an individual basis to fit previous academic experience and career goals. Two options are open for specialization, dependent on background, ability, and interests: Systems and Logico-Mathematical.

Systems — the integration of machine and human capabilities and techniques.

Logico-Mathematical — theoretical and systematic consideration of information systems and processes.

Maximum advantage is taken of courses in other departments on the campus. Consequently a student's program will be a combination of courses in the Information Sciences, together with offerings by the Departments of Electrical Engineering, Industrial Engineering, Mathematics, Philosophy, Psychology, Social Relations, and others.

**I.S. 311. Introduction to Linguistics (3)**
The description of speech at various levels: phonetics, phonology, morphology, phrase structure, and syntax. Social and regional dialects and other variations in speech and writing.

**I.S. 412. Sentence Syntax.**
Survey of various linguistic approaches to the analysis of sentences: co-occurrence, immediate constituents, phrase structure, kernels, transformations, and discourse considerations. Relevance of the material to language data processing will be considered. **Prerequisite I.S. 311.**

**I.S. 413. Discourse Analysis (3)**
Description of structures in discourse based on sentence-analysis and the distribution of elements beyond the domain of the sentence. (a) Substitution forms: pronominals, prop-construction, proforms of phrases, predicates, and sentences; lexical replacements, cover-terms, and included forms; text synonymy and equivalence chains; general characteristics of substitution. (b) Paragraph-like constituents of discourse. (c) Text-determination of sentence analysis. (d) Varieties of discourse and style-levels. **Prerequisite I.S. 412.**

**I.S. 418. Special Topics in Linguistics (3)**
Selected topics in linguistics not covered in other courses. (Offered as required).

**I.S. 421. Analysis of Information (3)**
History, theory, and structure of coding and classification systems for the organization of information; comparative analysis of selected retrieval schemes; experimental methods for developing coding systems and analyzing subject content.

**I.S. 481. Thesis (3)**

**I.S. 482. Thesis (3)**

**I.S. 492. Special Topics in the Information Sciences (3)**
Selected topics in the information sciences not covered in other courses. (Offered as required).

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# PHYSICS

Professors Emrich, Curtis, McLennan, Van Sciver, Folk
Associate Professors Spatz, Wheeler, Grismore, W. R. Smith, Fowler
Assistant Professors Fouchaux, Radin, Shaffer, Shieh, McCluskey, Trester, Borse
Messrs. Almoney, Ammirati, Bateman, Miss Byrd, Messrs. Corkum, Dudascik
Emkey, Gbur, Goldberg, Herrmann, Kuehner, Longo, Mack, Nolan, Ostermayer,
B. Ryan, Shea, Thomas, Van Itallie, Zalesak

**Phys. 1. Mechanics of Mass Points (3)**
Introduction to physics through a study of the laws of motion and conservation principles. Two lectures and one recitation-laboratory period per week. **Prerequisite: Math. 21, previously or concurrently.** First and second semesters, summer session.

**Phys. 3. Heat and Electricity (4)**
Introduction to heat, laws of thermodynamics, sound, and steady electric fields and currents. Two lectures, one recitation, and one laboratory period per week. **Prerequisites: Math. 23, previously or concurrently; Phys. 1.** First and second semesters.

**Phys. 4. Electricity, Light, and Atomic Physics (4)**
Continuation of Phys. 3. Electromagnetism, induced electromotive forces, electrical transients in circuits, geometrical and physical optics, introduction to quantum phenomena. Two lectures, one recitation, and one laboratory period per week. **Prerequisites: Math. 23, previously or concurrently; Phys. 3.** Second semester, summer session.

**Phys. 16. General Physics (3)**
A survey of the subject matter of heat, electricity, light, and atomic physics for students in the Colleges of Arts and Science and of Business Administration. Lec-

ture demonstrations and recitations. **Prerequisite: Phys. 1.** Second semester. (1966-67). First Semester (1967-68). Mr. Radin

**Phys. 17. General Physics Laboratory (2)**
A laboratory course in general physics to accompany Phys. 16. **Prerequisite: Phys. 16, preferably concurrently.** Second semester. (1966-67). First semester (1967-68). Mr. Radin

**Phys. 32. Electrostatics (3)**
Principles of electrostatics; Poisson's equation; steady currents and their sources. **Prerequisites: Math. 23; Phys. 4 and Math. 221, previously or concurrently.** Second semester. Mr. Folk

**Phys. 90. Electrical Phenomena (1)**
Laboratory studies of elementary electric and magnetic effects. Elementary laboratory techniques. **Prerequisite: Phys. 4, preferably concurrently.** Second semester. Messrs. Wheeler, Spatz

**Phys. 100. Industrial Employment**
Eight weeks industrial employment during the summer following the junior year, with submission of a written report.

**Phys. 171. Physics Proseminar (1)**
Discussion of current problems in physics. Intended for seniors majoring in the field. Second semester. Mr. Shaffer

**Phys. 191. Laboratory Techniques (2)**
Thermometric, calorimetric and vacuum techniques. Advanced electrical measurements. **Prerequisite: Phys. 4 or 17.** First semester. Messrs. Wheeler, Fouchaux

**Phys. 192. Advanced Physics Laboratory (1 or 2)**
Laboratory work of research type. Special problems assigned and the student placed largely on his own initiative. Intended for seniors majoring in the field. First semester. Mr. Van Sciver

**Phys. 193. Advanced Physics Laboratory (1 or 2)**
Continuation of Phys. 192. Intended for seniors majoring in the field. Second semester. Staff

**For Advanced Undergraduates and Graduates**

**Phys. 213. Electromagnetism (3)**
A continuation of Phys. 32. Electromagnetic induction; magnetic fields of steady currents; magnetic materials; development of Maxwell's equations; electromagnetic radiation. **Prerequisites: Phys. 4 and 32.** First semester.
Mr. Folk

**Phys. 215. Particles and Fields (3)**
Aims and fundamental concepts of theoretical physics; foundations of mechanics of mass points and of continuous media; alternative formulations of mechanics; waves; fields; conservation laws. **Prerequisites: Phys. 4; Phys. 213 previously or concurrently.** First semester. Mr. Shaffer

**Phys. 252. Optics (3)**
Wave theory of light, interference, diffraction, polarization. **Prerequisites: Phys. 4 and Math. 23.** Second semester. Mr. Wheeler

**Phys. 254. Optics Laboratory (2)**
Optical instruments and techniques. Examination of phenomena, of measuring procedures, and of light sources and recording devices. **Prerequisite: Phys. 252 previously or concurrently, or consent of chairman of department.** Second semester. Messrs. Curtis, Fouchaux

**Phys. 266. Modern Physics**
General foundations of quantum theory, special theory of relativity, atomic theory of origin of spectra, wave mechanics, atomic and nuclear structure, interaction of particles with matter, radioactivity, nuclear structure. Intended for non-physics majors. **Prerequisites: Math. 23, Phys. 4.** First semester.
Messrs. Spatz, Trester

**Phys. 268. Introduction to Modern Physical Theories I (3)**
Basic concepts of the special theory of relativity; relativistic kinematics and dynamics; survey of the general theory of relativity; experimental basis and historical development of the quantum theory. **Prerequisites: Phys. 213, 215 and Math. 221; or consent of chairman of department.** Second semester. Mr. Shaffer

**Phys. 270. Modern Physics Laboratory (1)**
Experiments in atomic and nuclear physics and in the physics of solids and fluids. **Prerequisites: Phys. 266 or 268.** First semester. Mr. Grismore

**Phys. 281. Basic Physics I (3)**
A course designed especially for secondary school teachers in the master teacher program. Presupposing a background of two semesters of college mathematics through differential and integral calculus and of two semesters of college physics, the principles of physics are presented with emphasis on their fundamental nature rather than on their applications. Open only to secondary school teachers and those planning to undertake teaching of secondary school physics. Summer session.

**Phys. 282. Basic Physics II (3)**
Continuation of Phys. 281. Summer session.

**Phys. 340. Heat, Thermodynamics and Pyrometry (3)**
Basic principles of heat, thermodynamics and kinetic theory of gases with emphasis on physical systems. Mr. W. R. Smith

**Phys. 362. Atomic and Molecular Structure (3)**
Structure of atoms and molecules, especially as related to their spectra. **Prerequisite: Phys. 252.** First semester. Mr. Curtis

**Phys. 363. Physics of Solids (3)**
Recent developments in the theory of solids with particular reference to the physics of metals. **Prerequisite: Phys. 266 or 268, or consent of chairman of department.** Second semester. Mr. Fouchaux

**Phys. 364. Nuclear Physics (3)**
Properties of stable and unstable nuclei and experimental methods of measuring them; radioactive decay; detectors of nuclear radiation; types of nuclear reaction and methods of producing them; cosmic rays. **Prerequisite: Phys. 268.** First semester. Mr. Grismore

**Phys. 365. Physics of Fluids (3)**
Basic concepts of classical fluid mechanics; continuum and molecular approaches; shock waves; high temperature properties of reacting ideal gases; plasma dynamics. **Prerequisites: Phys. 213 and 340.** Second semester.
Mr. W. R. Smith

**Phys. 369. Introduction to Modern Physical Theories II (3)**
Basic principles of wave mechanics; applications to atoms and molecules. **Prerequisite: Phys. 268, Math. 322.** First semester. Messrs McLennan, Borse

**Phys. 372. Special Topics in Physics (1-3)**
Special topics in physics not sufficiently covered in the general courses. Lectures and recitations or conferences. First and second semesters. Staff

## For Graduates

Candidates for the master's degree and the doctorate normally will have completed, before beginning their graduate studies, the requirements for a baccalaureate degree with a major in physics, including advanced mathematics beyond differential and integral calculus. Students lacking the equivalent of this preparation will be expected to make up deficiencies in addition to taking the specified minimum of work for the advanced degree sought.

The language requirement for the doctorate is customarily fulfilled by candidates majoring in physics by a reading knowledge of two of French, German, and Russian. Demonstration of a reading knowledge in at least one foreign language is expected of doctoral candidates within the first year of residence. Some graduate work in mathematics usually is required; and certain advanced courses in other fields, notably mechanics, electrical engineering, and chemistry, may be included in a graduate program. Further details regarding the special requirements for degrees in physics may be obtained on application to the head of the department.

At least eight semester hours of general college physics using calculus are required for admission to all "200"- and "300"-level courses. Additional prerequisites for individual courses are noted in the course descriptions. Admission to "400"-level courses generally is predicated upon satisfactory completion of corresponding courses in the "200" and "300" groups or their equivalent.

**Phys. 420. Theoretical Physics (3)**
Development of the classical theory of particles and fields. This and the three courses Phys. 421, 422, and 423 cover classical mechanics, electrodynamics, and the theory of relativity. First semester. Mr. Wheeler

**Phys. 421. Theoretical Physics (3)**
Continuation of Phys. 420. **Prerequisite: Phys. 420.** Second semester.
Mr. Emrich

**Phys. 422. Advanced Theoretical Physics (3)**
Continuation of Phys. 420 and 421. **Prerequisite: Phys. 421 or equivalent.** First semester. Mr. Shieh

**Phys. 423. Advanced Theoretical Physics (3)**
Continuation of Phys. 422. **Prerequisite: Phys. 422.** Second semester.
Mr. Shieh

**Phys. 424. Quantum Mechanics (3)**
General principles of quantum theory; approximation methods; spectra; symmetry laws; theory of scattering. **Prerequisite: Phys. 369 or equivalent.** Second semester. Messrs. McLennan, Borse

**Phys. 425. Quantum Mechanics (3)**
A continuation of Phys. 424. Relativistic quantum theory of the electron; theory of radiation. First semester, alternate years. (Not offered, 1967-68).
Mr. Shaffer

**Phys. 428. Methods of Mathematical Physics (3)**
The equations of theoretical physics and the methods of their solution. First semester. Mr. Folk

**Phys. 429. Methods of Mathematical Physics (3)**
Continuation of Phys. 428. Second semester. Mr. Folk

**Phys. 431. Theory of Solids (3)**
Theory of the structure and properties of solids. Symmetry properties, lattice dynamics, elastic and thermal properties. Quantum theory of electronic structure, energy bands, cohesion. Magnetic properties. Desirable preparation: Physics 363, 424. First semester, alternate years. (Not offered 1967-68). Mr. Fowler

**Phys. 434. Solids and Radiation (3)**
Phenomena in solids resulting from interaction with electromagnetic radiation or charged particles. Current theories of energy absorption, transport, and emission. **Prerequisite: Phys. 363 or equivalent.** First semester, alternate years. (Not offered 1966-67).

**Phys. 442. Statistical Mechanics (3)**
General principles of statistical mechanics with applications to thermodynamics and the equilibrium properties of matter. **Prerequisites: Phys. 340 and 424.** First semester. Messrs. McLennan, Radin

**Phys. 443. Statistical Mechanics (3)**
A continuation of Phys. 442. Applications of kinetic theory and statistical mechanics to non-equilibrium processes; non-equilibrium thermodynamics. **Prerequisite: Phys. 442.** Second semester, alternate years. (Not offered 1966-67).
Mr. McLennan

**Phys. 462. Theories of Elementary Particle Interactions (3)**
Relativistic quantum theory with applications to the strong, electromagnetic and weak interactions of elementary particles. **Prerequisite: Physics 425.** Second semester, alternate years. (Not offered 1967-68). Mr. Shaffer

**Phys. 465. Nuclear and Elementary Particle Physics (3)**
Nuclear structure and phenomena; interactions among elementary particles and methods of studying them. Second semester, alternate years. (Not offered 1967-68). Mr. Grismore

**Phys. 467. Nuclear Theory (3)**
Theory of low energy nuclear phenomena within the framework of non-relativistic quantum mechanics. Second semester, alternate years. (Not offered 1966-67). Mr. Folk

**Phys. 471 (Mech. 451.) Nonlinear Continuum Mechanics (1-3)**
An introduction will be given to the non-linear continuum theories of the mechanics of solids and fluids. This will include a discussion of the mechanical and thermodynamical bases of the subject, as well as the use of invariance principles in formulating constitutive equations. Applications of the nonlinear theories to specific problems will be given. Mr. Rivlin

**Phys. 472. Special Topics in Physics (1-3)**
Selected topics not sufficiently covered in the more general courses. May be repeated for credit. First or second semester. Staff

**Phys. 474. Seminar in Modern Physics (3)**
Discussion of important advances in experimental physics. First or second semester. Mr. Fouchaux

**Phys. 475. Seminar in Modern Physics (3)**
Discussion of important advances in theoretical physics. First or second semester. Messrs. McLennan, Shaffer

**Phys. 491. Research (3)**
Research problems in experimental or theoretical physics. First and second semesters. Staff

**Phys. 492. Research (3)**
Continuation of Phys. 491. May be repeated for credit. First and second semesters. Staff

**PORTUGUESE**

**See Romance Languages**

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# PSYCHOLOGY

Professor Wuest
Research Professor Brozek
Associate Professors Brody, Millon
Assistant Professors Nord, Marsh, Richter
Lecturers Fiedler, Orr, Shettel
Messrs. Foss, Guralnick, Ross

**Psych. 1. Introduction to Psychology (3)**
Principles of psychology as a science of behavior. Significant issues in sensation, perception, psychophysiology, learning, personality and social psychology will be considered in historical perspective. First and second semester.

**Psych. 11. General Experimental Psychology (3)**
A survey of basic data and research methods in learning, sensation, perception, and personality. An introduction to experimental psychology for all students and a foundation for further work in psychology when supplemented with Psych. 12. **Prerequisite: Psych. 1.** Second semester.

**Psych. 12. General Experimental Psychology Laboratory (2)**
Classical and operant conditioning, psychophysical methods and field study methods, among other research techniques, will be related to topics covered in Psych. 11. Applications of statistical methods and the planning and execution of psychological experiments will be emphasized. **Prerequisite: Psych. 11 preferably concurrently.** Second semester.

**Psych. 101. History of Psychology (3)**
Development of psychology from its roots in the thought of Greek philosophers to the formulation of contemporary systems. **Prerequisites: Psych. 1.** First semester.

**Psych. 102. Psychological Tests and Measures (3)**
An introduction to psychometric and projective tests utilized in the appraisal of intelligence, aptitudes, interests and personality. Principles of test construction and validation will be emphasized. **Prerequisite: Psych. 1.** Second semester. Offered in 1968-69 and alternate years.

**Psych. 103. Comparative Psychology (3)**
Behavior of representative animal species. Reference is made to ethology's contribution to the study of insects, fishes, and birds. Experimental quantitative study of mammal behavior constitutes the core of the course. **Prerequisites: Psych. 1.** First semester. Offered in 1968-69 and alternate years.

**Psych. 105. Personality and Abnormal Behavior (3)**
The development, mechanisms and structure of personality and its deviations. **Prerequisite: Psych. 1.** First semester.

**Psych. 106. Motivation (3)**
Evaluation of contemporary research and theories of animal and human motivation. **Prerequisite: Psych. 1.** Second semester. Offered in 1967-68 and alternate years.

**Psych. 107. Developmental Psychology (3)**
Contemporary theories, outstanding research contributions and methods of analysis concerning the sequential and interrelated patterns of physiological and social development. **Prerequisite: Psych. 1.** First semester. (Offered in 1967-68 and alternate years.)

**Psych. 160. Independent Study (1-3)**
Readings on topics selected in consultation with a staff member. Research on assigned problems. Supervised field studies. **Prerequisites: Psych. 1, 11, and 12, and consent of chairman of department. May be repeated for credit.** First and second semesters.

**For Advanced Undergraduates and Graduates**

**Psych. 201. Industrial Psychology (3)**
The application of psychological concepts and methods to business and industry. Includes personnel selection, placement and training; studies of work environment, motivation and morale; consumer research and advertising. **Prerequisite: Psych. 1.** Second semester.

**Psych. 203. Engineering Psychology (3)**
Experimental psychology as applied to the optimal design of machines and tasks. Survey of human capacities and limitations. Introduction to problems of information input, information processing and decision making for the human operator. **Prerequisite: Psych. 1.** First semester. Offered in 1968-69 and alternate years.

**Psych. 302. Theories of Personality (3)**
A systematic survey of the major theoretical approaches to personality with emphasis on personality as a product of social learning. Critical evaluation of the work of Freud, Adler, Fromm, Horney, Sullivan, Erikson, Lewin, Miller, and Dollard and others. **Prerequisite: Psych. 1 or S.R. 21 or consent of chairman of department.** Second semester. Offered jointly with Department of Social Relations in 1968-69 and alternate years.

**Psych. 303. Mathematical Models in Psychology (3)**
The application of mathematics in psychology, including models for psychophysics, learning acquisition curves, discrimination learning, concept formation and probability learning. **Prerequisite: Psych. 1, 11 and 12 or consent of chairman of department.** First semester. Offered in 1968-69 and alternate years.

**Psych. 304. Psychometric Methods (3)**
Principles of psychological measurement as related to test construction, psychophysical methods, attitude scales. **Prerequisite: Psych. 1, 11 and 12.** Second semester. Offered in 1967-68 and alternate years.

**Psych. 305. Theories of Perception (3)**
Evaluation of contemporary theories of human perception. **Prerequisite: Psych. 1, 11, and 12.** First semester. Offered as required.

**Psych. 306. Human Learning (3)**
A survey of theories and research in the areas of verbal learning, memory and verbal behavior. **Prerequisite: Psych. 1, 11 and 12.** Second semester. Offered in 1968-69 and alternate years.

**Psych. 363. Learning (4)**
Basic data and major theories of learning. Laboratory provides an opportunity for repetition of basic experiments using animal and human subjects. **Prerequisites: Psych. 1, 11, and 12.** First semester.

**Psych. 364. Sensation and Perception (4)**
Receptor processes of vision, audition, touch, taste and smell are considered with particular emphasis on problems of sensory intensity, sensory discrimination functions and perceptual processes. Quantitative methods are stressed. Laboratory exercises provide an opportunity to apply these methods. **Prerequisites: Psych. 1, 11, and 12.** Second semester.

**Psych. 365. Physiological Psychology (4)**
The physiological basis for psychological processes. Three hours of class presentation and one laboratory session. **Prerequisites: Psych. 1.** First semester.

**Psych. 367. Experimental Psychodynamics (3)**
Methodological and theoretical considerations in the design and execution of research in the areas of personality and psychopathology. Laboratory and field studies will supplement lectures. **Prerequisites: Psych. 1, 11, and 12.** Second semester. Offered in 1967-68 and alternate years.

**Psych. 378. Theory and Systems in Psychology (3)**
A critical analysis of the logical structure and orientation of models, theories and methodologies in contemporary psychology. Second semester.

**Psych. 381. Psychological Testing (3)**
An introduction to psychometric and projective tests utilized in the appraisal of intelligence, aptitudes, interests and personality with special emphasis on applications in educational situations. Principles of test construction and validation will be stressed. **Prerequisites: Psych. 1 or consent of chairman of department.** Open only to graduate students from the School of Education.

**Psych. 382. Child Psychology (3)**
A systematic analysis of the critical periods of development from infancy through adolescence. Alternate theories and recent research will be stressed. Open only to graduate students in the Department of Education. Mr. Millon

**Psych. 383. Personality (3)**
Review and analysis of psychological concepts and data relevant to the development and functioning of personality. Comparison and critical examination of the major historical schools of personality theory. **Prerequisites: Psych. 1 or the consent of the chairman of the department.** Open only to graduate students in the School of Education.

**For Graduates**

The primary purpose of the graduate program is to educate psychologists who choose to pursue careers in research or college teaching with specialization in learning, perception, sensation and psychophysics, psychophysiology or engineering psychology. Special opportunity for interdisciplinary work exists in the following areas: The behavioral option of the graduate program in the information sciences; in physiological psychology, students are encouraged to cross the boundaries between the Departments of Biology, Electrical Engineering and Psychology; in engineering psychology students may develop an appreciation of engineering problems by taking courses in Electrical and Industrial Engineering; and lastly, in Social Psychology, students may elect course work offered by the Department of Social Relations. All students have the opportunity and are encouraged, to take courses in collateral areas.

The research facilities of the department include: a) Psychology Laboratory, used for individual and group experiments with human subjects, b) Animal Laboratory for research in animal learning, c) Bioelectric Laboratory, a privately endowed laboratory for psychophysiological research with humans and animals. The facilities of these laboratories are available to graduate students for both thesis and non-thesis research. A weekly psychology colloquium provides an opportunity for graduate students to discuss research in progress presented by visiting scientists and members of the department.

The prerequisite for graduate work in psychology is a concentration of undergraduate courses equivalent to a major in psychology, plus collateral courses in biology, mathematics and the physical sciences. Promising students who lack the full requirements may be accepted with the understanding that deficiencies in the undergraduate program will be added to the minimum graduate program. Applicants for admission to the graduate program must submit scores for the Graduate Record Examination aptitude test and advanced test in psychology. Thesis credit of six hours is a required part of the work leading to a master's degree.

The doctoral degree is normally obtained after four years of full-time participation in the program. Admission to candidacy for the doctoral degree is contingent on demonstrated ability in advanced courses and aptitude for research. Applicants for advanced standing are required to present a master's degree or its equivalent from a recognized graduate school. Doctoral candidates are required to pass language examinations in two of the following: French, German or Russian. Six hours of courses within an area

of study related to the student's field of specialization may be substituted for the second language with the approval of the head of department.

Financial aid is regularly available in the form of teaching and research assistantships and graduate fellowships and scholarships. All doctoral candidates are required to serve at least two semesters as teaching assistants.

**Psych. 421. Analysis and Design of Experiments (3)**
Set theory, probability theory, inferential statistics, parametric and non-parametric statistical tests with emphasis on the analysis of variance, curve-fitting, trend analysis, regression analysis. First semester. Mr. Richter

**Psych. 422. Analysis and Design of Experiments (3)**
Continuation of Psych. 421. Emphasis on experimental design. **Prerequisite: Psych. 421.** Second semester. Mr. Richter

**Psych. 423. Seminar in Statistical Methods (3)**
Selected topics in statistics applied to psychological research. May be repeated for credit. First or second semester. Messrs. Brody, Richter

**Psych. 426. Research Methods (3)**
Planning of experiments under both laboratory and industrial conditions. Appraisal of research ideas, methodology, and instrumentation. First semester. Mr. Brody

**Psych. 428. Thesis (3)**
Original investigation for the master's thesis. Staff

**Psych. 429. Thesis (3)**
Continuation of Psych. 428. Staff

**Psych. 432. Perception (3)**
Evaluation of contemporary research and theories of human perception. Second semester. Offered in 1967-68 and alternate years.

**Psych. 433. Conditioning and Learning (3)**
Coverage of a variety of empirically investigated topics in learning. First semester. Offered in 1967-68 and alternate years. Mr. Richter

**Psych. 434. Personality (3)**
Traditional theories of personality will be reexamined in light of current research, particularly in the fields of learning and neurophysiology. Second semester. Offered in 1968-69 and alternate years. Mr. Millon

**Psych. 435. Social Psychology (3)**
Evaluation of contemporary research and theories of group behavior. First semmester. Offered in 1968-69 and alternate years. Mr. Jones

**Psych. 436. Physiological Psychology (3)**
The study of the anatomical, physiological and biochemical bases of behavior. Second semester. Offered in 1968-69 and alternate years. Mr. Nord

**Psych. 437. Psychophysical Measurement (3)**
An analysis of theoretical and methodological problems in psychological measurement with particular emphasis on psychophysical threshold determination and scaling. First semester. Offered in 1968-69 and alternate years. Mr. Wuest

**Psych. 438. History of Psychology (3)**
Interpretation of selected works of authors who have contributed significantly to the growth of scientific psychology. Second semester. Offered in 1967-68 and alternate years. Mr. Brozek

**Psych. 450. Mathematical Models of Learning (3)**
Stochastic models of learning; application of game and decision theory to learning. Offered as required. Mr. Brody

**Psych. 451. Vision (3)**
A systematic survey of the methods and chief results in the study of visual processes. First semester. Offered as required. Mr. Wuest

**Psych. 453. Advanced Topics in Learning (3)**
An intensive study of some topic in learning with emphasis on current research, e.g., discrimination learning, avoidance learning, concept learning, problem solving, verbal learning. May be repeated for credit. First or second semester. Messrs. Brody, Marsh, Richter

**Psych. 454. Theories of Learning (3)**
Critical survey of major theories of learning. Second semester. Offered in 1967-68 and alternate years.

**Psych. 455. Topics in Engineering Psychology (3)**
Selected topics related to the application of experimental psychology to man-machine systems, e.g., sensory load and performance; perception and motion; man-computer interaction; system development; psychophysiology of human performance. May be repeated for credit. First or second semester. Offered as required.

**Psych. 456. Advanced Social Psychology (3)**
Intensive treatment of theory and empirical research in an area of current interest in social psychology. Second semester. Offered as required. Mr. Jones

**Psych. 458. Sensory Psychophysiology (3)**
An analysis of the neurological bases of sensation based upon an investigation of receptor mechanisms, afferent processes and central integrative activities. Second semester. Offered in 1967-68 and alternate years. Mr. Nord

**Psych. 459. Advanced Topics in Psychophysics (3)**
A topic or topics of current interest in psychophysics will be covered intensively, e.g., adaptation level theory, theory of signal detectability, multidimensional scaling. May be repeated for credit. Offered as required. Mr. Wuest

**Psych. 460. Special Study (1-3)**
Study of some special topic not covered in the regular course offerings. Staff

**Psych. 461. Research (1-3)**
Original research not connected with master's or doctoral thesis. Staff

**Psych. 463. College Teaching of Psychology (1)**
The seminar will be devoted to the consideration of problems in the preparation and presentation of college courses in psychology. Ancillary problems associated with the profession of psychology will be considered. Practice in teaching. First and second semesters. May be repeated for credit. Staff

**Psych. 464. Instrumentation (1)**
Demonstrations and practical work covering the basic mechanical, electronic, optical and photographic techniques used in psychological research. An introduction to computer programming will be included. First and second semesters. May be repeated for credit. Staff

**Psych. 482. Abnormal Psychology (3)**
Principles underlying the major forms of behavior pathology. **Prerequisites: Psych. 383.** Open only to graduate students specializing in guidance and counselling or reading in the School of Education. Offered as required. Mr. Millon

**Psych. 483. Individual Testing (3)**
A practicum course on the use of individual tests in the assessment of intelligence and personality. **Prerequisites: Psych. 381, 383 and Educ. 473.** Open only to graduate students specializing in guidance and counselling or reading in the School of Education. Offered as required. Mr. Millon

**Psych. 484. Projective Techniques (3)**
Administration, scoring and basic interpretive principles of the Rorschach and TAT. Critical examination of these and allied techniques. **Prerequisites: Psych. 381, 482, and Educ. 473.** Open only to graduate students specializing in guidance and counselling or reading in the School of Education. Second semester. Offered as required. Mr. Millon

**Psych. 486. Theories of Psychotherapy (3)**
Review of theoretical formulations underlying the major approaches of psychotherapy. Discussion of principles of therapeutic interviewing, psychoanalysis and group treatment methods. **Prerequisites: Psych. 482.** Open only to graduate students specializing in guidance and counselling or reading in the School of Education. Offered as required. Mr. Millon

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# RELIGION

Professor Eckardt
Associate Professor Fuessle

**Religion 15. Phenomenology (3)**
Introduction to the field through study of selected data from different religious

traditions, using successive methods of interpretation: historical, scientific, theological, and philosophical. First and second semesters.

**Religion 16. Biblical Studies I (3)**
Study of Old Testament writings, with emphasis on early religious traditions of the Hebrews; the history of Israel from the founding of the Kingdom through the post-exilic period; social, economic, and political influences on Jewish religion; the prophetic movement; the law; the Temple and its worship; and the importance of Jewish religion for Christianity and for mankind. First semester.

**Religion 17. Biblical Studies II (3)**
Study of New Testament writings, with emphasis on the four Gospels, the Acts of the Apostles, and the major Epistles. The life and teachings of Jesus and of St. Paul. The theological viewpoint of the primitive Church as reflected in the New Testament. Second semester.

**Religion 101. Faiths of the Orient (3)**
Study of the rise, development, and teachings of selected major religions of India, China, Japan, and Southeast Asia. First semester.

**Religion 102. Faiths of the West (3)**
Study of the rise, development, and teachings of the major religions of Europe and North America with some attention to Islam. Second semester.

**Religion 151. The Jewish-Christian Dialogue (3)**
Analysis of the confrontation of synagogue and church in history and the present with the aid of current materials on the subject. Stress upon moral issues such as antisemitism and upon doctrinal similarities and differences between Judaism and Christianity. Some consideration of religious and sociopolitical aspects of the re-establishment of the State of Israel. First or second semester.

**Religion 211. Recent Theological Trends (3)**
Study of major twentieth-century movements in Catholic, Protestant and Jewish thought in the United States and Europe. Among the developments included are liberalism versus orthodoxy, the demythologization of Scripture, the crisis of technology and secularization, theologies of "the death of God," and the ecumenical movement. First semester.

**Religion 212. Theological Ethics (3)**
Study of alternative points of view on the relating of theology and of religious anthropology to practical moral questions. Consideration of the positions of influential theologians and movements respecting marriage, race, politico-economic life, and international affairs. Particular attention to "the new morality" and "situation ethics." Second semester.

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# RESERVE OFFICERS' TRAINING PROGRAM

Lehigh University offers both Army and Air Force Reserve Officers' Training Programs. A large number of University graduates have served their country with distinction in fulfillment of their military service obligation and in a career as professional officers. Student participation in either program is elective.

ROTC is strongly supported by the University. It is recognized that this program is an important facet in development of leadership characteristics in preparation for assumption of leadership responsibilities. Lehigh graduates have found that training received in the Reserve Officers' Training Program has great value and lasting benefit in any professional or business career.

Students pursuing ROTC are eligible to be selected for deferment from induction under the Selective Service laws. The number of deferments which may be granted are limited by existing Department of Defense Directives.

Students in the Colleges of Arts and Science and of Business Administration may substitute Advanced Military or Aerospace Studies credits for six hours ef electives.

Students in the College of Engineering may substitute advanced Military or Aerospace Studies credits for six hours of General Study (elective) courses.

A cash deposit of $25 is required of all students at the time of registration. The deposit is refunded to the student upon his return of all issued property.

## DEPARTMENT OF MILITARY SCIENCE

Colonel Stern
Majors Matheney, Gravette, Kreitz
Captain Boynton
Master Sergeant Gill
Staff Sergeants Strong, Harris
Mr. Loreaux

The Army Reserve Officers' Training Corps was established at Lehigh University in September 1919. The courses are conducted under Department of Army regulations; the General Military Science Program is followed.

The general objective of this course of instruction is to develop young men through education, training, and enhancement of their inherent qualities of character for commissions as officers in the United States Army. This training is not duplicated in any other college course. The student learns to organize and lead others. He acquires qualities many college men miss — self-discipline, physical stamina and bearing — qualities that contribute to a success in any career. Instruction provides a basic military education common to all branches of the service.

Traditionally, Army ROTC has been a four-year program, consisting of a two-year Basic Course which is elective and a two-year Advanced Course which is also elective, but only students who have demonstrated a potential for becoming effective officers are selected by the Professor of Military Science and approved by the President of the University for participation. Students in the Advanced Course are paid $40.00 per month

(non-taxable) during the school year. A six-week Advanced Course summer training camp is attended normally between the junior and senior years. Pay for this camp is at the rate of $147.30 per month. All uniforms, textbooks, and equipment needed by students for ROTC are furnished by the Army. Transportation to and from summer camp is paid by the Army.

Each students who successfully completes the ROTC Advanced Course is commissioned a Second Lieutenant in one of the components of the United States Army upon his graduation from Lehigh. He will be required to serve on active duty for two years followed by four years in a reserve status. A student who accepts a Regular Army commission or who completes the Army Aviation Program after entering service must serve on active duty for not less than three years.

Completion of the ROTC program and the requirement for active duty will not interfere with pursuit of instruction leading to an advanced degree. An ROTC graduate may delay his active military service for a period up to 48 months to pursue a full-time course of graduate-level instruction. Time spent in a delay status does not lengthen the active duty service obligation for an officer who accepts a Reserve commission.

Army ROTC Scholarship Program. The Army ROTC scholarship program is designed to offer financial assistance to outstanding young men in the four-year Army ROTC program who are interested in the Army as a career. Each scholarship provides for free tuition, textbooks and laboratory fees, in addition to pay of $50.00 per month, for the period that the scholarship is in effect. During the six-week summer training period at the end of the junior year, this pay is increased to $147.30 per month.

Scholarships may be awarded for either two or four years. Four-year scholarships are open to all students entering Army ROTC as freshmen. Applications must be made to the Army Headquarters serving the state of residence during the publicly announced period, usually between mid-January and 1 March, prior to the September of enrollment. Two-year scholarships are restricted to those students who have completed the first two years of ROTC and are selected for enrollment in the ROTC Advanced Course.

Two-Year Program. Students who have been unable to take ROTC during their first two years of college may apply for the Advanced Course and are subject to the same selection process. However, they must complete a six-week basic summer camp prior to their junior year of college and acceptance into the ROTC program. This summer training takes the place of the Basic Course and qualifies the student for entry into the Advanced Course. Pay for the summer training is at the rate of $88 per month. The Army furnishes or pays for transportation to and from the basic ROTC camp.

Basic Course. During the freshman and sophomore years training is provided in basic military subjects, military history, weapons, equipment

and leadership techniques. During the sophomore year the student cadet is given an opportunity to apply for the advanced program.

To enroll in the Basic Course, an applicant must be:

1. A citizen of the United States of America.
2. Between 14 and 23 years old.
3. Regularly enrolled as a student.
4. Screened and found acceptable by the Department of Military Science.

ADVANCED COURSE. Qualified students may apply for and be accepted into the Advanced Program, with a commission as Second Lieutenant in the United States Army as the objective. To be eligible for consideration and admission to the advanced program, a student regularly enrolled, must be a citizen of the United States between the ages of 14 and 25, of good moral character; he must have successfully completed the Basic Course or have credit in lieu through prior military experience, attendance at military schools, or completion of ROTC Basic Summer Camp; he must successfully complete the prescribed physical examination and officer qualification test. Prior to formal enrollment in the Advanced Course, a student who is selected for training is required to sign an agreement to complete the program of instruction during the remainder of his course at the University. He also agrees to accept appointment as an officer, if such appointment is offered, and to serve on active duty for the period prescribed. Once enrolled, the student receives training in subjects which will prepare him for his commission as an officer and subsequent service. Fundamentals of leadership techniques are stressed; military law, administration and logistics are covered, in addition to an understanding of tactics. Instruction is supplemented by student participation in operation of the ROTC program and in allied extra-curricular activities.

DMS PROGRAM. This is a competitive program which permits outstanding ROTC students to apply for a Regular Army commission immediately upon graduation. At the end of the junior year and prior to the Advanced course summer camp, approximately one-third of each junior ROTC class may be designated potential Distinguished Military Students. A student who maintains the same high standards throughout summer camp and his senior year may qualify for designation as a Distinguished Military Graduate and receive a Regular Army commission upon graduation.

FLIGHT TRAINING PROGRAM. Flight training is an extra-curricular activity conducted by an FAA approved flying school near the college. The instruction consists of 35 hours of ground training and more than 36 hours of flight instruction. Senior ROTC students who take flight training must agree to participate, if selected, in the Army Aviation Program upon entering active service.

TRANSFERS. Students transferring from other institutions may enter the ROTC program at the appropriate level and year, providing the institution from which transferred has a similar ROTC program for which the transferring student has received the necessary credits and the recom-

mendation of his former Professor of Military Science. Students who have successfully completed the ROTC Basic Summer Camp, prior to admission to Lehigh, may enter the Advanced Course in their junior year.

### Basic Course

**M.S. 13. Basic Military Science (1)**
An introductory course designed to provide the student with an understanding of the Army, the ROTC program, and military obligations under present laws. Training during leadership laboratory periods, i.e., squad drill, rifle marksmanship, customs of the Army, and introduction to military courtesy and discipline, enable the students to individually evaluate the Army ROTC program. One recitation and two hours of leadership laboratory a week. Fall semester.*

**M.S. 14. Basic Military Science (1)**
During this course the student gains an understanding of U.S. military policy, missions and responsibilities of the Army as a member of the National Defense Team. Emphasis is placed on the student's personal responsibilities as a citizen and leader in this Defense Team. One recitation and two hours of leadership laboratory a week. Spring semester.*

**M.S. 21. Basic Military Science (2)**
The objective of this course is to provide the ROTC student with a sound foundation in the principles of the art of warfare as exemplified in American Military History. Emphasis is placed on analyzing the principles of war and military leadership. Students are given greater responsibility in practicing leadership during leadership laboratory. Two recitations and two hours of leadership laboratory per week. Fall semester.

**M.S. 22. Basic Military Science (2)**
This course is designed to develop student proficiency in the use of maps and aerial photographs and to become familiar with small unit combat operations and military tactics. Leadership training is emphasized by assigning students to leadership positions to evaluate the student's potential for the advanced program. Two recitations and two hours of leadership laboratory per week. Spring semester.

### Advanced Course

**M.S. 105. Advanced Military Science (1)**
The student analyzes realistic leadership actions and solves leadership problems. The functions of the various branches of the Army are discussed with the objective of assisting the student in selecting the branch he desires as a commissioned officer. Tactical training of the individual soldier and physical fitness are stressed during the leadership laboratory periods. Two recitations and two hours of leadership laboratory per week. Fall semester.*

**M.S. 106. Advanced Military Science (2)**
The student is provided opportunities for practical work in applying the principles, techniques, and methods of military instruction and of small unit tactics. A required field trip to a military installation allows the student to apply the tactical lessons previously learned by performing as a military commander under conditions similar to active duty. Three recitations and two hours of leadership laboratory per week. After completing M.S. 106 the student is ready to participate in the six-week ROTC summer encampment. Spring semester.

**M.S. 107. Advanced Military Science (2)**
Course is designed to teach the value and basic concepts of military intelligence, administration, law, and develop an understanding of staff organization and functions. Students are appointed as cadet officers and given leadership assignments to assist in developing and training junior cadets. Three recitations and two hours of leadership laboratory per week. Fall semester.

**M.S. 108. Advanced Military Science (1)**
Students study the basic concepts and fundamentals of supply, evacuation and troop movements. To prepare the future officer for active duty, an orientation of Army life is presented with a brief review of leadership responsibilities. Two recitations and two hours of leadership laboratory a week. Spring semester.*

## DEPARTMENT OF AEROSPACE STUDIES

Lieutenant Colonel Armstrong
Major Wagner
Captains Pittard, Thoden
Technical Sergeants Holleran, Veilleux
Staff Sergeant Lee

The Lehigh Unit of the Air Force Reserve Officer Training Corps was established in October 1946. Its program is designed to prepare students for commissions in the United States Air Force upon successful completion of an undergraduate course. The Department of Aerospace Studies offers two programs for students to qualify for commission: one of four years and one of two years. *Any* student who has met or will meet the baccalaureate degree requirement at the end of his university education may apply for entrance into the four or two year program. He must complete his AFROTC training and university education and be commissioned by his 28th birthday.

Four-Year Program. The four year program consists of classroom and laboratory work during the four undergraduate years and one field training period of four weeks, usually between the junior and senior years, at a United States Air Force base.

During the first two years the program acquaints students with military and aerospace technological advances and current research and development activities. Leadership training is also begun. During the last two years, emphasis is placed on personal development. Students increase their leadership ability by assuming positions of responsibility in the Cadet Corps. To insure that they will keep abreast of the developments in the Air Force, students continue to receive information on technological changes.

While in an undergraduate status, Air Force ROTC students are furnished, free of charge, all text and reference books, uniforms, and equip-

*Students must take an approved three credit-hour course from the curricula of the Colleges of Arts and Science, Business Administration, or Engineering which contributes to their potential military capabilities.

ment required for aerospace study. Under the provisions of the Reserve Officers Training Corps Revitalization Act of 1964, Air Force ROTC Cadets who have successfully completed the requirements of the first two years (General Military Course) of the four-year program are offered on opportunity to compete, on a nationwide basis, for full scholarship assistance which includes tuition, fees and books, plus a retainer of $50 per month during their junior and senior years. Those fully enrolled cadets who do not obtain a scholarship will receive $40 monthly during their junior and senior years.

At the beginning of the junior year each student is required to sign a formal agreement that he will complete the Professional Officer Course and accept a commission as a second lieutenant in the United States Air Force when he has been granted his degree. Also, at the beginning of the junior year the student is sworn into the Enlisted Reserve of the United States Air Force. The term of commitment after commissioning for any non-flying professional area is four years. If the student is physically qualified and desires to become a pilot or navigator, the required term of service is five years.

Two-Year Program. The two-year program is for those students who are unable to complete the first two years of the four-year Air Force ROTC program. Such students may apply during their sophomore year for acceptance into the two-year program. Selections are based on nationwide competition, with criteria similar to the scholarship program. In lieu of completing the freshman and sophomore years of the four-year program, these men will receive field training in a six-weeks' officer training course conducted on an Air Force base during the summer between the sophomore and junior years. Upon successful completion of the six-week intensive military and academic program, they will return to the campus to be enrolled in the Professional Officer Course to complete the same academic program required of the four-year students. These students receive $40 a month in subsistence allowance.

Flight Instruction Program. Senior cadets who are physically qualified may take flight instructions in their senior year at no cost to themselves. The FIP provides 36½ hours of flying time, 35 hours of instruction (20 hours dual and 15 hours solo) plus 1½ hours for a final flight progress check. Cadets who complete the 35 hours of instruction and pass the FAA written examination and the final flight check, may receive an FAA private pilot's license.

General Information on Both Programs. Adjustment in the Aerospace program will be made to accommodate students enrolling in an honors or cooperative course. Students who are eligible for and desire graduate education immediately after completing their undergraduate work may request a delay in reporting for active duty until completing their graduate degree.

Eligibility Requirements. To be eligible for the Air Force ROTC program a student must be:

1. A male citizen of the United States.
2. Physically qualified for commission in the United States Air Force in accordance with existing Air Force regulations.
3. Not under 14 years of age; and upon graduation not more than 28 years of age.
4. Planning to pursue work leading to at least a bachelor's degree.
5. Willing to sign a formal agreement and enlist in the Air Force Reserve at the beginning of the junior year, which obligates him to remain in the ROTC program for the two final years, to accept a commission, and to serve the required period in the Air Force upon graduation.

### General Military Course

**A.S. 1. Aerospace Studies (1)**
World Military Systems: An introductory course exploring the causes of present world conflicts, the role and relationship of military power toward conflict, the responsibilities of an Air Force Officer, the evolution of different political philosophies and the means that nations develop to pursue their objectives.

**A.S. 2. Aerospace Studies (1)**
World Military Systems: A continuation of the study of military means that modern nations have developed. Emphasis is placed on the United States Department of Defense and the United States Air Force. Several of the major commands such as the Strategic Air Command are discussed at length.

**A.S. 11. Aerospace Studies (1)**
World Military Systems: A broadened study of military forces which includes surveys of the United States Army, the United States Navy, and future trends and implications of land, sea, and aerospace warfare. This study is limited to the military forces of the United States.

**A.S. 12. Aerospace Studies (1)**
World Military Systems: An analysis of major world powers to include Western Alliances such at NATO, SEATO, and CENTO; the Communist military forces of USSR, China, and the Soviet Satellites; and future trends toward war, peace, and world military alignments.

### Professional Officer Course

**A.S. 111. Aerospace Studies — Air Force Officer Development (3)**
Development of the knowledge and skills required of the junior officer in the Air Force. This will include the nature of war, history of air power, and the mission, doctrine, and employment of the United States Air Force.

**A.S. 112. Aerospace Studies — Air Force Officer Development (3)**
Continuation of the development of knowledge and skills required of a junior Air Force officer. This will include the history and importance of national space effort, orbits and trajectories, space vehicle systems, ground supports systems, manned space flight, and operations in space.

**A.S. 113. Aerospace Studies — The Professional Officer (3)**
Introduction to military professionalism. A study of the meaning of professional responsibilities of the professional officer, the foundations of the military profession, the military justice system, theories of leadership, discipline and human relations.

**A.S. 114. Aerospace Studies — The Professional Officer (3)**
A military explanation of leadership and management. Includes principles and functions of management, Air Force personnel policies, channels of communication, problem solving, the command-staff team, the subordinate, performance standards, data processing, and Air Force controls.

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# ROMANCE LANGUAGES

Professors Barthold, Van Eerde
Associate Professor Valenzuela
Messrs. Cravzow, Leyton

## FRENCH

**Fr. 1. Elementary French (3)**
Basic conversational French illustrating essential grammatical principles. Emphasis on aural-oral learning with required laboratory practice. First semester.

**Fr. 2. Elementary French (3)**
Continuation of Fr. 1, with the addition of simple vocabulary-building tests. **Prerequisite: Fr. 1.** Second semester.

**Fr. 11. Intermediate French (3)**
Reading based on works of the nineteenth and twentieth century writers; formal review of French grammar; prose composition; outside reading. **Prerequisite: One year of college French or two units of entrance French.** First semester.

**Fr. 12. Intermediate French (3)**
Continuation of Fr. 11. **Prerequisite: Fr. 11.** Second semester.

**Fr. 13. Types of French Literature (3)**
Training in the ability to read and understand representative works from the Middle-Ages to the nineteenth century. Outside reading and reports. Conducted in French. **Prerequisites: Two years of college French or 3 units of entrance French.** First semester.

**Fr. 14. Types of French Literature (3)**
Reading and discussion of representative works of the nineteenth and twentieth centuries. Outside reading and reports. Conducted in French. **Prerequisites: Two years of college French or 3 units of entrance French.** Second semester.

**Fr. 23. Seventeenth Century French Literature (3)**
A study of the main pre-classical and classical French writers of the seventeenth century. Lectures, discussion of texts, reports, and collateral readings. Conducted in French. **Prerequisites: Two years of college French or 3 units of entrance French.** First semester.

**Fr. 24. Seventeenth Century French Literature (3)**
Continuation of Fr. 23. Conducted in French. **Prerequisite: Fr. 23.** Second semester.

**Fr. 25. Eighteenth Century French Literature (3)**
The literature of the Enlightenment and pre-romanticism. Lectures, discussion of texts, reports, and collateral readings. Conducted in French. **Prerequisites: Two years of college French or 3 units of entrance French.** (Not offered 1967-68.)

**Fr. 26. Eighteenth Century French Literature (3)**
Continuation of Fr. 25. **Prerequisite: Fr. 25.** (Not offered 1967-68.)

**Fr. 31. Nineteenth Century French Literature (3)**
Main literary currents of the nineteenth century; romanticism and realism. Lectures, reports, collateral readings. **Prerequisites: Two years of college or 3 units of entrance French.** First semester.

**Fr. 32. Nineteenth Century French Literature (3)**
Continuation of Fr. 31. **Prerequisite: Fr. 31.** Second semester.

**Fr. 41. French Oral and Written Composition (3)**
For students who wish a greater opportunity for practice in the oral and written use of French than can be provided in the literature courses. **Prerequisites: Two years of college French or 3 units of entrance French.** First semester.

**Fr. 42. French Oral and Written Composition (3)**
Continuation of Fr. 41. **Prerequisite: Fr. 41.** Second semester.

**For Advanced Undergraduates and Graduates**

**Fr. 221. French Literature before the Seventeenth Century (3)**
A general review of French literature from its beginning through the sixteenth century. First semester.

**Fr. 222. Contemporary French Literature (3)**
Second semester.

**Fr. 223. Proseminar (3)**
A study of the works of some author or group of authors, or of a period. First semester.

**Fr. 224. Proseminar (3)**
Continuation of Fr. 223. Second semester.

**Fr. 301. French Classicism (3)**
A study of the French classical theatre, novel, and criticism with emphasis on Corneille, Racine, Moliere, Madame de Lafayette, Malherbe, and Boileau. Conducted in French. First semester.

**Fr. 302. The Age of Enlightenment (3)**
A study of the "philosophes" and "enclyclopedistes" of the 18th century, with emphasis on Voltaire, Rousseau, Montesquieu, and Diderot. Conducted in French. Second semester.

## ITALIAN

**Ital. 1. Elementary Italian (3)**
Grammar; composition; rapid reading of easy modern prose. No previous study of Italian required. First semester.

**Ital. 2. Elementary Italian (3)**
Continuation of Ital. 1. **Prerequisite: Ital. 1.** Second semester.

**Ital. 11. Intermediate Italian (3)**
The age of Dante. Lectures in English on Dante and his contemporaries; readings in the **Divina Commedia. Prerequisite: One year of college Italian or two units of entrance Italian.** First semester.

**Ital. 12. Intermediate Italian (3)**
The Romantic Period—lectures in English, and selected readings from the works of Manzoni and Leopardi. **Prerequisite: One year of college Italian or two units of entrance Italian.** Second semester.

## PORTUGUESE

**Port. 1. Elementary Portuguese (3)**
A study of Portuguese grammar and forms; practice in writing and speaking Portuguese. First semester.

**Port. 2. Elementary Portuguese (3)**
Continuation of Port. 1. **Prerequisite: Port. 1.** Second semester.

## SPANISH

**Span. 1. Elementary Spanish (3)**
Basic conversational Spanish illustrating essential grammatical principles. Emphasis on aural-oral learning with required laboratory practice. First semester.

**Span. 2. Elementary Spanish (3)**
Continuation of Span. 1, with the addition of the use of simple vocabulary-building and reading texts. **Prerequisite: Span. 1.** Second semester.

**Span. 11. Intermediate Spanish (3)**
Reading of modern Spanish prose, with a view to acquiring exactness and speed in reading; rapid review of grammar, composition, and conversation. **Prerequisite: One year of college Spanish or two units of entrance Spanish.** First semester.

**Span. 12. Intermediate Spanish (3)**
Continuation of Span. 11. **Prerequisite: Span. 11.** Second semester.

**Span. 13. Cultural Evolution of Spain (3)**
The historical and cultural evolution of Spain from its beginning to the present. Reading of representative Spanish authors. A term paper in Spanish is required. Conducted in Spanish. **Prerequisite: Span. 12 or three units of entrance Spanish.** First semester.

**Span. 14. Cultural Evolution of Latin-America (3)**
Continuation of Span. 13. The historical and cultural evolution of Latin America. Reading of representative Latin-American authors. A term paper in Spanish is required. Conducted in Spanish. **Prerequisite: Span. 12 or three units of entrance Spanish.** Second semester.

**Span. 21. Introduction to Spanish Fiction (3)**
Readings and discussion of selected novels and short stories; outside reading and reports. Conducted in Spanish. **Prerequisite: Span. 12 or three units of entrance Spanish.** First semester.

**Span. 22. Introduction to Spanish Drama (3)**
Reading and discussion of selected plays; outside reading and reports. **Prerequisite: Span. 21.** Second semester.

**Span. 31. Spanish Conversation and Composition (3)**
For students who wish a greater opportunity for practice in the oral and written use of Spanish than can be provided in the literature courses. Special attention given to the history and culture of Spain. Conducted in Spanish. **Prerequisite: Two years of college Spanish or three units of entrance Spanish.** First semester.

**Span. 32. Spanish Conversation and Composition (3)**
Continuation of Span. 31, with special attention given to Latin-America area studies. Conducted in Spanish. **Prerequisite: Span. 31.** Second semester.

**For Advanced Undergraduates and Graduates**

**Span. 231. Spanish American Literature (3)**
Reading and discussion of representative works of the literature of the Pre-Columbian, Conquest, and Colonial periods. Oral and written reports; term paper. Conducted in Spanish.

**Span. 232. Spanish American Literature (3)**
Reading and discussion of representative works of the literature of the nineteenth and twentieth centuries. Oral and written reports; term paper. Conducted in Spanish.

**Span. 301. The Spanish Essay (3)**
Reading and discussion of outstanding Spanish thinkers of the twentieth century, with emphasis on the works of Unamuno and Ortega y Gasset. Oral and written reports. Conducted in Spanish. First semester.

**Span. 302. The Latin-American Essay (3)**
Reading and discussion of distinguished Spanish-American essayists of the twentieth century with emphasis on the works of Rodo, Vasconcelos, Vaz Ferreira, and Francisco Romero. Oral and written reports. Conducted in Spanish. Second semester.

**Span. 303. Cervantes (3)**
Reading and critical study of the chief works of Miguel de Cervantes with special emphasis on Don Quijote. Collateral reading and reports. Given in Spanish. First semester.

**Span. 304. Lope de Vega (3)**
The development of the Spanish Drama of the Golden Age, including the important plays of Lope de Vega. Collateral reading and reports. Given in Spanish. Second semester.

**Span. 305. Spanish Literature of the Middle Ages (3)**
Reading and discussion of outstanding works such as: El Cid, El Libro de Buen Amor, La Celestina. Given in Spanish. First or second semester.

**Span. 306. Latin America Literature since World War II (3)**
Reading and discussion of representative works of contemporary Latin-American authors. Given in Spanish. First or second semester.

**RUSSIAN**
**See German, page 255**

**SPANISH**
**See Romance Languages, page 333**

**SPEECH**
**See English, page 239**

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# SOCIAL RELATIONS

Professor Williamson
Assistant Professors Herrenkohl, Jones, Szwed
Mr. McIntosh

**S.R. 3. Introduction to Social Relations (3)**
An interdisciplinary approach to the nature of culture, society, and the individual. Social-psychological, anthropological, and sociological materials will be presented on an integrated basis. Not open to students who have had or are taking S.R. 11, 21, or 31. First and second semester.

**S.R. 4. Introduction to Social Relations (3)**
A continuation of S.R. 3. **Prerequisite: S.R. 3.** Not open to students who have had or are taking S.R. 11, 21, or 31. First and second semester.

**S.R. 11. Principles of Sociology (3)**
An introduction to the field of sociology and its concepts and methods. Among the topics are the nature of the group, social organization and structure, socialization, stratification, social institutions, ethnic relations, social change. Not open to students who have had or are taking S.R. 3 or 4. First and second semester.

**S.R. 21. Social Psychology (3)**
An introduction to the theories, methods of investigation, and research results of social psychology with emphasis on psychological processes in social behavior, social attitudes, group behavior and social interaction. Not open to students who have had or are taking S.R. 3 or 4. First and second semester.

**S.R. 31. Cultural Anthropology (3)**
Examination of the scope, aims and methods of anthropology; the nature of culture; the cultural evolution of man; the range of culture phenomena emphasizing economic organization, kinship and social organization, political organization, and religion; and a brief introduction to the history of ethnological theory. Analysis of the characteristic features of the life, thought, and culture of selected primitive and peasant peoples throughout the world. Not open to students who have had or are taking S.R. 3 or 4. First and second semester.

**S.R. 65. Contemporary Problems in Society (3)**
The exploration of the social structures and the functions of certain public problems of contemporary importance as found in politics, science, education, business, the metropolis. Class discussions. First semester.

**For Advanced Undergraduates and Graduates**

**S.R. 298. Research Methods in Social Relations (3)**

Training in the methods of research used in the study of social relations. Study of selected problems and applications in research design, execution, analysis, and interpretation. Introduction to major techniques of research including laboratory experimentation, field study, and participant observation; questionnaire construction and interview procedure. Introduction to different levels of analysis. **Prerequisite: S.R. 11, 21, or 31.** Second semester.

**S.R. 301. Experimental Social Psychology (3)**

Training in design, execution and interpretation of experiments in social psychology. An opportunity for original research. **Prerequisite: S.R. 21 or consent of chairman of department.** First semester. Mr. Jones

**S.R. 302. Seminar in Social Psychology (3)**

Intensive consideration of selected topics in current theory and research in social psychology. The subject matter will vary from semester to semester, and will include such topics as the social psychology of education, the application of perception and learning theory to social psychological problems, the social psychology of science, and the social environment of communication. **Prerequisite: S.R. 21 or consent of chairman of department.** Second semester. May be repeated for credit. Mr. Jones

**S.R. 303. The Social Psychology of Groups (3)**

Survey of theories and empirical work on inter-personal behavior in small groups. Emphasis on such topics as: group process and structure, personality, group size, communication network, leadership, and social characteristics as they affect the interaction process, performance characteristics of individual versus group and group versus group. **Prerequisite: S.R. 21 or consent of chairman of department.** First semester. Mr. Jones

**S.R. 304. Human Communication (3)**

Problems in understanding the processes and functions of communicative behavior. Analysis of speech and language theories of communication, and the effects of communication in groups. **Prerequisite: One course in Social Relations or equivalent.** Second semester. Mr. Jones

**S.R. 305. Personality and Social Processes (3)**

An examination of theory and research concerning the influence of individual personality and motivation on interpersonal perception and on participation in social situations. Mr. Herrenkohl

**S.R. 331. Theories of Cultural Anthropology (3)**

A systematic analysis of the development of anthropology as a scientific discipline. Contemporary theory and practice in anthropological studies of society, culture and the individual are considered in historical perspective. **Prerequisite: S.R. 31. First semester.** Mr. Szwed

**S.R. 333. Primitive Political Systems (3)**

A comparative analysis of systems of law, government, and politics among selected tribal and peasant societies. Analysis of the sources and functions of law and government in particular societies, examination of systems of social control, and the conflict of these cultural systems in the modern world. Attention to historical contemporary anthropological theory in this area. **Prerequisite: S.R. 31.** Second semester. Mr. Szwed

**S.R. 335. Cultural Dynamics (3)**
Critical evaluation of approaches to the problems of culture change; analysis of invention and intergroup cultural borrowing; agents and conditions conducive to change; mechanics of culture growth; and application of techniques for inducing change. Attention to the impact of Western civilization upon traditional native societies; socio-cultural adjustments to the impact; and community disintegration and reintegration. **Prerequisite: S.R. 31 or consent of chairman of department.** First semester. Mr. Szwed

**S.R. 336. Religion and Magic (3)**
A comparative analysis of the origins, elements, forms and symbolism of religious beliefs and behavior; the role of religion in society with particular reference to nonliterate societies. Anthropological theories and methods of analysis of religion, both historical and contemporary, will be considered. **Prerequisite: S.R. 31 or consent of chairman of department.** Second semester. Mr. Szwed

**S.R. 338. Folklore and Culture (3)**
Traditional forms of expression (songs, tales, myths, proverbs, ritual, etc.) and their setting in non-literate and literate societies; the social and psychological functions of folklore, with particular emphasis on the concepts of myth, ritual, and superstition; the relationship between folklore and literature. Second semester. Mr. Szwed

**S.R. 339. Seminar in Anthropology (3)**
Intensive consideration of selected topics in contemporary or past research in cultural anthropology. The subject matter will vary from semester to semester. First or second semester. May be repeated for credit. Mr. Szwed

**S.R. 364. The Family (3)**
A sociological study of man's basic institution. Includes: an analysis of historical backgrounds, interaction within the family, relation to other groups and institutions, problems of family disorganization, legal aspects of marriage and divorce, family adjustment, the family in a changing society. Second semester.
Mr. Williamson

**S.R. 366. Population Problems (3)**
Quantitative and qualitative aspects of U. S. and world population. Includes: causes and effects of migrations, racial composition and race relations, population theories, legal aspects, social consequences of population trends, present trends and future predictions. **Prerequisite: S.R. 11 or 63 or consent of chairman of department.** Second semester.

**S.R. 367. Latin American Social Institutions (3)**
An introduction to the contemporary indigenous, mestizo and creole cultures of Latin American with analysis of specific communities. An investigation of family, education, religious, and recreational institutions with particular emphasis on intellectual developments. Attention to the problem of change and social planning. **Prerequisite: One course in Social Relations or consent of chairman of department.** First semester. Mr. Williamson

**S.R. 368. The Urban Community (3)**
A study of urban communities in the world and in the United States. A history of the city, ecological and demographic patterns and growth, institutional organization, status systems, suburban development, resources and problems, future development and planning. **Prerequisite: S.R. 11 or 63 or consent of chairman of department.** Second semester. Mr. McIntosh

**S.R. 369. Social Disorganization (3)**
Social disorganization of contemporary society, with special emphasis on the concepts of anomie and alienation. Evaluation of functional theory and conflict theory of disorganization with attention to selected deviant behavioral patterns; i.e., crime, delinquency, mental health. Mr. McIntosh

**S.R. 371. Special Topics in Social Relations (1-3)**
An opportunity for advanced work through supervised reading and research. **Prerequisite: Consent of chairman of department.** First semester.

**S.R. 372. Special Topics in Social Relations (1-3)**
Continuation of S.R. 371. Second semester.

**S.R. 373. Seminar in Sociology (3)**
Intensive consideration of selected topics in contemporary theory or research in sociology. The subject matter will vary from semester to semester. **Prerequisite: Sociology 11 or consent of chairman of department.** First or second semester. May be repeated for credit. Staff

**S.R. 374. Social Stratification (3)**
Examination of concepts of stratification, such as social class, and of theories using these concepts. Consideration also of research findings which indicate the significance of stratification for society. Mr. Herrenkohl

**S.R. 375. Minority Groups (3)**
Ethnic minorities and intergroups relations. Consideration of the historical and social character of minority groups and an examination of theory and research focusing on intergroup cooperation and conflict. Mr. Herrenkohl

**S.R. 381. Development of Sociological Theory (3)**
A critical and comparative study of the principal schools of social thought which have contributed to the development of sociological theory. The origins and development of sociology, major contributors, current trends. **Prerequisite: Consent of chairman of department.** First or second semester. Mr. McIntosh

**S.R. 384. Social Structure (3)**
The theory of social structure considered as a basic key to the understanding of social phenomena, with attention to such concepts as interaction, position, role and role-set, status, institutionalization, equilibrium, norm, and culture. Selected propositions concerning structural relationships and processes will be examined. **Prerequisite: S.R. 11 or consent of chairman of department.** Second semester.
Staff

**S.R. 394. The Individual, Society and Culture (1-3)**
This course will explore the interdisciplinary implications of the materials and methods of social psychology, sociology, and anthropology. **Prerequisite: two courses in Social Relations or Consent of chairman of department.** Second semester.

## For Graduates

**S.R. 401. Advanced Research Methods (3)**
A basic course in research theory and methods. Consideration given the nature of theory, hypotheses testing, the definition of variables and methods of measurement. Mr. Herrenkohl

**S.R. 402. Theory in Social Psychology (3)**
A critical analysis of theoretical orientations in social psychology, their place and relevance to the scientific study of human interaction. Behavioristic, phenomenological and mathematical theories will be compared and evaluated.
Mr. Jones

**S.R. 431. Economic Anthropology (3)**
An examination of the distribution, exchange, and consumption systems of tribal and folk societies; the integration of economic behavior in cultural systems; the impact of change on non-Western cultures. **Prerequisite: one course in anthropology or consent of the chairman of the department.** Mr. Szwed

**S.R. 432. Culture Patterns and Personality (3)**
The psychological implications of cultural variation, including the analysis of national character. Messrs. Williamson, Szwed

**S.R. 435. Current Anthropological Theory (3)**
An examination of the theoretical foci of anthropology and its relation to disciplines, e.g., ecology, linquistics, ethnohistory, the cross-cultural study of cognition, etc. Mr. Szwed

**S.R. 464. Seminar on the Family (3)**
Societal functions of marriage and the family and the relation of this institution to the social structure and demographic variables. Particular emphasis on the treatment of family disorganization. Mr. Williamson

**S.R. 465. Organizational Behavior (3)**
Theory and research concerning the development and functioning of organizations. Structure, goals, authority and power, communication, role conflict in large organizations. Cross-institutional comparisons of industrial, research, governmental, medical, and academic organizations. Staff

**S.R. 467. Latin American Social Structure (3)**
Analysis of given Latin American societies with special attention to economic and political structures. Individual projects. Mr. Williamson

**S.R. 468. Advanced Urban Sociology (3)**
Selected problems in urban research, urban and community planning and redevelopment. Relation of the city and the region to economic development and government functions. Mr. McIntosh

**S.R. 470. Contemporary Sociological Theory (3)**
An examination of current developments in sociology. Functional theory and other areas, (for example, conflict theory), as reflected in Parsons, Merton, Coser, Dahrendorf, and others. A critique of current theoretical schools.
Mr. McIntosh

**S.R. 471. Special Topics (3)**
Intensive study in an area of social relations, which is appropriate to the interests and needs of the staff and students. Staff

**S.R. 472. Special Topics (3)**
Continuation of S.R. 471. Staff

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# Division of Athletics and Physical Education

Wm. B. Leckonby, *Director*
P. E. Short, *Assistant Director and Business Manager*
J. S. Steckbeck, *Assistant Director of Physical Education*

The Division consists of the Department of Intercollegiate Athletics and the Department of Physical Education and Intramural Sports. It has supervision over the entire field of intercollegiate athletics and physical education

at the University. Its activities consist of intercollegiate athletics, intramural athletics, and required physical education, including corrective exercises.

Experience indicates that it is essential that the physical education program emphasizes the physical fitness and efficiency benefits to be derived from a well-rounded and athletic phase of the program. The purpose of the athletic, physical education, and intramural sports program is designed to:

A. Raise and maintain the physical standards of the University.

B. Develop and maintain a high level of all-around physical fitness so that the undergraduate student may more readily assimilate instruction.

C. Encourage regular and healthful exercise by the development of skills, techniques, and attitudes.

D. Foster an aggressive and cooperative team spirit, to increase the confidence of the individual, to develop sportsmanship, and to increase University pride through participation in vigorous competitive athletics.

Facilities for accomplishing these are afforded in Taylor Gymnasium, Grace Hall, the field house, the two playing levels of Taylor Field, and Sayre Park field, an area of seven acres located above the Look-Out on the top of South Mountain and only a short distance from the fraternity houses and residence halls, and Saucon Valley Fields located south of the campus and on the south side of South Mountain. These 410 acres have the following facilities: All-weather quarter mile track, nine all-weather tennis courts, lacrosse and soccer fields, three football practice fields, Varsity House, two baseball diamonds, twelve to sixteen intramural fields, and a football field which is the site of a future stadium. Almost all of the outdoor intramural sports contests and all upperclass intramural activities are held in this area. A shuttle bus service is provided to and from this field.

## DEPARTMENT OF INTERCOLLEGIATE ATHLETICS

Director Leckonby
Assistant Director Short
Messrs. Packer, Dunlap, Leeman, Christian, Havach, Carril, Maue, Chiodi, Hogan, Sanders, Sherman, Johnson, Schultz, Valentic

The Department of Intercollegiate Athletics offers opportunity to the undergraduate student body to participate in intercollegiate competition both at home and away with institutions which are Lehigh's natural rivals and also other institutions which are at some distance.

The intercollegiate program consists of varsity teams in football, cross country, soccer, wrestling, basketball, swimming, tennis, track, baseball, golf, lacrosse, fencing, and rifle. In addition, there are freshman teams in most of the above sports.

## DEPARTMENT OF PHYSICAL EDUCATION AND INTRAMURAL SPORTS

Professor Leckonby
Assistant Professors Steckbeck, Christian, Leeman, Packer, Chiodi, Carril
Messrs. Hogan, Sanders, Sherman, Maue, Johnson, Schultz, Valentic

The Department of Physical Education and Intramural Sports has supervision and control of the required recreational physical activities of the student body. The aim of the department is to insure the health and physical development of every student of the University.

Through its program in physical education and intramural sports the University endeavors to maintain among its students a high degree of physical fitness, to establish habits of regular and healthful exercise, to foster the development of such valuable by-products as self-confidence, good sportsmanship, and a spirit of cooperation, and to provide each student with ample opportunity for acquiring an adequate degree of skill in sports of the type in which participation can be continued after graduation.

Freshman students are required to register for and engage in some form of activity under departmental supervision. This requirement calls for three hours a week in the gymnasium or participation in an organized sport. Sophomore, junior, and senior students are encouraged to continue their physical activities and participation in intramural sports.

Prior to his arrival on campus, each new or transfer student must submit to the Health Service a Record of Physical Examination form filled in and signed by a physician, and a completed Health History form. All such forms are carefully checked by the Health Service and each student thereby classified for activities in the Department of Physical Education in accordance with his current health status.

All freshmen are required to take a physical efficiency test for the purpose of classification and development. All freshmen are required to take a swimming test during the first week of regularly scheduled classes. In the gymnasium, opportunity is offered in the following activities: physical development, recreational swimming, beginners' swimming, boxing, fencing, apparatus exercises, life-saving, controlled weight lifting, badminton, and sports fundamentals. All undergraduate students must swim 75 feet before graduation. Students are encouraged to change their activities whenever it is thought best for their all-around development.

A comprehensive program in intramural sports is sponsored for the student body including fraternity, residence hall, interclass, town, and independent groups in touch football, tennis, soccer, badminton, handball, individual athletics, basketball, swimming, wrestling, track, softball, volleyball, and recreative games. Students are encouraged to participate in these sports,

and awards are given for excellence in performance.

Individual exercises are prescribed for the correction of physical and functional defects. Students of this group are carefully examined and individually guided.

The University maintains a well-equipped Health Center for medical treatment. If a student is injured while engaged in any sport he must report as soon as possible to the first-aid room or to the University Health Service.

The following physical education courses are required of all physically qualified students:

**P.E. 1. Physical Education (0)**
Freshman first semester. Three hours per week.

**P.E. 2. Physical Education (0)**
Freshman second semester. Three hours per week.

# GENERAL INFORMATION

## General Regulations

### Eligibility for Degree

In order to be graduated, a candidate for a baccalaureate degree must achieve a minimum cumulative average of 1.50.

To be eligible for a degree from Lehigh University, a student not only must have completed all of the scholastic requirements for the degree, but also he must have paid all University fees, and in addition all bills for the rental of rooms in the residence halls, or for damage to University property or equipment, or for any other indebtedness to the University. It is understood, however, that this regulation does not apply to any indebtedness for scholarship loans or for loans from trust funds administered by the University which are protected by properly executed notes approved by the Treasurer.

Unless exempted by the Faculty for some special reason, such as poor health, a student must satisfy all physical education requirements in order to qualify for graduation.

### Final Date for Completion of Requirements

For graduation all requirements, scholastic and financial, must have been met by 12 noon on the Friday preceding the graduation exercises.

### Notice of Candidacy for Degree

Candidates for graduation on University Day file with the Registrar on or before April 15 a written notice of candidacy for the degree; candidates for graduation in February file a notice of candidacy on or before January 5; candidates for graduation on Founder's Day file a notice of candidacy on or before September 10. Failure to file such notice by the dates mentioned

debars the candidate from receiving the degree at the ensuing graduation exercises. If a petition for late filing is granted, a fee of $10 is assessed.

### Graduating Theses

Undergraduate theses, when required, are accompanied by drawings and diagrams, whenever the subjects need such illustration. The originals are kept by the University, as a part of the student's record, for future reference; but copies may be retained by students and may be published, provided permission has first been obtained from the faculty.

### Credit and Grades

A semester hour of college work consists of one hour a week of lectures or class work, or two or three hours of laboratory work (or laboratory work combined with class work) a week for one semester. The normal assumption is that the student will be expected to do at least two hours of study in preparation for each hour of class work.

Final grades in courses are A, B, C, D, and F. A, B, C, and D are passing. The key to grades is as follows: A—Excellent; B—Good; C—Satisfactory; D—Passing; F—Failure. Physical education is marked P (passing) or F (failure) without hour credit.

A student who withdraws from a course during the first seven weeks of instruction will receive a grade of "W." A student who withdraws from a course after the first seven weeks of instruction will receive "WF" unless the committee on standing of students, for cause, allows a grade of "W" to be recorded.

A student officially withdrawn from the University after the third week of instruction shall receive from each instructor a "WP" or "WF."

The letters "Abs." (absent) are used to indicate absence from a final examination in a course. The grade of "Abs." is reported with a letter grade in parentheses, such letter grade representing the department's estimate of the student's work up to the close of instruction with the provision that in cases where a department does not feel justified in reporting an estimated grade, a report of "Abs. (X)" will be returned.

The letters "Inc." are used to indicate that the work in a course is incomplete. The grade is accompanied by a letter grade. A student who incurs an "incomplete" in any course and fails to remove the "incomplete" within one calendar year, loses all equity in the course.

## PROBATION AND DROP REGULATIONS

General. The scholastic requirements for each student are expressed in terms of his cumulative scholastic average (the weighted point average of all grades received in residence, except as noted in paragraph two below).

The cumulative scholastic average will be computed at the end of each semester (and full summer session, i.e., one in which 12 or more semester hours have been rostered). Grades are weighted as follows: A, 4; B, 3; C, 2; D, 1; F, WF, Abs.F., Inc.F., 0.

Graduation Requirement. A student must have a cumulative scholastic average of 1.50 or better in order to be eligible for graduation. This cumulative scholastic average includes all courses passed or failed while in residence, except as noted in paragraph two above.

Probation. A student will be placed on scholastic probation when either:

(a) His cumulative scholastic average falls below these levels:
Freshman, 1st Semester ..... 1.10
Freshman, 2nd Semester ..... 1.20
Sophomore, 1st Semester ..... 1.30
Sophomore, 2nd Semester ..... 1.40
Junior, 1st Semester, and thereafter ..... 1.50, or

(b) He fails more than 7 semester hours in one semester.

The designation "Freshman, 1st Semester," etc., is the classification officially determined by the Registrar irrespective of the number of semesters the student has attended college.

Disabilities of Scholastic Probationers. A student who is on scholastic probation is ineligible for (a) intercollegiate competition and all other activities publicly representative of the University, (b) major office (elective or appointive) in any University organization, and (c) such other activity as may require more time than should be diverted from primary purposes by any student whose academic survival is at risk.

Removal from Probation. A student who has been placed on scholastic probation is restored to good standing if at the end of his next semester or full summer session he meets the standards indicated.

Dropped for Poor Scholarship. A student who makes a 2.00 average or better in his probationary semester but fails to meet the standards set forth in paragraph three above is continued on scholastic probation for another semester. A student who makes less than a 2.00 average in his probationary semester and fails to meet the standards in paragraph three above is dropped for poor scholarship.

## HONORS

Honors are of four kinds: class honors, graduation honors, departmental honors, and interdepartmental honors. (For interdepartmental honors, see page 70.)

### Class Honors

Upon completion of the work of the freshman and sophomore years, on recommendation of the Registrar and by vote of the faculty, class honors are awarded to those individuals who have made an average of 3.00 or better during the preceding year.

The names of these students are announced at the Founder's Day exercises and published in the Founder's Day Program.

### Graduation Honors

Degrees "with honors" are awarded by vote of the faculty to those students who have attained an average of not less than 3.00 in their last two years' work at the University.

Degrees "with high honors" are awarded by vote of the faculty to those students who have attained an average of not less than 3.50 in their last two years' work at the University.

Degrees "with highest honors" are awarded by vote of the faculty to those students who have attained 3.75 in their last two years' work at the University.

Candidates for graduation who have been in residence at the University for less than two years are not eligible for graduation honors.

Graduation honors are announced at the graduation exercises.

In computing the averages of candidates for graduation honors, semester grades are weighed according to the number of credit hours in the course concerned on the basis: A equals 4, B equals 3, C equals 2, D equals 1, and F equals 0.

### Departmental Honors

Special honors are awarded at the end of the senior year, on recommendation of the head of the department concerned and by vote of the faculty, to students who have done advanced work of unusual merit in some chosen field. Candidates for departmental honors must indicate to the head of the department concerned and to the Registrar during the junior year their intention to work for such honors. Awards are based on grades obtained in the subject chosen, the results in extra work assigned and the general proficiency of the candidate as evidenced either by a final examination or a thesis, as the head of the department involved may direct. Departmental honors are announced at the graduation exercises.

### Latest Date for Registration

No registration is accepted later than the tenth day of instruction in any semester.

# Financial Aid

## UNDERGRADUATE SCHOLARSHIPS AND LOANS

### General Statement

Lehigh University is desirous of extending tuition aid to deserving and promising students who otherwise would not be able to attend the University, to the extent that funds are available for such assistance. During the academic year 1966-67, over 650 students were granted financial assistance of approximately $780,000.

Scholarship aid is awarded on the basis of established financial need, exceptional academic achievement and promise, commendable participation in activities outside the classroom, and good citizenship. Scholarships are awarded on a yearly basis and for an entire scholastic year. Renewal of the scholarship is anticipated upon re-application in the spring of the year. However, continuation of an award assumes that the recipient will continue to show scholastic excellence and leadership activity commensurate with the promise evidenced when the scholarship was originally awarded. Continuing need and good citizenship are also requirements for continuation of awards.

*Tuition Scholarship Loans* are provided for students who are deserving and in need of aid, but for whom adequate free tuition scholarship aid is not available. The loan may be for a part or, in some instances, for the entire tuition fee, or may be used to supplement a partial free tuition scholarship. This plan enables many worthy and conscientious students to help finance their own way through college by deferment of the payment of part of their tuition. It is often better for a student to take out a partial tuition loan than to spend too many hours in outside work to support himself while in college.

*Trustee Scholarships* are awards covering the tuition charges in whole or part. These are provided by the Board of Trustees from general funds in order to supplement endowed tuition scholarships.

*Leadership Awards,* while still requiring evidences of genuine financial need, good scholarship, and good citizenship, place more emphasis on leadership attainments in non-academic activities. The available scholarships of this type include the Alumni Student Grants provided for good students with both aptitude and achievement in athletics and the Leonard Hall Scholarships for students who have evidenced both capacity and deep interest for the Christian ministry, with particular interest in the ministry of the Episcopal Church. These various scholarships are restricted in terms of the particular qualifications and interests of the applicants as indicated in each instance.

*Endowed and Supported Scholarships* are provided by individuals and

by corporations either through endowments or by annual contributions. These awards, described in the following pages, are granted to able and deserving students who otherwise would not be able to attend college.

Eligibility. Entering freshmen may apply for financial aid in accordance with instructions from the Office of Admission.

A student transferring from another four-year college, unless he has been graduated, is not eligible to apply for financial aid until he has completed one year of residence at Lehigh University. A student entering from a recognized junior college with full transferred credits (junior standing) may be a candidate for financial aid on his junior college record.

Students who are already enrolled at Lehigh and have been in residence for one college year or more are eligible to apply for financial aid.

Application. Candidates not previously enrolled in the University should write to the Office of Admission; candidates who have been enrolled in the University one academic year or longer should apply in person to the Office of Financial Aid. Closing dates for filing applications are:

1. Entering freshmen and junior college transfer students - January 15.
2. Resident students — March 15.

Later applications for financial aid can be given consideration only if funds are still available.

Awards. All awards are made by the faculty Committee on Undergraduate Financial Aid in accordance with policies and procedures established by that committee and announced through its Executive Secretary to students applying for financial aid.

Tuition loans are made on the basis of merit and need, at the discretion of the Committee on Undergraduate Financial Aid to the extent that loan funds are available.

No loan can be made to a student on scholastic or disciplinary probation. The maximum indebtedness to the University that any student may normally incur will generally not exceed one-half of his total tuition obligations up to and including the semester for which he is seeking tuition aid.

Each student qualifying for a tuition loan is asked to sign a note, endorsed by his parent(s) or guardian. Repayment schedules satisfactory to

the University may be arranged through the Office of Financial Aid. Tuition loans will bear interest at the rate of four per cent from the date of the note, with the provision that the rate shall increase to six per cent in the case of any note which falls into default.

SHORT-TERM LOANS are emergency loans and must be repaid, according to schedule agreed upon, before the end of classes of the semester for which they are granted. Short-term loans bear interest at the rate of four per cent per year from the date of the note. A minimum interest charge of fifty cents is made for each short-term loan granted.

The maximum amount for which a short-term loan may be granted, whether for tuition or for other purposes, is sixty per cent of the student's total bill to the University for that semester.

Every student incurring indebtedness to the University is required to undertake to pay his debt in full as rapidly as possible. Prompt repayment of loans insures the availability of a continuing fund for other student needs as they arise.

## DESCRIPTIONS OF ENDOWED SCHOLARSHIPS

### The Annual Giving Scholarship Fund

Through the gifts of alumni, parents, friends, and companies to the 1959-60 Annual Giving Fund, this fund was established to assist young men to obtain the advantages of higher education. The income from this fund is to be used to award scholarships on the basis of financial need, character and personality, high scholastic achievement, and leadership qualities, and without restriction as to college or curriculum.

### Atlas-Reinhold Scholarship Fund

Through its president, Paul B. Reinhold, '13, the Atlas Equipment Corporation of Pittsburgh, Pennsylvania, has established this scholarship fund. The income from this fund is used to provide scholarships covering tuition in such amounts as student need indicates, on the basis of character, intelligence, and leadership qualities.

### Robert J. Bartholomew Memorial Scholarship Fund

This fund was established by the late Mary A. Bartholomew in memory of her husband, Robert J. Bartholomew '95. The gift is to be used for the purpose of providing scholarships for needy and deserving students with preference given to those who are residents of Bath, Pennsylvania, or of Northampton County, Pennsylvania.

### Frank Breckenridge Bell Memorial Scholarship Fund

This fund has been established by Mrs. Frank B. Bell as a memorial to Frank Breckenridge Bell, M.E. '98, Eng.D. (Hon.) '45 and trustee of Lehigh University from 1936 to 1949. The income arising from the fund is to be used for the purpose of awarding annually a scholarship for a student attending or about to attend Lehigh University. Primary consideration is to be

given to the following factors: financial need, character and integrity, and capacity for creative or original thinking, preferably in the field of engineering.

**The J. D. Berg Scholarship Fund**

This fund was established by Mrs. J. D. Berg in memory of her husband, John Daniel Berg, M.E. '05, Eng.D. (Hon.) '47, who devoted many years to Lehigh University as alumnus and as trustee. An annual scholarship providing for tuition, fees, and an amount for books shall be awarded to a student who is in financial need and has prerequisites of character and personality, high scholastic achievement, and leadership qualities which merit the award. Preference shall be given to students residing in the West Pennsylvania district and who enroll in an engineering curriculum at Lehigh University.

**Award of Bethlehem Fabricators, Inc.**

Bethlehem Fabricators, Inc. established this scholarship fund in honor of the late Robert Parke Hutchinson, E.M. '04, and in recognition of his forty years of service to the company and devotion to his alma mater. It is hoped that these incentive scholarship awards from this fund will serve "to spread and implement his belief in the American tradition of private industrial development and his interest in the education of worthy young men to carry forward that tradition." This scholarship will be awarded annually to the engineering student about to enter his senior year who "has shown the most improvement during his sophomore and junior years," and under the rules of the Committee on Undergraduate Financial Aid.

**The Bethlehem Fabricators' Scholarship Fund**

This fund was established by Bethlehem Fabricators, Inc., to provide tuition scholarships for students who are in need of assistance. Character and personality, high scholastic achievement, and leadership qualities shall be given consideration when these awards are made. Other qualifications being equal, preference shall be given to candidates applying from the counties of Lehigh or Northampton in Pennsylvania.

**The Brodhead Scholarship**

Albert Brodhead, '88, left practically his entire estate to establish a fund for general University purpose. Part of the income of this fund has been designated as the Brodhead Scholarship in memory of Albert Brodhead; his father, Charles Brodhead, an early trustee of Lehigh University; his mother, Camilla Brodhead; and his sister, Kate Brodhead Wilbur. The scholarship is awarded by the Committee on Undergraduate Financial Aid to an undergraduate in the Department of Electrical Engineering.

**Eugene C. Brown Memorial Scholarship Fund**

This fund was established by bequest of the late Blanche C. Brown in memory of her husband, Eugene C. Brown, E.E. '95. Awards from the income of this fund are made in accordance with regulations governing such awards.

**The Harvey M. Burkey Scholarship Fund**
**Endowed by the American Metals Company, Limited**

This fund was established by the American Metals Company, Ltd., in honor of Harvey M. Burkey, Class of 1906, and in recognition of his outstanding career in serving the Company with exceptional devotion and ability for over forty-five years. The income from the fund is to be used to award scholarships to qualified students seeking a bachelor's degree in metallurgical or chemical engineering.

**Class of '04 Scholarship Fund**

Members of the Class of '04, on the occasion of their Golden Anniversary in June '54, established this scholarship fund as a memorial to the class. The income from the fund is to be used to award a senior scholarship on the basis of character, scholarship, qualifications indicating promise of future leadership, and extra-curricular activities. Financial need is not a requisite for the award.

**The William W. Coleman Fund**

William W. Coleman, Met. '95, established this fund in 1951. The income provides annual awards in general equal to the amount of tuition, for undergraduates, preferably seniors in metallurgical engineering, on the basis of financial need, high scholastic achievement, character, personality, and leadership qualities.

**William Wheeler Coleman Memorial Scholarship**

The Bucyrus-Erie Foundation, Incorporated has established a fund for this scholarship in memory of the late William Wheeler Coleman, Class of 1895, Chairman and President of Bucyrus-Erie Company for forty-six years. The income from the fund is used for the purpose of awarding a scholarship or scholarships to undergraduates in the College of Engineering. The awards, administered by the Committee on Undergraduate Financial Aid, are based upon financial need, character, personality, scholastic achievement, and leadership qualities. The number of awards each year depends on the income available from the fund.

**The Stewart J. Cort Scholarship**

A gift to establish scholarships was made by Stewart J. Cort, El. Met. '06, Eng. D. (Hon.) '48, president of the Alumni Association, 1937-1938, and a member of the Board of Trustees from 1942 until his death in 1958. The income from this fund is to be used for scholarships for students seeking

degrees in one of the engineering departments with preference being given to students in metallurgical engineering who meet the normal qualifications as to need, scholarship, character, and leadership.

**The William S. Cortright Memorial Scholarship**

Mrs. William S. Cortright established in 1938 a fund, the income from which provides a scholarship annually in memory of her husband, who was graduated from Lehigh University in 1872. The award is designated for a student who is a resident of Bethlehem or the immediate vicinity and who is enrolled in the curriculum of mechanical engineering.

**The George C. Coutant Scholarship Fund**

This scholarship fund was established by a bequest from Hedwig A. Coutant in memory of her husband, George C. Coutant, M.E. '00, to provide scholarships for meritorious students in need of assistance.

**The Eckley B. Coxe Scholarship Fund**

Mrs. Eckley B. Coxe, the widow of a trustee who served Lehigh University from 1871 until his death in 1895, established this fund to aid needy and worthy students. The income from the fund is used for scholarships.

**The John R. W. Davis Memorial Scholarship Fund**

This fund was established by Mrs. John R. W. Davis of Seattle, Washington, in memory of her husband, John R. W. Davis, C.E. '91. The income is to provide for scholarships in civil engineering for meritorious students in need of financial assistance.

**The Alban and Eleanor Eavenson Scholarship Fund**

This fund was established by Alban Eavenson, Chem. '91, as an expression of his interest in helping young men obtain a Lehigh education. The income from the fund is to be used to award scholarships with preference to students enrolled in either the chemistry or chemical engineering curricula.

**The Natt Morrill Emery Scholarship**

Established in memory of the late Natt Morrill Emery, vice-president and controller of Lehigh University, by an alumnus and former student of Dr. Emery's, the Natt Morrill Emery Scholarship covers the full tuition fee. It will be awarded by Lehigh University every four years (or whenever it becomes vacant) to a graduate of the high schools of Richmond, Virginia, who during his scholastic career has exemplified in character and conduct the qualities of loyalty and ability which marked the services of Dr. Emery to Lehigh University.

**Harold Farkas Memorial Fund**

The Harold Farkas Memorial Committee established an endowment fund to be known as the Harold Farkas Memorial Fund. The income from

this fund is to be used for awarding a scholarship or scholarships which shall be accomplished by the regular agency of the University. Such award or awards shall be based upon financial need, character and personality, scholastic achievement and leadership qualities.

**The John T. Fuller Memorial Fund**

This fund was established by Esther Fuller Warwick in memory of her father, John T. Fuller '03. The income from the fund is to be used to provide scholarships in engineering which are to be awarded to deserving students from Pennsylvania.

**Julian W. Gardy Memorial Scholarship Fund**

This fund has been established as a memorial to the late Julian W. Gardy, '23. The income from the fund is used to award scholarships as determined by the Committee on Undergraduate Financial Aid on the basis of financial need, character and personality, scholastic achievement, and leadership qualities.

**The Alfred R. Glancy Fund**

The late General Alfred R. Glancy, M.E. '03, Eng.D. (Hon.) '43, established this fund in 1949. The income provides for undergraduate scholarship awards made by the Committee on Undergraduate Financial Aid, in addition to the Alfred Noble Robinson Award of $1,000 annually to a selected faculty member in memory of General Glancy's grandfather.

**The Morris Goldstein Scholarship Fund**

An endowed scholarship has been established through the gifts of Morris Goldstein '34. The income of the fund is to be used for a scholarship to an undergraduate in the College of Business Administration.

**The Granite City Steel Company Scholarship Fund**

The Granite City Steel Company, Granite City, Illinois, established this fund in 1951. The income provides annual awards for undergraduates in the College of Engineering, on the basis of financial need, character and personality, scholastic achievement, and leadership qualities.

**The Henry S. Haines Memorial Scholarship**

Mrs. Henry S. Haines, of Savannah, Ga., established in 1889 a scholarship as a memorial to her son, Henry Stevens Haines, M.E. '87. By the terms of the bequest this scholarship is awarded to a student in the curriculum in mechanical engineering. The requirements governing the award of University scholarships apply likewise to this scholarship.

**Lillie Robb Hall Memorial Scholarship**

The bequest for this scholarship came from the estate of the late William R. Hall, C.E. '02. The scholarship is awarded annually for a student's senior year in Civil Engineering and is based on character, scholarship, qualifications indicating promise of future leadership, and record in extracurricular activities.

**James Clark Haydon Memorial Scholarship Fund**

Mary Haydon Hansen bequeathed the residue of her estate to Lehigh University as a memorial to her father, James Clark Haydon. The gift is to be used for the purpose of providing scholarships for needy and deserving persons.

**The Samuel P. Hess Memorial Scholarship Fund**

Recognizing the value of Lehigh University's contribution toward the training and education of young men, the family of Samuel P. Hess '10, of Detroit, Michigan, has established this scholarship fund as a memorial. The income from the fund shall be used to make awards based upon financial need, character and personality, scholastic achievement, and leadership, and leadership qualities. Preference shall be given to a student residing in the metropolitan area of Detroit, Michigan. The awarding of the scholarship or scholarships shall be accomplished by the regular agency as determined by the Board of Trustees at Lehigh University

**Albert George Isaacs '04 Endowed Scholarship Fund**

This fund has been established by Kenneth L. Isaacs, M.E. '25, as a memorial to his father, Albert George Isaacs '04. The award covering tuition and an allowance for books and supplies will be made to a student selected by the Committee on Undergraduate Financial Aid under the established rules governing the award of University scholarships.

**The Anna Carpenter Richards Isaacs Scholarship**

This fund was established by Kenneth L. Isaacs, M.E. '25, as a memorial to his mother, Anna Carpenter Richards Isaacs. The income from this fund shall be used to provide scholarships on the basis of financial need, character and personality, high scholastic achievement, and leadership qualities, without restriction as to college or curriculum.

**The Kenneth L. Isaacs '25 Scholarship**

Kenneth L. Isaacs, M.E. '25, established a fund to assist worthy young men to obtain the advantages of a higher education. The income is to be used to award scholarships to worthy students on the basis of financial need, character and personality, high scolastic achievement, and leadership qualities, without restriction as to college or curriculum.

**The Reese D. Isaacs Memorial Scholarship**

Kenneth L. Isaacs, M.E. '25, established this fund as a memorial in in honor of his grandfather, Reese D. Isaacs, and to assist worthy young men to obtain the advantages of a higher education. The income from this fund is used to award scholarships on the basis of financial need, character and personality, high scholastic achievement, and leadership qualities, and without restriction to college or curriculum.

**The Bernard H. Jacobson Fund**

This fund was established by Bernard H. Jacobson, El.Met. '17. The income is to be used to provide financial aid, for one or more students in the College of Engineering who shall show financial need, good character and personality, high scholastic achievement, and qualities of leadership.

**The Henry Kemmerling Memorial Scholarships**

These scholarships have been provided through the gifts of Henry Kemmerling, C.E. '91, M.S. '03. Preference in making the awards is to be given to graduates of the public senior high schools of Scranton, Pennsylvania. The scholarships are to cover the tuition fee of the holder thereof.

A scholarship award is to be renewed yearly to the initial holder thereof until he graduates, provided he remains in school and maintains a grade at least equal to the average of his class during the preceding year.

The following qualifications only are to be the basis of the award of the scholarship: (a) a good character, (b) need of financial assistance, (c) high scholastic ability. The awarding of these scholarships will be administered through the Committee on Undergraduate Financial Aid.

At the discretion of the Committee, each full scholarship may be divided into two or more partial scholarships so that two or more may benefit by any annual award.

**The Jacob B. Krause Scholarship Foundation**

The Jacob B. Krause Scholarship Foundation was established under the will of Jacob B. Krause, B.A. '98, for the purpose of assisting needy students in the College of Arts and Science. Scholarships are to be awarded only to male students who maintain good scholastic standing and are in need of financial help.

**Lambert Scholarship Fund**

This fund was established by Blanche B. Lambert under her will bequeathing one-third of her residuary estate to Lehigh University as a gift for endowment to be known as the Lambert Scholarship Fund in memory of her husband, Sylvanus E. Lambert, '89. The principal thereof and the net income therefrom is to be used by the University for loans and scholarships to needy students of character, ability, and promise at the University, and is to be administered by the Officials of the University currently in charge of administering scholarships and loans to students at the University, in a manner approved by the Board of Trustees of the University. Mrs. Lambert stated in her will, "Lehigh University offered the benefit of its teaching staff and equipment, tuition free, for four years to my now deceased husband; hence this bequest."

**The J. Porter Langfitt Scholarships**

The I. A. O'Shaughnessy Foundation, Incorporated, established a fund of $50,000, the income from which is to be used to establish scholarships in honor of J. Porter Langfitt, B.A. '24, M.E. '25, president of the Alumni Association, 1954-1955, and an alumnus member of the Board of Trustees from 1956-. The scholarships shall be awarded on the basis of financial need, character, personality, leadership qualities, and high scholastic achievement.

**The Lehigh Alumni of Tau Delta Phi Scholarship Fund**

This fund was established by the Lehigh Alumni of Tau Delta Phi Fraternity in recognition of the achievements of the University and to provide for the continued growth of its educational program. A prominent portion of this fund was contributed by the Dale Memorial Committee as a memorial to the honor of the brothers Herbert Dale, class of 1933, and Robert Tiefenthal, class of 1935. In recognition of the special opportunities offered by Lehigh University for the education and training of young men, the income from the fund is to be used to award scholarships based on financial need, character and personality, scholastic achievement, and leadership qualities. Preference shall be given to any applicant who is an undergraduate member of Tau Chapter of Tau Delta Phi.

**The Lehigh Portland Cement Company Scholarship Fund**

The Lehigh Portland Cement Company established this fund in 1952. The income from the fund is to be used for the purpose of awarding scholarships to undergraduate students on the basis of financial need, character and well adjusted personality, intelligence, and above average potential for leadership.

**Arthur Lehr Memorial Scholarship Fund**

The Arthur Lehr Memorial Scholarship Fund has been established under an agreement between Anne Lehr and Lehigh University. The awarding of the scholarship or scholarships shall be accomplished by the regular agency as determined by the Board of Trustees of Lehigh University. Such award or awards shall be based upon financial need, character and personality, scholastic achievement and leadership qualities.

**Alvan Macauley Scholarship Fund**

This fund was established by Mrs. Alvan Macauley in honor of her husband, Alvan Macauley '92, who was chairman of the board of the Packard Motor Car Company. The income from this fund is to be used to award scholarships to worthy students in need of financial assistance.

**The Mart-Hammonton Scholarship**

The late Leon T. Mart, M.E. '13, formerly president of the Marley Company of Kansas City, Missouri, established this scholarship fund in 1953. The income from the Mart-Hammonton Scholarship Fund is to support one continuous tuition scholarship in the College of Engineering at Lehigh University. Preference shall be given to graduates of Hammonton High School, Hammonton, New Jersey, or graduates of any of the public or private secondary schools of the greater Kansas City area—this shall include schools of Jackson County, Missouri, and Johnson County, Kansas. In the event that no suitable candidates from these areas are available the scholarship can be awarded at large.

**Alexander and Clara Maysels Scholarship Fund**

Dr. Alexander Maysels, of Bethlehem, established this fund as a memorial to his wife, Clara Maysels. The awarding of the scholarship or scholarships shall be accomplished by the regular agency as determined by the

Board of Trustees of Lehigh University. The basis of award shall be financial need, character and personality, high scholastic achievement, and leadership qualities regardless of race, creed, or color.

**R. L. McCann Scholarship**

Raymond L. McCann, E.M. '17, has established a fund to assist young men with limited financial support to obtain an engineering education. The scholarship is to be awarded to a student seeking a degree in one of the engineering departments with preference being given to Metallurgical Engineering. The basis of the award shall be financial need, character, personality, leadership qualities, and scholastic attainment.

**Herbert Weymouth McCord Memorial Scholarship**

Mrs. Celia M. Couch, Mrs. Henry Eccles, and Frank P. McCord have established this scholarship fund, as a memorial to their brother Herbert Weymouth McCord, C.E. '27. The income from this fund is to be used to award an annual scholarship to a senior student in the College of Engineering. The basis of the award shall be financial need, character and integrity, high scholastic achievement, and leadership qualities.

**The Fred. Mercur Memorial Fund Scholarship**

Friends of the late Frederick Mercur, of Wilkes-Barre, Pa., general manager of the Lehigh Valley Coal Company, desiring to establish a memorial of their friendship and esteem, and to perpetuate his memory, contributed and placed in the hands of the trustees of the University a fund called the Fred. Mercur Memorial Fund. The income from this fund is awarded to students of the University.

**The Mansfield Merriman Scholarship Fund**

This fund was established under the will of Bazena T. D. Merriman to provide a scholarship in civil engineering in memory of her husband. Dr. Merriman served as professor of civil engineering at Lehigh University from 1878 to 1907, during which time his textbooks were widely adopted by engineering schools in the country and translated into many foreign languages.

**The Henry L. Moses Scholarship**

Mrs. Henry L. Moses established this fund as a memorial to her husband to assist worthy and deserving students. The income from this fund is used to make awards to a student or students selected by the Committee on Undergraduate Financial Aid under the established rules governing the award of University scholarships.

**The Theophil H. Mueller '18 Scholarship Fund**

This fund was established by the late Theophil H. Mueller, a corporate trustee of the University. The income is to be used to assist in defraying the expenses of some worthy student or students who are in need of financial assistance, provided, however, that if it is possible and advisable the student or students selected to receive such financial assistance shall be of the Moravian faith and preferably from Bethlehem, Pennsylvania, or its environs.

**Franklin C. Murphy Scholarship Fund**

This fund was established under the will of Franklin C. Murphy, Bus.Ad. '32. The income from the fund is to be used to award scholarships to high school graduates who are legal residents of the State of Ohio. However, if there are no acceptable applicants from the State of Ohio, then the awards shall be made to any applicant under the regular requirements governing the award of other University scholarships.

**The Ray Sands Nostrand Memorial Scholarship**

The Ray Sands Nostrand Memorial Scholarship was established by the late Benjamin Nostrand, Jr., M.E. '78, in memory of his son, Ray Sands Nostrand '17. The income from this fund is awarded to students of the University. The requirements governing the awards of University scholarships apply likewise to this scholarship.

**C. Henry and Emily Nancy Offerman Scholarship**

This fund was established by the late Emily N. Offerman in 1959. The income from this fund shall be used to provide scholarships to worthy students of good moral character, maintaining satisfactory scholastic grades and who require financial assistance to enable them to further their education.

**John Howell Powell (M.E. '04) Scholarships**

In 1954 Mr. Powell of the Borough of Latrobe, County of Westmoreland, Pennsylvania, set up a Deed of Trust with the Mellon National Bank and Trust Company of Pittsburgh, the principal of which is to continue in perpetuity for scholarships to be awarded by Lehigh University, with first preference to be given to applicants who are from the Borough of Latrobe or who are graduates of the Mining and Mechanical Institute, Freeland, Pennsylvania.

**The Murtha P. Quinn Scholarship**

Mr. Murtha P. Quinn, '78, left one-thirteenth of his residual estate to Lehigh University for the purpose of granting scholarship aid with preference given to students whose homes are in south Bethlehem.

**Isadore Raiff Memorial Fund Scholarship**

The fund was established by the Raylass Department Stores, New York City, in honor and in memory of their late President, Isadore Raiff. The income from the fund is to be used to award a scholarship to worthy students in the College of Business Administration. Preference will be given to candidates from the states of Georgia, New York, North Carolina, Tennessee, and Virginia.

**The Victor C. Records L. U. '98 Delaware Scholarship Fund**

The income from this fund, established by Victor C. Records, Class of 1898, is to be used for the benefit of students attending Lehigh University

who are in need of financial assistance to enable them to carry on or complete their studies at the University and who by character and application are deemed worthy of such assistance. Preference shall be given to residents of the state of Delaware with particular attention being paid to the counties of Laurel, Sussex, Kent, and New Castle.

**Elijah Richards Endowed Scholarship Fund**

This fund was established by Kenneth L. Isaacs, M.E. '25, as a memorial to his grandfather, Elijah Richards. The awarding of the scholarship or scholarships shall be accomplished by the regular agency as determined by the Board of Trustees of Lehigh University. The basis of award for the Elijah Richards Scholarship or scholarships shall be financial need, character and personality, high scholastic achievement, and leadership qualities. Preference shall be given to students from Luzerne or Lackawanna Counties, Pennsylvania.

**The Benjamin DeWitt Riegel Scholarship**

This fund was established by Mrs. Benjamin DeWitt Riegel as a memorial scholarship in honor of her late husband, M.E. '98. This award is available to undergraduates of any college or curriculum who qualify on the basis of financial need, character and personality, high scholastic achievement, and leadership ability.

**The Rust Engineering Company Fund**

The Rust Engineering Company established this fund in memory of two of its co-founders, E. M. Rust, and E. J. Lee Rust, for the purpose of awarding scholarships to students in the College of Engineering of Lehigh University on the basis of financial need, character and well adjusted personality, intelligence, and above average potential for leadership.

**Frederick C. Seeman, Jr., Scholarship Fund**

This scholarship fund was established by a bequest from Aringdale D. Seeman of Baltimore, Maryland, in memory of his son, Frederick C. Seeman, Jr. '27, who was killed in an automobile accident in 1927. Income from the fund is to be used to award scholarships to worthy students from the state of Maryland who are in need of financial assistance.

**Donald B. and Dorothy L. Stabler Scholarship Fund**

This fund was established by Donald B. Stabler, C.E. '30, M.S. '32, to provide scholarships at Lehigh for needy prospective students or undergraduates, the recipients being determined by their character, motivation, and personal achievements. In recognition of the financial aid received under this program while a student at Lehigh, each recipient is asked to sign a statement of intent that, after his graduation from college and insofar as financially able, he will make contributions to this fund equivalent to the aid which he received. Thus a student of a later college generation may enjoy the same financial aid which made it possible for the original recipient to attend Lehigh.

**The David R. Thomas Memorial Fund**

This fund was established by Professor and Mrs. Harold P. Thomas after their son's death in a plane crash on South Mountain in June, 1950. Donations from friends and family have been included in the fund. The income is to be used for tuition scholarships for one or more students who have completed at least one year at Lehigh University and are in need of financial assistance to complete their education. The award or awards will be made to students who exemplify in their lives the high ideals which were characteristic of David up to his untimely death.

**Helen A. and Nathaniel Thurlow Memorial Scholarship Fund**

This fund was established under the will of Helen A. Thurlow, sister of Nathaniel Thurlow, '95. The income from the endowment is to be used for the awarding of scholarships by the regular agency of the University.

**Sonia and Alfred D. Tiefenthal Memorial Scholarship Fund**

This fund was established by Alfred D. Tiefenthal for the purpose of awarding from income a scholarship or scholarships to a student or students enrolled in the College of Business Administration. The awarding of the scholarship is to be accomplished by the regular agency of the University, and is to be based upon financial need, character and personality, scholastic achievement, and leadership qualities.

**Treadwell Corporation Scholarship Fund**

The Treadwell Corporation of Easton, Pennsylvania, has established at Lehigh University the Treadwell Corporation Scholarship Fund for annual tuition scholarships in such number and amounts as the income will support. The scholarships are for students in mechanical engineering, with preference given to candidates from Lehigh and Northampton counties in the state of Pennsylvania.

**The Samuel Foster York Memorial Scholarship Fund**

This fund was established by Warren W. York, B.S. '24, as a memorial to his father, Samuel Foster York. The income is to be applied towards tuition scholarships for needy and worthy graduates of Allentown, Pennsylvania, secondary schools who desire to pursue business administration courses at Lehigh University.

**York-Shipley Scholarship Fund**

This fund was established by York-Shipley Inc. of York, Pa., through its president, S. H. Shipley, Ch.E. '32. The income is to be used to provide scholarships to worthy students in need of financial assistance enrolling in the College of Engineering, with preference being given to students from the County of York in Pennsylvania enrolling in the mechanical egineering curriculum.

### The Luther Rees Zollinger Memorial Fund

The sister of Luther Rees Zollinger left the residue of her estate to Lehigh University to establish this memorial fund to provide tuition scholarships for worthy students who are in need of financial assistance.

## ENDOWMENT OF SCHOLARSHIPS

Undergraduate or graduate scholarships named to honor an individual or corporation may be established in perpetuity by arrangement with the board of trustees of Lehigh University. The income from this donation will be paid to the holder of the scholarship to be applied toward the payment of University fees. The University does not, however, guarantee that this income will be forever sufficient to pay such fees in full.

## DESCRIPTIONS OF SUPPORTED SCHOLARSHIPS

### Air Force ROTC Financial Assistance Program

The Air Force ROTC financial assistance program is designed for outstanding young men participating in the four-year Air Force ROTC program and who are interested in the Air Force as a career. These are two-year awards restricted to those students who have completed the first two years of Air Force ROTC and are selected to participate in the advanced program.

### Alcoa Foundation Scholarships

The Aluminum Company of America supports at Lehigh University several undergraduate scholarships. The University also receives a grant-in-aid to the amount of $125 per student recipient. The awards are to be made by the Committee on Undergraduate Financial Aid under the established rules governing the award of University scholarships.

### The Allied Chemical Foundation Scholarship

The Allied Chemical Corporation, through its Foundation, supports a scholarship at Lehigh University for a student in chemical engineering. In making the selection the Committee on Undergraduate Financial Aid places emphasis upon intellectual capability, scientific ability, breadth of interests, and leadership qualities.

### Army ROTC Scholarship Program

The Army ROTC scholarship program is designed to offer financial assistance to outstanding young men in the four-year Army ROTC program who are interested in the Army as a career. Each scholarship provides for free tuition, textbooks and laboratory fees in addition to pay of $50 per month for the period that the scholarship is in effect. During a six-week summer training period at the end of the junior year, this pay is increased to $120.60 per month. The scholarships are provided under provisions of Public Law 88-647, The ROTC Vitalization Act of 1964.

Scholarships may be awarded for either two or four years. Four-year scholarships are open to all students entering Army ROTC as freshmen,

while the two-year scholarships are restricted to those students who have completed the first two years of ROTC and are selected for enrollment in the ROTC Advanced Course.

**Frank Breckenridge Bell Memorial Scholarship**

The Edgewater Steel Charitable Trust has established an annual scholarship of $1,000 in honor of Frank Breckenridge Bell, M.E. '98, Eng.D. '45, former chairman of the board of Edgewater Steel Company, and a trustee of Lehigh University from 1936-1949. The award is available to a student in any college or curriculum, on the basis of financial need, character and integrity, and capacity for creative or original thinking, preferably in the field of engineering.

**Carpenter Steel Scholarships**

The Carpenter Steel Company makes available two scholarships for entering freshmen who are sons of employees of the Company and plan to major in specialized fields of engineering and science. The amount of the award, as determined by an analysis of the Parents' Confidential Statement, ranges from $250 to $1,500 annually. Scholarships may be renewed on recommendation of the Committee on Undergraduate Financial Aid.

**Chevron Oil Company Scholarship**

The Chevron Oil Company has established a scholarship in the amount of $500 for a senior in chemical engineering. A cost-of-education grant of $500 is also made to the department of chemical engineering in support of the scholarship. The award is made by the Committee on Undergraduate Financial Aid under the established rules governing the award of University scholarships.

**Fort Pitt Bridge Works Scholarship**

The Fort Pitt Bridge Works Scholarship is to be awarded to a junior enrolled in the civil engineering curriculum who will major in the structural option. In recognition of the fact that tuition does not cover the full cost of education of the student, the company will make an unrestricted gift to the University of $300 each year.

**General Motors Scholarships**

The General Motors Corporation in its program of aiding private colleges has made available to Lehigh University several undergraduate scholarships. These scholarships which are renewable range up to $2,000 annually depending upon "demonstrated need." In addition the University receives a grant-in-aid for each award.

**Kennecott Copper Corporation Scholarship Program**

The Kennecott Copper Corporation has established an annual undergraduate scholarship in the amount of $1000 for a junior or senior whose program emphasizes Mineral Sciences at Lehigh University. The recipient is selected by the Committee on Undergraduate Financial Aid with the

approval of Kennecott or a subsidiary company. Selection criteria include: proficiency in studies; enthusiasm, leadership, cooperativeness, initiative, ambition; good health and sturdy constitution; and financal need.

**The Kift-Mullen Memorial Foundation Scholarship**

The Kift-Mullen Memorial Foundation of Allentown, Pennsylvania, makes available to graduates of Allentown high schools four annual scholarships of $200 to students of junior standing in various teacher training institutions, who are preparing to enter the secondary school teaching profession. The University Committee on Scholarships and Loans makes recommendations of qualified Lehigh University students to the Kift-Mullen Memorial Foundation, which passes such recommendations from various teacher training institutions on to a committee of the Allentown high schools' representatives who make the final selection.

**The Lebovitz Fund Scholarship**

Through the Lebovitz Fund, Samuel L. Lebovitz, E.M. '23, President of The Modern Transfer Company of Allentown, Pennsylvania, has established at Lehigh University a scholarship in the amount of $1,000 a year which is awarded annually by the Committee on Undergraduate Financial Aid. This award is made on the basis of high intelligence, financial need, and the qualities that give promise of leadership.

**Lehigh University Merit Scholarships**

In cooperation with the National Merit Scholarship Corporation Lehigh University will annually award up to twenty four-year Merit Scholarships financed through the Annual Giving Program of the alumni. The National Merit Scholarship Corporation conducts the competition for these scholarships as well as all the others under its supervision. Final selection of Lehigh University Merit Scholars is limited to Merit Finalists who wish to attend Lehigh University and are qualified to do so. The individual stipend is based on the candidate's need as estimated by the National Merit Scholarship Corporation and is adjusted annually according to the financial status of his parents and his own ability to earn funds during vacation periods. Stipends range from $100 to $1,500 per year.

**Lever Brothers Company Scholarship**

The Lever Brothers Company has established two scholarships, one for a junior and the other for a senior in chemical engineering. A cost-of-education grant is also made to the Department of Chemical Engineering in support of the scholarships. The awards are made by the Committee on Undergraduate Financial Aid under the established rules governing the award of University scholarships.

**Christian R. and Mary F. Lindback Foundation Scholarship**

The Trustees of the Christian R. and Mary F. Lindback Foundation have established a scholarship fund in the amount of $1,000 to be expended

for scholarships to deserving students who are residents of one of the states of New Jersey, Pennsylvania, Delaware or Maryland, without regard to race or religious affiliation and who, "by reason of their scholastic attainment, character, personality, and all-around ability give great promise of benefiting therefrom and be useful and valuable citizens of their communities."

**Milton Roy Sheen Memorial Scholarship**

Through its president, Robert T. Sheen, B.S. '31, Ch.E. '36, the Milton Roy Company of Philadelphia, Pennsylvania, has established a scholarship as a memorial to the founder of the company, Milton Roy Sheen. The Milton Roy Sheen Memorial Scholarship provides an annual award of $1,200. The scholarship is to be awarded to employees or sons of employees of the Milton Roy Company. If no candidates are available, the scholarship is to be awarded to either a junior or senior enrolled in the chemical engineering or mechanical engineering curricula.

**Pennsylvania Power & Light Company Scholarships**

The Pennsylvania Power & Light Company in its program of aiding both public and private colleges within its 29-county service area has made available to Lehigh University two undergraduate scholarships, one of which is restricted to study in either electrical or mechanical engineering. Each scholarship is in the amount of $1,450 annually and is renewable. In addition the University receives a grant-in-aid for each award. The candidate for such a scholarship should secure an appropriate form from his secondary school counselor.

**Pitcairn-Crabbe Christian Education Scholarships**

These scholarships have been provided by the Pitcairn-Crabbe Foundation for students with strong Christian motivation, pre-ministerial students, or those who plan to enter the fields of social work, religious education, or eleemosynary activities. Preference will be given to the sons of clergymen or educators.

**Procter and Gamble Scholarship Program**

A Scholarship Program established in 1955 by the Trustees of The Procter & Gamble Fund makes available annual scholarship awards for entering freshmen at designated colleges, including Lehigh University. The awards are renewable annually throughout the four years on the basis of successful undergraduate performance and continuing financial need.

The participating colleges administer the scholarships, select the recipients from all eligible candidates on the basis of the colleges' own standards of academic achievement and distribute the money on the basis of the recipient's financial need.

At Lehigh the award is made to an entering student in the field of science or engineering selected by the Committee on Undergraduate Financial Aid under the established rules governing the award of University scholarships.

The scholarships provide an amount equal to full tuition and fees plus an allowance for books and supplies. In addition, an unrestricted grant of $600 for each recipient is made annually to the University to help meet the cost of educating the scholarship holder.

**Residence Halls Scholarship Fund**

The Residence Halls Council of Lehigh University has provided four scholarships in the amount of $400 each to be awarded to a freshman, sophomore, junior and senior living in the Residence Halls of Lehigh University. The recipient of the scholarship must continue his residence throughout the term of the scholarship.

**Schlumberger Collegiate Award**

The Board of Managers of the Schlumberger Foundation of Houston, Texas, has made available to Lehigh University an undergraduate scholarship in the amount of $500, with a further matching grant of $500 as a contribution to the University. The Foundation has designated this scholarship and matching grant as the "Schulmberger Collegiate Award." The basic requirements state that the student be of high academic standing in his junior or senior year in electrical or mechanical engineering, physics or geology, and that his program include at least twelve hours of study in electricity.

**The Alfred P. Sloan National Scholarships**

The Alfred P. Sloan Foundation, Incorporated, has granted Lehigh University eight of its national scholarships. Normally each scholarship will be for an amount equal to tuition plus an allowance for other college expenses. However, the University may award a lesser or a greater amount depending upon the financial need of the recipient.

Recipients of this scholarship shall be preferably students pursuing studies in mathematics, the sciences, engineering, or business administration. They shall also meet the regular requirements of financial need, high academic achievement, good character, and promising leadership qualifications.

**Special Awards**

Recognizing the need of many worthy and able students for financial aid in addition to tuition scholarships, friends of Lehigh have made grants to the University for this purpose. From this fund one or two awards are made on an annual basis to students in the College of Engineering by the Committee on Undergraduate Financial Aid in accordance with its established policies.

**Texaco Scholarships**

Texaco, Inc., has provided undergraduate scholarships available to students who have successfully completed at least two years of college work in any of several fields which would prepare them for careers in the petroleum industry. The donor also grants to the University a cost-of-education supplement. The scholarships are restricted to citizens of the United States who have proven scholastic ability and who have demonstrated qualities of leadership as well as a recognition of the values of higher education, and who give evidence of good health and financial need.

**Union Bank and Trust Company Scholarships**

The Union Bank and Trust Company of Bethlehem, Pennsylvania, has established four scholarships in the College of Business Administration. Each award is in the amount of $1250 and provides for a grant-in-aid to the University of $250.

**United States Rubber Company - Foundation Scholarship**

The United States Rubber Company, through its Foundation, has established a scholarship for a student who has successfully completed at least two years of college, who has need of financial assistance, and who has demonstrated interest in a career in industry. Also, the recipient must be willing to assume a moral obligation to repay over a reasonable period of time at least 25% of the scholarship aid received as worked out with the institution. In addition the University receives a grant-in-aid for each award.

**The Union Carbide Scholarships**

The Union Carbide Corporation, through the Union Carbide Education Fund, has established at Lehigh University annual scholarships in the amount of full tuition plus $100 for books and supplies, to assist deserving students in chemical, mechanical, and metallurgical engineering.

**The Western Electric Fund Scholarships**

The Western Electric Fund has established at Lehigh University three annual scholarships, to a maximum of $975 each, two to be awarded to undergraduate students in the College of Engineering, and one to an undergraduate in either the College of Business Administration or the College of Arts and Science. The scholarships may be granted to an upperclassman or to a first or second year student if the University desires. The recipient shall be a United States citizen without regard to color, creed, or national origin.

## DESCRIPTION OF LOAN FUNDS

**National Defense Student Loan Program**

Under the National Defense Education Act of 1958, since amended, the federal government has made available through the University loans to students who show themselves capable of maintaining good standing and who show financial need.

During undergraduate study, the maximum loan under the law is $1,000 per academic year, with not more than $5,000 total indebtedness.

The National Defense Student Loan Program is administered by the Committee on Undergraduate Financial Aid.

**W. Appleton Aiken Memorial Loan Fund**

The Residence Halls Council of Lehigh University has provided the sum of $3,000 as an undergraduate loan fund. The administration of the loan fund is under the usual University agencies. Preference in the granting of all loans is to be given to students residing in the residence halls of the University.

**C. S. Albright Loan Fund**

In memory of Carl Samuel Albright, E.E. '11, his family has provided

the sum of $2,500 as an undergraduate loan fund. The administration of the loan fund is by the Committee on Undergraduate Financial Aid, and is for the assistance of worthy students requiring financial aid.

**The Eckley B. Coxe Loan Fund**

Mrs. Eckley B. Coxe, the widow of a trustee who served Lehigh University from 1871 until his death in 1895, established this fund in 1897 and continued to make contributions to it during her lifetime. The several gifts were invested, and the income from this principal has created a revolving loan fund in excess of $170,000 which is administered for worthy and needy students by the Committee on Undergraduate Financial Aid.

**The Frazier and Ringer Memorial Fund**

The Frazier and Ringer Memorial Fund was established in 1906 by the late Robert H. Sayre in memory of Benjamin West Frazier, A.M., Sc.D., former professor of mineralogy and metallurgy, and Severin Ringer, U.J.D., former professor of modern languages and literature and of history, each of whom served Lehigh University for one-third of a century. The income from the fund and payments made by the former borrowers are available for loans to cover the medical and surgical care of worthy students.

**The Kenneth Hankinson, Jr., Memorial Fund**

Mr. and Mrs. Kenneth Hankinson established this fund in memory of their late son, Bus. '50. The principal from this fund shall be used to grant emergency loans to deserving students of Lehigh University. Administration of the fund is at the discretion of the Dean of Students of the University.

**R. L. McCann Loan Fund**

Mr. R. L. McCann, E.M. '17, established this endowment fund to provide income for loans to needy students of Lehigh University.

**George F. Pettinos Memorial Fund**

An endowment fund has been established by George F. Pettinos, Jr. in memory of George F. Pettinos, M.E. '87. The income earned on the principal of the fund shall be used "to grant loans to students for tuition and fees." Repayments of the principal and interest on loans to students are also to be used to grant similar loans to students.

**The Edward W. Pratt Fund**

Edward Williams Pratt, M.E. '90, bequeathed to Lehigh University the sum of $1,000 to be used "as a revolving fund for loans to students" to be administered at the discretion of the Dean of Students.

**The President's Fund**

The President's Fund was established during the early years of the University for the help of deserving students. As payments are made by former beneficiaries they are immediately available for the assistance of students of the University.

**The Frank Williams Fund**

Frank Williams, B.S. '87, E.M. '88, bequeathed to the University the greater part of his estate as an endowment, the income of which is lent to deserving students.

**United Student Aid Funds Loan Program**

Lehigh University is one of more than 600 colleges and universities participating in this national nonprofit loan program for needy and deserving students. Full-time undergraduate students who have completed satisfactorily the freshman year may borrow up to $1,000 per year and graduate students may borrow as much as $2,000 per year, but no student may borrow more than $4,000. Interest of 6% simple and payments of interest and principal begin the fifth month after graduation and may be anticipated. In case of dropouts, payments are due to begin at once. The financial aid officer recommends the loan, after consultation with the student, and the loan is then negotiated at the student's home town bank on the student's own signature.

# Graduate Scholarships And Fellowships

Candidates for scholarships or fellowships must make application on blanks which will be provided by the University on request to the Office of Admission, Lehigh University, Bethlehem, Pa. Application must be filed on or before March 1. Each application must be supplemented by an official transcript of the candidate's college work, a statement concerning his practical experience, and any other evidence of his qualifications which he may choose to submit. Scores made by the applicant in the Graduate Record Examination; or, for those in Education, the National Teachers Examination; and for M.B.A. candidates, the Admissions Test for Graduate Students in Business, are desired whenever possible. An applicant must indicate the line of graduate study he desires to undertake and his special qualifications for such work.

A holder of a scholarship or fellowship may not accept any employment for pay without the written permission of the Dean of the Graduate School.

## SCHOLARSHIPS

**The William C. Gotshall Scholarship**

A bequest from the late William C. Gotshall provides funds for as many as six scholarships to be awarded annually to worthy graduate students

in any branch of engineering offered at Lehigh University. Appointment is for one year, with an annual stipend of $1800 or more, depending on the qualifications of the applicant, plus remission of tuition fees. No duties other than graduate study are required of the holders.

**The Daniel S. Whiteman Memorial Scholarship**

The Reilly-Whiteman-Walton Company of Conshohocken, Pennsylvania, makes an annual grant to support this scholarship in memory of the late Daniel S. Whiteman, E. M. '17. It is awarded to a graduate student specializing in colloid chemistry or a related field.

**Graduate Tuition Grants**

The Board of Trustees has authorized the annual award to graduate students, on the basis of superior qualifications and of need, of twelve Graduate Tuition Grants. These Grants are awarded to accompany certain research fellowships and provide for the remission of graduate tuition.

## ENDOWED RESEARCH FELLOWSHIPS

Graduates in appropriate curricula of colleges, universities, and technical schools whose requirements for graduation are substantially the same as those of Lehigh University are eligible to apply for any of the following research fellowships as may be available, excepting only the Student Chemistry Foundation Fellowship, which is restricted to graduates of Lehigh University.

Appointment to these fellowships is for a period of two semesters and may be renewed, provided the work of the holder is of such quality as to justify continuation of financial aid. Usually the research work can be used for the thesis or dissertation.

Annual stipends for most fellowships are $1800 or more, depending upon the qualifications of the applicant. Graduate fellows pay the regular tuition fees. However, the Graduate School, in awarding a fellowship, may award at the same time a Graduate Tuition Grant. This grant provides remission of all tuition fees during the period for which it is awarded.

**The Alumni Fund Fellowship**

The Alumni Fund for 1960 established an endowment, the income from which is to provide a graduate fellowship in any of the departments offering graduate study.

**The C. Kemble Baldwin Research Fellowship in Aeronautics**

A fund established by Mrs. C. Kemble Baldwin as a memorial to her husband, C. Kemble Baldwin, M.E., '95, provides for the appointment of a research fellow in any branch of science having a bearing on the field of aeronautics. One or occasionally two appointments are available each year.

**The Lawrence Calvin Brink Research Fellowship in Civil Engineering**

A fund established by the late Mrs. L. C. Brink as a memorial to her husband, Lawrence Calvin Brink, C.E., '94, provides for the occasional appointment of a research fellow in civil engineering.

**The Henry Marison Byllesby Memorial Research Fellowships**

In 1926 Mrs. H. M. Byllesby, widow of Col. H. M. Byllesby, M. E., '78, President of the Byllesby Engineering and Manufacturing Corporation, provided an endowment fund for the establishment of the Henry Marison Byllesby Memorial Research Fellowships in Engineering. The time of the holders of these fellowships must be devoted to graduate study and research work on some problem in electrical, mechanical, or hydraulic engineering. Usually two awards are made each year.

**The William L. Heim Research Fellowship in Chemistry**

A research fellowship in chemistry was established by William L. Heim, B.S. in Chem., '02.

**The Garrett Linderman Hoppes Research Fellowship in Civil Engineering**

A fund established by the late Mrs. Maria B. Hoppes in memory of her son, the late Garrett Linderman Hoppes, C.E., '83, provides for the occasional appointment of a research fellow in civil engineering.

**The Roy R. Hornor Research Fellowship in Metallurgy and Inorganic Chemistry**

The income from a bequest by Roy R. Hornor, B.S., '99, provides for a research fellowship in either metallurgy or inorganic chemistry, the holder of which devotes his time to research under the direction of the faculty and to graduate study. While the followship generally will be granted alternately to students in the two departments concerned, the appointment may be determined by the qualifications of available candidates.

**The Chester W. Kingsley Memorial Fellowship**

This fund is a bequest by Mrs. C. W. Kingsley in memory of her husband for the education of young men of exceptional scientific ability. An annual stipend up to $2200 plus tuition is available for graduate study in engineering or science.

**The New Jersey Zinc Company Research Fellowship**

The New Jersey Zinc Company provided funds in 1924 for a research fellowship to be known as the New Jersey Zinc Company Research Fellowship.

**The James Ward Packard Research Fellowship**

The income from a bequest made by James Ward Packard, M.E., '84, provides for a research fellowship in any field in which Lehigh University offers work for the doctorate.

**The Charles W. Parkhurst Research Fellowship**

A fund established by Mrs. C. W. Parkhurst as a memorial to her husband, Charles W. Parkhurst, E.E., '93, provides for the occasional appointment of a research fellow in any field in which the University offers a graduate major.

**The Student Chemistry Foundation Fellowship**

In the spring of 1927, members of the class of 1930 established the Student Chemistry Foundation in honor of Harry Maas Ullmann, A.B., Ph.D., a member of the chemistry department from 1894 to 1938 and head of the department from 1912 until his retirement. Subsequent classes have contributed to this fund which now provides an annual research fellowship in chemistry or chemical engineering. Only Lehigh graduates are eligible for this fellowship.

**The Katherine Comstock Thorne Fellowship in Biology**

The late Gordon Comstock Thorne of the class of 1916 endowed, in memory of his mother, a fellowship in biology, to be known as the Katherine Comstock Thorne Fellowship.

## ADDITIONAL FELLOWSHIPS

Certain fellowships are supported annually by various foundations, learned societies, and industrial organizations. For the most part these fellowships are reserved for applicants well along in the work towards the doctorate. Ordinarily the fellow devotes full time to academic work and receives a stipend ranging from $1800 to $3000, or occasionally more, plus remission of tuition fees. Appointments are for the academic year in most cases.

The following fellowships are currently available:

**The Air Products and Chemicals Incorporated Fellowship**
in Chemical Engineering.

**The Air Reduction Company Fellowship**
in Engineering

**The Allegheny-Ludlum Fellowship**
in Metallurgy.

**Althouse Chemical Fellows**
in Chemistry.

**American Society for Tool and Manufacturing Engineers Fellowship**
in Industry Engineering

**The Armstrong Cork Company Fellowship**
in Physics.

**Azoplate Corporation Fellowship**
in Chemistry

**The Louis Calder Foundation Fellowship**
in Chemistry.

**The California Oil Company Fellowship**
in Chemical Engineering.

**The Carpenter Steel Company—J. Heber Parker Fellowship**
in Mathematics, Science, or Engineering.

**Thomas R. Caton Fellowship**
in Chemistry.

**The Esso Foundation Fellowship**
in Chemical Engineering.

**The George Gowen Hood Fellowship**
(supported by the Catherwood Foundation) in any field leading to the doctorate.

**The Materials Research Fellowship**
in Materials Research.

**The National Aeronautics and Space Administration Fellowships**
in space-related Sciences and Engineering.

**The National Defense Education Act Title IV Fellowship**
in various fields.

**The National Science Foundation Fellowship**

A. Graduate Fellowships in Science, Mathematics, or Engineering.
B. Traineeships in Science and Engineering

**The Ogden Corporation Fellowship**
in Management Science

**National Printing Ink Research Institute Fellowship**
in Chemistry.

**Paint Research Institute Fellowship**
in Chemistry

**Stressteel Corporation**
in Metallurgy

**Texaco Fellowship**
in Chemical Engineering.

**The Union Bank and Trust Company Fellowship**
in Business Administration.

**The United States Public Health Service (Water Pollution) Fellowship**
in Biology.

**The United States Steel Foundation Fellowship**
in Engineering.

## ENDOWMENT OF FELLOWSHIPS

A research fellowship, named in honor of an individual or a corporation, offering opportunities for graduate work and training in research in any designated field of study, may be established in perpetuity through the payment to the Board of Trustees of an appropriate fund.

## LOAN FUNDS

### National Defense Education Act Loan Funds

ELIGIBILITY. Graduate students are eligible to apply for NDEA loans provided they are full-time graduate students who show themselves capable of "maintaining good standing" and show financial need.

"Special consideration" is mandatory for (1) students with superior academic backgrounds who plan to become elementary or secondary school teachers, and (2) students whose academic backgrounds indicate a superior capacity for or preparation in science, mathematics, engineering, or a foreign language. This does not exclude other students.

AMOUNT OF LOANS. The maximum loan available is $1,000 in an academic year and a total of $5,000.

REPAYMENT. The student's note will be taken for repayment in ten equal installments, beginning one year after the date on which he stops being a full-time student. Interest is charged at the rate of three per cent starting with the first payment. In the case of death or disabiliy, liability for repayment of any balance then due is waived.

TEACHERS. If a graduate becomes a full-time teacher in a public elementary or secondary school, up to one-half of the loan (plus the interest on that portion) will be waived at the rate of ten per cent per annum.

**Ford Foundation Science and Engineering Loan Fund**

ELIGIBILITY. Candidates for the Ph.D. degree in engineering who are interested in a career in college-level teaching are eligible to apply for these forgivable loans, provided they:

a. Hold a master's degree or its equivalent in engineering or related sciences:

b. Are enrolled as graduate students seeking a Ph.D. degree in engineering;

c. Have interest in, and legal possibility of, a faculty career in the United States or Canada;

d. Need funds to pursue the doctorate on at least three-fourths time, and meet the financial responsibilities for at least one dependent (exclusive of themselves); and

e. Are under 40 years of age at the time of the first loan.

AMOUNT OF LOANS. The amount of each loan will be determined on the basis of need, considering income from assistantships or fellowships, or other resources of the individual, against his dependents, financial obligations, and the like. The maximum amount is $10,000 over a three-year period.

FORGIVENESS OR REPAYMENT OF LOAN. The loan will be forgiven or repaid by the student after study for the degree is terminated, under the following provisions:

a. If he is employed as a full-time faculty member in the U. S. or Canada, the debt is to be cancelled at the rate of $1,000 or 20 per cent of the total debt per year, whichever is greater.

b. If not so employed, he is to repay the debt to the University at the rate of $1,000 per year minimum.

c. The debt repayment and cancellation will be suspended during leaves of absence of at least three months for military service, postdoctoral research, or for reasons of health.

Applications. Qualified individuals should request application forms from the head of the department in which they wish to major, or at the Office of the Graduate School.

### GRADUATE ASSISTANTSHIPS

A limited number of teaching assistantships are available in applied mechanics, biology, business administration, chemistry, English, education, geology, government, history, international relations, mathematics, physics, political science, psychology, and in chemical, civil, electrical, industrial, mechanical, and metallurgical engineering. Appointees serve as readers, teaching aides, laboratory assistants, and in similar capacities under the supervision of the senior teaching staff. Half-time assistants devote 15 to 20 hours per week to their duties and receive $2200 ($2500 after one year of satisfactory service or to holders of the master's degree) for the academic year plus remission of tuition fees. They may take up to 10 hours of graduate work a semester. Applications should be made to the head of the department concerned.

# Prizes and Awards

Student prizes and awards are announced at commencement exercises on Founder's Day, the second Sunday in October, and on University Day in June.

### William Appleton Aiken Award

This medal is awarded to the outstanding student in History 11 and 12 each year.

### Alumni Prizes

Funds are provided by the Alumni Association for the annual award of four prizes of $25 each. Two prizes are awarded to the highest ranking juniors in the College of Engineering, one to the highest ranking junior in the College of Arts and Science, and one to the highest ranking junior in the College of Business Administration.

### Medal of the Philadelphia Chapter, American Institute of Chemists

This medal is awarded to the academically highest ranking senior majoring in chemistry or chemical engineering.

**American Society for Testing Materials Student Membership Prize**

The American Society for Testing Materials awards each year four student memberships to students who in their junior year have demonstrated interest and meritorious work in the engineering courses which are related to the American Society for Testing Materials.

**Bethlehem Fabricators Award**

This tuition award is made to the senior who has shown the most improvement in academic achievement over previous years.

**The Robert W. Blake Memorial Prize**

The Robert W. Blake Memorial Prize is awarded annually at the Founder's Day exercises to a freshman, upon his completion of one year of studies in the College of Arts and Science, who is recommended by the faculty of the College of Arts and Science as the most outstanding in high scholastic achievement and in promise of worthy leadership.

**The John B. Carson Prize**

An annual prize of $50 was established by Mrs. Helen Carson Turner, of Philadelphia, Pennsylvania, in memory of her father, John B. Carson, whose son, James D. Carson, was a graduate of the civil engineering curriculum of Lehigh University in 1876. It is awarded to that senior in civil engineering who shows the most marked excellence in the professional courses of his curriculum.

**The William H. Chandler Prizes in Chemistry**

Four annual prizes of $25 each, one in each class, for excellence in the chemistry and chemical engineering curricula were established by Mrs. Mary E. Chandler, of Bethlehem, Pennsylvania, widow of Dr. William H. Chandler who was professor of chemistry at Lehigh University from 1871 until his death in 1906.

**The N. I. Stotz and D. E. Pickert Choral Cup**

The Choral Cup provided by Norman I. Stotz, Jr. '53 and Donald E. Rickert '53, is awarded to the outstanding senior participating in the choral organizations of the Department of Music.

**The R. K. Burr and J. D. Kirkpatrick Concert Cup**

The Concert Cup provided by Richard K. Burr '53 and J. Donald Kirkpatrick '55, is awarded to the outstanding senior(s) participating in the instrumental organizations of the Department of Music.

**The Cornelius Prize**

The Cornelius Prize of $25, established by William A. Cornelius, M.E. '89, and endowed by a bequest by his widow, Mrs. Eleanor R. W. Cornelius, will be awarded annually to the senior student in mechanical engineering

who is judged to have profited most by his opportunities at Lehigh University. The award will be based 70 per cent on scholarship, 20 per cent on attainment in general culture, and 10 per cent on development in personality. To be eligible for the award, a student's scholastic standing must be in the top quarter of the class in the College of Engineering.

**The Philip Francis du Pont Memorial Prize in Electrical Engineering**

The Philip F. du Pont Memorial Prize Fund was established in 1929 by L. S. Horner, E.E. '98. The annual income of this fund is awarded each year in the way of prizes, two-thirds to the highest ranking senior and one-third to the second highest ranking senior in electrical engineering.

**Fraternity Alumni Advisory Council Scholarship Improvement Award**

This trophy is awarded to the Lehigh Fraternity chapter whose scholastic average for the year is most improved over the average for the previous year.

**Malcolm J. Gordon, Jr. Physics Prize**

An annual award of $40.00 is made to the highest ranking sophomore majoring in physics with some extra-curricular activity.

**The Hamilton Humanities Award**

The Hamilton Watch Company awards an engraved electric watch each year to the senior engineering student who has most successfully combined proficiency in his major field of study in engineering with achievements (either academic, extra-curricular, or both) in the social sciences or humanities.

**The Bill Hardy Memorial Prize**

An annual award of $100 is given by Mr. and Mrs. C. Edson Hardy in memory of their son to the junior who most nearly reflects the qualities that typified Bill Hardy, who was outstanding in many activities, academic and otherwise.

**Haskins and Sells Foundation Award**

An annual award of $500 is awarded to that accounting student in the College of Business Administration or the College of Arts and Science who after three years has demonstrated excellence in scholarship, professional potential, extra-curricular activities, and moral character.

**The Harold J. Horn Prizes**

The heirs of Harold J. Horn, E.E. '98, established a fund, the income of which is used in the award of a first and second prize of $40 and $20 respectively for the two highest ranking juniors in electrical engineering.

### The Andrew Wilson Knecht III Memorial Award

This award is made each year to the member of the mechanical engineering class graduating in June who has exhibited the greatest potential for applying his technical training to practical application. The award is a specially designed medallion with hand engraving and enclosed in a leather folder and presentation case.

### The McClain Award for Meritorious Painting

The McClain Award for Meritorious Painting, consisting of a trophy and a fifteen ($15) dollar purchase prize, and provided by Mr. A. V. McClain, shall be presented the student of painting in the Department of Fine Arts studio classes who completes the most meritorious painting during the academic year.

### The McClain Progress Award

The McClain Progress Award, consisting of a trophy and a fifteen ($15) dollar purchase prize, and provided by Mr. A. V. McClain, shall be presented to that student whose progress in painting in the Department of Fine Arts studio classes during the year shall be most marked.

### Merck Index Award

A copy of the *Merck Index* is awarded by Merck and Co., Inc. to a senior in chemistry who is an outstanding student, who has been active in student society affairs and who has promise of a successful career in chemistry in the judgment of the faculty of the Department of Chemistry.

### The Elizabeth Major Nevius Award

The Elizabeth Major Nevius Award was established by Walter I. Nevius, E.E. '12, "in loving memory of his wife, who profoundly admired young men of diligence, intelligence, aggressiveness and sterling character." The award of $500 shall be made annually to that senior enrolled in any five-year combination curriculum leading to two baccalaureate degrees who, upon completion of his first four years at Lehigh University and upon graduation with his class, shall be adjudged the most outstanding of the seniors completing work for their first baccalaureate degree and continuing to a second baccalaureate degree at Lehigh University, judged upon the basis of leadership, citizenship, and scholarship.

### The Pendleton Award

This silver bowl is awarded yearly to the student who has produced the most effective contemporary painting.

### The Pennsylvania Institute of Certified Public Accountants Prize

The Pennsylvania Institute of Certified Public Accountants awards each year an Accountants' Handbook to the senior in the College of Business Administration majoring in accounting who is outstanding in academic achievement and leadership.

**Phi Sigma Kappa Scholarship Cup**

A scholarship cup, to be awarded for one year to the fraternity in the interfraternity council having the highest scholastic average for the preceding year and to become the permanent property of the fraternity winning it for three successive years, was provided by an alumnus of the Nu Chapter of Phi Sigma Kappa social fraternity in 1923.

New cups, to be awarded on the same terms as the original, have been provided by the local chapter of Phi Sigma Kappa.

**The Allen S. Quier Prize in Metallurgy**

An annual prize of $15 has been provided by the daughters of the late Allen S. Quier in memory of their father, to be awarded to the senior who was adjudged by the staff of the Department of Metallurgical Engineering to have made the most progress in his work in that curriculum. While high scholastic standing is a requisite, the prize is awarded on the basis of progressive achievement in scholastic work, rather than an average rating.

**Bosey Reiter Leadership Cup**

This award is given to the student whose leadership shall contribute primarily to the best interest of the University. Leadership is defined chiefly as moral character and shall combine intellectual ability and common sense. High scholarship and athletic achievements shall be included as cases of leadership, but neither is necessary or sufficient alone.

**Robert Ridgeway Senior Prize**

The Robert Ridgeway Senior Prize is awarded annually to the Engineering senior with the highest cumulative average.

**The Senior Band Plaque**

The Senior Plaque was established by the seniors on the executive committee of The Lehigh University Band to honor a member(s) of the senior class of the Band who has given outstanding performances in both marching and concert seasons for four years and who has not served in a major administrative capacity in the Band.

**The T. Edgar Shields Cup**

The Shields Cup was established by the late Dr. T. Edgar Shields, former director of music at Lehigh. It is awarded annually to the student who is considered most outstanding in over-all musical activities.

**Sigma XI Undergraduate Research Award**

An award of $50.00 and associate membership in the society is made each year to an undergraduate student by the Chapter Executive Committee from departmental nominations. The basis of the award is research potential and demonstrated achievement in research.

**Bradley Stoughton Student Award**

This award is given to an outstanding senior student in the Department of Metallurgy. It consists of a certificate and twenty-five dollars awarded annually.

### Thornburg Mathematics Prize

The Thornburg Mathematics Prize is made possible through a bequest by the late W. P. Tunstall ('03) in honor of the late Professor Charles L. Thornburg. The prize, consisting of a credit slip in the amount of forty dollars to purchase books in the field of mathematics or allied disciplines at the Book Store, shall be awarded to the senior with the most outstanding record in an advanced course in mathematics.

### Trustees' Scholarship Cup

The trustees of the University have provided a scholarship cup which is awarded for one year to the living group having the highest scholarship average for the preceding year. The trustees' scholarship cup becomes the permanent property of any living group winning it for three successive years.

### University Service Award

This award is given annually to the senior who has been adjudged to have contributed most during his career at Lehigh University, to promote student body unity, campus cooperation for worthy objectives, and loyalty to the alma mater. It is expected that the student selected shall be of sound character and satisfactory scholarship.

### William Whigham, Jr. Memorial Prize

This is awarded annually to the top ranking freshman in engineering, based on accumulative average of the first two semesters.

### The Elisha P. Wilbur Prizes

A fund was established by the late E. P. Wilbur, trustee of Lehigh University from 1872 until 1910, for distribution in prizes as the faculty might determine. The income from this fund is used to provide two awards.

Wilbur Mathematics Prizes. A first and second prize of $50 and $25 respectively to be awarded annually to the two highest ranking freshman engineers in the first year of freshman engineering mathematics completed at Lehigh University, as recommended by the Department of Mathematics.

Wilbur Scholarship Prize. This prize of $200 is awarded annually to the sophomore with the best semester average for the sophomore year.

### The Williams Prizes in English

The late Professor Edward H. Williams, Jr., an alumnus of the University of the Class of 1875, established prizes for excellence in English composition and public speaking. The freshman, sophomore, and junior prizes are awarded by the faculty on the recommendation of the Department of English.

Freshman Composition Prizes. A first prize of $100, a second prize of $75, and a third prize of $50 are awarded annually for the three best compositions submitted by freshmen of regular standing as required work in their English courses.

Sophomore Composition Prizes. A first prize of $100, a second prize of $75, and a third prize of $50 are awarded annually for the three best compositions submitted by sophomores of regular standing as required work in their English courses.

JUNIOR COMPOSITION PRIZES. A first prize of $100, a second prize of $75, and a third prize of $50 are awarded for the three best essays submitted by juniors as part of the required work in their courses in English.

**The Williams Prizes in Extempore Speaking**

A first prize of $100 and a second prize of $50 are awarded annually to freshmen of regular standing who excel in a contest in extempore speaking.

A first prize of $100, a second prize of $75, and a third prize of $50 are awarded annually to the winners in a contest in extempore speaking for sophomores, juniors, and seniors. Winners of first prizes are not eligible to compete in subsequent years.

**The Williams Prizes in Intramural Debating**

Sums totaling $300 are awarded annually as prizes in intramural debating. Students engaged in this activity are organized under the direction of the Department of English into teams which compete in a series of debates. The sum of $200 is divided equally between the two members of the first place team and the sum of $100 is divided equally between the two members of the second place team. Winners of first place prizes are not eligible to compete in subsequent years.

**The Williams Prize in Dramatics**

A prize of $100 is awarded annually to a Lehigh undergraduate whose interpretation of a role in a production of the Mustard and Cheese Dramatics Club is judged the most outstanding.

**The Williams Prize in Interpretive Reporting**

A prize of $100 is awarded annually to a Lehigh undergraduate for meritorious reporting, published or unpublished, intended to interpret the meaning of events or developments which are significant in the life of the University.

**The Williams Prize in Creative Writing**

A prize of $100 is awarded annually to the author of a meritorious short story, play, or poem submitted by a Lehigh undergraduate.

**The Williams Prize in Varsity Debating**

A prize of $100 is awarded annually to a Lehigh undergraduate whose performance in intercollegiate debating is judged the most outstanding.

**The Williams Senior Prizes**

The Williams Senior Prizes are awarded by the faculty on the recommendation of the committee on Williams Prizes.

1. First prizes of $200, second prizes of $100, and third prizes of $50 are awarded annually in each of the five fields of economics, English, philosophy, psychology, and history and government for dissertations submitted by regular members of the senior class on or before April 15.

2. The committee on Williams Prizes publishes, before the close of

the academic year, a list of recommended subjects for dissertations; but a senior may submit a dissertation upon any other subject in the respective field if the subject has received the approval of the committee.

3. Each senior entering the competition shall submit to the committee his choice of subject and plan of work by November 15.

4. The awards are made by the faculty upon recommendation of the committee, but no award is made if in any case a dissertation does not meet the standards of merit established by the committee. This standard includes such points as excellence in thought, plan, development, argument, and composition.

**The Theodore B. Wood Prize**

A prize of $50 is awarded, annually, under the terms of the will of the late Theodore Wood to the mechanical engineering student who has made the greatest scholastic improvement during the first two years of his college course.

**Prizes Awarded by Student Organizations**

ALPHA A. DIEFENDERFER AWARD. In recognition of Professor Emeritus A. A. Diefenderfer's long service as faculty adviser to the organization, the Lehigh University Chemical Society established this award for the highest ranking senior in analytical chemistry. Each winner is presented with an engraved certificate, and his name is inscribed on a plaque given by the Society and displayed in the Chemistry Building.

ALPHA EPSILON DELTA AWARD. Alpha Epsilon Delta places the name of the pre-medical biology freshman with the highest cumulative average on a plaque in the Department of Biology.

ALPHA KAPPA PSI KEY. The Alpha Sigma Chapter of Alpha Kappa Psi, a professional fraternity in commerce, awards annually the Alpha Kappa Psi Scholarship Key to the senior student pursuing a degree in the College of Business Administration, who has attained the highest scholastic average for three years of collegiate work at Lehigh University.

THE ALPHA PI MU PRIZE. The Alpha Pi Mu honorary fraternity in industrial engineering awards each year an industrial engineers' handbook to a high-ranking sophomore with demonstrated interest in the industrial engineering curriculum.

AMERICAN CHEMICAL SOCIETY AWARD. The Lehigh Valley Section of the American Chemical Society awards a membership in the American Chemical Society and a subscription to a journal of this society to the highest ranking junior in chemistry or chemical engineering.

AMERICAN SOCIETY OF CIVIL ENGINEERS PRIZE. The Lehigh Valley Section of the American Society of Civil Engineers offers a prize of a junior membership in the American Society of Civil Engineers to the outstanding senior in civil engineering holding membership in the student chapter.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS JUNIOR MEMBERSHIP PRIZE. The Anthracite-Lehigh Valley Section of the American Society of Mechanical Engineers awards annually a prize of the value of $10 to an outstanding member of the Lehigh Student Branch of the ASME. This prize takes the form of junior membership for one year in the parent society.

ETA KAPPA NU PRIZE. The Eta Kappa Nu honorary fraternity in electrical engineering awards a handbook in electrical engineering to the highest ranking freshman in the curriculum in electrical engineering.

THE GOLD-HANSEN TROPHY. The Gold-Hansen Trophy, provided by Stephen R. Gold and Robert A. Hansen, both members of the Class of 1960, is awarded to a student of at least four semesters' standing with the Lehigh University Band who has shown outstanding merit in other ways than musical or marching performance.

PHI ETA SIGMA AWARD. The Lehigh chapter of this national freshman honor society for men offers an award to the residence halls section with the highest freshman average for the fall semester each year. The trophy is a gift from Professor Harold V. Anderson of the Department of Chemistry.

PI LAMBDA PHI JOURNALISM AWARD. This is awarded to an undergraduate for outstanding editorial or business achievement in the field of publications. The trophies are made available by the local chapter of Pi Lambda Phi Fraternity.

PI TAU SIGMA PRIZE. The Pi Tau Sigma honorary fraternity in mechanical engineering awards each year a mechanical engineers' handbook to the highest ranking sophomore in the curriculum in mechanical engineering.

WILLIAM H. SCHEMPF AWARD. This award is made annually to the freshman who has shown outstanding ability and interest beyond the requirements of a normal freshman bandsman. It is made in honor of a former head of the Music Department by the Beta Sigma Chapter of Theta Chi Fraternity.

TAU BETA PI PRIZE. The Tau Beta Pi honorary engineering fraternity awards each year a slide rule or other prize of equivalent value to the engineering sophomore having the highest scholastic average.

# Summer Session

The Summer Session is divided into two equivalent sessions. These sessions, for both the graduate and undergraduate students, meet from Monday through Friday for periods of 90 minutes each. A student may register for a maximum of six semester hours during any one session. The Summer Session also provides an opportunity to enroll in many of the workshops and institute activities designed to meet the current needs of students in the various departments. These activities are scheduled from 9 a.m. to 3 p.m. Because of the nature of these special programs, students should not plan to enroll in courses which conflict with the workshop schedule. The 1966 Summer Session workshops and institutes provide activities for teachers of children of elementary and secondary school age, for undergraduate and graduate students, and for professional personnel.

The SUMMER SESSIONS ANNOUNCEMENT, containing a full description of courses to be offered, together with information concerning admission, fees, etc., will be sent on request addressed to the Director of the Summer Sessions.

## General College Division

The General College Division, plans for which were approved by the faculty on April 6, 1942, was organized to supplement the work of the established undergraduate curricula by meeting the educational needs of certain special groups of students. The division aims to provide an opportunity for young men, not planning a four-year program, to pursue such work, either of a general or a more specialized nature, as their preparation and interests make desirable; a trial period for those who wish to become candidates for baccalaureate degrees but whose preparatory training does not fully satisfy the entrance requirements for the curricula of their choice; and facilities for qualified male adults to continue their education without being committed to a restricted or specialized program.

Although all work available through the General College Division will be found at present among the regular offerings of the several departments, the work taken by students enrolled in this division is not regarded as primarily preparation for admission to the upper classes of the University; rather, the courses are looked upon as complete in themselves.

Each student in the General College Division has an individual program, one not subject to distribution or curriculum requirements, yet one limited by the student's ability to meet the prerequisites of the courses which he desires to take. With but few exceptions, the student enrolled in this division enjoys the same privileges as all other undergraduates in the University, including eligibility to unrestricted prizes, access to student aid, and the right of petition; and he is also subject to the same general regulations, those pertaining to scholastic probation not excepted. The General College Division student will not, however, be a candidate for a degree, save in those instances where transfer to one of the undergraduate programs of study leading to degrees is approved by the Committee on Standing of Students.

## Bureau of Educational Service

The Bureau of Educational Service was organized in 1953 to provide professional assistance to public and private schools and various other educational groups.

Among the purposes of the Bureau are the rendering of professional assistance to educational institutions by a cooperative study of their problems, by fostering research in the field of educational practice, and by helping to make the resources of the University more readily available to communities and agencies in need. In fulfilling these purposes the Bureau obtains the services of specialists from all areas of the academic profession.

Detailed information on assistance with specific problems can be secured from the Director, Bureau of Education Service, School of Education.

## Adult Education Program

The Adult Education Program is committed to serving the needs and interests of people in all walks of life. It is limited to special non-credit courses offered chiefly in the evening but is open alike to men and women students.

A wide variety of courses is included in the present program. Some are intended to meet specific needs of special groups. Others attempt to serve the general public in such fields as art, literature, language, history, government, and international relations. Still others result from cooperative arrangements with business-industry, and government.

The Adult Education Program, approved by the faculty on March 6, 1944, is a recognition of the principle that social institutions have service responsibilities within their spheres of influence. As a private educational institution, Lehigh University's interest is as great but its area of operation is properly more restricted than that of a publicly supported institution of higher learning. It is the desire of the University to meet the increasing demand for this new service through a flexible program closely adjusted to individual needs and interests.

## Evening Classes

For the benefit of graduate students who by reason of employment in the fields of teaching or industry, cannot attend classes during the day, a certain number of courses are generally offered in the late afternoon, evening, and on Saturday morning. It cannot be announced in advance which courses these will be, but a student who is interested may receive the necessary information by communicating, before the beginning of each semester, with the head of the department in the field in which he is interested. During the year 1966, evening and Saturday classes were held in accounting, business law, chemical engineering, civil engineering, economics, education, English,

finance, government, history, industrial engineering, international relations, marketing, mathematics, mechanical engineering, metallurgy, and psychology. It is anticipated that in the future courses will be offered as the demand warrants.

## University Library

Two principles underlie the operation of the Lehigh University Library. The first is the development of sound, balanced collections in support of education and research on the campus. The second is the provision of a reference and information service to assist students and faculty in making maximum use of materials available. A policy of open access to the general collection affords the user the opportunity to browse at leisure or to exploit the literature of his special field.

General and special collections now number some 460,000 volumes, with annual accessions of about 13,000 volumes. Over 4,000 current periodicals and serials are received, including important newspapers, both foreign and domestic. The Library is a depository for a wide selection of U. S. government documents. Collections are particularly strong in the physical and natural sciences, mathematics, engineering and British Colonial history. The Honeyman Collection of rare books is distinguished for its strength in English and American Literature and the History of Science.

The Mart Science and Engineering Library, the collections of which will be available to graduate and undergraduate students, is now under construction. The Center for the Information Sciences will use this library as an operating laboratory for experiments in information transfer. When the Mart Library is completed, the present Linderman building will serve the Humanities and Social Sciences.

## Religious Observances

Sunday Protestant Chapel Services are held in Packer Memorial Church under the direction of the University Chaplain.

At 9:30 A.M. there is a service of Holy Communion, according to the form contained in the Episcopal Book of Common Prayer. Everyone is invited to participate in this service, regardless of denominational affiliation.

At 11:00 A.M. services of a general Protestant character are held. Outstanding clergymen of the Church occupy the pulpit approximately once a month. On these occasions the Glee Club usually sings. The Chaplain or a local minister delivers the sermon on the remaining Sundays.

The Roman Catholic Diocese of Allentown provides the services of

a full time Chaplain to care for the spiritual life of the Catholic students. Mass is celebrated each Sunday during the academic year at 10:30 A.M. in the Osbourne Room of the University Center. Mass is also said in Packer Memorial Church on Sundays at 12:30 P.M., and at 5:00 P.M. on Mondays through Fridays.

There are also a number of special religious observances, such as the Chapel Service and Convocation at the beginning of Freshman Orientation; and the annual Christmas Vesper Choral Program on the Sunday preceding Christmas recess.

Attendance at all religious services is voluntary.

## Student Personnel Services

General counseling of individual students, especially in the freshman year, is largely the responsibility of the student personnel services—a group of cooperating agents and agencies. For the new student and his parents, such services begin in their earliest discussions with the Director of Admission and his staff. Most of the student's early contacts after his entrance are with the Residence Hall Counselors. These counselors are carefully selected upperclassmen, appointed by the President of the University, who help the freshman and who direct him to more highly specialized aid when needed. The entire program is conducted under the supervision of the Dean of Residence.

Freshmen whose problems transcend the competence of the Residence Hall Counselors come to other advisers for guidance in many areas of student life and welfare and, at all levels, academic questions, personal problems, social adjustment difficulties, financial needs, and many other troubles are dealt with daily. Problems of vocational choice and academic adjustment are not uncommon during the freshman and sophomore years.

Each student in the College of Arts and Science is considered from the beginning of his course as an individual and his choice of studies is carefully organized in terms of his specific backgrounds of preparation and his future objectives. Individual counseling continues throughout the student's four years in the College. In the College of Business Administration faculty advisors work with the individual student and his individual problems for the same purposes. Similarly, the Associate Dean of the College of Engi-

neering curriculum spends much time with the freshman engineering students in an effort to help in the adjustment of academic difficulties and in better definition of vocational objectives. These forms of advisement are carried on through the following years with the student's academic advisors.

A student's problems often reveal the need of more highly specialized attention, whereupon the student is referred to the particular service which he should consult. Problems of mental or physical well being are, of course, referred to the University Health Service which is described in another section. The University Chaplain is available for the student with religious, moral, or personal concerns that are interfering with his peace of mind and his studies.

If a student is not certain about his vocational or professional choice, he needs to know both more about his own capacities and interests and more about the professions and their demands. The Counseling and Testing Service is available without charge. A large library of occupational information is there for the student's use and study. Later, in his senior year, the question of prime importance is the decision of a position after graduation. The Director of Placement, in personal and group conferences, advises on applying for a position, on being interviewed, and on the relative advantages and disadvantages in working for the different business and industrial firms seeking the services of college graduates. (See page 394).

Financial problems can become a serious hazard for a student. The Executive Secretary of the Committee on Undergraduate Financial Aid is always available for conference and may find other related concerns.

If the student is a veteran of military service and has questions involving relations with the Veterans Administration, he will find the Registrar informed in this field. The Registrar also is an advisor on the draft and military service, on matters of transferred credits, graduation requirements, and allied topics.

A serious hazard to success in a student's academic life may be in poor study habits or reading skills. The Reading and Study Clinic can provide help. (See page 395).

Not all student problems are individual problems. Many are group problems, having to do with group living in the residence halls, with student activities, student organizations of many kinds, fraternity life, and campus social life in general. The deans and their aides give much of their time to this area of student life.

Many members of the teaching faculty are deeply interested in students and student life and spend a great deal of time working with student groups. They contribute their services as academic advisors, activity sponsors, group sponsors and advisors, chaperones at social affairs, by entertaining in their homes, and in friendly personal relationships with students. Their contributions are invaluable and appreciated all the more because they are largely voluntary.

In these and in other ways Lehigh University endeavors to maintain the close contacts with students which characterize the smaller institutions. Services are available for all student needs, and the student need only turn to his nearest residence hall counselor, professor, or closest campus friend to learn where he can receive the help he needs.

## Students' Health Service

A dispensary is maintained which is equipped and staffed for routine medical and minor surgical care. Twelve beds are available for short periods of observation. Dispensary hours are from 8:30 a.m. to 5 p.m. weekdays; 8:30 a.m. to 12:30 p.m. Saturdays; and 10 a.m. to 12 noon on Sundays. During vacation periods and during the summer sessions, no Sunday hours are held.

A night medical attendant is on duty through the fall and spring semesters from 5 p.m. to 8 a.m. Facilities are available during these hours for the treatment of minor injuries and illnesses. A physician is on call at all times during the fall and spring semesters.

Patients requiring more than a few days bed care are sent home or to local hospital when indicated. Any expenses so incurred must be paid by the student.

Due to limited staff and multiplicity of dispensary duties, Health Service physicians are not able to make professional calls on students in living groups or in rooms, except in cases of absolute emergency. If unable to visit the dispensary in the event of illness or injury, students are advised to call local physician for treatment. Such physicians' fees will be paid by the student, his family, or his Health Insurance Plan.

The Health Service wishes to work closely with the student's family physician and, as far as possible, will continue any treatment or follow-up requested by him.

A necessarily limited emergency service is extended by the Health Service to faculty members and other employees.

**Physical Examinations**

Prior to arrival on campus each new undergraduate student is required to submit a Health History Form and Record of Physical Examination completed and signed by his own physician. At the appropriate time these forms are mailed to new students with specified date for completion and return to the Director of the Health Service.

The physicians of the Health Service carefully analyze the results of all physical examinations in order to detect any latent or obvious physical, emotional, or mental abnormality. When found, the person involved may be invited for a conference and his disability discussed with him confidentially.

All new employees are expected to have a physical examination before beginning their duties at the University. Such pre-employment examinations may be done by the Health Service staff, or by the applicant's chosen physician (at the applicant's expense) on Health Service forms supplied for that purpose. All completed forms are to be returned to the Director of the Health Service as soon as possible for confidential analysis and filing.

Close cooperation between the Department of Physical Education and the Health Service permits the establishment of rehabilitation measures, etc., as indicated. All students are classified for the physical education program according to their abilities to participate in physical activities.

**Tuberculosis Survey**

A 70 mm. Chest X-ray is made of each incoming student. Any departure from normal noted during the reading of these films calls for a 14″ x 17″ chest X-ray and further investigation.

**Immunizations**

All new and transfer students are required to show evidence of vaccination against smallpox within three years, or to submit to such vaccination prior to the beginning of classes.

Immunization with Tetanus Toxoid and the Salk or oral Polio Vaccine within four years preceding admission is required.

**Laboratory**

Facilities are available for routine laboratory procedures. Additional procedures are performed at a local hospital at the expense of the student.

**X-ray Services**

The X-ray equipment of the Health Service includes a diagnostic unit, a 70 mm. Chest X-ray unit, and necessary developing and drying apparatus.

X-ray services are limited to bone and chest films. No X-rays are taken of any body organs which involve the use of dyes, barium, etc.

A small charge is made to cover the cost of reading the films by a local radiologist.

### Physiotherapy

A well-equipped physiotherapy section is a valuable adjunct to the University Health Service. A well-trained technician administers treatment under the supervision of the University physicians with such equipment as diathermy, whirlpool, ultra-violet and infra-red lamps.

### Personnel

Full-time Health Service personnel normally include three physicians, a physiotherapist, a laboratory and X-ray technician; two nurses, a night medical attendant, a secretary, an administrative assistant, and a receptionist.

### Accident and Sickness Reimbursement Insurance

The University offers students insurance coverage against accident and sickness at nominal cost, and on an entirely voluntary basis.

The Health Service highly recommends this insurance plan to both present and prospective students. Past experience has emphasized the importance of such protection, and we urge all students to participate in this plan throughout their college careers. The policy covers such items as prescription drugs, out-patient X-rays, and consultations which are not covered by the usual hospitalization policies.

All foreign students and others who, in the opinion of the administrative officers of the University, may not be in a position to meet the costs of accident or sickness are usually required to carry this insurance.

## Placement, Counseling and Testing Services

In order to prepare the student for the exigencies of college life, the University maintains a placement, counseling, and testing service. This service functions to help the student make satisfactory adjustments to his college environment and to provide counseling and aid in obtaining employment upon graduation.

### Counseling and Testing Services

The primary aim of counseling is to aid the student to gain a better understanding of himself and how his personal characteristics bear on his present and future adjustments. Students who avail themselves of the pro-

fessionally administered techniques of psychological testing and personal counseling profit by establishing realistic guideposts by which to direct their courses of action.

Psychological tests, including those administered during Freshman Week, are used to assess a student's aptitude, achievement, skills, interests, and personality characteristics. Interpretations of these tests are made with the student to help him orient his course work, study, and campus life toward achieving his maximum effectiveness. When the student feels that a more extensive evaluation of his situation is needed, further testing and personal counseling aimed at helping him understand his direction and motivation are undertaken. Also, cross communication with other University personnel agencies is maintained in gathering together information and expediting plans made cooperatively with the student. The counseling service maintains a library of educational and occupational information to which students can refer as they attempt to develop a clear conception of the educational and vocational world and their place in it. These services are available, without cost, to all University students.

The counseling service is also the administrative center of a variety of local and national testing programs in which students might be asked to participate during their college career. The most frequently administered of these programs are the Graduate Records Examinations, Law School Admissions Test, Medical College Admission Test, Graduate Study in Business Tests, National Teacher Examination, and Millers Analogies Tests.

The Service also engages in research on tests, counseling, and other personnel functions. The results of such research are ultimately useful in the counseling of individual students.

### Placement

The University provides a centralized placement service to alumni, graduate students and seniors. It also serves underclassmen seeking summer employment.

Alumni are asked to register with the Placement Office if they wish assistance in changing positions or seeking new employment.

Annually several hundred industries, business firms and government agencies send representatives to the campus to interview candidates. In addition to those who visit the campus there are many employers who seek candidates by direct referral.

A well developed library of employment literature is maintained for the use of candidates.

## Reading and Study Clinic

There are many factors which influence the performance of college students. An important one is the expertness with which they master the skills necessary for college work. High level skills are needed in preparing assign-

ments, note-taking, outlining, listening, recalling information and facts, taking examinations, preparing written and oral reports, and reading critically and accurately. The Reading and Study Clinic, School of Education, offers Lehigh men an opportunity to develop satisfactory reading and study habits. The following services are available to all students:

Analysis of reading and study skills
Reading and study improvement programs
Individual guidance on problems of academic adjustment.

First-year students, particularly, are encouraged to arrange for a conference so that they can be assisted in making an evaluation of their learning tools and in planning for more effective work.

The improvement programs are offered periodically during the fall and spring semesters. Small group instruction is scheduled for interested students. The instruction is adapted to the needs of the individual in well-equipped facilities.

## Use of Motor Vehicles at Lehigh University

Permission for students to have and to operate motor vehicles while in residence is granted so long as there is no evidence that having such a motor vehicle interferes with academic progress and the demands of good citizenship, except that:

Any student operating a motor vehicle on the property of the University must register it with the Office of Buildings and Grounds and must conform to the regulations of that Office.

A freshman is not permitted to have or to operate a motor vehicle while in residence.

A sophomore will be issued a motor vehicle permit provided:

a. He has applied to the Dean of Students for the permit and has submitted a written request from his parents supporting the application.
b. He has a cumulative average of 1.5 or better and is in good standing academically.
c. His permanent record shows no adverse action by the University Discipline Committee.
d. He and his motor vehicle are adequately covered by liability insurance.
e. His application has been approved by the Dean of Students.

A sophomore permit shall automatically become invalid if changes in the student's record are such that they would have prevented the issuing of a permit originally.

Exceptions to the foregoing may be made for students living at home, for students under medical care, or in other exceptional cases upon petition by the student to the Dean of Students.

The University reserves the right, for cause, to deny to any student permission to have or to operate a motor vehicle while in residence. The University assumes no jurisdiction over the use of a motor vehicle on family business by a student living at home.

# Academic Observances

### Baccalaureate Sunday

Baccalaureate Services were held Sunday afternoon, June 12, 1966, in Eugene Gifford Grace Hall. The sermon was delivered by The Rt. Rev. Frederick John Warnecke, B.A., B.D., S.T.M., D.D., Bishop of the Episcopal Church, Diocese of Bethlehem.

### University Day

University Day was observed Monday, June 13, 1966. The 98th Commencement Exercises were held in Eugene Gifford Grace Hall. The address to the graduating class was delivered by Thomas Keith Glennan, B.S., Eng.D., D.Sc., LL.D., President, Case Institute of Technology, and President, Associated Universities, Inc.

### Founder's Day

The 88th annual exercises in honor of the Hon. Asa Packer, founder of the University, were held Sunday afternoon, October 9, 1966 in Eugene Gifford Grace Hall. The address to the graduating class was delivered by Frederick Seitz, A.B., Ph.D., D.Sc., LL.D., Doctore Hon. Causa, President, National Academy of Sciences.

# Alumni Association

The Lehigh University Alumni Association which has been in existence since 1876, was incorporated in 1917. The offices of the Association are located in the Alumni Memorial Building. Along with the regular alumni activities, the Association is also concerned with fund raising to help meet the needs of the University.

The officers of the Alumni Association for 1966-67 are:

President, Frank G. Kear '26, Washington, D. C.
Senior Vice President, Malcolm Carrington, Jr., '39, Newark, N. J.
Junior Vice President, D. T. Stevenson, '37, Harrisburg, Pa.
Treasurer, John K. Conneen '30, Bethlehem, Pa.
Archivist, James D. Mack '38, Bethlehem, Pa.
Comptroller, Donald W. Schmoyer '44, Allentown, Pa.
Executive Secretary and Editor of the *Lehigh Alumni Bulletin,*
Robert A. Harrier '27, Pen Argyl, Pa.

Over 19,500 Lehigh alumni throughout the country who maintain an active interest in the University are afforded opportunities for frequent social contact with Lehigh men of all classes through 42 alumni clubs established in areas of alumni concentration. Important outposts of the University, these clubs hold meetings and carry on activities that support the programs of the University in its cultural, social, financial, and recreation phases.

The following are the alumni clubs:

Allentown Lehigh Club
Atlanta Lehigh Club
Bergen-Passaic Lehigh Club
Lehigh Home Club (Bethlehem, Pa.)
Central New York (Sycracuse)
Central Ohio Lehigh Club
Central Pennsylvania Lehigh Club
Chicago Lehigh Club
Connecticut Lehigh Club
Delaware Lehigh Club
Delaware Valley Lehigh Club (Trenton, N. J.)
Detroit Lehigh Club
Fairfield County (Conn.) Lehigh Club
Maryland Lehigh Club
Monmouth County (N. J.) Lehigh Club
New York Lehigh Club
Nittany Valley (Penn State) Lehigh Club
North Central Pennsylvania Lehigh Club
Northeastern Pennsylvania Lehigh Club
Northern Calfiornia Lehigh Club
Northern New England (Boston) Lehigh Club
Northern New Jersey Lehigh Club
Northern New York Lehigh Club
Northern Ohio Lehigh Club
Pacific Northwest Lehigh Club
Philadelphia Lehigh Club
Pittsburgh Lehigh Club
Rochester (N. Y.) Lehigh Club
Rocky Mountain Lehigh Club
St. Louis (Mo.) Lehigh Club
Southeastern Pennsylvania Lehigh Club
Southern New Jersey Lehigh Club
Southern Anthracite Lehigh Club
Southern California Lehigh Club
Southern New York (Binghamton) Lehigh Club
South Florida Lehigh Club
Twin City Lehigh Club
Washington, D. C. Lehigh Club
Watchung Lehigh Club
Western New York Lehigh Club
York-Lancaster Lehigh Club
Youngstown Lehigh Club

# Student Organizations

**National Honor Societies — General**

Beta Gamma Sigma (business administration)
Omicron Delta Kappa (student leadership)
Phi Beta Kappa (scholarship)
Phi Eta Sigma (freshman scholarship)
Sigma Xi (scientific research)
Tau Beta Pi (engineering)

**National Honor Societies — Departmental**

Alpha Epsilon Delta (pre-medical)
Alpha Pi Mu (industrial engineering)
Beta Alpha Psi (accounting)
Chi Epsilon (civil engineering)

Delta Phi Alpha (German)
Eta Kappa Nu (electrical engineering)
Phi Alpha Theta (history)
Pi Mu Epsilon (mathematics)
Pi Sigma Alpha (government and international relations)
Pi Tau Sigma (mechanical engineering)

**National Recognition Societies**

Alpha Phi Omega (campus service)
Arnold Air Society (Air Force)
Eta Sigma Phi (classics)
Pershing Rifles (military)
Pi Delta Epsilon (college journalism)
Psi Chi (psychology)
Scabbard and Blade (military)

## COURSE SOCIETIES

Intellectual interest in various fields of study and professional spirit among arts, business, and engineering students is promoted by a group of organizations commonly called course societies. The first of these organizations historically was the Chemical Society, established in 1871. The list now includes:

**In Arts and Science**

Delta Omicron Theta (debating)
International Relations Club
Newtonian Society

**In Business Administration**

Alpha Kappa Psi (business administration)
Beta Alpha Psi (accounting)
Lambda Mu Sigma (marketing)
Lehigh Accounting Society
Student Marketing Research Corps

**In Engineering**

American Chemical Society (chapter of student affiliates)
American Institute of Chemical Engineers (student chapter)
Institute of Electrical and Electronic Engineers (student branch)
American Institute of Industrial Engineers (student branch)

American Institute of Physics (student section)
American Society of Civil Engineers (student branch)
American Society of Mechanical Engineers (student branch)
Howard Eckfeldt Society and Geological Society (student branch of the American Institute of Mining and Metallurgical Engineers)
Metallurgical Society
Society of American Military Engineers
Student Chemical Society

**Other Student Organizations**

Acolytes' Guild
A.I.E.S.E.C. (foreign job exchange)
Alpha Chi Epsilon (Episcopal pre-theological honorary society)
Alpha Lambda Omega (Allentown group)
Band (including Brass Choir, Woodwind Chamber Group, etc.)
Baptist Student Group
Bethlehem Tutorial Project
Bridge Club
Canterbury Club
Chess Club
Circle K Club
Christian Science Organization
Computer Society
Cosmopolitan Club
Crossroads Africa Committee (of Arcadia)
Cut and Thrust Society (fencing)
Cyanide Club (junior honorary society)
French Club
German Club
Glee Club
Gryphon Society
Hillel Society
Hockey Club
Interfaith Council
Interfraternity Council
Arcadia, the Student Council
Lehigh Christian Fellowship
Lehigh Valley College Volunteers (mental hospital project)
Lutheran Student Organization
Methodist Youth Movement
Model Railroad Club
Mustard and Cheese (dramatic club)
Newman Club
Outing Club
Parnassus (fine arts, photography, films)
Political Science Assembly
Radio Society (W3AEQ)
Residence Halls Council
Roger Williams Fellowship
Sailing Club
Skiing Club
Spanish Club
Sports Car Club
Students for a Democratic Society
Town Council
United Church of Christ Student Group
Westminster Fellowship

The following Greek-letter social fraternities have chapters at Lehigh University: Alpha Chi Rho, Alpha Sigma Phi, Alpha Tau Omega, Beta Theta Pi, Chi Phi, Chi Psi, Delta Chi, Delta Phi, Delta Sigma Phi, Delta Tau Delta, Delta Upsilon, Kappa Alpha, Kappa Sigma, Lambda Chi Alpha, Phi Delta Theta, Phi Gamma Delta, Phi Kappa Theta, Phi Sigma Kappa, Pi Kappa Alpha, Pi Lambda Phi, Psi Upsilon, Sigma Alpha Mu, Sigma Chi, Sigma Nu, Sigma Phi, Sigma Phi Epsilon, Tau Delta Phi, Theta Chi, Theta Delta Chi, Tau Alpha Kappa, Theta Xi. There is also the local living group: Das Deutsche Haus.

**Student Publications and Radio**

The students of Lehigh University publish a semi-weekly newspaper, *The Lehigh University Brown and White;* a literary magazine, *Paisley*, and a yearbook, *The Epitome*. The students' modern radio stations WLRN, 640 kc., and WLVR, 690 kc., (The Lehigh Radio Network) both broadcast throughout the day.

# Performing Arts and Lectures

Committee on Performing Arts. Founded in 1936 as the Student Concert-Lecture Series, this committee's program is a concert series presented during the academic year by the University for the student body, the faculty and staff, and the community. Included in the series are presentations by soloists, chamber and choral groups, symphonic orchestras, dramatic groups, and occasionally dance groups.

Cleaver Concerts. The Cleaver Concerts, which are endowed through the gift of Mrs. Elizabeth K. Cleaver, are named for her husband, the late Albert N. Cleaver, a former trustee of the University. Some of the concerts are given by professional soloists and by chamber ensembles. Others are student performances in collaboration with professional singers and orchestra players.

Senior Lecture Series. Established by the Class of 1960 and Omicron Delta Kappa, this Series presents several public lectures by members of the Lehigh University faculty under the sponsorship of the Senior Class and ODK, the senior honorary leadership society.

Poetry Readings. A series of poetry readings by students and faculty is offered in the University Center on alternate Friday afternoons during most of the academic year. The series is sponsored by the Department of English and is open to the public.

Band. The University's Concert Band, Varsity Band, and Marching Band have won national recognition for their excellence in performance and programming. Performances are given at concerts, academic convocations, and athletic events. Information on student participation in the organization is given on page 303.

Glee Club. The University Glee Club has distinguished itself in performances of major choral works with orchestra, often in collaboration with choruses of women's colleges. On four different occasions the Club has visited Puerto Rico to give concerts, and it travels frequently to perform on other campuses. The Glee Club is also heard at concerts and special occasions on the Lehigh campus. Information on student participation in the organization is given on page 304.

Instrumental Ensembles. These groups consist principally of woodwind and brass players of the Band, but also include strings, piano, and voice on occasion. The concerts, which are open to the public, are presented under the sponsorship of the Department of Music and the University Center Advisory Committee.

Mustard and Cheese. The Mustard and Cheese Dramatics Club produces two major plays a year, sponsors a series of foreign-language and classic films, and occasionally presents student-produced and -directed one-act plays.

# Buildings and Grounds

The University occupies thirty-two buildings, exclusive of the fraternities on campus, which are located on a tract of land covering 180 acres on the north side of South Mountain, overlooking the valley of the Lehigh River and the city of Bethlehem. The University recently acquired additional land on the slope of South Mountain and in Saucon Valley south of Bethlehem, bringing the total acerage to almost 700. A locker building and playing fields in Saucon Valley are among the University's athletic and recreation facilities.

### Alumni Memorial Building

The Alumni Memorial Building, which is used as the administration building of the University, was erected as a memorial to 1,921 Lehigh men who served in World War I and especially to the forty-six who gave their lives. The cost of erection was raised by subscription from about 1,700 alumni. The Memorial Hall contains the records of the Lehigh men who served and those who died in the war.

In the south wing of the building are the offices of the President, Provost, Vice-President—Administration, Treasurer, Dean of Students, Registrar, Superintendent of Buildings and Grounds, and the Accounting Office. The north wing contains the offices of the Bursar, Vice-President—Development, Director of Admission, Development, Public Information, Publications, and the Alumni Association.

The lobby of the building contains art galleries in which exhibitions are presented throughout the academic year. There is one automatic elevator in the building.

A collection of boxwood trees and shrubs, donated by the late Robert Parke Hutchinson, Class of '04, landscapes the building and the nearby President's Home.

### Arboretum

The Arboretum is a tract of about eleven acres adjoining Sayre Park. It was established by a friend of the University as a tree nursery for the purpose of furnishing illustrative specimens of American trees and of cultivating trees and shrubs for the beautifying of the park. All of the more important species of North American trees are to be found in the Sayre Park and the Arboretum. A tract of seven acres adjoining the Arboretum has been planted with a variety of trees as an exhibition of indigenous tree culture.

### Chemistry Building

The Chemistry Building is a three-story fire-proof sandstone edifice, 259 feet long and 44 feet wide, with a wing of 62 feet long and 42 feet wide, and with a three-story extension, 60 feet long and 37 feet wide. An additional three-story wing, 116 feet long by 52 feet wide, has been added to the east of the original building.

Laboratory space and equipment are provided for qualitative and quantitative analysis, inorganic chemistry, organic chemistry, sanitary chemistry, industrial biochemistry, colloid chemistry, X-ray analysis, gas analysis, the furnace assay of ores, industrial chemistry, and research in chemistry.

The trustees of the University named this building, exclusive of the new east wing, the William H. Chandler Chemistry Laboratory in recognition of Dr. Chandler's thirty-five years' service as professor of chemistry, 1871-1906. The east wing was named the Harry M. Ullmann Chemistry Laboratory, in recognition of Dr. Ullmann's service as head of the Chemistry Department.

A special Hydrogenation building annex has been erected on the outside southwest corner of the court adjacent to the stairway, for the prevention of spark explosions. Access is from the main lobby of the Chandler building.

### Christmas-Saucon Hall

Christmas-Saucon Hall is a three-story brick and stucco building. It has historic interest as the first building of Lehigh University. Asa Packer bought it from the Moravians. It was originally a church.

Renovation of Christmas-Saucon Hall was completed in 1958. The remodeled facilities provide headquarters for the departments of English, Mathematics, and Philosophy.

The Office of Placement and Counseling occupies the east wing and the north center section of the first floor.

On the first floor west wing are the common room, statistics laboratory, waiting room, and mathematics department offices.

The second and third floors provide a lecture room, seminar and conference room, and classrooms for the departments housed in the building.

### Coppée Hall

Coppée Hall, named for the University's first president, is a three-story stone and stucco building. It contains the recitation rooms and offices of the departments of Government, History, International Relations, Fine Arts, and Religion. There is one large lecture room for common use.

### Eckley B. Coxe Laboratory

The Eckley B. Coxe Laboratory is a two-story sandstone building, 100 feet long and 75 feet wide, occupied by the Materials Research Center. The building was named in memory of Eckley B. Coxe, a pioneer and leader in mining engineering in this country. He was a close associate of the founder of the University and served as a trustee from its early days until his death in 1895. His widow established an endowment fund for this building.

The portion of the building occupied by the Materials Research Center includes the Electron Microscopy Laboratory and a Crystal Growing and Zone Processing Laboratory.

### Drown Memorial Hall

Drown Memorial Hall was erected by friends and alumni as a memorial to the late Thomas Messinger Drown, LL.D., fourth President of the University, who served from 1895 to 1904. The building now houses the offices, lecture rooms, classrooms, and laboratories of the College of Business Administration.

### Education Building

The School of Education is headquartered in a two-story, three-unit building at 520-524 Brodhead Avenue, across from the west entrance to the campus. The building, formerly a private residence, has been remodeled to accommodate

eighteen offices, a conference room, and a library. The department had been in a one-story, 76x30-foot wooden frame structure at the east end of Packer Hall since April, 1947. That building was razed November 18, 1964.

### Fritz Engineering Laboratory

Fritz Engineering Laboratory, headquarters for the Department of Civil Engineering, was established on the campus in 1909 by the late John Fritz of Bethlehem, known as the father of the steel industry in the United States, who served as trustee of the University for 35 years.

The original building, which was designed and erected under the personal supervision of Mr. Fritz, has been used by the department for various research and industrial projects and for laboratory instruction in mechanics of materials and hydraulics.

In October 1955, a new addition to the laboratory was dedicated. It houses the world's largest universal hydraulic testing machine capable of applying a 5,000,000-lb. load to tension or compression members up to 40 feet in length and flexure specimens up to 120 feet long.

The new addition consists of a seven-story section 130 ft. by 70 ft., plus a four-story section 114 ft. by 24 ft. The new building is a steel structure with reinforced concrete flooring and yellow brick and granite exterior. Two large aluminum-framed solex glass windows permit a maximum amount of natural light to enter the 50 ft. by 130 ft. crane bay which houses the huge vertical testing machine and the Amsler repeated load equipment, another outstanding feature of the new addition. The repeated load bed is a heavily reinforced concrete structure measuring 70 ft. by 14 ft. in plan, and 6½ ft. deep. Carefully machined steel plates in the top surface are designed to transmit shear and direct forces under all types of repeated loads.

A floor-controlled 20-ton capacity crane, 70 feet above floor level, services the new south bay and the 5,000,000-lb. testing machine. A 10-ton crane services the original north bay with its 800,000-lb. machine, 2,000,000 inch-pound torsion machine, and other machines of smaller capacity.

Research and student instructional laboratories in hydraulics, soil mechanics, concrete, structural models, and sanitary engineering, as well as a separate student laboratory for materials testing, are provided.

The concrete laboratory includes storage bins for aggregates, together with equipment for making and storing all types of plain, reinforced, and prestressed concrete specimens.

The hydraulics laboratory has three levels, with pumps, tanks, turbines, weirs, and other appropriate apparatus used both for student instruction and industrial tests. Space is available for model test of spillways, rivers, channels, etc.

The laboratory machine shop is completely equipped with lathes, millers, drill-presses, grinders, power saws, and miscellaneous tools and equipment. The welding shop provides facilities for both electric arc and gas welding.

Other facilities include photoelastic stress analysis equipment, a photographic darkroom, research library, staff offices, seminar rooms, and a conference room.

### Eugene Gifford Grace Hall

Eugene Gifford Grace Hall, named for the donor, who served as president of the Board of Trustees from 1924 to 1956, is a stone structure 120 feet wide and 180 feet long used for sports and recreation. The building contains an athletic palestra, which also serves as an assembly hall for the University, with a seating capacity of 3,000. The second floor is a large drill floor which is avail-

able for the major University dances and receptions. In addition, there are classrooms for the Music Department, dressing rooms for athletic squads, and classrooms and offices for the departments of Aerospace and Military Science. Promenade terraces at the level of the dance floor on three sides of the building afford views over the Lehigh Valley and of south Bethlehem.

### Health Services Building

The Health Center is located on University Avenue diagonally across from Taylor Hall. Built in 1955, it is a three-story building constructed of native stone with the main entrance on University Avenue.

The main floor contains a waiting lounge, record office, clinical laboratory, examining offices, dispensary, X-ray, observation rooms, and an ear and throat room. On the ground floor are the physiotherapy department, library and conference room, director's office and administrative offices.

The second floor contains two physicians' apartments and several rooms which are used for storage and filing of inactive medical records. The Center for Business Economics occupies the ground floor.

### Lamberton Hall

Lamberton Hall, named after Lehigh's second president, Robert A. Lamberton, was built in 1907. Originally built as a University Commons, it was renovated in 1958. It serves as the language headquarters of the College of Arts and Science, and provides rehearsal and practice facilities for Lehigh musical organizations.

The first floor contains a modern language laboratory and a large classroom as well as the headquarters for the Department of Romance Languages. The second floor provides classrooms for all language departments and offices for the department of German.

Two indoor rifle and pistol ranges used by the military department are located in a section of the ground level. The remainder of the ground floor is used as headquarters for Mustard and Cheese, Lehigh's student dramatic organization.

### University Library

The University Library is a five-story building of native stone, with limestone trim, in the collegiate Gothic style of architecture. It incorporates a part of the original library building, erected in 1877 by Asa Packer and named in memory of his daughter, Lucy Packer Linderman. The more modern section of the building was opened in 1929.

The main floor is occupied by the reading room, offices of the library staff, a portion of the book stack, and the large lobby, where the loan desk, reference department, and public card catalog are located. The upper floors contain seminar rooms, the Rare Book Room and the Honeyman Collection. The offices of the Institute of Research are located on the ground floor, east end; and the office of the Dean of the College of Arts and Science found on the ground floor, west end. The remainder of the building is devoted to book stacks, of which there are four floors.

### The Ordnance Laboratory

The facilities of the departments of Aerospace and Military Science, located in Eugene Gifford Grace Hall, have been augmented by a temporary one-story frame structure, 60 feet long and 25 feet wide. This building contains Army and Air Force ROTC supply storage facilities and garage space.

### James Ward Packard Laboratory of Electrical and Mechanical Engineering

The late James Ward Packard, who was graduated from Lehigh University in 1884 with the degree of mechanical engineer, and was the designer of the first Packard motor car and founder of the Packard Motor Car Company of Detroit, Michigan, and of the Packard Electric Company, of Warren, Ohio, donated $1,200,000 for the erection and equipment of an electrical and mechanical engineering laboratory, which was completed in 1929.

This building, named for the donor, is a five-story steel-framed sandstone structure 225 feet long and 180 feet wide. The lobby is finished in Italian travertine. The halls throughout the building are wainscoted with Tennessee marble. An auditorium on the first floor with a seating capacity of 622 is equipped with still- and motion-picture apparatus.

The western half of the building contains the offices, classrooms, research rooms, and laboratories of the Department of Electrical Engineering. The eastern half of the building houses the departments of Mechanical and Industrial Engineering with classrooms, drawing rooms, offices, research rooms, shops, laboratories, instrument rooms, and a photographic dark room.

The laboratories of the Electrical Engineering Department include the dynamo laboratory, which is equipped with a variety of rotating machines, transformers, circuit components, and instruments; the transient laboratory, which includes a surge generator, artificial lines, and oscillographs; a high voltage laboratory; an A.C. network analyzer with six generators, sixteen load units, and sixteen transmission line sections; and an electronics laboratory equipped with sine wave and square wave generators, oscilloscopes, vacuum-tube voltmeters, and components for the experimental study of vacuum-tube and transistor circuits in the audio and R. F. range. A fifteen-amplifier analog computer is also available.

The main mechanical engineering laboratory contains a modern oil-fired steam boiler, turbo-generator sets with condensers and auxiliaries, dynamometer test stands for steam turbines and reciprocating engines, steam jet refrigeration equipment with a barometric condenser, along with various types of pumps and flow-measuring instrumentation. Equipment associated with the compression and flow of air includes two reciprocating compressors, an axial flow fan with adjustable blades on rotor and stator and dynamometer drive, ventilating fans and an air conditioning unit adaptable for extensive testing. The internal combustion engine laboratory features a supercharged variable compression engine of the CFR type, completely instrumented for tests. Another variable compression CFR type engine may be adapted for either spark or compression ignition. Strain gage-type pick-ups are available for study of pressure variations. Dynamometer equipment is available for tests of engines of the automatic type. A diesel test stand has fuel-measuring facilities and a strain gage-type torque meter. An instrumentation laboratory provides means for studying the characteristics of the instruments associated with the measurements basic to mechanical engineering. For work in experimental stress analysis a 60,000 lb. universal testing machine is available along with strain gage equipment, oscilloscopes, and two polariscopes for photoelastic investigations. For vibration and balancing studies, the equipment includes vibration velocity meters, a displacement indicator, recording vibrometer, electromagnetic torque meter, and portable balancing equipment.

The manufacturing processes laboratory contains the most modern machine tools, including two 20-h.p. 16″ engine lathes, a 20-h.p. turret lathe, two milling machines, large drill press, and auxiliary grinding equipment for the maintenance of cutting tools. This laboratory is fully equipped with machinability analog computer, profilometer, dynamometers and recorders, optical comparator, and other precision measuring equipment for laboratory and experimental work in metal machining.

The Computer Laboratory has a General Electric 225 solid-state computing and information processing facility, as well as a Royal McBee LGP-30 digital computer, and is equipped with seminar facilities and a conference room so as to permit maximum use of the computer for educational purposes.

### Packer Memorial Church

Packer Memorial Church, in which religious services are held, was the gift of the late Mrs. Mary Packer Cummings, daughter of the founder of the University. It was built in 1887. Occasional musical recitals and the annual Bach Festivals are held in this building which now contains the Starkey Memorial Organ.

### Physics Building

The Physics Building is a five-story sandstone structure, 240 feet long and 44 to 56 feet wide. In addition to offices, classrooms, and lecture rooms, there are laboratory rooms for undergraduate and graduate exercises, laboratories for research, a reading room, machine shop, glass-blowing shop, electronic shop, constant-temperature room, chemical preparation room, and dark rooms.

### Henry Reese Price Hall

Henry Reese Price Hall, named in honor of Dr. Henry Reese Price, an alumnus of the University of the Class of 1870 and late president of the board of trustees, provides offices and seminar rooms for the departments of classical languages and social relations. It formerly furnished accommodations for 35 students and was remodeled to service as an accademic office building in 1966.

### Psychology Building

The Psychology Department is housed in the former Delta Chi house which is located to the west of the University Center building. The building is a three-story brick structure, 36 feet long by 34 feet wide. It contains departmental and staff offices, seminar, and library, a photographic dark room, rooms for statistical machine calculations psychometric testing and research.

### Psychology Laboratory Building

This two-story stone building, 70 feet by 20 feet in plan, temporarily houses the elementary and advanced instructional laboratories, together with student and staff shop facilities of the psychology department. Adjoining the building is a one-story annex, 25 feet long and 20 feet wide, which contains the machine shop.

### Saucon Valley Fields

These facilities are located on a 550 acre tract in Saucon Valley, of which approximately 120 acres include the following: an all-weather track (one of the finest in the United States), lacrosse field, soccer field, nine green grass-tex composition tennis courts, freshman and varsity baseball fields, a freshman football field, varsity practice football field, one lighted field, eight intra-mural football

fields and eight intra-mural softball fields. The fields were put into service during the 1963 fall season. The freshman baseball field is a generous gift of the Class of 1942.

### Sayre Observatory

Sayre Observatory was the gift of the late Robert H. Sayre, one of the original trustees of the University.

The observatory contains three rooms on the first floor which house animal laboratories for research and teaching in the Psychology Department.

The land upon which the observatory stands, consisting of seven acres adjoining the original grant, was presented to the University by the late Charles Brodhead of Bethlehem.

### Sayre Park

Development of the mountainside on the University grounds was effected through the donation in 1909 of the sum of $100,000 by the children of the late Robert H. Sayre, to be used in the development of Sayre Park as a memorial to their father, who was a trustee of the University from its foundation until his death in 1907.

### Sayre Park Field

Approximately 8½ acres of intra-mural playing fields located on the top of South Mountain at the southeast corner of Sayre Park. The playing fields are completely enclosed by cyclone fence affording athletic activity to students near the fraternity houses. Area includes a one story block building with masonry veneer, 24′, 2″ X 16′ 2″ with toilet facilities and storage area, constructed in 1961. Students began using these facilities in 1962.

### Service Building

The Service Building, headquarters of the Department of Buildings and Grounds, consists of one main building, a five-story brick structure 160 feet long by 40 feet wide and an annex, a one and one-half story brick structure 160 feet long by 40 feet wide. Located at Adams and Fourth Streets, it is two blocks from the University campus.

The main building is used chiefly for the storage of maintenance materials and supplies, lumber, building materials, plumbing and heating supplies, and electrical supplies. A freight elevator 20 feet by 10 feet is used to handle materials to the various levels. The annex houses the various maintenance shops, carpenter shop, tinsmith shop, paint shop, and cement mason's shop, along with the materials used by the trades.

### Taylor Field

An athetic field more than nine acres in area is provided for the accommodation of students who participate in the various outdoor sports. The stadium, located on the lower level, provides football and baseball fields, surrounded by concrete stands having a seating capacity of 12,000. New steel stands were erected in 1953 above the south concrete stands providing 4,000 more seats for a total

seating capacity of 16,000. A new press box, rest rooms, and concession booths under the steel stands were erected. On the upper level there is a practice field for football, baseball, lacrosse, and soccer; also a quarter-mile track and a 220-yard straight-away.

### Taylor Gymnasium and Field House

In 1913, Charles L. Taylor, E.M. '76, donated to the University the funds for the erection of a gymnasium and field house.

These buildings were remodeled, re-equipped, and expanded as one of the major projects of the Lehigh Progress Fund.

Taylor Gymnasium, which adjoins the athletic field, is a building 222 feet long and 73 feet wide. It has been expanded by the addition of a new swimming pool measuring 75 by 42 feet, and a new gymnasium measuring 94 by 77 feet. The new swimming pool ranges in depth from five to ten feet, and includes a large gallery for spectators, an observation room below the water line, and the latest filtration equipment.

Included in the renovation of the old buildings and in the new construction are locker facilities for 2,600 students, a faculty locker room, coaches' locker room, five basketball courts, weight room, fencing room, golf practice room, wet and dry steam rooms, and a specially designed wrestling room. Also included are a well-equipped first aid room for physical education activities, corrective exercise gymnasium, trainer's room, and class meeting rooms.

Athletic, Physical Education, and business offices were incorporated in the new construction. Improved heating is furnished by electric blowers. Framed pictures of all athletics teams grace the halls of this floor and stair halls.

The former entrance way has been transformed into a trophy room measuring 26 by 55 feet as a repository for athletic prizes and awards. The third floor addition, known as the Samuel E. Berger Room, the gift of Mr. Samuel Erwin Berger, B.A. '89, has also been remodeled.

### The University Center

The University Center unites the original exterior lines of Packer Hall (215 feet long, by 60 feet wide), eliminating most of the original structural wood construction, and substituting therefor steel girders, steel columns, and I beams, with a new three-story stone addition connected and running parallel with new-windowed, old Packer Hall, this addition being 185 feet long, by 53 feet wide.

The basement section of the east wing contains the offices and classroom of the Division of Journalism and the facilities of The Brown and White, The Epitome, and radio stations WLRN and WLVR.

In addition to executive and business offices for each of the publications and radio stations, the facilities include a large news room with twenty typewriters, a photographic darkroom, a teletype room, three modern, fully-equipped broadcasting studios, an engineering control room, an electronics workshop, and a library containing some ten thousand recordings and tapes.

To the west of the publications area is a large game room, a music practice room, and the headquarters of the Lehigh Radio Society (W3AEQ). The basement of the new section is taken up entirely by service areas for the dining services.

On the main floor, east end, of the center, are the information desk, the Student Activities Office, and the offices of the Chaplain and the Associate Dean of Students. The remainder of the floor is devoted to the dining services, including the main kitchen, cafeteria, two dining rooms, each of which will accommodate approximately two hundred and seventy-five people.

The second floor houses the central files of student organizations, and provides eight meeting rooms. The Snack Bar, student lounge, bookstore, hi-fi room, and the room for cards and chess are together on this floor, thus providing an ample, centrally-located area for recreation and relaxation. There is a balcony affording a fine view of Bethlehem north of the lounge, and the building may be entered on the south side at the level of this floor.

The faculty lounge, card and writing room, and a private dining room are on the third floor, east, of Packer Hall, and in the center section is the faculty and guest dining room which retains some of the architectural features of the room's initial use as the University Chapel. The third floor of the addition includes a completely equipped kitchen for service to the several dining areas on this floor, and two large multi-purpose rooms which can be used for dances, lectures, recitals, meetings, and banquets. Folding partitions permit one room to be divided into two smaller rooms and the other room into four. Both rooms are equipped with public address facilities and one has in addition projection equipment, a sound system, and a permanently installed screen for motion pictures. At the west end there is an additional meeting room which may also serve as a private dining room. There is a balcony north of one multi-purpose room, and in the tower of Packer Hall is a small, handsomely appointed private dining room.

There is a fourth floor of Packer Hall at the east end only. The facilities here include two small meeting rooms, a large meeting room, and a small television lounge.

There are three automatic elevators in the building.

### Varsity House

The Varsity House is a two-story locker building, 121 by 82 feet in size. It contains offices for coaches, a doctor, and a trainer, a room for game officials, locker and shower rooms for home and visiting teams, and rooms for the storage and issue of equipment. This building was dedicated in June, 1963 and is the first of the buildings in the Saucon Valley Fields which will house the athletic facilities in the future.

### Whitaker Metallurgical and Chemical Engineering Laboratory

A Metallurgical and Chemical Engineering Laboratory, comprising a five-story laboratory and two-story classroom wing, opened in the fall of 1965. The laboratory is located on the north side of Packer Avenue, across from Fritz Laboratory.

Facilities of the new laboratory include 90,000 square feet of floor space, a darkroom, metallographic room, specimen preparation room, electron microscope room, balance room, ion-microscope room, physical ceramics rooms, and physical properties measurement room.

Among the more than twenty separate areas for scientific and engineering investigation will be laboratories for high pressure research and reaction kinetics, nuclear studies, analog computation, process control, high temperature thermodynamics and kinetics, analytical studies, and fine structures and metallography.

The classroom wing includes an auditorium-lecture hall with a seating capacity of 225.

### W. A. Wilbur Engineering Laboratory and Power House

The W. A. Wilbur Engineering Laboratory and Power House is a two-story sandstone building, 188 feet long and 44 feet wide.

The Power plant contains four Babcock and Wilcox straight-tube cross-drum boilers, each rated at 300 boiler horse-power. Two boilers are equipped with Petro oil burners and are fully automatic-controlled. A third boiler has been equipped with a B. & W. oil burner, also fully automatic-controlled. The fourth

boiler is a fully automatic Faber fuel oil burner. Four 15,000-gal. fuel oil storage tanks are installed at convenient locations for receiving oil supply.

The plant is designed and equipped to provide steam at 250 pounds pressure to the engineering laboratories, in addition to heating the University buildings. It is so arranged that any boiler can be isolated for laboratory tests for long periods if necessary. From this plant a six-inch line carries steam to the Packard Laboratory at the pressure desired for the laboratory work. Modern safety appliances and measuring equipment have been incorporated.

### Williams Hall

Williams Hall, the donation of the late Dr. Edward H. Williams, Jr., of the Class of 1875, was so named by the trustees of the University in recognition not only of this gift but also of Dr. Williams' long, continued, and important service to the University as Professor of Mining and Geology.

Originally a three-story brick building, 186 feet long and 70 feet wide, Williams Hall was rebuilt as a four-story building after it had been severely damaged by fire in January, 1956. It contains the offices, classrooms, laboratories, department libraries, and special collections of the departments of Biology, Geology, and Psychology.

Williams Hall Annex contains some of the research facilities of the departments of Biology and Psychology. This concrete and brick structure is connected to Williams Hall by a bridge passage between the third floor of the annex and the second floor of Williams Hall.

The northern portion consists of a three-story section, 35 feet long and 25 feet wide, which houses animal quarters together with aquatic-biology, virology, and bacteriology laboratories of the biology department. The entire third floor is a green house.

The southern portion, a single-story section, 35 feet long and 21 feet wide, contains the bioelectric research laboratory of the Psychology Department. This laboratory has electrically shielded and sound proofed recording and instrument rooms, an operating and work room, photographic darkroom, and an electronics shop.

## THE RESIDENCE HALLS

Eight residence halls are located on the campus. These modern structures provide living accommodations for approximately 1,400 students. They are located near the center of the campus within walking distance of the Student Health Services Building, the University Center, and the classroom buildings.

### Centennial Houses

A complex of six residence halls in three three-story buildings, the newest residence facilities on campus, was occupied in September, 1965. The complex will house 264 upperclassmen. It is located just east of the Freshman Quadrangle, overlooking Taylor Stadium. Six former faculty members and administrators were honored by the naming of individual units in the Centennial Houses complex for them. The individual houses are: Charles G. Thornburg; Natt M. Emery; C. Maxwell McConn; E. Kenneth Smiley; Wray H. Congdon. Each unit provides the atmosphere of a small living group, accommodating 44 students in two-man sleeping and study rooms located on the second and third floors. The ground floor of each unit contains a large living room, a library, and recreation and game room areas for students living in the individual housing unit.

### Dravo House

Dravo House, a five-story fireproof residence hall completed in 1948, provides accommodations for approximately 280 students. The building was made possible by the alumni and friends of the University through their contributions to the Progress Fund. It is named in memory of Francis R. Dravo and Ralph M.

Dravo, former University trustees. Each of the four-wing structures which compose the building has its own lounge, and the center unit has a lounge and reception room for visiting friends. There are rooms for one, two, and three students.

### Henry Sturgis Drinker House

Henry Sturgis Drinker House, named for the University's fifth president, was completed in 1940. It is a four-story fireproof residence hall with accommodations for 190 students. It has rooms for two and three students, and a spacious lounge.

### McClintic-Marshall House

McClintic-Marshall House was completed in 1956, providing accommodations for 296 upperclass students. The building consists of three student living floors each with 48 double rooms, two section-president rooms, a lounge, and two special purpose rooms. The ground floor holds the office of the Director of Residence Halls, the House president's and Residence Halls Council president's suite, and a large recreation room.

### Park House

Park House was formerly the Delta Tau Delta house. It is a three-story building with accommodations for sleeping and study, presently occupied by students of Theta Xi fraternity.

### Charles Russ Richards House

Charles Russ Richards House, named in honor of the sixth president of the University, was completed in 1938. It is a four-story fireproof residence hall accommodating a total of approximately 210. The building contains a spacious lounge.

### Charles Lewis Taylor Hall

Charles Lewis Taylor Hall, the gift of Mr. Andrew Carnegie, is a three-story concrete residence hall with accommodations for approximately 170 students, the majority of whom are housed in three-room suites, three to each suite. The building was named Taylor Hall by Mr. Carnegie in honor of Charles L. Taylor, his former partner in business, a graduate of the University in the Class of 1876 and a trustee of the University. The building was completed in 1907.

# Registration Statistics

## SUMMARY OF STUDENT REGISTRATION

**Spring 1966**

**Students in the University**

| | |
|---|---|
| Undergraduate Students | 2861 |
| Graduate Students | 1561 |
| Total | 4422 |

**Students in Undergraduate Curricula**

| Curriculum | Seniors | Juniors | Sophomores | Freshmen | G.C.D. | Total |
|---|---|---|---|---|---|---|
| Arts and Science | 216 | 170 | 167 | 193 | .... | 746 |
| Arts and Engineering | 46 | 20 | 23 | 45 | .... | 134 |
| Business Administration | 145 | 148 | 155 | 100 | .... | 548 |
| Chemical Engineering | 44 | 36 | 57 | .... | .... | 137 |
| Chemistry | 15 | 15 | 11 | .... | .... | 41 |
| Civil Engineering | 24 | 24 | 49 | .... | .... | 97 |
| Electrical Engineering | 73 | 70 | 80 | .... | .... | 223 |
| Engineering Mechanics | 12 | 11 | 11 | .... | .... | 34 |
| Engineering Physics | 17 | 8 | 11 | .... | .... | 36 |
| Fundamental Science | 1 | .... | 2 | .... | .... | 3 |
| Industrial Engineering | 49 | 45 | 68 | .... | .... | 162 |
| Mechanical Engineering | 66 | 63 | 56 | .... | .... | 185 |
| Metallurgical Engineering | 17 | 18 | 22 | .... | .... | 57 |
| Unclassified Engineers | .... | .... | 9 | 445 | .... | 454 |
| General College Division | .... | .... | .... | .... | 4 | 4 |
| Total | 725 | 628 | 721 | 783 | 4 | 2861 |

**Summer 1966**

**Students in the University**

| | |
|---|---|
| Undergraduate Students | 632 |
| Graduate Students | 908 |
| Total | 1540 |

**Fall 1966**

**Students in the University**

| | |
|---|---|
| Undergraduate Students | 3070 |
| Graduate Students | 1749 |
| Total | 4819 |

**Students in Undergraduate Curricula**

| Curriculum | Seniors | Juniors | Sophomores | Freshmen | G.C.D. | Total |
|---|---|---|---|---|---|---|
| Arts and Science | 171 | 194 | 227 | 207 | .... | 799 |
| Arts and Engineering | 34 | 21 | 32 | 57 | .... | 144 |
| Business Administration | 157 | 165 | 149 | 99 | .... | 570 |
| Chemical Engineering | 42 | 50 | 72 | 2 | .... | 166 |
| Chemistry | 13 | 16 | 8 | 2 | .... | 39 |
| Civil Engineering | 20 | 46 | 49 | 3 | .... | 118 |
| Electrical Engineering | 71 | 81 | 102 | 2 | .... | 256 |
| Engineering Mechanics | 10 | 8 | 13 | .... | .... | 31 |
| Engineering Physics | 9 | 10 | 13 | .... | .... | 32 |
| Fundamental Science | 2 | 1 | 2 | .... | .... | 5 |
| Industrial Engineering | 53 | 65 | 56 | .... | .... | 174 |
| Mechanical Engineering | 56 | 63 | 73 | 1 | .... | 193 |
| Metallurgical Engineering | 20 | 25 | 24 | .... | .... | 69 |
| Unclassified Engineers | .... | 1 | 17 | 452 | .... | 470 |
| General College Division | .... | .... | .... | .... | 4 | 4 |
| Total | 658 | 746 | 837 | 825 | 4 | 3070 |

## GEOGRAPHICAL DISTRIBUTION OF UNDERGRADUATE STUDENTS

**Fall 1966**

| | | | |
|---|---|---|---|
| Alabama | 3 | South Carolina | 2 |
| Alaska | 1 | Tennessee | 3 |
| Arizona | 1 | Texas | 8 |
| California | 14 | Vermont | 3 |
| Colorado | 7 | Virginia | 37 |
| Connecticut | 150 | Washington | 2 |
| Delaware | 34 | West Virginia | 5 |
| District of Columbia | 9 | Wisconsin | 5 |
| Florida | 12 | Bermuda | 1 |
| Georgia | 2 | Brazil | 3 |
| Hawaii | 2 | Canal Zone | 1 |
| Illinois | 20 | Chile | 1 |
| Indiana | 6 | Colombia | 1 |
| Iowa | 3 | Ecuador | 2 |
| Kansas | 1 | El Salvador | 2 |
| Kentucky | 5 | Germany | 1 |
| Louisiana | 3 | Great Britain | 1 |
| Maine | 2 | Ghana | 1 |
| Maryland | 137 | Haiti | 1 |
| Massachusetts | 64 | India | 2 |
| Michigan | 8 | Italy | 1 |
| Minnesota | 2 | Netherlands | 1 |
| Missouri | 7 | Nicaragua | 1 |
| Nebraska | 2 | Pakistan | 1 |
| New Hampshire | 6 | Panama | 3 |
| New Jersey | 639 | Paraguay | 1 |
| New York | 491 | Peru | 4 |
| Ohio | 63 | Philippines | 2 |
| Oklahoma | 1 | Puerto Rico | 3 |
| Oregon | 3 | Switzerland | 1 |
| Pennsylvania | 1263 | Venezuela | 2 |
| Rhode Island | 6 | Virgin Islands | 1 |

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