

Lehigh University Publication

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University Catalog

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University Catalog



1964-1965

Lehigh University

Bethlehem, Pennsylvania

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UNIVERSITY CALENDAR

January 1964-1965

1964

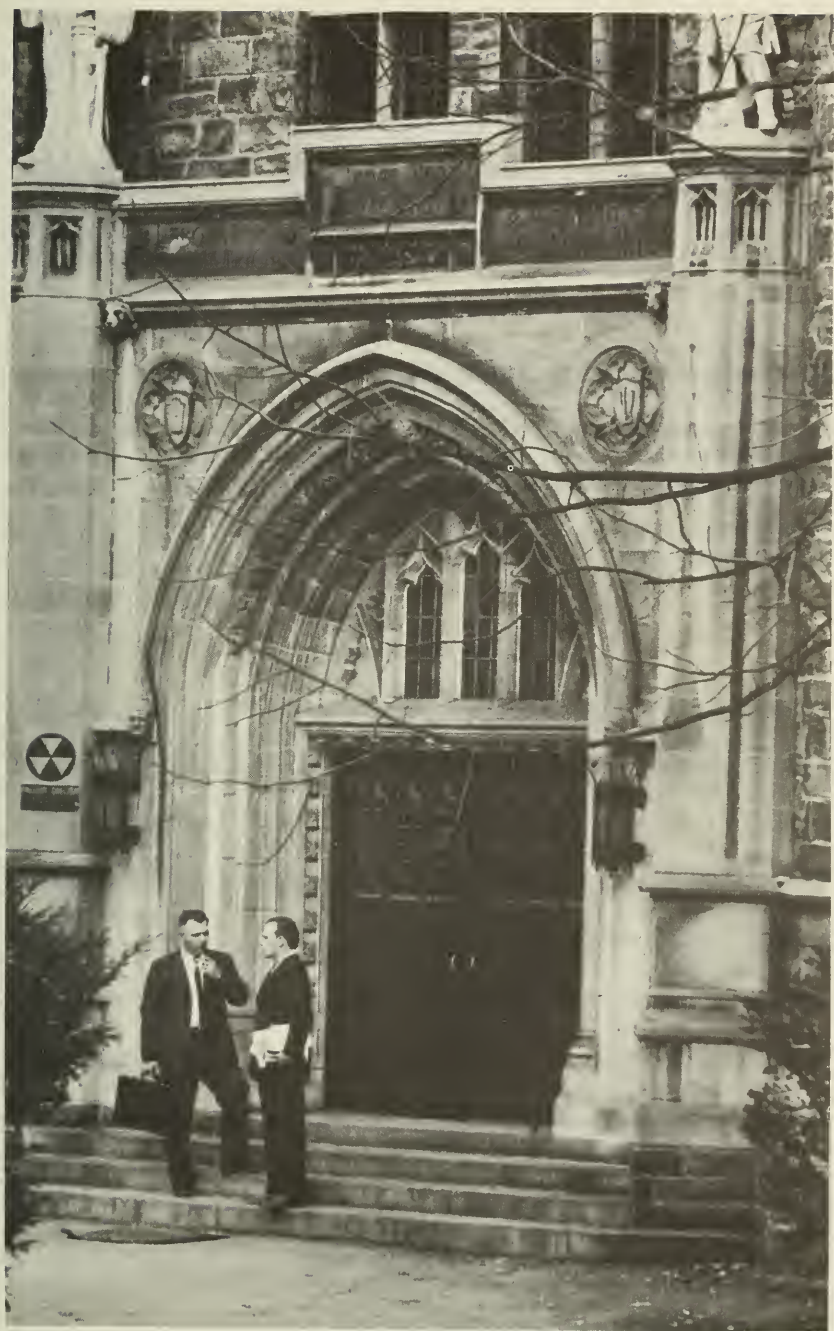
January 6, 8:10 a.m. (Mon.).....	Christmas vacation ends Last day for filing applications for degrees to be granted in January
January 8-11 (Wed.-Sat.).....	Comprehensive examinations for arts seniors
January 11 (Sat.).....	Last day of classes in fall semester
January 13 (Mon.).....	Course examinations begin
January 22 (Wed.).....	Course examinations end
January 28 (Tues.).....	Registration for spring semester
January 29 (Wed.).....	Spring semester instruction begins
February 8 (Sat.).....	Last day on which registration for spring courses will be permitted
March 21, 1 p.m. (Sat.).....	Spring vacation begins
March 30, 8:10 a.m. (Mon.).....	Spring vacation ends Preregistration begins
April 4 (Sat.).....	Preregistration ends
April 15 (Wed.).....	Last day for filing applications for degrees to be conferred in June
May 12 (Tues.).....	Last day of classes for arts seniors taking comprehensive examinations
May 15-19 (Fri.-Tues.).....	Comprehensive examinations for arts seniors
May 19 (Tues.).....	Last day of classes in spring semester
May 20 (Wed.).....	Course examinations begin
May 29 (Fri.).....	Course examinations end
June 7 (Sun.).....	Baccalaureate Sunday
June 8 (Mon.).....	University Day
June 15 (Mon.).....	Registration for summer session (1st 6 weeks, undergraduate session)
June 16 (Tues.).....	Summer Session instruction begins (1st 6 weeks, undergraduate session)
July 24 (Fri.).....	End of summer session (1st 6 weeks, undergraduate session)
July 27 (Mon.).....	Registration for summer session (2nd 6 weeks, undergraduate session)
July 28 (Tues.).....	Summer Session instruction begins (2nd 6 weeks, undergraduate session)
September 4 (Fri.).....	End of summer session (2nd 6 weeks, undergraduate session)
September 10 (Thurs.).....	Last day for filing applications for degrees to be conferred on Founder's Day
September 13 (Sun.).....	Freshman Orientation begins
September 14-15 (Mon.-Tues.).....	Make-up examinations and special examinations
September 16 (Wed.).....	Registration for fall semester
September 17 (Thurs.).....	Fall semester instruction begins

1964 (Continued)

September 21 (Mon.).....	First faculty meeting
September 28 (Mon.).....	Last day on which registration for fall courses will be permitted
October 11 (Sun.).....	Founder's Day
October 19-21 (Mon.-Wed.).....	Engineering inspection trips
November 9 (Mon.).....	Mid-semester reports due Preregistration begins
November 14 (Sat.).....	Preregistration ends
November 25, 10 p.m. (Wed.)....	Thanksgiving vacation begins
November 30, 8:10 a.m. (Mon.)....	Thanksgiving vacation ends
December 19, 1 p.m. (Sat.).....	Christmas vacation begins Last day of classes for arts seniors taking com- prehensive examinations

1965

January 4, 8:10 a.m. (Mon.).....	Christmas vacation ends Last day for filing applications for degrees to be granted in January
January 13-16 (Wed.-Sat.).....	Comprehensive examinations for arts seniors
January 16 (Sat.).....	Last day of classes in fall semester
January 18 (Mon.).....	Course examinations begin
January 27 (Wed.).....	Course examinations end
February 2 (Tues.).....	Registration for spring semester
February 3 (Wed.).....	Spring semester instruction begins
February 13 (Sat.).....	Last day on which registration for spring courses will be permitted
March 27, 1 p.m. (Sat.).....	Spring vacation begins
April 5, 8:10 a.m. (Mon.).....	Spring vacation ends Preregistration begins
April 10 (Sat.).....	Preregistration ends
April 15 (Thurs.).....	Last day for filing applications for degrees to be conferred in June
May 18 (Tues.).....	Last day of classes for arts seniors taking com- prehensive examinations
May 21-25 (Fri.-Tues.).....	Comprehensive examinations for arts seniors
May 25 (Tues.).....	Last day of classes in spring semester
May 26 (Wed.).....	Course examinations begin
June 4 (Fri.).....	Course examinations end
June 13 (Sun.).....	Baccalaureate Sunday
June 14 (Mon.).....	University Day



Classroom discussions often extend beyond the scheduled time.

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 NEVIN ELWELL FUNK, E.E., ENG.D.Philadelphia, Pa.
 ROBERT EDWIN McMATH, A.B., LL.B., LL.D.Bethlehem, Pa.
 FRANK WILLIAM STERRETT, A.B., B.D., D.D., S.T.D., LL.D.Dennis, Mass.
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 ALFRED VANSANT BODINE, M.E., ENG.D.Bridgeport, Conn.
 FRANK LYNN MAGEE, E.E., ENG.D., LL.D.Pittsburgh, Pa.
 LEONARD MEAD HORTON, B.S. IN BUS. ADM.New York, N. Y.
 EDWARD A. CURTIS, B.S. IN BUS. ADM., LL.B., LL.D.Newark, N. J.
 ALBERT BRISTOL MAGINNES, B.A., LL.B.New York, N. Y.
 HENRY RANDOLPH MADDOX, M.E.Chestertown, Md.
 KENNETH LOTHAIRE ISAACS, M.E., M.B.A.Boston, Mass.
 **HOWARD STOLPP BUNN, B.A., CH.E., ENG.D.New York, N. Y.

*Since
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 *Resigned, December 31, 1963.

**Deceased, December 12, 1963.

Members Elected by Alumni

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Class of 1921	Term Expires 1964
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Class of 1934	Term Expires 1965
EDWIN HENRY SNYDER, E.E.	Newark, N. J.
Class of 1923	Term Expires 1966
GEORGE SAWTELLE, B.S. IN CHEM., SC.D.	Houston, Texas
Class of 1916	Term Expires 1967
WILLIAM FREDERIC COLCLOUGH, B.A., LL.B.	New York, N. Y.
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**Deceased, January 12, 1964

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*On leave of absence, effective February 1, 1962.

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LUCILE LEWIS BARRETT, A.B., *Assistant to Director*

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HARRY BOHLIN RAMSEY, B.A., *Assistant to the Executive Secretary*

Office of Publications

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Alumni Bulletin (to December 31, 1963)*
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of the Lehigh Alumni Bulletin*

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neering and Fritz Engineering Laboratory*
LYNN SIMPSON BEEDLE, B.S. in C.E., M.S., Ph.D., *Director, Fritz Engineer-
ing Laboratory*
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Division*
GEORGE CLARENCE DRISCOLL, JR., B.S., M.S., Ph.D., *Ch. Structural Metals
Division*
ROGER GEORGE SLUTTER, B.S., M.S., *Engineer of Tests, Ch. Operations
Division*
JOHN BRONISLAW HERBICH, B.Sc., M.S., *Ch. Hydraulics Division*
*ROY JUNIOR LEONARD, B.C.E., M.S., Ph.D., *Ch. Soil Mechanics Division*
CHARLES CURTIS DEININGER, *Business Officer*
IVAN JACKSON TAYLOR, *Instruments Associate*
*On Leave of Absence 1963-1964

Institute of Research

GEORGE ROBERT JENKINS, B.A., Ph.M., *Director*

PAUL C. PARIS, B.S. in Eng. Mech., M.S., Ph.D., *Assistant Director*
(to January 31, 1964)

JOHN M. CHEEZUM, JR., *Assistant Director* (from April 1, 1964)

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LUCILLE H. PLEISS, R.N., *Nurse*

WILHELMINA SANDELLA, R.N., *Nurse*

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REUBEN RICE RAWLS, B.A., *Assistant to the Director of Placement*

MICHAEL ANTHONY CIAVARELLO, B.S., M.Ed., D.Ed., *Counselor, Counseling and Testing Service*

VERNON GUINN WILLIAMS, B.A., M.S., Ph.D., *Counselor, Counseling and Testing Service*

Division of Athletics and Physical Education

WILLIAM BADER LECKONBY, B.S., *Director*

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*

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JONATHAN BRITTON ELKUS, A.B., M.A., *Director*

University Glee Club

ROBERT BENJAMIN CUTLER, A.B., M.A., *Director*

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.)

- GEORGE LEONARD ADAIR (1962)*Lecturer in Economic Geology*
B.A., University of Wisconsin, 1918.
- PETER FREDERICK ADAMS (1963)*Research Assistant in Civil Engineering*
B.Eng., Nova Scotia Technical College, 1958; M.Eng., 1961.
- RONNIE GENE ADAMS (1962)*Research Assistant in Civil Engineering*
B.C.E., Fenn College, 1961.
- RICHARD ALFRED AGLIETTI (1962)*Research Assistant in Civil Engineering*
B.C.E., Manhattan College, 1962.
- DARRYL LOUIS ALBRIGHT (1962)*Research Assistant and Instructor in
Metallurgical Engineering*
B.S., University of Illinois, 1959; M.S., Rensselaer Polytechnic Institute, 1962.
- JOHN JOSEPH WENHAM ALDEN (1963)*Visiting Assistant Professor of Religion*
B.A., Bowdoin, 1956; B.D., Harvard Divinity School, 1959; M.A., Yale, 1960.
- CARL ELMER ALLEN (1930, 1945)*Professor of Accounting*
B.S., Illinois 1923; M.S., 1925; Ph.D., 1930; C.P.A., Pennsylvania, 1939.
- THOMAS AMMIRATI (1962)*Graduate Assistant in Physics*
B.S., Brooklyn Polytechnic Institute, 1962.
- EDWARD DELBERT AMSTUTZ (1938, 1960)*Professor of Organic Chemistry,
Head of the Department of Chemistry*
B.S., Wooster, 1930; M.S., Institute of Paper Chemistry, 1932; Ph.D., Cornell, 1936.
- YOGINDER ANAND (1963)*Graduate Assistant in Electrical Engineering*
B.S., Panjab University (India), 1955; M.Sc., 1956; M.S., University of Washington, 1961.
- GRANT SPENCER ANDERSON (1962)*Graduate Assistant in Physics*
B.S., Lehigh, 1962.
- HAROLD VICTOR ANDERSON (1918, 1960)*Professor Emeritus of Chemistry*
B.Ch.E., Michigan, 1912; M.S., Lehigh, 1925.
- GEORGE WILLIAM ARMOLD, JR. (1962)*Assistant Director of Public Information*
B.A., Lehigh, 1958; M.A., Pennsylvania, 1962.
- RAY LIVINGSTONE ARMSTRONG (1946, 1958)*Associate Professor of English*
B.A., Williams, 1930; B.A., Oxford, 1932; M.A., 1936; Ph.D., Columbia, 1941.
- LYNN E. ATWOOD (1962)*Assistant Professor of Air Science*
B.B.A., University of Texas, 1957; Major, U.S.A.F.
- WILLIAM KENNETH AUNGST (1963)*Graduate Assistant in
Mechanical Engineering*
B.S. in M.E., Bucknell University, 1961.
- ROBERT BADALIANCE (1963)*Research Assistant in Civil Engineering*
B.S., Oklahoma State, 1963.
- JOHN CLAUDE BADOUX (1962)*Research Assistant in Civil Engineering*
Dipl., Federal Institute of Technology E.T.H. (Switzerland), 1958.
- DONALD ROSS BAKER (1961)*Graduate Assistant in Chemistry*
B.S. in Chem., Randolph-Macon, 1961.
- FRANK BAKER (1963)*Instructor in Social Psychology*
B.A., Vanderbilt, 1958; M.A., Northwestern, 1962.

- JOHN ROSS BAKER (1962)*Instructor in English*
B.A., Rice University, 1952; M.A., 1954.
- NICHOLAS W. BALABKINS (1957, 1962)*Associate Professor of Economics*
Dipl. rer. pol., Gottingen, 1949; M.A., Rutgers, 1953; Ph.D., 1956.
- *SAUL BENJAMIN BARBER (1956, 1960)*Associate Professor of Biology*
Associate Director of the Marine Science Center
B.S., Rhode Island State, 1941; Ph.D., Yale, 1954.
- THOBURN VAIL BARKER (1953, 1962)*Associate Professor of Speech*
B.A., Ohio Wesleyan, 1943; M.A., Columbia, 1951.
- LUCILE LEWIS BARRETT (1944)*Assistant to Director of Public Information*
A.B., Syracuse, 1939.
- DONALD DELYLE BARRY (1963)*Assistant Professor of Government*
A.B., Ohio University, 1956; M.A., Syracuse, 1959; Ph.D., 1963.
- ALLEN JENNINGS BARTHOLD (1939).....*Professor of Romance Languages,*
Head of the Department of Romance Languages
B.A., Lehigh, 1921; Ph.D., Yale, 1931.
- WILLIAM GEORGE BARTHOLOMEW (1960).....*Part-time Lecturer in Education*
B.S., Kutztown State Teachers, 1936; M.A., Lehigh, 1948; Ed.D., Temple, 1958.
- FAY CONANT BARTLETT (1917, 1956).....*Assistant Professor Emeritus*
of Physical Education
- DAVID ROBINSON BASSETT (1961)*Research Assistant in Chemistry*
A.B., Lafayette, 1961; M.S., Lehigh, 1963.
- ELIZAJANE KEMMERER BAUER (1958, 1960)*Circulation Librarian*
B.A., Moravian, 1937; B.S. in L.S., Drexel Institute of Technology, 1938.
- DENNIS WILLARD BAUM (1963)*Graduate Assistant in Physics*
B.S., Muhlenberg, 1963; M.S., Lehigh, 1964.
- STANISLAW LEON BAZANSKI (1963)*Visiting Research Associate in Physics*
M.Sc., University of Warsaw, 1954; Ph.D., 1959.
- FRANK SWAN BEALE (1930, 1949).....*Associate Professor of Mathematics*
B.S., Maine, 1921; M.S., 1923; Ph.D., Michigan, 1931.
- JACK OSCAR BEAMER (1962)*Graduate Assistant in Mathematics*
B.S., Juniata, 1962.
- JACOB LYNFORD BEAVER (1917, 1952)....*Professor Emeritus of Electrical Engineering*
E.E., Lehigh, 1904; M.S., 1921; Sc.D., Harvard, 1932.
- DONALD RICHARDSON BECK (1962)*Graduate Assistant in Physics*
B.S., Dickinson College, 1962.
- OSCAR E. BECK (1957)*Manager of Duplicating Services*
- FRANK CHESTER BECKER (1927, 1950)....*Associate Professor Emeritus of Philosophy*
A.B., Wesleyan, 1905.
- LYNN SIMPSON BEEDLE (1947, 1957).....*Research Professor of Civil*
Engineering; Director, Fritz Engineering Laboratory
B.S. in C.E., California, 1941; M.S., Lehigh, 1949; Ph.D., 1952.
- FERDINAND PIERRE BEER (1947, 1957).....*Professor of Mechanics,*
Head of the Department of Mechanics
B.S., Geneva (Switzerland), 1933; M.S., 1935; Ph.D., 1937; M.S., Paris (France), 1938.
- HENRY R. BEGANIE (1962)*Assistant Professor of Military Science*
B.A., Findlay College, 1941; M.A., Ohio State University, 1950; Lieutenant Colonel,
U.S.A.
- JOHN ANTHONY BEIDLER (1962)*Graduate Assistant in Mathematics*
A.B., King's College, 1962.

*On leave of absence, 1963-64.

16 Faculty and Staff

- PETER G. BEIDLER (1963) *Graduate Assistant in English*
B.A., Earlham College, 1962.
- LOUIS BENDER (1962) *Part-time Lecturer in Education*
B.A., Moravian, 1950; M.A., Lehigh, 1951.
- 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) *Professor of Medical Microbiology*
B.S., Pittsburgh, 1944; M.D., 1946; M.S., Minnesota, 1952.
- PAUL BERLFEIN (1962, 1963) *Psychometrist, Counseling and Testing Service*
A.B., Hunter College, 1962.
- CHARLES CLARENCE BIDWELL (1927, 1947) *Professor Emeritus of Physics*
A.B., Rochester, 1904; Ph.D., Cornell, 1914.
- MELVIN DAVID BINDERMAN (1962) *Heat Exchange Institute
Research Assistant in Chemical Engineering*
B.S., Drexel Institute of Technology, 1962.
- JOSEPH WADE BINGEMAN (1963) *Lecturer in Education, Coordinator of
Placement, Department of Education*
B.S., Franklin & Marshall, 1927; M.A., Columbia, 1934; D.Ed., Temple, 1944.
- STEPHEN EDWARD BLANKINSHIP (1963) *Graduate Assistant in Chemistry*
B.S., College of William and Mary, 1963.
- FREDERICK C. BLECK (1963) *Research Assistant in Psychology*
B.A., Michigan State, 1962.
- WILLIAM M. BLOCK (1962) *Research Assistant in Chemistry*
B.S., St. Peter's College, 1962.
- JOHN FRANCIS BONNER (1962) *Graduate Assistant in Mathematics*
B.A., LaSalle, 1962.
- IRVING JULIUS BOROWITZ (1962) *Assistant Professor of Chemistry*
B.S., City College of New York; 1951; M.A., Indiana University, 1952; Ph.D., Columbia, 1956.
- HENDERSON BAMPFIELD BRADDICK (1956, 1960) *Associate Professor of
International Relations*
A.B., University of Washington, 1942; LL.B., Harvard, 1949; Ph.D., University of Washington, 1957.
- FREDERICK ALDEN BRADFORD (1926, 1935) *Professor of Finance,
Head of the Department of Finance*
A.B., Michigan, 1921; M.A., 1923; Ph.D., 1926.
- FRANCIS MARIO BRADY, JR. (1955, 1957) *Assistant Professor of Accounting*
B.S., Drexel Institute of Technology, 1950; C.P.A., Pennsylvania, 1955; M.B.A., Lehigh, 1957.
- ELMER CLARK BRATT (1929, 1958) *Professor of Economics,
Head of the Department of Economics*
A.B., Nebraska, 1925; A.M., 1926; Ph.D., Wisconsin 1935; LL.D. (Hon.), Nebraska, 1955.
- ROBERT ALLEN BREAM (1947) *Associate Professor of Education*
B.S., Gettysburg, 1929; M.A., Columbia, 1933; Ed.D., Pennsylvania State, 1943.
- HOWARD EARLE BRECHT (1963) *Research Assistant in Civil Engineering*
B.S. in C.E., Drexel Institute of Technology, 1963.

- CHARLES WILFRID BRENNAN (1955, 1960).....*Associate Professor of Industrial Engineering, Associate Dean of the College of Engineering*
B.S., Alabama, 1934; M.B.A., 1952.
- IRA MARK BRINN (1961).....*Graduate Assistant in Chemistry*
B.S. in Chem., Bucknell, 1961.
- BRIAN GEORGE BROCKWAY (1963)*Assistant Professor of Business Law*
B.S., Northwestern, 1957; LL.B., Georgetown, 1961; LL.M., 1963.
- ARTHUR LIONEL BRODY (1957, 1963)*Associate Professor of Psychology*
B.A., George Washington, 1951; Ph.D., Indiana, 1956.
- *BARRY PHILIP BROUS (1963)*Research Assistant in Chemistry*
B.S., Adelphi University, 1962.
- DUDLEY CHAMBERLAIN BROWN (1962)*Graduate Assistant in English*
B.A., Marietta College, 1962.
- RICHARD MILLER BROWNELL (1963)*Lecturer in Electrical Engineering*
B.S., in Phys., Yale, 1951; M.Eng. in E.E., 1956; D.Eng., 1961.
- JOSEF MARIA BROZEK (1959, 1963)*Research Professor of Psychology*
Ph.D., Charles (Prague), 1937.
- HENRY POSEY BRUBAKER (1963)*Graduate Assistant in Government*
A.B., Franklin & Marshall, 1962.
- ARTHUR WILLIAM BRUNE (1952)*Assistant Professor of Civil Engineering*
B.S. in E.M., Missouri School of Mines, 1941; M.S. in E.M., 1946; Ph.D., Pennsylvania State, 1952; P.E. Missouri, 1947.
- RICHARD C. BRUSIE, JR. (1963)*Assistant Director of Public Information*
B.A., University of Connecticut, 1959.
- ANTHONY JOSEPH BRYSKI (1962)*Associate Professor of Economics*
B.S., Temple, 1940; M.A., New York University, 1948; Ph.D., 1957.
- JEAN PEARL BUCKINGHAM (1962)*Technical Assistant in Chemistry*
B.S., Moravian, 1956.
- RAYMOND COOLEY BULL (1923, 1944).....*Director Emeritus, University Health Service*
B.S., Colorado, 1904; A.B., Kansas, 1906; M.D., Jefferson Medical, 1909.
- JOHN JOSEPH BURBRIDGE, JR. (1962)*Research Assistant in Industrial Engineering*
B.S., Lehigh, 1962.
- DOUGLAS ALLAN BURGER (1959).....*Graduate Assistant in English*
A.B., Colorado State, 1959; M.A., Lehigh, 1962.
- LEO H. BURPEE (1963)*Assistant in Military Science*
Specialist Five, U.S.A.
- C. HARRY BUSH (1961)*Assistant Professor of Physical Education, Assistant Football Coach, Varsity Lacrosse Coach*
B.A., Western Maryland, 1950; M.Ed., Hofstra, 1957.
- ALLISON BUTTS (1916, 1957)*Professor Emeritus of Metallurgical Engineering*
A.B., Princeton, 1911; B.S., Massachusetts Institute of Technology, 1913.
- ROBERT EMMETT CAFFREY (1960).....*Lecturer in Metallurgical Engineering*
B.S., Pennsylvania State, 1949; Ph.D., 1955.
- CLARENCE BOWEN CAMPBELL (1955, 1959)*Associate Dean of Students, Director of Residence Halls*
B.A., Temple, 1937; M.A., Lehigh, 1947.
- NEIL CAROTHERS (1923, 1949).....*Dean Emeritus, College of Business Administration*
B.A., Arkansas, 1905; Dip. in Econ., Oxford, 1907; Ph.D., Princeton, 1916.

*Resigned, February 1, 1964.

18 Faculty and Staff

- JOHN S. CARTWRIGHT (1962)*Professor of Education*
A.B., Cornell University, 1927; M.A., New York University, 1942.
- JOHN H. CARY (1963)*Associate Professor of History,*
Head of the Department of History
B.S., University of Wisconsin, 1950; M.A., Pennsylvania State, 1951; Ph.D., University of Illinois, 1959.
- JAMES WILLIAM CASKEY (1961).....*Professor of Air Science*
B.A. in Pol. Science, California, 1958; Lt. Colonel, USAF.
- WARREN EDGAR CHASE (1963)*Graduate Assistant in Mathematics*
B.S., Franklin & Marshall, 1956; M.S., University of New Hampshire, 1962.
- KEITH E. CHAVE (1959, 1962)*Associate Professor of Geology,*
Director of the Marine Science Center
Ph.B., Chicago, 1948; M.S., 1951; Ph.D., 1952.
- CHIA TING CHEN (1961)*Research Assistant in Chemistry*
B.S., Taiwan Normal University, 1956.
- JOHN JOSEPH CHESSICK (1948, 1957).....*Research Assistant Professor of Chemistry*
B.S., Pennsylvania State, 1948; M.S., Lehigh, 1950; Ph.D., 1952.
- KEUNG-YUK CHEUNG (1962)*Graduate Assistant in Mathematics*
Dipl. of Sc., Chung Chi College (Hong Kong), 1962.
- GLENN JAMES CHRISTENSEN (1939, 1962).....*Provost and Vice-President,*
Professor of English
B.A., Wooster, 1935; Ph.D., Yale, 1939.
- WILLIAM THOMAS CHRISTIAN (1947, 1949).....*Assistant Professor of Physical*
Education, Varsity Swimming Coach, Varsity Soccer Coach,
Assistant Baseball Coach
B.S. in Ed., New Jersey State Teachers (Trenton), 1939; M.A., Lehigh, 1960.
- RICHARD JAY CHRISTOPHER (1962)*Research Assistant in Civil Engineering*
B.S. in C.E., Bradley University, 1962.
- MICHAEL ANTHONY CIAVARELLA (1963)*Counselor,*
Counseling and Testing Service
B.S., Pennsylvania State University, 1956; M.Ed., 1958; Ed.D., 1963.
- PETER JOHN CISTONE (1963)*Graduate Assistant in Education*
A.B., Muhlenberg, 1963.
- CURTIS ROBERT CLARK (1963)*Research Assistant in Geology*
A.B., Franklin & Marshall, 1963.
- CURTIS WILLIAM CLUMP (1955, 1960).....*Associate Professor of Chemical*
Engineering
B.S., Bucknell, 1947; M.S., 1949; Ph.D., Carnegie Institute of Technology, 1954.
- DONALD LARRABEE COCKBURN (1958).....*Assistant in Air Science*
B.S., Denver, 1951; Technical Sergeant, U.S.A.F.
- ALVIN COHEN (1962)*Assistant Professor of Economics*
B.A., George Washington University, 1953; M.B.A., Columbia, 1955; Ph.D. University of Florida, 1962.
- GEORGE POWELL CONARD II (1952, 1960).....*Professor of Metallurgical Engineering,*
Director of Magnetic Materials Laboratory
B.S., Brown, 1941; M.S., Stevens Institute of Technology, 1948; Sc.D., Massachusetts Institute of Technology, 1952.
- RENÉ CONCEPCION (1963)*Instructor in Romance Languages*
B.A., College of the City of New York, 1961.
- WRAY HOLLOWELL CONGDON (1934, 1961).....*Dean Emeritus*
B.A., Syracuse, 1914; M.A. (Engl.), 1915; M.A. (Ed.) Michigan, 1922; Ph.D., 1929.
- SAMUEL IRVIN CONNOR (1961).....*Director, Office of Public Information*
B.A., Lehigh, 1949.

- WILLIAM A. COOK (1963)*Graduate Assistant in English*
B.A., King's College, 1959; M.A., Lehigh, 1962.
- MICHAEL THOMAS COOLEY (1950, 1962).....*Assistant Professor of Physical Education,*
Varsity Football Coach
B.S. in Ed., Georgia, 1948.
- PETER BRUCE COOPER (1958, 1960).....*Research Instructor in Civil Engineering*
B.S., Lehigh, 1957; M.S., 1960.
- JOSEPH ARTHUR CORRADO (1963)*Research Assistant in Civil Engineering*
B.C.E., University of Detroit, 1963.
- RONALD R. COWDEN (1962)*Visiting Lecturer to the Marine Science Center*
B.S., Louisiana State, 1953; Ph.D. Vienna, 1956.
- RAYMOND GIBSON COWHERD (1946, 1963)*Professor of History*
A.B., William Jewell, 1933; M.A., Pennsylvania, 1936; Ph.D., 1940.
- SAMUEL LEE COZZENS (1954)*Research Associate in Chemistry*
B.S., Muhlenberg, 1954; M.S., Lehigh, 1956.
- GERARD EUGENE COZZOLINO (1960).....*Graduate Assistant in Mathematics*
B.A., Middlebury, 1959.
- EUGENE ARNOLD CRAIG (1960).....*Associate Professor of Psychology*
B.A., Tulsa, 1948; M.A., 1949; Ph.D., Colorado, 1950.
- WALTER HOWARD CRESSMAN (1963)*Instructor in Finance*
A.B. in Econ., Dickinson, 1961; M.B.A., Lehigh, 1963.
- CLOYD CRISWELL (1947, 1949)*Assistant Professor of English*
B.S. in Ed., Pennsylvania State Teachers (Millersville), 1933; M.A., New York, 1937.
- ROBERT JESSE CUNITZ (1962)*Research Assistant in Psychology*
B.A., Lehigh, 1962.
- JEROME MICHAEL CURRY (1962)*Graduate Assistant in English*
B.A., LaSalle College, 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,*
Head of the Department of Music, University Organist
A.B., Bucknell, 1934; M.A., Columbia, 1935.
- JEROME DAEN (1958, 1962)*Associate Professor of Chemistry*
B.Ch.E., City College of New York, 1950; Ph.D., Brooklyn Polytechnic Institute, 1955.
- MICHAEL ANTHONY D'APICE (1963)*Research Assistant in Civil Engineering*
B.C.E., Manhattan College, 1963.
- DAVID FRANCIS D'ATTILIO (1962)*Graduate Assistant in Economics*
B.S. in Econ., Villanova, 1962.
- WALTER EMIL DAHLKE (1964)*National Science Foundation Senior Visiting*
Professor of Electrical Engineering
Diploma, University of Berlin; Ph.D., University of Berlin, 1936; Ph.D., (habil)
University of Jena, 1939.
- HUGH LAWSON DAVIDSON (1963)*Research Assistant in Civil Engineering*
B.S. in C.E., University of Maryland, 1963.
- H. BARRETT DAVIS (1946, 1953).....*Professor of Speech, Head 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)*Part-time Instructor in Classical Languages*
B.S., Temple, 1938; M.A., Pennsylvania, 1960.

20 Faculty and Staff

- JOHN JOSEPH DEBARBADILLO (1963)*Research Assistant in Metallurgical Engineering*
B.S., Lehigh, 1963.
- CHARLES CURTIS DEININGER (1960).....*Business Officer, Department of Civil Engineering*
- ALBERT WILLIAM DE NEUFVILLE (1948, 1957).....*Associate Professor of Mechanics*
Dipl. Ing., Berlin, 1922; M.S., Stevens Institute of Technology, 1948; Ph.D., Lehigh,
- MARGARET LINN DENNIS (1953, 1954).....*Reference Librarian*
A.B., Allegheny, 1939; B.S. in L.S., Syracuse, 1940.
- ROBERT ALLEN DEPAUL (1961)*Research Assistant and Instructor in Metallurgical Engineering*
B.S., Lehigh, 1961; M.S., 1963.
- RAMANATHAN DHARMARAJAN (1963)*Research Assistant in Metallurgical Engineering*
B.Sc. (Met.E.), Banaras Hindu, 1961; M.S., Washington State, 1963.
- GERARD JOSEPH D'HUY (1962)*Research Assistant in Civil Engineering*
B.S. in C.E., Duke University, 1959.
- HERBERT MAYNARD DIAMOND (1927, 1962)*Acting Dean of the College of Business Administration* (to January 31, 1964); *Consultant to the Dean of Business Administration* (from February 1, 1964); *Professor of Economics*
B.A., Yale, 1914; Ph.D., 1917.
- ALFRED JAMES DIEFENDERFER (1961).....*Assistant Professor of Chemistry*
B.S., Pittsburgh, 1957; Ph.D., Massachusetts Institute of Technology, 1961.
- ALPHA ALBERT DIEFENDERFER (1902, 1946).....*Professor Emeritus of Quantitative Analysis and Assaying*
B.S. in Chem., Lehigh, 1902; M.S., 1908.
- WILLIAM ALBERT DIGEL (1960)*Graduate Assistant 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, 1954.
- *GEORGE HENRY DOTY (1960)*Director of Publications*
B.A., State University of Iowa, 1954.
- JAMES A. DOUGHERTY (1962)*Graduate Assistant in Chemistry*
B.S., Mount Union College, 1959; M.S., Purdue, 1962.
- 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, 1960).....*Research Associate Professor of Civil Engineering*
B.S. in C.E., Rutgers, 1950; M.S., Lehigh, 1952; Ph.D., 1958.
- JAMES WELLONS DUFTY (1963)*Graduate Assistant in Physics*
B.A., Williams, 1962.
- AURIE NICHOLS DUNLAP (1948, 1957).....*Associate Professor of International Relations*
A.B., Union (New York), 1929; A.M., Columbia, 1931; Ph.D., Columbia, 1955.
- JOHN BEST DURKEE (1962)*Graduate Assistant in Chemical Engineering*
B.S., Lehigh, 1962.
- NIKOLAI EBERHARDT (1962) ..*Research Associate Professor of Electrical Engineering*
Dipl. Engr., University of Munich, 1957; Ph.D., 1962.

*Resigned, December 31, 1963.

- EVELYN STRAWN EBERMAN (1955, 1957).....*Assistant Director of Residence Halls*
B.A., Swarthmore, 1921.
- *ARTHUR ROY ECKHARDT (1951, 1956)*Professor of Religion, Head of the Department of Religion*
B.A., Brooklyn, 1942; B.D., Yale, 1944; Ph.D., Columbia, 1947.
- **ANDREW J. EDMISTON (1957)*Supervisor, Counseling and Testing Service*
A.B., West Virginia Wesleyan, 1951; M.S., University of Miami, 1953; Ph.D., Pennsylvania State, 1960.
- JONATHAN BRITTON ELKUS (1957, 1960).....*Associate Professor of Music*
B.A., California, 1953; M.A., Stanford, 1954.
- RICHARD McELVAIN ELRICK II (1953, 1960).....*Research Assistant in Physics*
B.S. in M.E., Lehigh, 1951; M.S., 1955.
- RAYMOND JAY EMRICH (1946, 1958).....*Professor of Physics, Head of the Department of Physics*
A.B., Princeton, 1938; Ph.D., 1946.
- WILLIAM JOSEPH ENEY (1936, 1946).....*Joseph T. Stuart Professor of Civil Engineering, Head of the Department of Civil Engineering and Fritz Engineering Laboratory*
B.E., Johns Hopkins, 1927; M.S., Lehigh, 1938; P.E., Pennsylvania, 1939.
- JAMES VANDEUSEN EPPES (1940, 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 Mechanical Engineering*
Yuk Muh, Technical University of Istanbul, 1948; Ph.D., Lehigh, 1955.
- FIGRELLO DEL ROSARIO ESTUAR (1961, 1963)*Research Instructor in Civil Engineering*
B.S. in C.E., University of the Philippines, 1959; M.S. in C.E., Lehigh, 1962.
- WARREN WALTER EWING (1920, 1955)*Professor Emeritus of Physical Chemistry*
B.S., Parsons, 1912; M.S. Chicago, 1918; Ph.D., 1920.
- GEORGE DORMER FARNE (1927, 1945).....*Assistant Professor of Romance Languages*
A.B., Columbia, 1926; M.A., 1927.
- DOUGLAS DAVID FEAVER (1956, 1960).....*Associate Professor of Classical Languages*
B.A., Toronto, 1948; M.A., Johns Hopkins, 1949; Ph.D., 1951.
- ANTHONY JOSEPH FEDOR (1962)*Research Assistant in Chemical Engineering*
B.Ch.E., Fenn College, 1962; M.S. Lehigh, 1963.
- ROBERT JOSEPH FEENAN (1962)*Research Assistant in Civil Engineering*
B.S. in C.E., Drexel Institute of Technology, 1962.
- ANDREW BASIL FERRENTINO (1962)*Graduate Assistant in Mathematics*
B.A., Middlebury College, 1962.
- JACQUELINE MARIE FETSKO (1949, 1961).....*Assistant Research Director, National Printing Ink Research Institute*
B.A., Pennsylvania, 1946; M.S., Lehigh, 1953.
- HOWARD T. FIEDLER (1963)*Lecturer in Psychiatry*
B.S., University of Pittsburgh, 1926; Hahnemann Medical College, 1930; Diplomate in Psychiatry, American Board of Psychiatry and Neurology.
- FREDERIC N. FIRESTONE (1963)*Associate Professor of Economics*
B.A., Olivet College, 1948; M.S., Wisconsin, 1952; Ph.D., 1958.
- ***FRED JACK FISCH (1960, 1961)*Instructor in Mechanical Engineering*
B.S. in M.E., Lehigh, 1956; M.S. in M.E., 1960.

*On leave of absence, 1963-64.

**Resigned, August 31, 1963.

***Resigned, January 31, 1964.

22 Faculty and Staff

- 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.
- VELMER BERNEL FISH (1948, 1954) *Associate Professor of Chemistry*
B.S., Iowa State, 1936; Ph.D., 1942.
- JOHN WILLIAM FISHER (1961) *Research Instructor in Civil Engineering*
B.S. in C.E., Washington University; M.S., Lehigh, 1958; P.E., Illinois, 1961.
- ANNE STROWD FLANNERY (1960) *Assistant Librarian*
A.B., Duke, 1934; A.B. in L.S., Emory, 1942; M.A., Duke, 1945.
- CATHERINE RILEY FLECKSTEINER (1945, 1961) *Cataloger*
- DEAN A. FLINCHBAUGH (1962) *Graduate Assistant in Chemistry*
B.S., Lebanon Valley College, 1962.
- BRYAN VINCENT FLUCK (1963) *Senior Graduate Assistant in Education*
B.S., Millersville State College, 1948; M.Ed., Lehigh, 1963.
- ROBERT THOMAS FOLK (1961, 1963) *Associate 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.
- ROGER FORTIN (1963) *Graduate Assistant in History*
B.A., St. Francis College, 1962; M.A., University of New Hampshire, 1963.
- ROBERT DARROW FOUCHAUX (1963) *Assistant Professor of Physics*
B.A., Lehigh, 1956; B.S., in Eng.Phys., 1956; M.S., University of Illinois, 1958; Ph.D., 1963.
- ALAN SHIVERS FOUST (1952, 1962) *Professor of Chemical Engineering,
Dean of the College of Engineering*
B.S. in Ch.E., Texas, 1928; M.S., in Ch.E., 1930; Ph.D., Michigan, 1938; P.E., Michigan, 1947.
- JOHN JOSEPH FOX, JR. (1961) *Graduate Assistant in History*
B.S. in Ed., Massachusetts State College, North Adams, 1959.
- JAMES RICHARD FRAKES (1958) *Assistant 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.
- RAYMOND EUGENE FUESSLE (1953) *Chaplain of the University,
Associate Professor of Religion*
B.A., New York, 1930; B.D., Virginia Episcopal Theological Seminary, 1933.
- JOSE HUMBERTO FUEYO (1963) *Graduate Assistant in Physics*
B.S., Merrimack College, 1963.
- MERTON OTIS FULLER (1912, 1955) *Associate Professor Emeritus of
Civil Engineering*
C.E., Syracuse, 1910; M.S., Lehigh, 1934.
- KURT-PETER GAEDKE (1963) *Graduate Assistant in Civil Engineering*
B.S., Technische Hochschule, Stuttgart, 1961.
- THEODORE VICTOR GALAMBOS (1956, 1962) *Research Associate Professor
of Civil Engineering*
B.S., North Dakota, 1953; M.S., 1954; Ph.D., Lehigh, 1959; P.E., Pennsylvania, 1961.
- ROBERT TAYLOR GALLAGHER (1942, 1951) *Professor of Mining Engineering;
Assistant to the Director, Materials Research Center*
B.S. in E.M., Pennsylvania State, 1927; M.A. in Geol., Missouri, 1938; D.E.M., Colorado School of Mines, 1941; P.E., Colorado, 1940.

- *ALFREDO TENGONCIANG GANZON (1963)*Research Assistant in Chemistry*
B.S. in Ch.E., Manuel Luis Quezon University (Philippines), 1962.
- THEODORE MAX GARD (1962)*Graduate Assistant in Geology*
A.B., Franklin & Marshall, 1962.
- ARTHUR PARCEL GARDNER (1958)*Assistant Professor of German*
A.B., Duke, 1944; A.M., Harvard, 1945; Ph.D., 1950.
- JOHN DAVID GAVURA (1960)*Assistant in Air Science*
Technical Sergeant, U.S.A.F.
- MICHAEL W. GAYNOR (1963)*Research Assistant in Psychology*
B.A., Muhlenberg, 1962.
- JACOB MYER GEIST (1959)*Lecturer in Chemical Engineering*
B.S., Purdue, 1940; M.S., Pennsylvania State, 1942; Ph.D., Michigan, 1950.
- DAVID WILLIS GERRIDGE (1963)*Research Assistant in Civil Engineering*
B.S., Drexel Institute of Technology, 1963.
- BHASKAR KUMAR GHOSH (1961, 1963)*Associate Professor of Mathematics*
B.Sc., Calcutta (India) 1955; Ph.D., London, 1959.
- BARRY GILBERT (1963)*Graduate Assistant in Physics*
B.S., Brooklyn Polytechnic Institute, 1963.
- LEANOR RUTH GILBERT (1930, 1943)*Recorder*
- CLINTON HOWARD GILKEY (1963)*Graduate Assistant in Civil Engineering*
B.S., Bucknell, 1960.
- EDMUND JOE GION (1959)*Research Assistant in Physics*
B.A., Reed, 1959; M.S., Lehigh, 1961.
- LAWRENCE HENRY GIPSON (1924, 1952)*Research Professor Emeritus of History*
A.B., Idaho, 1903; B.A., Oxford, 1907; M.A., 1951; 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.
- GARY BERTRAM GLASS (1962)*Graduate Assistant in Geology*
B.S., Bucknell, 1962.
- ELMER WILLIAM GLICK (1949, 1952)*Treasurer*
B.A., Lehigh, 1933.
- WILLIAM MONROE GLOSE III (1960)*Assistant Accountant*
B.S. in Bus. Adm., Lehigh, 1958.
- STUART GOFF (1962)*Graduate Assistant in Mathematics*
B.S., California Institute of Technology, 1958; M.S., 1959.
- IRWIN STANLEY GOLDBERG (1963)*Graduate Assistant in Physics*
B.S. in E.E., Drexel Institute of Technology, 1963.
- ROBERT EDWARD GOLDSTEIN (1962)*Graduate Assistant in Civil Engineering*
B.S. in C.E., Rutgers, 1962.
- FREDERICK GOLL, JR. (1963)*Graduate Assistant in Biology*
B.S., Muhlenberg, 1958; M.S., Lehigh, 1960.
- ARTHUR FREEMAN GOULD (1947, 1953)*Professor of Industrial Engineering,*
Head of the Department of Industrial Engineering
S.B., Massachusetts Institute of Technology; 1938; M.S., Lehigh, 1949; P.E., Pennsylvania, 1949.
- WARREN GOULD (1957, 1962)*Director of Development*
B.A., George Washington, 1951; M.A., 1955.
- ROY WALTER GRABNER (1961)*Research Assistant in Chemical Engineering*
B.S. in Ch.E., Lehigh, 1961; M.S., 1963.

*Resigned, November 1963.

24 Faculty and Staff

- 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.
- CHARLES THEODORE GRANT (1963) *Graduate Assistant in Physics*
B.S., Yale, 1962.
- MANETH GRAVELL (1963) *Graduate Assistant in Biology*
B.S., Muhlenberg, 1959; M.S., Lehigh, 1963.
- MARGUERITE B. GRAVEZ (1957) *Instructor in Mathematics*
B.A., Hunter, 1950; M.A., Radcliffe, 1951.
- PAUL WILLIAM GREEN (1963) *Graduate Assistant in International Relations*
LL.B., Osgoode Hall Law School, 1962; LL.M., University of Michigan, 1963.
- DAVID MASON GREENE (1958) *Assistant Professor of English*
B.A., San Diego State, 1951; M.A., California, 1952; Ph.D., 1958.
- DONALD E. GREENE (1963) *Assistant in Military Science*
Staff Sergeant, U.S.A.
- *EDWARD STANISLAUS GREGOREK, JR. (1956) *Graduate Assistant in Chemistry*
B.S., Lehigh, 1954.
- **GEORGE WALTER GRIMM (1958, 1963) *Research Assistant in Physics*
B.S., Rochester, 1958; M.S., Lehigh, 1960.
- ROGER GRISMORE (1962) *Associate Professor of Physics*
B.S., University of Michigan, 1947; M.S., 1948; Ph.D., 1957.
- HOWARD DIETRICH GRUBER (1914, 1948) *Associate Professor Emeritus of Electrical Engineering*
E.E., Lehigh, 1909; M.S., 1923.
- MARY ELIZABETH GRUBER (1953, 1956) *Serials Cataloger*
B.A., Pennsylvania State, 1952; M.S. in L.S., Drexel Institute of Technology, 1953.
- 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) *Instructor in Mathematics*
B.S., City College of New York, 1949; M.A., Princeton, 1950.
- ALBERT LUTHER GUNDRUM (1956) *Lecture Assistant in Physics*
Fellow, American Guild of Organists.
- MICHAEL JOEL GURALNICK (1963) *Research Assistant in Psychology*
B.A., University of Michigan, 1962.
- JOSÉ ROBERTO GUZMÁN (1963) *Graduate Assistant in Spanish*
- ELLIS A. HAGSTROM (1962) *Assistant Professor of Education*
A.B., Colgate, 1950; A.M.T., Harvard, 1951; Ed.D., 1960.
- WALTER CHARLES HAHN, JR. (1963) *Assistant Professor of Metallurgical Engineering*
B.S. Met. Engr., Lafayette, 1952; M.S., Pennsylvania State, 1958; Ph.D., 1960.
- ***JOHN MCVICKAR HAIGHT, JR. (1949, 1953) *Assistant 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.

*Resigned, September 1963.

**Resigned, March 1, 1964.

***On leave of absence, 1963-64.

***On leave of absence, 1963-64.

- GEORGE FREDERICK HALFACRE (1956, 1960).....*Assistant Professor of Physical Education, Assistant Football Coach, Varsity Track Coach*
B.A., Lehigh, 1950; M.A., 1957.
- ROBERT J. HALL (1963).....*Instructor in Economics*
B.B.A., State University of Iowa, 1960; M.A., 1961.
- *ROBERT WILLIAM HALL (1902, 1942).....*Professor Emeritus of Biology*
Ph.B., Yale, 1895; A.B., Harvard, 1897; M.A., 1898; Ph.D., 1901.
- EDWARD JAMES HAMER (1962).....*Instructor in Physical Education, Freshman Wrestling Coach, Varsity Cross Country Coach, Golf Coach*
B.S. in Bus. Adm., Lehigh, 1960.
- FRED HANGA (1963).....*Assistant Professor of Economics*
A.B., Syracuse, 1957; M.A., New School for Social Research, 1959; Ph.D., Syracuse, 1963.
- WILLIAM CHARLES HANSELL (1960, 1961).....*Research Instructor in Civil Engineering*
B.S., Drexel Institute of Technology, 1957; M.S., Cornell, 1959.
- JOHN MELVIN HANSON (1960).....*Research Instructor in Civil Engineering*
B.S., South Dakota State, 1953; M.S. Iowa State, 1957; P.E., Colorado, 1960.
- **ROBERT JOHN HARDY (1961, 1962).....*Research Associate in Physics*
B.S., Reed, 1956; M.S., Lehigh, 1958; Ph.D., 1962.
- GEORGE DEWEY HARMON (1925, 1946).....*Professor of American History*
B.A., Duke, 1921; M.A., 1922; Ph.D., Pennsylvania, 1930.
- ROBERT AUSTIN HARRIER (1951).....*Executive Secretary, Alumni Association*
E.M., Lehigh, 1927.
- FREDERICK WILLIAM HARTMANN (1963).....*Graduate Assistant in Mathematics*
B.A., Lehigh, 1962.
- RONALD JOHN HARTRANFT (1963).....*Graduate Assistant in Mechanics*
B.S., Lehigh, 1963.
- ALBERT EDWARD HARTUNG (1947, 1961).....*Associate Professor of English*
B.A., Lehigh, 1947; M.A., 1949; Ph.D., 1957.
- JARED D. HASELTON (1960).....*Graduate Assistant in Geology*
B.S., St. Lawrence, 1959.
- EMIL ANDREW HAVACH (1941, 1949).....*Head Trainer*
D. Surg. Chiropr., Temple, 1936.
- PETER HAVAS (1946, 1954).....*Professor of Physics*
Absol., Technische Hochschule (Vienna), 1938; Ph.D., Columbia, 1944.
- WILBUR FRANK HAYES (1960).....*Research Assistant in Biology*
B.A., Colby, 1959; M.S., Lehigh, 1961.
- THOMAS MORRIS HAYNES (1952, 1961).....*Associate Professor of Philosophy*
A.B., Butler, 1941; M.A., Illinois, 1949; Ph.D., 1949.
- NORMAN DALE HAZZARD (1962).....*Graduate Assistant in Mathematics*
B.S., Anderson, 1963.
- STANLEY FREDERICK HEFFNER (1930, 1946).....*Manager of the Supply Bureau*
- GEORGE KENNETH HERB (1960).....*Graduate Assistant in Physics*
B.S., Muhlenberg, 1959; M.S., Lehigh, 1962.
- ELIZABETH ANNE HERBERT (1962).....*Research Assistant in Chemistry*
A.B., Immaculata College, 1962.

*Deceased, August 13, 1963.

**Resigned, December 1, 1964.

26 Faculty and Staff

- JOHN BRONISLAW HERBICH (1957, 1960)*Associate Professor of Civil Engineering*
B.Sc., Edinburgh, Scotland, 1949; M.S., Minnesota, 1957; Ph.D., Pennsylvania State University, 1963.
- PAUL THEODORE HERMAN (1960).....*Graduate Assistant in Physics*
B.S., Muhlenberg, 1960; M.S., Lehigh, 1962.
- SIDNEY SAMUEL HERMAN (1962)*Assistant Professor of Biology*
B.S., Georgetown University, 1953; M.S., Rhode Island, 1958; Ph.D., 1962.
- JOHN WILLIAM HERRMANN (1961)*Research Assistant in Physics*
B.S., Providence, 1961; M.S., Lehigh, 1963.
- HANSMARTIN PETER HERTLEIN (1961, 1962)*Instructor in Electrical Engineering*
Dipl. Ing., Munich Institute of Technology, 1959; M.S. in E.E., Lehigh, 1962.
- JOHN ATLEE HERTZ (1945, 1958)*Assistant Professor of English,*
Director of Adult Education
A.B., Moravian, 1938; M.A., Lehigh, 1947; Ph.D., 1958.
- ARTHUR HESS II (1962)*Assistant in Air Science*
Staff Sergeant U.S.A.F.
- *JOHN WILLIAM HIGHFIELD (1961)*Assistant to the Executive Secretary,*
Alumni Association
B.A., Lehigh, 1961.
- PHILIP G. HILAIRE (1963)*Lecturer in Education*
B.A., Moravian, 1948; M.A., Lehigh, 1951.
- DONALD JOHN HILLMAN (1960, 1963)*Associate Professor of Philosophy,*
Head of the Department of Philosophy
B.A., Cambridge (England), 1955; M.A., 1959; M.Litt., 1962.
- WALDO RALPH HILTON (1963)*Research Assistant in Philosophy*
B.A., Lehigh, 1963.
- CARL B. HOFFMAN (1963)*Part-time Lecturer in Education*
B.A., Ursinus College, 1943; M.A., University of Pennsylvania, 1947; M.S., 1956; Ph.D., 1960.
- RICHARD BRUCE HOFFMAN (1962).....*Graduate Assistant in Physics*
B.S. in Eng. Phys., Lehigh, 1962; M.S., 1963.
- ROBERT MARK HOLCOMBE (1963)*Assistant Director of Development*
B.S., Lehigh, 1958.
- WILLIAM FOWLER HOLLABAUGH (1960).....*Instructor in Electrical Engineering*
B.S. in E.E., Lehigh, 1959; M.S. in E.E., 1960.
- LAWRENCE ROZIER HOLLAND (1960, 1962)*Assistant Professor of Physics*
A.B., Harvard, 1952; M.A., Bryn Mawr, 1957; Ph.D., 1962
- FRANK SCOTT HOOK (1952, 1957).....*Associate Professor of English*
A.B., Missouri, 1942; M.A., 1947; Ph.D., Yale, 1952.
- LADD E. HOOVER (1960).....*Assistant Director, University Health Service*
B.S., Nebraska, 1924; M.D., 1926.
- RICHARD HENRY HOPKINS (1963)*Research Assistant in Metallurgical*
Engineering
B.S., Lehigh, 1963.
- ROBERT HAZEN HOPKINS (1959, 1961).....*Assistant Professor of English*
B.A., Kalamazoo, 1951; M.A., Pennsylvania, 1954; Ph.D., 1961.
- DONALD DAVID HORINE (1962)*Instructor in Journalism*
B.S. in J., Northwestern, 1959; M.S. J., 1960.

*Resigned, September 1, 1963.

- BENJAMIN KENT HOUGH (1960).....*Professor of Civil Engineering*
B.S. in C.E. Massachusetts Institute of Technology, 1928; M.S. in C.E., 1932; P. E., New York, 1937.
- CHUAN-CHIH HSIUNG (1952, 1960)*Professor of Mathematics*
B.S., National Chekiang (China), 1936; Ph.D., Michigan State, 1948.
- CORNIE LEONARD HULSBOS (1960).....*Research Professor of Civil Engineering*
B.S., Iowa State, 1941; M.S., 1949; Ph.D., 1953; P.E., Iowa, 1954.
- WILLIE P. ISAACS (1962)*Assistant Professor of Civil Engineering*
B.S. in C.E., Mississippi State University, 1958; M.S. in San Eng., Virginia Polytechnic Institute, 1961; P.E., Virginia, 1962.
- R. DORESWMY IYENGAR (1962)*Research Associate in Chemistry*
B.Sc., University of Mysore (India), 1951; M.Sc., University of Madras (India), 1954; Ph.D., University of Miami, 1962.
- RALPH JAMES JACCODINE (1960).....*Lecturer in Metallurgical Engineering*
B.S., United States Naval Academy, 1947; M.S., Stevens Institute of Technology, 1952; Ph.D., Notre Dame, 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.
- EUSTACE ANTHONY JAMES (1962)*Instructor in English*
A.B., Princeton, 1958; M.A., Pennsylvania, 1960.
- *EDWARD JOHN JARLONOWSKI (1959, 1961) ..*Instructor in Metallurgical Engineering*
B.S., Virginia Polytechnic Institute, 1956; M.S., Lehigh, 1961.
- JURIS JAUNTIRANS (1962)*Research Assistant in Civil Engineering*
B.S. in C.E., Drexel Institute of Technology, 1962.
- RALPH ALBERT JELIC (1961, 1962)*Assistant Professor of Physical Education,*
Assistant Varsity Football Coach,
Varsity Tennis Coach, Supervisor of Weight Room
B.A., Pittsburgh, 1958.
- 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, 1964)*Professor of Economics*
A.B., Southern California, 1934; M.A., 1935; Ph.D., 1940
- ROBERT LEE JOHNSTONE (1962)*Graduate Assistant in English*
B.S.Ed., Bloomsburg State College, 1961.
- DUDLEY MARTIN JONES (1963)*Graduate Assistant in Mechanical Engineering*
B.S., Lehigh, 1963.
- GLYNWR DESMOND ANTHONY JONES (1962)*Graduate Assistant in International Relations*
B.Sc. in Econ., University of London, 1962.
- CAREY BONTHRON JOYNT (1951, 1960)*Professor of International Relations,*
Head of the Department of International Relations
B.A., Western Ontario, 1945; M.A., 1948; Ph.D., Clark, 1951.
- ***PETEE BETH JUNG (1962)*Instructor in Mathematics*
A.B., Hunter, 1956; M.S., Emory, 1958.
- BRUCE NORMAN KALISER (1963)*Graduate Assistant in Geology*
B.Sc., Reading University (England), 1963.

*Resigned, October 15, 1963.

**On leave of absence, second semester 1963-64.

***Resigned, January 31, 1964.

28 Faculty and Staff

- RICHARD JEROME KALISH (1962, 1963)*Assistant Professor of Economics*
B.S., North Carolina State College, 1954; B.S., Oregon State, 1959; M.F., 1959; Ph.D.,
University of Colorado, 1963.
- GEORGE EUGENE KANE (1950, 1960).....*Associate Professor of Industrial*
Engineering
B.S., Pennsylvania State, 1948; M.S., Lehigh, 1954; P.E., Pennsylvania, 1955.
- RICHARD DAVID KANE (1962)*Graduate Assistant in History*
B.S., Temple, 1961; M.A., 1962.
- JOHN J. KARAKASH (1946, 1956)*Distinguished Professor of Electrical Engineering,*
Head of the Department of Electrical Engineering
B.S. in E.E., Duke, 1937; M.S. in E.E., Pennsylvania, 1938; P.E., Pennsylvania, 1948.
- CHETAN LALCHAND KARNA (1963)*Instructor in Mechanics*
B.E., College of Engineering, Poona (India), 1953; M.S. in M.E., Lehigh, 1960; M.S.
in Appl. Mech., 1960.
- MUMTAZ K. KASSIR (1963)*Research Assistant in Mechanics*
B.Sc., University of Manchester (England), 1957; M.S., Stanford, 1962.
- WELLS HAMILTON KEDDIE (1961).....*Instructor in Economics*
B.A., Stanford, 1948.
- JOHN DANIEL KEEFE (1955).....*Instructor in Economics*
B.S., Lehigh, 1948; M.A., Miami (Florida), 1955.
- GEORGE R. KEISER (1962)*Graduate Assistant in English*
B.A., Lehigh, 1962.
- ROSALIE BROOKS KELSEY (1963)*Graduate Assistant in Chemistry*
A.B., Randolph-Macon Woman's College, 1963.
- ROBERT PAUL KERFOOT (1962)*Graduate Assistant in Civil Engineering*
B.S., Iowa State University, 1962.
- CLARENCE DAVID KERN (1962)*Graduate Assistant in Mathematics*
B.S. in Ed., East Stroudsburg State College, 1958; M.A., Lehigh, 1960.
- *SAMIR ANTON KHABBAZ (1960)*Assistant Professor of Mathematics*
B.A., Bethel College, 1954; M.A., Kansas, 1956; Ph.D., 1960.
- PAUL KICSKA (1963)*Research Assistant in Physics*
B.S., Muhlenberg, 1958; M.S., Lehigh, 1960.
- JERRY PORTER KING (1962)*Assistant Professor of Mathematics*
B.S. in E.E., University of Kentucky, 1957; M.S. in Math., 1958; Ph.D. 1962.
- KENNETH CARLTON KIRBY, JR. (1963)*Graduate Assistant in Chemistry*
B.S., Rutgers University, 1963.
- JOHN A. KLIMEK (1962)*Graduate Assistant in Chemistry*
B.S., King's College, 1962.
- GEORGE CHARLTON KLINGMAN (1963)*Graduate Assistant in Mathematics*
B.S., Juniata College, 1963.
- BYRON HORTON KNAPP (1961).....*Graduate Assistant in Biology*
B.S., Columbia, 1956; M.A., 1958.
- JANE M. KNAUERHASE (1962)*Assistant in Economics*
B.S., Temple, 1956; M.S., 1961.
- **RAMON KNAUERHASE (1960)*Instructor in Economics*
A.B., Temple, 1957; M.A., Pennsylvania, 1961.
- CARL JACOB KNAUSS, JR. (1954, 1961).....*Research Associate in Chemistry*
B.S., Kansas State, 1952; M.S., 1953.

*On leave of absence, 1963-64.

**Resigned, September 1, 1963.

- REINHARD HEINRICH KNERR (1962)*Graduate Assistant in Electrical Engineering*
Dipl., Rheinisch-Westfälische Technische Hochschule, Aachen (Germany), 1960; Dipl.
d'Ing., Ecole Nationale d'Electrotechnique, d'Electronique et d'Hydraulique, Toulouse
(France), 1962.
- JERE B. KNIGHT (1957).....*Research Assistant in History*
B.A., Pennsylvania, 1929; M.A., 1930.
- ALFRED PAUL KOCH (1946, 1961).....*Professor of Accounting*
B.S., Pennsylvania State College (Bloomsburg), 1939; M.S., Bucknell, 1940; C.P.A.,
Pennsylvania, 1952.
- JUN KONDO (1961).....*Research Assistant in Civil Engineering*
B.A., Osaka University (Japan), 1958; M.E., 1960.
- RALPH WAYNE KRAFT (1962)*Associate Professor of Metallurgical Engineering*
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)*Assistant 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)*Assistant Professor of Metallurgical Engineering*
B.S. in Met.E., Lehigh, 1955; M.S., Massachusetts Institute of Technology, 1958;
Sc.D., 1961.
- 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.
- *SHERMAN ROY KRUPP (1961, 1962)*Associate Professor of Finance*
B.A., Brooklyn College, 1949; Ph.D., University of California, 1960.
- THOMAS CHARLES KUBELIUS (1948, 1957).....*Associate Professor of Business Law*
B.S., Illinois, 1945; LL.B., 1947.
- GUNNAR KULLERUD (1962)*Visiting Lecturer in Geochemistry*
M.S.C., Technical University (Norway), 1946; Ph.D., University of Oslo (Norway),
1948; D.Sc., 1954.
- ALBERT BARRY KUNZ (1962)*Graduate Assistant in Physics*
B.S., Muhlenberg, 1962; M.S., Lehigh, 1964.
- GEORGE WALLACE KYTE (1946, 1951).....*Associate Professor of History*
A.B., California, 1940; M.A., 1941; Ph.D., 1943.
- GARY BERNARD LAISON (1961).....*Instructor in Mathematics*
B.A., Pennsylvania, 1958; M.A., 1960.
- MILES LANDRUM LAMPSON (1963)*Graduate Assistant in Physics*
B.A., Franklin & Marshall, 1963.
- MICHAEL WILLIAM LAPORTA (1961).....*Instructor in Physical Education,*
Assistant Trainer
B.S., East Stroudsburg State College, 1959.
- PETER AMBROSE LAPPAN, JR. (1962, 1963)*Assistant Professor of Mathematics*
A.B., Princeton, 1957; M.S., University of Notre Dame, 1959; Ph.D., 1963.
- ARTHUR IRVING LARKY (1954, 1960).....*Associate Professor of Electrical Engineering*
B.S., Lehigh, 1952; M.S., Princeton, 1953; Ph.D., Stanford, 1957.

*On leave of absence, 1963-64.

30 Faculty and Staff

- VORIS V. LATSHAW (1931, 1947).....*Associate Professor of Mathematics*
B.A., Indiana, 1927; A.M., 1928; Ph.D., 1930.
- JOSEPH ARTHUR LAVELLE (1963)*Research Assistant in Chemistry*
B.S., University of Scranton, 1958.
- MAXWELL GORDON LAY (1961, 1963)*Research Instructor in Civil Engineering*
B.C.E., Melbourne University (Australia), 1958; M. Eng. Sci., 1960.
- ROBERT E. LAYDEN*Teaching National Defense Education Act
Fellow in English*
B.A., Boston College, 1962.
- *ANTHONY OSBORNE LEACH II (1962)*Instructor in Classical Languages*
A.B., Bowdoin, 1960; M.A., Pennsylvania, 1961.
- WILLIAM BADER LECKONBY (1946, 1962).....*Professor of Physical Education,
Director of the Division of Athletics and Physical Education*
B.S., St. Lawrence, 1939.
- 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)*Senior Graduate Assistant in Education*
B.S., Kutztown State College, 1959; M.A., Lehigh, 1961.
- JOHN DOUGLAS LEITH (1945, 1958).....*Dean of Students*
A.B., North Dakota, 1920; A.M., Columbia, 1924.
- WILLIAM C. LENNOX (1963)*Instructor in Mechanics*
B.A.Sc., University of Waterloo, 1962; M.Sc., 1963.
- **LAWRENCE ALBERT LEONARD (1962)*Associate Professor of Economics*
B.S., University of Kansas, 1948; M.S. Kansas State University, 1952; Ph.D., Cornell University, 1956.
- ***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.
- STEPHEN BARRY LEONARD (1963)*Graduate Assistant in Mathematics*
A.B., Middlebury College, 1963.
- WILLIAM C. LENNOX (1963)*Instructor in Mechanics*
B.A.Sc., University of Waterloo, 1962; M.Sc., 1963.
- STANLEY SYLVAIN LEROY (1962)*Graduate Assistant in Mathematics*
B.S., Manhattan College, 1962.
- SANDER ALVIN LEVY (1962)*Research Assistant and Instructor in
Metallurgical Engineering*
B.S., Lehigh, 1962; B.A., 1962; M.S., 1963.
- HAI SANG LEW (1962)*Research Assistant in Civil Engineering*
B.S., Washington University, 1960.
- JOSEPH FRANCIS LIBSCH (1946, 1960)*Professor of Metallurgical Engineering,
Head of the Department of Metallurgical Engineering,
Director of the Materials Research Center*
B.S., M.S., Massachusetts Institute of Technology, 1940; Sc.D., 1941; P.E., Pennsylvania, 1947.
- ELIZABETH K. LIDICOAT (1963)*Graduate Assistant in Education*
B.S., West Chester State College, 1959; M.A., Lehigh, 1961.

*Resigned, August 31, 1963.

**On leave of absence, 1963-64.

***On leave of absence, 1963-64 and first semester of 1964-65.

- JOHN ORTH LIEBIG, JR. (1946, 1955).....*Associate Professor of Civil Engineering*
B.S., Lehigh, 1940; M.S., 1949; P.E. Pennsylvania, 1951.
- BARRY MURRAY LINDER (1963)*Research Assistant in Civil Engineering*
B.S., University of Manitoba, 1963.
- *CLYDE BRUCE LINDSLEY (1960)*Assistant Director of Public Information*
B.A., Drew, 1959.
- JONG-DING LIU (1962)*Research Assistant in Mathematics*
B.Sc., Taiwan Normal, 1955; M.S., Lehigh, 1963.
- THEODORE CHARLES LODER III (1962)*Graduate Assistant in Marine Science*
B.A., University of Rochester, 1962.
- **MANFRED LOHRMANN (1962)*Research Assistant in Civil Engineering*
Dipl.Ing., Stuttgart Technische Hochschule (Germany), 1962.
- DONALD PAUL LOOKINGBILL (1963)*Graduate Assistant in Chemistry*
B.S. in Chem., Lehigh, 1963.
- NARENDRA PAUL LOOMBA (1962, 1963)*Professor of Management*
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.
- RALPH H. LONG, JR. (1963)*Professor of Mechanical Engineering,
Head of the Department of Mechanical Engineering*
B.S., Tufts College, 1943; M.Eng., Yale, 1948; D.Eng., 1952; P.E., Maryland, 1954.
- MICHAEL L. LOSEE (1963)*Graduate Assistant in Chemistry*
B.A., Dartmouth, 1963.
- ROLAND WILLIAM LOVEJOY (1962)*Assistant Professor of Chemistry*
B.A., Reed College, 1955; Ph.D., Washington State University, 1960.
- ROGER P. LOVELL (1963)*Instructor in German and Russian*
B.A., Kent State, 1959.
- LE-WU LU (1957, 1961)*Research Assistant Professor of Civil Engineering*
B.S., National Taiwan, 1954; M.S., Iowa State, 1956; Ph.D., Lehigh, 1960.
- ROBERT ALAN LUCAS (1958, 1959).....*Instructor in Mechanical Engineering*
B.S. in M.E., Lehigh, 1957; M.S., 1959.
- YIU-KWAN LUI (1959).....*Research Assistant in Chemistry*
B.S., Chung Chi College, 1959; M.S., Lehigh, 1961.
- JAMES DECKER MACK (1946, 1950).....*Librarian*
B.A., Lehigh, 1938; M.A., 1949.
- FREDERICK T. MACKENZIE (1963)*Visiting Lecturer in Marine Geology*
B.S., Upsala, 1955; M.S., Lehigh, 1959; Ph.D., Lehigh, 1962.
- ***CARL HALFORD MADDEN (1960)*Professor of Economics*
B.A., Virginia, 1942; M.A., 1952; Ph.D., 1954.
- DAVID A. MAGEE (1962)*Research Assistant in Civil Engineering*
B.S. in C.E., Virginia Military Institute, 1962.
- THEODORE JACK MAHAFFEY (1960).....*Assistant in Air Science*
Staff Sergeant, U.S.A.F.
- RICHARD GRIFFITH MALSBERGER (1959, 1962)*Associate Professor of Biology*
B.A., Lehigh, 1948; M.S., 1949; Ph.D., 1958.
- DONALD G. MARION (1962)*Research Assistant in Chemistry*
A.B., Brooklyn College, 1962.
- PAUL MARX (1963)*Instructor in English*
A.B., Michigan, 1953; M.F.A., Iowa, 1957.

*Resigned, September 1, 1963.

**Resigned, January 27, 1964.

***Resigned, September 1, 1963.

32 Faculty and Staff

- JAMES PATRICK MATHEWS (1947).....*Physiotherapist, University Health Service*
- JOSEPH ABELE MAURER (1947, 1956).....*Associate Professor of Classical Languages,
Head 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.
- 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.
- JAMES FRANCIS McCUE (1961, 1962).....*Assistant Professor of Philosophy*
A.B., Xavier University, 1955; M.A., Loyola University, 1958; Ph.D., Wisconsin, 1961.
- *JOSEPH BRENDAN MCFADDEN (1948, 1961)*Professor of Journalism,
Head 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.
- HUGH FRANCIS McKEEGAN (1964)*Part-Time Lecturer in Education*
B.S., St. Vincent College, 1948; M.S., University of Pittsburgh, 1951; Ed.D., 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.
- BETHA DEROTHER McMILLAN, JR. (1962)*Graduate Assistant in Mathematics*
B.S., Lehigh, 1962.
- CHARLES PATRICK McTIGUE (1963)*Assistant Instructor in Military Science*
Staff Sergeant, U.S.A.
- ANDRE T. MEADE (1963)*Instructor in Education*
B.A., Montclair State College, 1956; M.A., 1961.
- NORMAN PAUL MELCHERT (1962)*Instructor in Philosophy*
B.A., Wartburg College, 1955; B.D., Lutheran Theological Seminary, 1958;
M.A., Pennsylvania, 1959.
- JOSEPH ROBERT MERKEL (1962)*Associate Professor of Biochemistry*
B.S., Moravian, 1948; M.S., Purdue, 1950; Ph.D., University of Maryland, 1952.
- ARCHIE ROSCOE MILLER (1922, 1961).....*Professor Emeritus of Electrical Engineering*
B.S. in E.E., Illinois, 1918; M.S., Lehigh, 1925.
- DICK MORRISON MILLER (1961).....*Research Assistant in Civil Engineering*
B.S., Washington University, 1961.
- **MALCOLM FAY MILLER (1961)*Assistant Director of Development*
A.B., Princeton, 1958.
- PAUL THEODORE MILLER (1961).....*Assistant Superintendent of
Buildings and Grounds*
- RICHARD J. MILLER (1959)*Graduate Assistant in Chemistry*
B.S., Union, 1959.
- THEODORE MILLON (1954, 1959).....*Associate Professor of Psychology*
B.S., City College of New York, 1949; M.A., 1950; Ph.D., Connecticut, 1953.

*On leave of absence, 1963-64.

**Resigned, September 1, 1963.

- SAMUEL HAROLD MISSIMER (1950, 1962)*Director of Admission*
B.A., Lehigh, 1950.
- PAUL MOSES MOISIADES (1962)*Graduate Assistant in English*
B.A., Lycoming College, 1961.
- RICHARD ALLEN MOLL (1962)*Instructor and Research Assistant in*
Metallurgical Engineering
B.S., Illinois Institute of Technology, 1962.
- ALBERT CHARLES MOLTER (1960)*Purchasing Agent*
B.S., Norwich, 1928.
- SUTTON MONRO (1959)*Associate Professor of Industrial Engineering*
B.S., Massachusetts Institute of Technology, 1942.
- CARL LELAND MOORE (1948, 1963)*Professor of Accounting*
A.B., Bucknell, 1943; M.A., Pittsburgh, 1948; C.P.A., Pennsylvania, 1952.
- DOROTHY HELEN MORAN (1962)*Graduate Assistant in Computing Laboratory*
B.A., Mount Saint Mary, 1962.
- ROBERT PATTISON MORE (1916, 1956)*Dean Emeritus of the College of*
Arts and Science
B.A., Lehigh, 1910; M.A., Harvard, 1913.
- CHARLES DAVID MORGAN (1960)*Instructor in Mechanical Engineering*
M.E., Stevens Institute of Technology, 1956; M.S. in M.E., Rensselaer Polytechnic
Institute, 1960.
- STANLEY MORGANSTEIN (1962)*Graduate Assistant in Psychology*
B.S., Brooklyn College, 1962.
- JOHN RODGERS MORONEY, JR. (1963)*Instructor in Economics*
B.A., Southern Methodist University, 1960.
- PETER JOSEPH MOROZ, JR. (1963)*Research Assistant in*
Metallurgical Engineering
B.S., Lehigh, 1963.
- THOMAS HENRY MORRILL (1962)*Graduate Assistant in Physics*
B.S., Worcester Polytechnic Institute, 1962.
- 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)*Research Assistant in Civil Engineering*
B.S., Manhattan, 1958; M.S., Lehigh, 1960.
- LARRY ROBERT MUGRIDGE (1962)*Graduate Assistant in Mathematics*
B.A., Wartburg College, 1962.
- JAMES WIGHT MUIR (1963)*Graduate Assistant in Industrial Engineering*
B.S. in M.E., University of Rochester, 1963.
- HUGH DONALD MURPHY (1962)*Research Assistant in Civil Engineering*
B.C.E., Manhattan College, 1962.
- JOHN WAYNE MURPHY (1962)*Assistant Director of Publications*
B.S., Marshall University, 1959; M.A., State University of Iowa, 1962.
- PAUL BENTON MYERS, JR. (1962)*Assistant Professor of Geology*
A.B., Colgate, 1955; M.S., Lehigh, 1957; Ph.D., 1960.
- RAYMOND REEVER MYERS (1950, 1961)*Research Professor of Chemistry*
B.A., Lehigh, 1941; M.S., Tennessee, 1942; Ph.D., Lehigh, 1952.
- KHALID NAEEM (1963)*Graduate Assistant in Mathematics*
B.S., Peshawar (Pakistan), 1956; M.S., 1961.
- NADIGAR RAMARAO NAGARAJARAO (1961)*Research Assistant in Civil Engineering*
B.E., University of Mysore (India), 1956; M.S., University of Madras (India), 1957;
M.S., Lehigh, 1960.

34 Faculty and Staff

- JAMES STEWART NAGLE (1962)*Graduate Assistant in Geology*
B.S., Lehigh, 1962.
- VIKAS V. NAIK (1963)*Graduate Assistant in Mechanics*
B.S. in M.E., University of Poona (India), 1962.
- KRISHNASWAMY SATYA NARAYAN (1963)*Research Associate in Chemistry*
B.Sc., University of Mysore (India), 1955; M.Sc., Indian Institute of Science, 1956;
Ph.D., 1962.
- RONALD SALVATORE NARZISI (1963)*Senior Graduate Assistant in Education*
B.A., Moravian, 1961; M.Ed., Lehigh, 1963.
- RODOLFO BAUTISTA NAVIDAD (1963)*Research Assistant in Chemistry*
B.S.Ch.E., Mapua Institute of Technology, 1959.
- TIMOTHY LING-SUNG NEE (1962)*Graduate Assistant in Physics*
Dipl. in E.E., Taiwan Provincial Taipei Institute of Technology (Formosa), 1958.
- CHARLES HENRY NEHF, JR. (1964)*Graduate Assistant in Electrical Engineering*
B.S. in E.E., Massachusetts Institute of Technology, 1961.
- A. CONRAD NEUMANN (1961, 1963)*Assistant Professor of Marine Geology*
B.S., Brooklyn, 1955; M.S., Agricultural and Mechanical College of Texas, 1958;
Ph.D., Lehigh University, 1963.
- HARVEY ALEXANDER NEVILLE (1927, 1961)*President*
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.
- BENJAMIN EDWARD NEVIS (1960, 1962)*Instructor in Mechanical Engineering*
B.S., in M.E., Lehigh, 1955; M.S. in M.E., 1960.
- AKIYO NISHINO (1963)*Research Assistant in Psychology*
B.A., Tokyo University of Education, 1961.
- FUMIO NISHINO (1961)*Research Assistant in Civil Engineering*
B.S., University of Tokyo, 1959; M.S., 1961.
- *WELDON NORMAN NIVA (1960)*Assistant Professor of English*
B.A., Montana, 1952; M.A., Pennsylvania, 1957; Ph.D., 1959.
- RAYMOND EDGAR NOONAN (1962)*Graduate Assistant in Computing Laboratory*
B.S., Lehigh, 1962.
- ROBERT WARREN NUMBERS (1960)*Superintendent of Buildings and Grounds*
B.S. in C.E., Lehigh, 1950.
- ENVER ODAR (1962)*Research Assistant in Civil Engineering*
B.Sc., Middle East Technical University (Turkey), 1962.
- THOMAS J. O'DONNELL (1964)*Graduate Assistant in Mechanical Engineering*
B.S. in M.E., Manhattan College, 1963.
- KOICHI OGAWA (1963)*Research Assistant in Civil Engineering*
B.S., Waseda University, 1963.
- CYRUS JOHN OHNMACHT, JR. (1962)*Graduate Assistant in Chemistry*
B.S., Muhlenberg, 1961.
- **JOHN FRANCIS O'LEARY, JR. (1958)*Instructor in Economics*
B.S., Villanova, 1955; M.B.A., Pennsylvania, 1959.
- JOHN FURNIFOLD O'NEAL (1959)*Assistant Professor of Education*
B.S., North Carolina, 1950; M.Ed., 1952; Ph.D., Cornell, 1961.
- ***FELICISIMO SALAZAR OPLE, JR. (1960)*Research Assistant in Civil Engineering*
B.S., University of the Philippines, 1958; M.S. in C.E., Lehigh, 1960.

*Resigned, September 1, 1963.

**Resigned, September 1, 1963.

***Resigned, November 15, 1963.

- 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. — ABEPPH — Clin.
- POLLY FISHER ORSAGH (1961) *Assistant Reference Librarian*
A.B., Wilson, 1950; M.S. in L.S., Drexel Institute of Technology, 1953.
- THOMAS JAMES ORSAGH (1957) *Instructor in Economics*
B.S., Pennsylvania, 1954; M.A., 1958.
- 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) *Visiting Research Associate in Physics*
B.S., University of Tokyo, 1944; D.Eng., 1961.
- ALEXIS OSTAPENKO (1957, 1961) *Associate 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.
- JERZY ANTONI OWCZAREK (1960) *Associate 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.
- RUTH COSGROVE PACE (1948, 1962) *Acquisitions Librarian*
B.A., Moravian, 1941; B.S. in L.S., Carnegie Library School, 1942; M.A., Lehigh, 1951.
- ANTHONY PACKER (1946, 1950) *Assistant Professor of Physical Education, Varsity Basketball Coach, Varsity Baseball Coach, Supervisor of Athletic Fields*
B.S., St. Lawrence, 1938.
- NICHOLAS J. PAGANO (1963) *Part-time Instructor in Mechanics*
B.S., Drexel Institute of Technology, 1955; M.S., 1961.
- LORRAINE ZELINDA PAOLINI (1963) *Graduate Assistant in Education*
A.B., Immaculata College, 1962.
- NOOTAN PAREKH (1964) *Graduate Assistant in Electrical Engineering*
B.S. in E.E., University of Wisconsin, 1962.
- BALMUKUND PRABHULAL PARIKH (1963) *Research Assistant in Civil Engineering*
B.E., Gujarat University, 1960; M.S.E., University of Michigan, 1962.
- PAUL C. PARIS (1955, 1963) *Associate 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, Head of the Department of Biology*
S.B., Massachusetts Institute of Technology, 1933; A.M., Harvard, 1935; Ph.D., Massachusetts Institute of Technology, 1939.
- PRESTON PARR (1949, 1956) *Associate Dean of Students*
B.S. in Ch.E., 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, 1962.
- HARRY GORDON PAYROW (1916, 1950) *Associate Professor Emeritus of Sanitary Engineering*
B.S. in C.E., Tufts, 1907.
- WILLARD JOHN PEARCE (1962) *Associate Professor of Electrical Engineering*
B.S., Florida Southern University, 1942; Ph.M., University of Wisconsin, 1945; Ph.D., 1950.

36 Faculty and Staff

- ALAN WIGGINS PENSE (1957, 1962) *Assistant Professor of Metallurgical Engineering*
B.S. in Met.E., Cornell, 1957; M.S., Lehigh, 1959; Ph.D., 1962.
- ARMAND BENJAMIN PERLMAN (1963) *Graduate Assistant in Mechanics*
B.S., Lehigh, 1961; M.S., Stanford, 1962.
- JOSEPH ANTHONY PERNA (1961) *Instructor in Mechanics*
B.S. in E.E., Drexel Institute of Technology, 1944; M.S. in M.E., Pennsylvania, 1946.
- MARIO PETRICH (1963) *Assistant Professor of Mathematics*
M.S., Purdue, 1958; Ph.D., University of Washington, 1961.
- LAWRENCE RICHARD PHILLIPS (1962) *Graduate Assistant in Economics*
B.S. in Bus. Adm., Lehigh, 1962.
- WARREN AIKEN PILLSBURY (1962, 1963) *Assistant Professor of Economics*
A.B., New Hampshire, 1953; M.S., University of Virginia, 1962; Ph.D., 1963.
- ARTHUR EVERETT PITCHER (1938, 1960) *Distinguished Professor of Mathematics, Head 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.
- LUCILLE H. PLEISS (1961) *Nurse, University Health Service*
R.N., St. Luke's Hospital School of Nursing, 1949.
- THEODORE JOHN PODOLSKY (1956) *Assistant in Military Science*
Master Sergeant, U.S.A.
- JOHN EDWARD POIST (1963) *Graduate Assistant in Chemistry*
B.S., King's College, 1963.
- EDWARD POLLAK (1963) *Instructor in Mathematics*
B.S., Cornell University, 1954; M.S., North Carolina State College, 1956.
- JOSEPH GEORGE POMPONIO (1956, 1961) *Associate Director, University Health Service*
B.S., Vermont, 1949; M.D., 1953.
- H. BENJAMIN POWELL (1963) *Graduate Assistant in History*
A.B., Drew University, 1959; M.A., Lehigh, 1963.
- ROBERT ELLIS POWELL (1963) *Graduate Assistant in Mathematics*
B.A., Michigan State, 1958; M.A., 1959.
- RICHARD CARL PROGELHOF (1961, 1962) *Assistant Professor of Mechanical Engineering*
B.S., Newark College of Engineering, 1958; M.S., Stanford, 1959; Ph.D., Lehigh, 1962.
- WILLIAM LEROY QUAY (1963) *Assistant Dean of Students*
A.B., Muhlenberg, 1956; M.A., Pennsylvania, 1957.
- FRANÇIS JOSEPH QUIRK (1950, 1953) *Professor of Fine Arts, Head of the Department of Fine Arts*
Dipl., Rhode Island School of Design, 1929.
- SHELDON HENRY RADIN (1963) *Assistant Professor of Physics*
B.S., Worcester Polytechnic Institute, 1958; M.S., Yale, 1959; Ph.D., 1963.
- MINAKSHISUNDARAM RAJAGOPALAN (1963) *Assistant Professor of Mathematics*
B.Sc., Andhra University (India), 1950; M.A., 1950; Ph.D., Yale, 1963.
- THILLAISTHANA BALASUBRAMANYA RAMACHANDRAN (1961, 1962) *Research Assistant Professor of Electrical Engineering*
B.Sc., Madura (India), 1950; Dipl., Madras Institute of Technology (India), 1953; M.S., Lehigh, 1959; Ph.D., 1961.
- HARRY B. RAMSEY (1963) *Assistant Executive Secretary, Alumni Association*
B.A., Lehigh, 1950.
- ARLAN EDWARD RATHNE (1963) *Research Assistant in Metallurgical Engineering*
B.Sc. in Met.Engr., Montana School of Mines, 1958.

- REUBEN RICE RAWLS (1962) *Assistant to the Director of Placement*
B.A., Lehigh, 1959.
- GERHARD RAYNA (1955) *Instructor in Mathematics*
A.B., Harvard, 1952; M.A., Princeton, 1953.
- GEORGE EMIL RAYNOR (1931, 1946) *Professor of Mathematics*
B.S., Washington, 1918; M.A., Princeton, 1920; Ph.D., 1923.
- GEORGIA EMILY RAYNOR (1961) *Cataloger (Humanities)*
A.B., Chatham, 1945; M.A., Lehigh, 1954; M.S. in L.S., Columbia, 1954.
- MICHAEL MARK REA (1963) *Graduate Assistant in Physics*
B.A., LaSalle College, 1963.
- RICHARD JAMES REDD (1958, 1961) *Assistant Professor of Fine Arts*
B.Ed., Toledo, 1953; M.F.A., Iowa, 1958.
- 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.
- JOSEPH H. RENO (1947, 1961) *Part-time Physician, University Health Service*
M.D., Temple, 1941.
- FREDERICK EUGENE RESSLER (1952) *Assistant Registrar*
B.A., Lehigh, 1952.
- RODNEY EARL RESSLER (1947, 1952) *Administrative Assistant to Registrar*
- JOSEPH BENSON REYNOLDS (1907, 1948) *Professor Emeritus of Mathematics
and Theoretical Mechanics*
B.A., Lehigh, 1907; M.A., 1910; Ph.D., Moravian, 1919.
- *LEIGH CARRINGTON RHETT (1962) *Lecturer in Economics*
B.A., University of Virginia, 1943; LL.B., 1950; M.A., Columbia, 1952; Ph.D., New York University, 1962.
- BURGESS HAROLD RHODES (1960, 1962) *Instructor in Mathematics*
S.B., Massachusetts Institute of Technology, 1960.
- JAMES R. RICE (1962) *Graduate Assistant in Mechanics*
B.S., Lehigh, 1962; M.S., 1963.
- 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.
- ALBERT AUGUSTUS RIGHTS (1933, 1943) *Assistant Professor of English*
A.B., Maine, 1927; A.M., Harvard, 1931.
- EDGAR HEISLER RILEY (1926, 1928) *Associate Professor Emeritus of English*
A.B., Cornell, 1915; Ph.D., 1925.
- THEODORE DONALD RISCH (1960) *Assistant Professor of Military Science*
B.A., Connecticut, 1952; Major, U.S.A.
- VICTOR SMITH ROBINSON (1962) *Research Assistant in Metallurgical Engineering*
B.S., Lehigh, 1962.
- EDWARD ARLEN ROEDER (1961) *Graduate Assistant in Physics*
B.S., Lafayette, 1961; M.S., Lehigh, 1963.
- GEORGE FULTON ROEMHILD (1957, 1960) *Research Assistant in Physics*
B.A., Reed, 1957; M.S., Lehigh, 1959.
- CHARLES R. ROPER, JR. (1961) *Research Assistant in Metallurgical Engineering*
B.S. in Met.E., Lehigh, 1961; M.S., 1963.
- DONALD ROSS, JR. (1963) *Graduate Assistant in English*
B.A., Lehigh, 1963.

*Resigned, September 1, 1963.

38 *Faculty and Staff*

- WILLIAM HENRY RUCKLE (1963) *Assistant Professor of Mathematics*
A.B., Lincoln University, 1960; M.S., Florida State University, 1962; Ph.D., 1963.
- BRUCE ALBERT RYAN (1963) *Graduate Assistant in Physics*
B.S., Boston College, 1963.
- HELEN GENEVIEVE RYAN (1917) *Secretary to the President*
- JOHN DONALD RYAN (1952, 1962) *Professor of Geology,*
Head of the Department of Geology,
Chairman of the Comprehensive Honors Program
B.A., Lehigh, 1943; M.S., 1948; Ph.D., Johns Hopkins, 1952.
- CLARK DAVID SACHSE (1963) *Graduate Assistant in Industrial Engineering*
B.S. in M.E., Lehigh, 1958.
- IVAN JEROME SACKS (1962) *Graduate Assistant in Electrical Engineering*
B.S., Lehigh, 1962.
- PERCY LEE SADLER (1946, 1962) *Professor Emeritus of Physical Education*
Brig. Gen., Inf., U.S.A. (Ret.)
- NORMAN HAROLD SAM (1962) *Assistant Professor of Education,*
Director of Summer Sessions
B.S., Pittsburgh, 1951; M.Ed., 1955; Ed.D., 1962.
- KARLIS SAMTINS (1962) *Instructor in Russian*
Engr. Tech., Polytechnic Institute of Riga (Latvia), 1912; Struct. Engr., 1915.
- JOHN S. SANDEL (1957) *Part-time Lecturer in Education*
B.A., Pennsylvania, 1946; M.Ed., 1947; Ed.D., 1955.
- WILHELMINA SANDELLA (1962) *Nurse, University Health Service*
R.N., Philadelphia General, 1936.
- SUSARLA APPALANARASIMHA SARMA (1962) *Research Assistant in Chemistry*
B.Sc., Andhra University, 1949; B.Sc.(Tech.), Nagpur University, 1952; M.Sc.(Tech.),
Laxminarayan Institute of Technology, Nagpur University, 1958.
- ROBERT GUY SARUBBI (1960, 1963) *Assistant Professor of Mechanics*
B.S. in C.E., Cooper Union, 1953; M.S. in C.E., Lehigh, 1957; Ph.D., in Applied
Mech., 1963.
- RAYMOND BURKERT SAWYER (1946) *Associate Professor of Physics*
Ph.B., Ripon, 1921; M.S., Wisconsin, 1925; Ph.D., Chicago, 1930.
- EDWARD CHARLES SCANLAN (1961) *Assistant Professor of Education*
B.A., Buffalo, 1954; Ed.M., Harvard, 1958; Ed.D., 1961.
- WILLIAM DWIGHT SCHAEFFER (1956, 1961) *Associate Research Director,*
National Printing Ink Research Institute
B.S., Lehigh, 1943; M.S., 1947.
- MURRAY SCHECHTER (1963, 1964) *Assistant Professor in 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.
- HENRY ROBERT SCHNECK, JR. (1963) *Graduate Assistant in Civil Engineering*
B.S., Lehigh, 1963.
- RAY K. SCHULTZ (1959) *Graduate Assistant in Chemistry*
B.S., Muhlenberg, 1959; M.S., Lehigh, 1961.
- ERNST BERNHARD SCHULZ (1927, 1946) *Professor of Political Science*
B.S., Michigan, 1920; M.A., 1921; Ph.D., 1927.
- FRED WILLIAM SCHUMACHER (1961) *Professor of Military Science*
B.S., Gettysburg, 1943; Lt. Colonel, U.S.A.

- BARTON MOREY SCHWARTZ (1963)*Assistant Professor of Cultural Anthropology*
B.A., Los Angeles State College, 1959; Ph.D., University of California at Los Angeles, 1963.
- ELI SCHWARTZ (1954, 1962)*Professor of Finance*
B.S., Denver, 1943; M.A., Connecticut, 1948; Ph.D., Brown, 1952.
- PAUL STANLEY SCHWOK (1962)*Graduate Assistant in English*
B.A., King's College, 1962.
- PETER HAMILTON SCOTT (1960)*Research Assistant in Chemistry*
Sc.B., Brown, 1960.
- WILLIAM BEN SEAMAN (1963)*Research Assistant in Civil Engineering*
B.S., Lafayette, 1962.
- 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*
- OSCAR SEIN (1960)*Cataloger (Social Sciences)*
LL.B., University of Tartu (Estonia), 1928; M.L.S., Rutgers, 1960.
- PATRICK CARMEN SESSA (1961)*Assistant Professor of Air Science*
B.Bus.Adm., Loyola University (Los Angeles), 1955; Captain, U.S.A.F.
- DAVID EUGENE SETZER (1961)*Instructor in Mechanics*
B.S. in M.E., Lehigh, 1958; M.S. in E.M., New York University, 1960.
- JONATHAN BURKE SEVERS (1933, 1951)*Distinguished Professor of English,
Head of the Department of English*
A.B., Rutgers, 1925; A.M., Princeton, 1927; Ph.D., Yale, 1935; F.R.S.A., 1962.
- JAMAL KHALIL SHAHIN (1960, 1962)*Instructor in Mathematics*
A.B. California, 1960; M.S., Lehigh, 1962.
- JAMES HOWARD SHEA (1961)*Graduate Assistant in Physics*
B.S., Lehigh, 1958.
- KEITH DOUGLAS SHEFFLER (1963)*Research Assistant in
Metallurgical Engineering*
B.S., Lehigh, 1963.
- CAMILLE LOUISE SHENK*Teaching National Defense Education
Act Fellow in English*
B.A., Marymount College, 1962.
- FRANKLIN LOVING SHENK (1962)*Graduate Assistant in English*
B.A., Franklin & Marshall, 1962.
- RAYMOND SHETTEL (1963)*Lecturer in Psychology*
B.S., Dickinson, 1933; M.D. Hahnemann Medical College, 1938.
- FRANCIS JOSEPH SHIELDS (1962)*Instructor in Physical Education;
Freshman Football, Hockey Club and Lacrosse Coach*
B.S. in Phys.Ed., Saint Lawrence University, 1954.
- CLARENCE ALBERT SHOOK (1930, 1946)*Professor 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.
- RAMESH NAGINLAL SHROFF (1959)*Research Assistant in Chemistry*
B.S., Bombay University, 1959; M.S., Lehigh, 1961.
- JOHN T. SHUMAN (1954)*Part-time Lecturer in Education*
Ph.B., Dickinson, 1928; M.S., Pennsylvania State, 1934; D.Ed. 1944.
- ROBERT PETER SHURTLEFF (1963)*Assistant to the Director of Residence Halls*
B.A., Lehigh, 1955.

40 Faculty and Staff

- RICHARD MILTON SIGLEY, JR. (1961, 1962)*Instructor in Electrical Engineering*
B.S., in E.E., Lehigh, 1959; M.S., 1962.
- GEORGE C. M. SIH (1958, 1963)*Associate Professor of Mechanics*
B.S. in M.E., Portland, 1953; M.S. in M.E., New York, 1957; Ph.D., Lehigh, 1960.
- DALE RODEKOHRSIMPSON (1960).....*Assistant Professor of Geology*
B.S., Pennsylvania State, 1956; M.S., California Institute of Technology, 1958; Ph.D., 1960.
- STEFAN SLAK (1962)*Research Assistant in Psychology*
Dipl., Institute of Psychology, University of Paris, 1961.
- CLIFFORD WILSON SLOYER, JR. (1956, 1958).....*Instructor in Mathematics*
B.A., Lehigh, 1956; M.S., 1958.
- ROGER GEORGE SLUTTER (1961)*Research Instructor in Civil Engineering;*
Engineer of Tests, Fritz Engineering Laboratory
B.S. in C.E., Lehigh, 1953; M.S. in C.E., 1956.
- *EARL KENNETH SMILEY (1934, 1962)*Vice-President*
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.
- PAUL DAVID SMITH (1962)*Graduate Assistant in Civil Engineering*
B.S.C.E., University of Akron, 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; P.E., Pennsylvania, 1959.
- OLEM M. SMOLANSKY (1963)*Assistant Professor of International Relations*
A.B., New York University, 1953; A.M., Columbia, 1955; Ph.D., 1959.
- 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.
- ANDREW KAGEY SNYDER (1961).....*Graduate Assistant in Mathematics*
B.A., Swarthmore, 1959; M.A., University of Colorado, 1961.
- JESSE M. SNYDER, JR. (1963)*Assistant in Military Science*
Staff Sergeant, U.S.A.
- RAFAEL ARCHANGEL SOTO (1935, 1954).....*Associate Professor Emeritus of*
Romance Languages
B.S., Illinois, 1912; B.A., 1915; M.A., 1917.
- WILBER DEVILLA BERNHART SPATZ (1946, 1954).....*Associate Professor of Physics*
B.S., Lafayette, 1930; M.S., Purdue, 1934; Ph.D., New York, 1943.
- **HERBERT SPITZ (1961)*Instructor in Economics*
B.A., Brooklyn College, 1947.
- ROBERT STEACY SPRAGUE (1957, 1960).....*Associate Professor of Chemistry*
B.S., Washington and Jefferson, 1943; Ph.D., Illinois, 1949.
- PERICLES SPYROPOULOS (1963)*Research Assistant in Psychology*
A.B., Wilkes College, 1962.
- RICHARD PIERCE STAPLETON (1963)*Research Assistant in Geology*
B.Sc., Queen's University, 1963.

*On leave of absence effective February 1, 1962.

**Resigned, September 1, 1963.

- JOAN ESTELLE STECHER (1963)*Graduate Assistant in Education*
- 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)*Assistant Professor of Chemical Engineering*
B.S., Lehigh, 1956; M.S.E., University of Michigan, 1957; Ph.D., 1960.
- *GILBERT ALLAN STENGLE (1960, 1961)*Assistant Professor of Mathematics*
B.E.P., Cornell, 1954; M.S., Wisconsin, 1957; Ph.D., 1961.
- GORDON HUMPHREY STERLING (1963)*Research Assistant in Civil Engineering*
B.A.Sc., University of Waterloo, 1963.
- REBECCA WEEBER STEWART (1958)*Part-time Lecturer in Education*
B.A., Pittsburgh, 1933; M.A., Kent State, 1952; Ed.D., Columbia, 1958.
- JOHN A. STOOPS (1959, 1962)*Professor of Education,
Head of the Department of Education*
B.S., California State Teacher's College, 1948; M.S., Pennsylvania, 1949; Ed.D., 1960.
- ROBERT DANIEL STOUT (1939, 1960)*Professor of Metallurgical Engineering,
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.
- JAMES FREDERICK STROME (1963)*Instructor in Education*
B.A., King's College, 1959.
- 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)*Visiting Associate Professor of Journalism*
B.A., Syracuse, 1947; M.A., 1951.
- PEI SUNG (1963)*Research Assistant in Metallurgical Engineering*
B.S., Taiwan Cheng Kung University, 1958; M.S., University of Washington, 1963.
- JOSEPH JOHN SUOZZI (1963)*Lecturer in Electrical Engineering*
B.S. in E.E., Catholic University, 1949; M.S., 1954; Ph.D., Carnegie Institute of Technology, 1958.
- RUTH Y. SUPER (1960)*Assistant to the Dean, Graduate School*
- STEWART L. SWIHART (1960, 1963)*Instructor in Biology*
B.A., Haverford, 1954; M.S., Lehigh, 1960.
- DONALD LEE TALHELM (1960)*Instructor in Electrical Engineering*
B.S. in E.E., Lehigh, 1959; M.S. in E.E., 1960.
- STEPHEN FRANCIS TALIAN (1962)*Graduate Assistant in Civil Engineering*
B.S., Lehigh, 1962.
- LAMBERT TALL (1955, 1961)*Research Assistant Professor of Civil Engineering*
B.E., Sydney (Australia), 1954; M.S., Lehigh, 1957; Ph.D., 1961.
- STEPHEN KENNETH TARBY (1961)*Assistant Professor of
Metallurgical Engineering*
B.S., Carnegie Institute of Technology, 1956; M.S., 1958; Ph.D., 1962.
- HARVEY BERNARD TAUB (1963)*Graduate Assistant in Psychology*
B.A., Brooklyn College, 1963.

*On leave of absence, 1963-64.

42 Faculty and Staff

- CHARLES CHRISTOPHER TAYLOR (1960) *Assistant Professor of Mechanics*
B.S., Virginia Polytechnic Institute, 1951; M.S., 1953.
- IVAN JACKSON TAYLOR (1953) *Instruments Associate in Civil Engineering*
- ROBERT SAXTON TAYLOR (1950, 1957) *Associate Librarian;*
Director, Center for the Information Sciences
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, 1960) *Associate Professor of Electrical Engineering*
B.S. in E.E., Lehigh, 1951; M.S. in E.E., 1952; Ph.D., 1960.
- 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.
- **HAROLD PRESCOTT THOMAS (1932, 1962) *Professor Emeritus of Education*
B.S., Colgate, 1920; Ed.M., Harvard, 1925; Ed.D., 1932.
- JOHN RUSSELL THOMPSON, JR. (1961) *Instructor in Metallurgical Engineering*
B.S., University of Cincinnati, 1960; M.S., Lehigh, 1963.
- THEODORE ELWYN TOROK (1959) *Research Assistant and*
Instructor in Metallurgical Engineering
B.S. in Met.E., University of Idaho, 1954; M.S. in Met.E., Lehigh University, 1962.
- FRANCIS JOHN TREMBLEY (1928, 1949) *Professor of Ecology*
B.S., Hobart, 1928; M.S., Lehigh, 1931; Ph.D., Pennsylvania, 1934.
- JOHN SCHRADER TREMPER (1939, 1955) *Associate Professor of German,*
Head of the Department of German
A.B., Colgate, 1928; M.A., Cornell, 1932; Ph.D., 1938.
- ***ROCCO JOHN TRESOLINI (1949, 1958) *Professor of Political Science,*
Head of the Department of Government
A.B., Hartwick, 1942; M.A., Syracuse, 1947; Ph.D., 1949.
- JEROME T. TREXLER (1963) *Graduate Assistant in Psychology*
B.S., Pennsylvania State, 1963.
- L. REED TRIPP (1964) *Dean of the College of Business Administration,*
Frank L. Magee Professor of Business Administration
B.A. in Econ., Union College, 1934; Ph.D., Yale, 1942.
- HOWARD CHARLES TROY (1960, 1963) *Assistant Dean of Students*
B.S., Lehigh, 1952; M.A., 1959.
- KENNETH MANGOLD TRUMBORE (1946) *Assistant Manager of the Supply Bureau*
B.A., Moravian, 1940.
- WENDELL PIGGOTT TRUMBULL (1957, 1958) *Professor of Accounting,*
Head of the Department of Accounting
B.S., Illinois, 1937; M.A., Michigan, 1941; Ph.D., 1954; C.P.A., Mississippi, 1949.
- JOHN HARMS UBBEN (1960, 1961) *Associate Professor of German*
A.B., Central College (Iowa), 1936; M.A., Kentucky, 1937; Ph.D., Chicago, 1942.
- JOHN HENRY URBAN (1954, 1958) *Associate Professor of Economics*
B.S., Purdue, 1948; M.S., 1949; Ph.D., 1951.
- VICTOR MANUEL VALENZUELA (1957) *Assistant Professor of Romance Languages*
B.A., San Francisco State, 1951; M.A., Columbia, 1952.

*On leave of absence, first semester 1963-64.

**Retired, September 1, 1963.

***On leave of absence, first semester 1963-64.

- RALPH NEWCOMB VAN ARNAM (1928, 1961).....*Associate Professor of Mathematics and Astronomy*
E.E., Cornell, 1926; M.S., 1927.
- PETER DAVIES VAN DYKE (1963)*Graduate Assistant in Physics*
B.S., Lehigh, 1963.
- 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)*Research Associate 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)*Associate Professor of Physics*
B.S., Massachusetts Institute of Technology, 1940; Ph.D., Stanford, 1954.
- BRIAN JOSEPH VAN WEELE (1963)*Research Assistant in Civil Engineering*
B.S.C.E., Clarkson College, 1963.
- JACQUELINE IRENE VERBA (1958).....*Laboratory and X-Ray Technician, University Health Service*
Eastern School for Physicians' Aides.
- CHARLES JOSEPH VERSACCI (1958, 1959).....*Instructor in Education*
B.A., Lafayette, 1954; M.A., Lehigh, 1959.
- P. AARNE VESILIND (1962)*Graduate Assistant in Civil Engineering*
B.S., Lehigh, 1962.
- JOHN F. VICKREY (1961).....*Assistant Professor of English*
Ph.B., Chicago, 1949; A.M., 1952; Ph.D., Indiana, 1960.
- REIN VIRKHAUS (1961)*Research Assistant in Chemistry*
A.B., Harvard, 1959.
- CONSTANTIN MIRCEA VLAD (1961)*Research Assistant in Metallurgical Engineering*
Bacc. Dipl., Eudoxiu Hurmuzachi College, 1947; Met. Eng. Dipl., University of Timisoara, 1952; M.S., Lehigh, 1963.
- LOIS ANN VOORHEES (1963)*Graduate Assistant in Chemistry*
B.S., Muhlenberg, 1961.
- M. HERBERT WACHS (1962)*Research Assistant in Mechanical Engineering*
B.S. in M.E., Drexel Institute, 1959; M.S., Lehigh, 1961.
- JAMES HAROLD WAGNER (1949, 1951)*Registrar*
B.A., Gettysburg, 1947; M.A., Pennsylvania, 1950.
- ALLAN JAMES WALDRON (1963)*Research Assistant in Civil Engineering*
B.A., Lehigh, 1963.
- JAMES JOSEPH WALLAERT (1962)*Research Assistant in Civil Engineering*
B.S., University of Illinois, 1962.
- RICHARD GLENN WARNOCK (1960).....*Assistant Professor of Mechanics*
B.S.C.E., Illinois, 1950; M.S. in Mech. and Hydraulics, Iowa, 1952; Ph.D., 1964.
- ROBERT F. WATSON (1962)*Assistant Professor of Air Science; Executive Officer, Department of Air Science*
M.B.A., University of Chicago, 1958; Major, U.S.A.F.
- DAVID HOWARD WEANER (1959)*Research Assistant in Physics*
A.B., Gettysburg, 1956; M.S., Lehigh, 1962.
- EUGENE D. WEBB (1963)*Supply Sergeant*
Sergeant First Class, U.S.A.
- WILLIAM J. WEINBERGER (1963)*Graduate Assistant in English*
B.A., College of the City of New York, 1963.

44 Faculty and Staff

- LEONARD ANDREW WENZEL (1951, 1962)*Professor of Chemical Engineering,
Head 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.
- JAMES HARLEY WESTON (1962)*Graduate Assistant in Mathematics*
B.Sc., McMaster University, 1962.
- DONALD BINGHAM WHEELER, JR. (1947, 1957).....*Associate Professor of Physics*
B.S. in Eng. Phys., Lehigh, 1938; Ph.D., California Institute of Technology, 1947.
- LAWRENCE WHITCOMB (1930, 1939).....*Associate Professor of Geology*
Ph.B., Brown, 1922; A.M., Princeton, 1928; Ph.D., 1930.
- KEMBLE WIDMER II (1963)*Graduate Assistant in Industrial Engineering*
B.S., Lehigh, 1963.
- 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.
- FREDERICK MCGEE WILLIAMS (1963)*Assistant Professor of Biology*
B.A., Stanford, 1955.
- VERNON GUINN WILLIAMS, JR. (1962)*Counselor and Acting Supervisor,
Counseling and Testing Service*
B.A., Southwestern University, 1954; M.S., University of Michigan, 1959; Ph.D., 1963.
- ROBERT CLIFFORD WILLIAMSON (1963)*Associate Professor of Sociology,
Acting Director of the Division of Social Relations*
B.A., University of California at Los Angeles, 1938; M.A., 1940; Ph.D., University of
Southern California, 1951.
- LEOPOLD B. WILLNER (1963)*Instructor in Industrial Engineering*
B.S. in Ch.E., Newark College of Engineering, 1959; M.S., Northwestern, 1961.
- GRANT McDONALD WILSON (1962)*Lecturer in Chemical Engineering*
B.S., Brigham Young University, 1953; Ph.D., Massachusetts Institute of Technology,
1958.
- KEVIN F. WINCH (1963)*Instructor in Economics*
B.A., Wisconsin, 1958; M.A., Michigan State, 1960.
- BRUCE CHARLES WITTMAYER (1963)*Assistant to the Director of Admission*
B.A., Lehigh, 1963.
- ROBERT ALFRED WOLFFE (1960)*Teaching Intern in Chemical Engineering*
B.S., Maryland, 1960; M.S., Lehigh, 1962.
- PUI-KEI WONG (1962)*Assistant Professor of Mathematics*
B.S., Pacific Union College, 1956; M.S., Carnegie Institute of Technology, 1958;
Ph.D., 1962.
- JOHN DUDLEY WOOD (1960, 1962)*Assistant Professor of Metallurgical
Engineering*
B.S. in Met.E., Case Institute of Technology, 1953; M.S., Lehigh, 1959; Ph.D., 1962.
- RALPH CHARLES WOOD (1958, 1961)*Professor of German*
B.A. and B.E., Cincinnati, 1928; M.A., 1930; Ph.D., Cornell, 1933.
- DON K. WRIGHT (1961).....*Assistant Professor of Speech*
A.B., Baylor, 1953; B.D., Southern Baptist Seminary, 1957; A.M., Baylor, 1960.
- HORACE WETHERILL WRIGHT (1921, 1950).....*Professor Emeritus of Latin*
A.B., Wisconsin, 1908; Ph.D., Pennsylvania, 1917.
- FRANCIS JOSEPH WUEST (1962, 1963)*Associate Professor of Psychology,
Head of the Department of Psychology*
B.A., LaSalle College, 1951; M.A., Fordham, 1953; Ph.D., Brown 1961

- DOUGLAS HIDEO YANO (1962)*Research Assistant in Mechanical Engineering*
B.S., in M.E., Lehigh, 1962.
- EROL YARIMCI (1962)*Research Assistant in Civil Engineering*
Yuk.Muh., Technical University of Istanbul (Turkey), 1958; M.S. in C.E., Georgia
Institute of Technology, 1962.
- 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, 1961)*Research Assistant Professor of*
Civil Engineering
B.S., National Taiwan, 1955; M.S., Lehigh, 1959.
- YU-CHIN YEN (1960).....*Research Assistant in Civil Engineering*
B.S., Taiwan Provincial Cheng Kung University, 1954; M.S., Lehigh, 1961.
- THOMAS EDWIN YOUNG (1958, 1960).....*Associate Professor of Chemistry*
B.S., Lehigh, 1949; M.S., 1950; Ph.D., Illinois, 1952.
- CHING-KUO YU (1962)*Research Assistant in Civil Engineering*
B.S., Taiwan Cheng-Kung University, 1960.
- JOSEPH ANDREW YURA (1961, 1963)*Research Instructor in Civil Engineering*
B.S.C.E., Duke, 1959; M.S. in C.E., Cornell, 1961.
- BRUCE ZABAWA*Teaching Fellow in English*
B.A., Upsala College, 1962.
- ZAFARULLAH (1963)*Graduate Assistant in Mathematics*
B.A., Panjab University, Lahore (Pakistan); M.A., 1959; M.S., Rose Polytechnic In-
stitute, 1963.
- ALBERT CHARLES ZETTMEOYER (1941, 1960).....*Distinguished Professor of*
Chemistry, Director National Printing Ink Research Institute
B.S. in Ch.E., Lehigh, 1936; M.S., 1938; Ph.D., Massachusetts Institute of Technology,
1941.
- CHARLES KELLER ZUG (1961).....*Advisor on Bequests, Trusts, and Insurance*
B.S. in I.E., Lehigh, 1927; B.S. in E.E., 1927.

FELLOWS AND SCHOLARS

- ROBERT C. AHLERT*North American Aviation Fellow in Chemical Engineering*
B.Ch.E., Polytechnic Institute of Brooklyn, 1952; M.S.E., U.C.L.A., 1958.
- GRANT SPENCER ANDERSON*National Science Foundation Cooperative*
Fellow in Physics
B.S., Lehigh, 1962.
- MORRIS ANSHEL*Althouse Chemical Company Research Fellow in Chemistry*
B.S., College of the City of New York, 1962.
- JERRY D. BADGER*National Defense Education Act Graduate Fellow*
in Mathematics
B.S., Rose Polytechnic Institute, 1962.
- STEPHEN MICHAEL BALABAN.....*National Defense Education Act Fellow in*
Chemical Engineering
B.S. in Chem.E., University of Rochester, 1961.
- FREDERICK KRISTOPHER BEARD*University Scholar in Business Administration*
B.S., Lehigh, 1963.
- GABRIEL BIGURIA*Air Products & Chemicals Incorporated Fellow in*
Chemical Engineering
B.S. in Ch.E., Case Institute of Technology, 1963.

46 Faculty and Staff: Fellows and Scholars

- GORDAN H. BRADLEY*Charles W. Parkhurst Fellow in Industrial Engineering*
B.S. in M.E., Lehigh, 1962.
- PETER REESE BRIDENBAUGH*J. Heber Parker Fellow in Metallurgical Engineering*
B.S., Lehigh, 1962.
- EARL JOHN BROWN*National Aeronautics and Space Administration Fellow in Mechanics*
B.S., New Hampshire, 1959; M.S., Purdue, 1961.
- ANTHONY MICHAEL BUTTO*Louis Calder Foundation Fellow in Chemistry*
B.S., Pennsylvania State University, 1961.
- CHIANG-SHUEI CHENG*William C. Gotshall Scholar in Physics*
B.S., National Taiwan University, 1958; M. S. National Tsing Hua, 1960.
- PETER JOHN CISTONE*Teaching Fellow in Education*
A.B., Muhlenberg, 1963.
- HARRY E. COLE*National Defense Education Act Fellow in English*
B.S. in Ed., Bloomsburg State College, 1962.
- CHARLES COE COUTANT*U. S. Public Health Service Predoctoral Fellow in Biology*
B.A., Lehigh, 1960.
- JAMES ROLAND CRAIG*National Science Foundation Fellow in Geology*
B.A., Pennsylvania, 1962.
- JAMES P. CRAWFORD*National Science Foundation Science Faculty Fellow in Mathematics*
A.B., Grove City College, 1957; M.S., Lehigh, 1961.
- RONALD PAUL DANNER.....*National Defense Education Act Fellow in Chemical Engineering*
B.S., Lehigh, 1961; M.S., Lehigh, 1963.
- MARIA DEL PILAR DE LA MORA*New Jersey Zinc Company Fellow in International Relations*
Dipl., University Javeriana, Bogota (Columbia), 1961.
- GLORIA R. DUSSINGER*National Defense Education Act Fellow in English*
B.A., Muhlenberg, 1963.
- THEODORE DIETER ECK*William L. Heim Research Fellow in Chemistry*
A.B., Dartmouth, 1959.
- HERBERT E. EHLERS*Management Science Fellow in Business Administration*
B.A., Lehigh, 1962.
- SHELDON MERVEN EISENBERG*National Defense Education Act Graduate Fellow in Mathematics*
A.B., Temple, 1963.
- WILLIAM MEYLIN FLEISCHMAN*National Science Foundation Graduate Fellow in Mathematics*
B.A., Lehigh, 1959.
- KARL ERIC FRIEND*National Aeronautics and Space Administration Fellow in Chemistry*
B.A., Cornell University, 1959; M.S., University of Rhode Island, 1962.
- GEORGE GOINS*Norwich Pharmacal Company Fellow in Chemistry*
B.A., New York University, 1956; M.S., Lehigh, 1959.
- LAWRENCE DONALD GRAHAM*National Science Foundation Fellow in Metallurgical Engineering*
B.S., Lehigh, 1962.

- STANLEY GREENDA *Roy R. Hornor Research Fellow in Inorganic Chemistry*
B.S., DePaul, 1958.
- RONALD JOHN HARTRANFT *National Science Foundation Cooperative
Fellow in Mechanics*
B.S., Lehigh, 1963.
- PAUL THEODORE HERMAN *Armstrong Cork Company Fellow in Physics*
B.S., Muhlenberg, 1960; M.S., Lehigh, 1962.
- ELEANOR WEST HERTZ *United States Public Health Service Fellow in Biology*
A.B., Radcliffe, 1939; M.A., Lehigh, 1958.
- RICHARD BRUCE HOFFMAN *National Science Foundation Fellow in Physics*
B.S. in Eng. Phys., Lehigh, 1962; MS., 1963.
- CHARLES EUGENE HOUCK *National Aeronautics and Space Administration
Research Fellow in Metallurgical Engineering*
B.S., Pennsylvania State University, 1962.
- ELIZABETH J. HOWE *National Defense Education Act Fellow in English*
B.A., Pennsylvania State University, 1963.
- WILLIAM WALLACE HUSSEY *National Science Foundation Cooperative
Fellow in Chemistry*
A.B., Middlebury College, 1959; M.S. in Chemistry, Bucknell, 1962.
- JOHN PAUL JANOWSKI *C. Kemble Baldwin Fellow in Electrical Engineering*
B.S. in E.E., Lehigh, 1963.
- PETER MOYER JEFFERS..... *National Science Foundation Fellow in Chemistry*
B.A., Lehigh, 1961.
- ROBERT JONES *National Science Foundation Faculty Fellow in
Metallurgical Engineering*
- TIBOR KALNOSKI-KIS *Socony Mobil Oil Company Fellow in Chemical Engineering*
B.S., in Ch.E., Case Institute of Technology, 1963.
- MURRAY R. KIRCH *National Defense Education Act Graduate
Fellow in Mathematics*
B.A., Temple, 1962.
- JOSEPH JOHN KOCISCIN..... *Esso Foundation Fellow in Chemical Engineering*
B.S., Maryland, 1959; M.S., Lehigh, 1962.
- GARY KEITH KOHLER *National Aeronautics and Space Administration
Graduate Fellow in Chemical Engineering*
B.S., Lehigh, 1963.
- LYNTON STUART LAND *American Chemical Society Petroleum Research
Fellow in Geology*
A.B., Johns Hopkins, 1962; M.A., 1963.
- HOWARD B. LANGE *National Defense Education Act Fellow in
Chemical Engineering*
B.S., Lehigh, 1962.
- JOHN WILLIAM LARIMER *National Aeronautical Space Administration Fellow
in Geology*
B.A., Lehigh, 1962; M.S., 1963.
- WILLIAM DAVID LAVERELL *National Defense Education Act Graduate
Fellow in Mathematics*
B.S., Ursinus College, 1963.
- ROBERT E. LAYDEN *Teaching National Defense Education Act Fellow in English*
B.A., Boston College, 1962.
- JAMES DALE LEAR *Union Carbide Corporation Fellow in Chemistry*
B.S., Juniata, 1961.

48 *Faculty and Staff: Fellows and Scholars*

- JONG-DIING LIU*University Scholar in Mathematics*
B.Sc., Taiwan Normal, 1955; M.S., Lehigh, 1963.
- GEORGE BUCHANAN MACDONALD*James Ward Packard Fellow in English*
B.A., Boston College, 1962.
- JOHN ROBERT MAGAN.....*National Science Foundation Cooperative Fellow in Physics*
B.S., Muhlenberg, 1959; M.S., Lehigh, 1961.
- VASANT V. MAINKAR*William C. Gotshall Scholar in Physics*
M.Sc., Bombay University (India), 1959.
- ROBERT J. MCNELIS*National Defense Education Act Graduate
Fellow in Mathematics*
B.A., King's College, 1962.
- IRWIN MURRAY MARCUS*George Gowen Hood Fellow in History*
B.S., Pennsylvania State, 1958; M.A., Lehigh, 1959.
- FORTUNATO JOSEPH MICALÉ*Sun Chemical Corporation Fellow in Chemistry*
B.A., St. Bonaventure, 1956; B.S., Niagara University, 1959; M.S., Purdue, 1961.
- SHINICHI NEGAMI.....*Orthopedic Research Association Research Fellow in Chemistry*
B.S., Yokohama National University, 1957.
- DALE FRANCIS OEXMANN*Graduate Fellow in Mathematics*
B.S., Rose Polytechnic, 1962; M.S., Lehigh, 1963.
- ARMAND BENJAMIN PERLMAN*United States Steel Foundation
Fellow in Mechanics*
B.S., Lehigh, 1961; M.S., Stanford, 1962.
- ARNOLD PIACENTINI*National Defense Education Act Fellow in
Chemical Engineering*
B.S., Tufts, 1962.
- MICHAEL PICCIRILLO*University Scholar in Government*
B.S., Pennsylvania State University, 1963.
- JOHN ROBERT PIVNICHNY*Henry Marison Byllesby Fellow in Electrical Engineering*
B.S., Lehigh, 1963.
- NANCY H. RENT*National Science Foundation Fellow in Chemical Engineering*
B.S., Tufts University, 1963.
- WILLIAM LEE RHOADS*Henry Marison Byllesby Fellow in Mechanical Engineering*
B.S., Drexel Institute of Technology, 1963.
- JAMES R. RICE*National Science Foundation Cooperative Fellow in Mechanics*
B.S., Lehigh, 1962; M.S., 1963.
- JACK RIDGE*National Science Foundation Faculty Fellow*
B.S., Moravian, 1953; M.S., Lehigh, 1956.
- GEORGE WARREN ROLAND*Alumni Fund Fellow in Geology*
B.Sc., Acadia University, 1961.
- SUMAN TRIMBAK SABNIS*American Chemical Society Petroleum Research
Fund Fellow in Chemical Engineering*
B.Sc., Christ Church College (India), 1954; A.H.B.T.I. (Ch.E.), H. B. Technological
Institute (India), 1957; M.S., Lehigh, 1960.
- ROBERT H. SCHIESSER*Howard Flint Fellow in Chemistry*
B.Ch.E., Clarkson College of Technology, 1958; M.Ch.E., 1960.
- KEITH DOUGLAS SHEFFLER*Roy H. Hornor Research Fellow and Foundry
Foundation Fellow in Metallurgical Engineering*
B.S., Lehigh, 1963.
- JAMES THOMAS SEDLOCK.....*National Defense Education Act Graduate Fellow
in Mathematics*
B.A., LaSalle, 1961.

- VENKATACHALAM SESHAN*William C. Gotshall Scholar in Chemical Engineering*
B.Ch.E., Bombay (India), 1962; M.S., Louisville, 1962.
- JOHN ARCHIBALD SHEDDEN.....*William C. Gotshall Scholar in Chemical Engineering*
B.S., Pennsylvania State University, 1956; M.S., Lehigh, 1962.
- CAMILLE LOUISE SHENK*Teaching National Defense Education Act Fellow*
in English
B.A., Marymount College, 1962.
- HERBERT BRUCE SILBER*Student Chemistry Foundation Fellow in Chemistry*
B.S., Lehigh, 1962.
- RICHARD C. SMITH*National Aeronautics and Space Administration Fellow*
in Physics
B.S., Davidson, 1960; M.S., Lehigh, 1962.
- RICHARD ALAN STANLEY*National Aeronautics and Space Administration*
Graduate Fellow in Electrical Engineering
B.S. in E.E., Lehigh, 1963.
- JOHN RUSSELL THOMPSON, JR.*General Telephone and Electric Company*
Fellow in Metallurgical Engineering
B.S., University of Cincinnati, 1960; M.S., Lehigh, 1963.
- TSUNEO TSUIJI*Garrett Linderman Hoppes Research Fellow in Civil Engineering*
B.S., Kyushu University (Japan), 1957.
- MARTIN URRUTIA*Kennecott Copper Corporation Fellow in Chemical*
Engineering
- JOHN KINER WAGNER*Tau Beta Pi Fellow and University Scholar in*
Electrical Engineering
B.S. in E.E., Lehigh, 1963.
- GEORGE B. WALZ*Chester W. Kingsley Fellow in Psychology*
B.S., Pennsylvania State, 1962.
- JEROLD CHARLES WEBER*National Aeronautics and Space Administration*
Fellow in Chemical Engineering
B.Ch.E., Rensselaer Polytechnic Institute, 1963.
- JOHN HERBERT WEBER, JR.*Materials Research Fellow in Materials Research*
Center
B.S., Lehigh, 1963.
- YUNOSUKE YAMAMOTO*Linde Air Products Company Fellow in*
Metallurgical Engineering
M.Eng., Osaka University (Japan), 1963.
- BRUCE ZABAWA*Teaching Fellow in English*
B.A., Upsala College, 1962.
- JULIUS F. ZAVAR*Union Bank & Trust Company Fellow in Economics*
B.S., Lehigh, 1963.

SUMMER SESSIONS

(In addition to the Regular Staff)

- E. CARLTON ABBOTT*Superintendent of Schools, Lansdowne, Pennsylvania*
 ELIZABETH SLATER ALBRECHT.....*Assistant Executive Director, Northampton County Tuberculosis & Health Society, Bethlehem, Pennsylvania*
 WALTER H. BRACKIN.....*Chairman, Department of Psychology, Muhlenberg College, Allentown, Pennsylvania*
 ALFRED CASTALDI*Belmont Hills Elementary School, Belmont Hills, Pennsylvania*
 CHARLES E. CHAFFEE.....*Superintendent of Schools, Bethlehem, Pennsylvania*
 JAMES P. CRAWFORD.....*Instructor in Mathematics, Lafayette College, Easton, Pennsylvania*
 PAUL DRUMM*Assistant Professor of Education, Kutztown State College, Kutztown, Pennsylvania*
 ROY H. DUNGAN.....*Supervising Principal, Souderton Area Schools, Souderton, Pennsylvania*
 ARDIS W. GAUMER.....*Head of School Nurses, Allentown Public Schools, Allentown, Pennsylvania*
 NEIL R. GRABOIS.....*Instructor in Mathematics, Lafayette College Easton, Pennsylvania*
 PHIL HARBACH.....*Elementary school teacher, Merion Township Schools, Philadelphia, Pennsylvania*
 PHILLIP HILLAIRE.....*Reading Consultant, Air Force Schools, British Isles*
 RICHARD W. JACKSON.....*Executive Director, Lehigh County Tuberculosis and Health Society, Allentown, Pennsylvania*
 PAUL KUKLENTZ.....*Head Teacher of Health and Physical Education, Northeast Junior High School, Bethlehem, Pennsylvania*
 PETER LAMANA.....*Reading Supervisor, Hellertown-Lower Saucon Joint Schools, Hellertown, Pennsylvania*
 MRS. DOROTHY LOCHNER.....*Reading Specialist, Allentown Public Schools, Allentown, Pennsylvania*
 BERNICE MAGNIE.....*Director of Art, Public Schools, East Orange, New Jersey*
 SLAVA MALAC.....*Senior Nutrition Consultant, Pennsylvania Department of Health, Reading, Pennsylvania*
 CHRISTIAN W. MULLSTEFF.....*School Health Education Coordinator, Lehigh County TB and Health Society, Allentown, Pennsylvania*
 JAMES E. NANCARROW.....*Principal, Upper Darby Township Senior High School, Upper Darby, Pennsylvania*
 BERNARD NOONAN.....*Associate Professor of Mathematics, University of Manitoba, Winnipeg, Manitoba, Canada*
 TED OCHS.....*Private Reading Consultant, Strasburg, Pennsylvania*
 DAVID H. ORR.....*Director of Psychological Services, Allentown State Hospital, Allentown, Pennsylvania*
 REBECCA W. STEWART.....*Director of Elementary Education, Bethlehem Public Schools, Bethlehem, Pennsylvania*
 MRS. NANCY STINE.....*Speech Specialist, Northampton County Schools, Bethlehem, Pennsylvania*
 HELEN STRASSBURG.....*Private Reading Consultant, Bethlehem, Pennsylvania*
 RAYMOND L. WALLER.....*Assistant Superintendent of Schools in Charge of Research and Special Projects, Allentown, Pennsylvania*
 PHILIP WEXLER.....*Director of Professional Education and Training, Department of Mental Hygiene, State of New York, Albany, New York*
 LORENZO A. ZEUGNER.....*Director of Special Education, Reading Public Schools, Reading, Pennsylvania*

**SUPERVISORS OF STUDENT TEACHING IN
COOPERATING HIGH SCHOOLS**

GERALDINE ALLEY.....	<i>Mathematics, Easton Area Senior High School</i>
JOSEPH A. BELLETI.....	<i>Mathematics, Northeast Jr. High School</i>
CARMELA C. DEBLASIO.....	<i>Mathematics, Dieruff High School</i>
JOSEPH FARRIS.....	<i>English, Broughal Jr. High School</i>
BERNARD J. FRITZ.....	<i>English, Nitschmann Jr. High School</i>
JOHN F. HETZEL.....	<i>Mathematics, Broughal Jr. High School</i>
RAYMOND MAKOS.....	<i>Social Studies, Nitschmann Jr. High School</i>
THOMAS PERSING.....	<i>Science, Dieruff High School</i>
GEORGIA RUSSOPULOS.....	<i>Mathematics, Southern Lehigh High School</i>
PETER SARDO.....	<i>Social Studies, Dieruff High School</i>
JOHN C. SAUNDERS, JR.....	<i>Science, Nitschmann Jr. High School</i>
FAYE SPRANDEL.....	<i>English, Southern Lehigh High School</i>
CLIFFORD STEINBACH.....	<i>Mathematics, Liberty High School</i>
ERNEST F. WESCOE.....	<i>Science, Dieruff High School</i>
EDWARD ZAMISKIE.....	<i>Science, Hellertown-Lower Saucon High School</i>

STANDING COMMITTEES OF THE FACULTY, 1962-63

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

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

ATHLETIC ELIGIBILITY: A. P. Koch (1964), A. C. Zettlemoyer (1965), G. W. Kyte (1966); W. B. Leckonby, Executive Secretary (ex officio).

COOPERATIVE LECTURE SERIES: S. Monro (1964), J. B. Elkus (1965), H. B. Braddick (1966), L. E. Krouse (1967); H. C. Troy, Executive Secretary (ex officio); student member: Thomas E. Tyson.

DISCIPLINE: J. D. Leith (ex officio); J. A. Hertz (1964), V. V. Latshaw (1965); student members: D. R. Decker, R. A. Marmon.

EDUCATIONAL POLICY: L. S. Beedle (1964), J. F. Libsch (1964), J. D. Mack (1965), W. R. Yates (1965); H. M. Diamond, A. S. Foust, J. D. Leith, R. D. Stout (ex officii); J. H. Wagner, Secretary (ex officio).

ENDORSED FELLOWSHIPS: L. A. Wenzel, K. E. Chave, N. W. Balabkins.

FACILITIES: E. W. Glick, C. B. Campbell, W. R. Yates, H. M. Diamond, A. S. Foust, T. E. Jackson, R. W. Numbers, P. Parr (all members ex officii).

GRADUATE FACULTY EXECUTIVE COMMITTEE: R. D. Stout (ex officio); J. D. Ryan (1964), G. P. Conard II (1965), R. J. Tresolini (1966), F. B. Jensen (1967); R. J. Emrich, G. J. Christensen (ex officio).

HONORARY DEGREES: B. W. Parker (1964), J. A. Maurer (1965), R. R. Myers (1966), F. B. Jensen (1967), A. S. Foust (1968), K. E. Chave (1969).

LEHIGH UNIVERSITY CENTENNIAL PLANNING COMMITTEE: P. J. Franz, Jr., C. W. Brennan, S. I. Connor, R. B. Cutler, J. D. Mack, P. Parr, R. J. Tresolini, A. C. Zettlemoyer.

LONG-RANGE UTILITY PLANNING COMMITTEE: R. W. Numbers (ex officio);

NOMINATIONS: J. J. Karakash (1964), N. W. Balabkins (1965), C. B. Joynt, A. S. Foust, T. E. Jackson, W. P. Isaacs, J. Teno (1966).

PERFORMING ARTS: D. M. Greene (1964), J. A. Van Eerde (1965); S. I. Connor, Executive Secretary (ex officio); student members: R. M. Bennett, W. P. Dawson, P. D. Grudin.

PUBLICATIONS BOARD OF: E. N. Dilworth (1964); G. P. Conard III (1965); J. D. Leith, R. J. Sullivan, S. I. Connor (ex officii); student members: J. G. Gellings, D. W. Mattson, B. M. Pastor, J. S. Casolo, R. G. Stiles.

RELIGIOUS LIFE: W. P. Trumbull (1964), E. D. Amstutz (1965); J. F. McCue (1966); R. E. Fuessle, J. D. Leith (ex officii); members of the Alumni Association: W. F. Murphey (1964), M. C. Schrader (1965); F. A. Murray (1966); student members: M. A. Monson, J. S. Montgomery, F. J. Gorski.

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

STANDING OF STUDENTS: W. R. Yates, H. M. Diamond, A. S. Foust, J. D. Leith, Executive Secretary; J. H. Wagner, Recording Secretary (all members ex officii).

STUDENT ACTIVITIES: P. Parr (ex officio); W. A. Smith, Jr., (1964), A. P. Gardner (1965); student members: S. Burakoff, R. S. Blair, B. W. Evans, Jr.

STUDENT APPRAISAL OF INSTRUCTORS AND COURSES: E. C. Bratt (1964), J. Daen (1965), F. S. Hook (1966); student members: K. E. Jacobi, B. H. Griffiths.

STUDENT LIFE: W. J. Richardson (1964), C. B. Joynt (1965), R. J. Redd (1966); J. A. McLennan, Jr. (representing the Committee on Educational Policy); C. B. Campbell, R. E. Fuessle, P. Parr (ex officii); student members: V. R. Digilio, S. J. Orlando, Jr., H. J. Kligora, R. A. Miller.

UNDERGRADUATE AWARDS AND PRIZES: T. V. Barker (1964), A. J. Diefenderfer (1965); J. D. Leith, W. B. Leckonby (ex officii); J. H. Wagner, Secretary (ex officio).

UNDERGRADUATE FINANCIAL AID: J. D. Leith (ex officio); C. L. Moore (1964), S. H. Missimer (1965), A. E. Hartung (1966), C. W. Clump (1967); T. L. Kropp, Executive Secretary (ex officio).

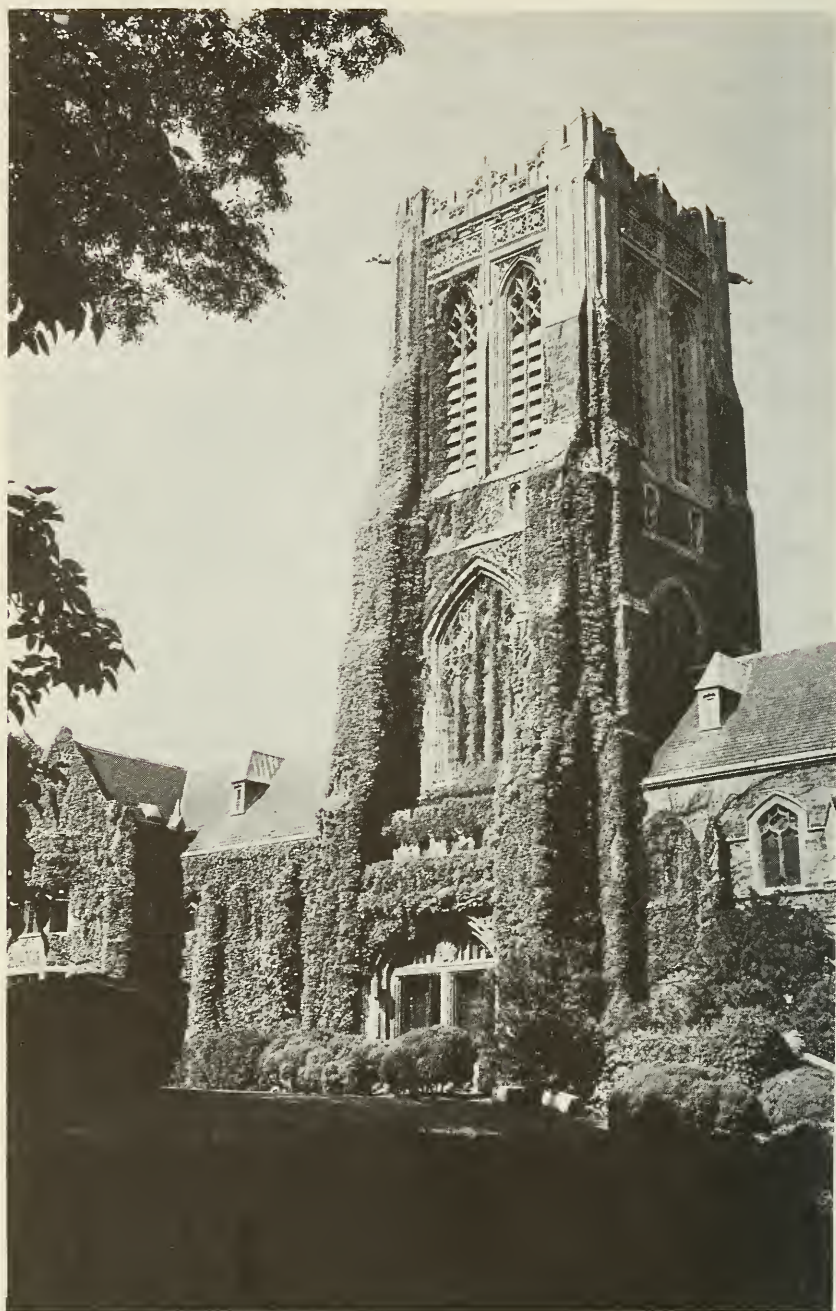
UNIVERSITY CENTER ADVISORY COMMITTEE: P. Parr, C. B. Campbell, E. W. Glick (ex officii); F. M. Brady (1964), W. A. Smith (1965), J. W. McGeady (1966), R. H. Hopkins (1967), A. J. Larky (1968); student members: D. R. Burg, M. D. Feit, J. W. Sundlie, T. S. Freund, M. H. Reich, R. C. Varnum, and the President of Arcadia.

UNIVERSITY EXERCISES: A. C. Molter, S. I. Connor, F. W. Schumacher, J. W. Caskey (ex officii); C. W. Curtis (1964), R. G. Cowherd (1965).

USHERS: C. W. Brennan (1964), L. A. Wenzel (1964), F. M. Brady (1965), M. D. Snider (1965), A. J. Mazurkiewicz (1966), L. Whitcomb (1966), R. J. Leonard (1967), W. E. Schiesser (1967), J. F. O'Neal (1968), R. M. Kraus (1968).

WILLIAMS PRIZES: J. B. Severs, F. A. Bradford, J. M. Brozek, H. B. Davis, G. D. Harmon, T. M. Haynes.

SECRETARY OF THE FACULTY: R. N. Van Arnam (1964).



*The Alumni Memorial Building, University
administrative office center.*

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, 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 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 heri-

tage 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 342.)

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

<i>Subjects</i>	<i>Units</i>
English	4
Foreign Language (4 units are recommended)	2
Elementary and Intermediate Algebra	2
Plane Geometry	1
Plane Trigonometry	$\frac{1}{2}$
Solid Geometry or Advanced Algebra	$\frac{1}{2}$
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 passing 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 1964-65 schedule is shown below.)

WRITING SAMPLE: Lehigh also requires each candidate to submit a Writing Sample. This is an English essay exercise by College Board on all testing dates. Students will be given one hour in the afternoon to write an essay on an assigned topic. Their essays will be reproduced and copies sent to the colleges which they name. Essays submitted to Lehigh will be graded by Lehigh's Department of English to provide an indication of the students' preparation in English if the students are accepted for admission. Lehigh prefers the December and January testing dates for the Writing Sample.

ACHIEVEMENT TESTS: Each candidate is required to write two additional afternoon College Board Achievement Tests. 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 1964-65 (All dates are Saturday except July 14.)

December 5,	1964	<i>Note:</i> The SAT, the afternoon Achievement Tests, and the Writing Sample will be offered on all five testing dates. However, the Level II (Intensive) Mathematics Achievement Test will be offered only in January and May.
January 9,	1965	
March 6,	1965	
May 1,	1965	
July 14,	1965	

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 and the Writing Sample be written in December or January of the senior year and the two 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 (other than examinations) 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 \$800 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 \$68 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 ac-

cepted 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 301.

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	\$1600
Books and Supplies	125
Room (average)	340
Subsistence (estimate)	550
	\$2615

(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 seven University residence halls (50 per cent), or in 30 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.

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.

Students who do not reside on the campus may participate in any of the above board plans if space is available in existing facilities, or they may eat in the coffee shop.

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.

The freshmen occupy residence halls staffed by a corps of carefully selected upperclass counselors responsible to the Director of Residence Halls.

Room rents in the residence halls range from \$130 to \$180 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 \$78 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.

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 committing himself to the whole program. Such special permission will be of the Honors Council, schedule one or more Honors Seminars without 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 225) 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.



Packer Hall, The University Center.

THE COLLEGE OF ARTS AND SCIENCE

ADMINISTRATIVE OFFICES

Harvey Alexander Neville, *President*

Glenn James Christensen, *Provost and Vice-President*

W. Ross Yates *Dean of the College of Arts and Science*

Charles Augustus Seidle, *Vice-President—Administration*

John Douglas Leith, *Dean of Students*

Samuel Harold Missimer, *Director of Admission*

James Harold Wagner, *Registrar*

James Decker Mack, *Librarian*

The College of Arts and Science of Lehigh University comprises the departments of biology, classical languages, education, English, fine arts, geology, German, government, history, international relations, mathematics and astronomy, music, philosophy, psychology, religion, and romance languages. Interdepartmental programs are offered in foreign careers and natural resources. Courses in economics, accounting, and finance are provided by the College of Business Administration; physics and chemistry are supplied by the College of Engineering.

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 PROFESSIONAL SCHOOLS
AND THE PROFESSIONS**

The College of Arts and Science provides the preliminary training necessary for admission to the various graduate schools and, in some cases, prepares directly for a profession. Since a large proportion of the graduates of the College of Arts and Science of Lehigh University continue their work in graduate schools, the College offers a number of course combinations designed to give preliminary training for such various fields as medicine, dentistry, public service, public health, law, theology, engineering, and business administration. Students who plan to enter graduate school should consult the dean of the College and the director of their major program.

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 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.

Group I: Humanities

FRESHMAN ENGLISH. Six semester hours. 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 successfully completes Engl. 11 and 12, he is given, in addition to the 6 hours of credit for those courses, 6 hours of advanced standing credit for Engl. 1 and 2.

LITERATURE. Six semester hours. This requirement can be met by passing two courses chosen from:

- (a) Courses in English or American literature.
- (b) Greek 50, Greek Literature in Translation.
Latin 51, Latin Literature in Translation.
- (c) 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.

Students who meet the Freshman English requirement by passing Engl. 11 and 12 will be considered to have met the Literature requirement as well as the Freshman English requirement.

FOREIGN LANGUAGE. Number of hours varies depending on previous language study. Each student is required to complete successfully one year (6 hours) of advanced courses in one language. The requirement is normally met by pursuing in course the language to be used in satisfaction of the requirement. Eighteen hours of course work are normally taken by students who begin a new language in college.

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 or by examination.

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.

FINE ARTS OR MUSIC. Three semester hours.

PHILOSOPHY OR RELIGION. Three semester hours.

Group II: Natural and Physical Science

Twelve semester hours chosen from at least three of the following fields: astronomy, biology, chemistry, geology, mathematics, physics, psychology. Two of these courses must be in laboratory sciences.

One course chosen to meet this requirement shall be Math. 6, Finite Mathematics; Math. 21, Analytic Geometry and Calculus I; or Phil. 14, Logic and Scientific Method. If the course chosen from these three is Phil. 14, it may not also be used to meet the Philosophy or Religion requirement.

Group III: Social Science

Twelve semester hours, chosen from at least three of the following fields: ancient civilization, economics, education, government, history, international relations, sociology, cultural anthropology, social psychology.

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 78-100.

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 95). 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 95-100.

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 both of the dean of the College of Arts and Science and of the department head 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. Such an irregular program requires a petition to the Committee on Standing of Students.

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.

Arts-Engineering students will normally complete by the end of their fourth year approximately the number of hours required for the B.S. in their chosen branch of engineering.

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 six hours in economics, which may be counted as part of the distribution requirements in Social Science, twenty-one 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	(5)
E.co.	45.	Statistical Method	(3)
Mkt.	11.	Marketing	(3)
Acctg.	104.	Fundamentals of Accounting	(3)
Acctg.	115.	Cost Accounting	(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 Professor Bradford 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 Professor F. A. Bradford, 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. 67.

Honors 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 heads.

Details of Major Sequences

MAJOR SEQUENCES IN ARTS AND SCIENCE

Biology. The biology major provides a comprehensive view of the life sciences. In the first two years, basic courses in biology and collateral science are required. Specialization is deferred until the junior and senior years and is provided by a broad choice of electives depending upon the student's interest and competence. The program is thus prefatory to graduate study in biology and research or teaching.

The required and elective sequences in the biology major exceed substantially the minimum science requirements for admission to medical or dental school. Experience of our major students has shown that this program provides superior preparation for successful work in medicine or dentistry.

Required Preliminary Courses

FRESHMAN YEAR

FRESHMAN YEAR							
FIRST SEMESTER				SECOND SEMESTER			
Biol.	11	General Biology	4	Biol.	12	General Biology	4
Chem.	4	General Chemistry	4	Chem.	5	General Chemistry	4
Math.	21	Anal. Geo. & Cal. I ...	4	Math.	6	Finite Math.	3

Required Major Courses

SOPHOMORE YEAR

SOUTHWESTERN YEAR							
FIRST SEMESTER			SECOND SEMESTER				
Biol.	18	Genetics	2	Biol.	14	Comparative Anatomy.	3
Chem.	51	Organ. Chem.	3	Biol.	35	Microbiology	3
Chem.	53	Organ. Chem. Lab.	2	Chem.	52	Organ. Chem.	3

JUNIOR YEAR

Chem.	38	Anal. Chem.	3	Phys.	16	General Phys.	3
Phys.	1	Mech. of Mass Points....	3	Phys.	17	Gen. Phys. Lab.	2
		*Approved Elect	3			*Approved Elect.	3

SENIOR YEAR

Biol.	320	Physiology	3			*Approved Elect.	3
		*Approved Elect	3				

Four semesters are available to take three of these lectures which must be chosen with the approval of the major adviser from the following courses:

Biol.	313	General Histology.....	3	Biol.	314	Embryology	3
Biol.	353	Virology	3	Biol.	306	Ecology	3
Biol.	221	Undergrad. Res.	3				

Additional courses, generally available to graduate students, may be taken by qualified undergraduates depending upon the interest and competence of the student and availability of the course: Biol. 356, Industrial Microbiology (3), Biol. 361, Sanitary Microbiology (3).

Suggested additional courses outside of the department are: Chem. 371, Elements of Biochemistry (3); Phil. 261, Philosophy of the Natural Sciences (3); Phil. 241, Evolution of Scientific Ideas (3); Geol. 311, Paleontology (3); Psych. 425, Intermediate Psychological Statistics (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 114 and 115 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. Other respects in which the curricula differ are that the B.A. candidate is required to take six more hours of language than the B.S. candidate, and he is not required to take a course in Chemical Engineering. Adequacy in German will be found beneficial for those having a professional interest in Chemistry (See German requirements on page 226). 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.	4,	5	General Chemistry	(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)

JUNIOR YEAR

Chem.	91.		Physical Chemistry	(3)
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.	358.		Advanced Organic Chemistry	(3)

SENIOR YEAR

Chem.	194.		Physical Chemistry	(3)
Chem.	197.		Physical Chemistry Laboratory	(1)
Chem.	236.		Analytical Chemistry	(3)
			(and at least one of the following)	
Chem.	303.		Nuclear and Radiochemistry	(3)
Chem.	305.		Inorganic Preparations	(2)
Chem.	306.		Systematic Inorganic Chemistry	(3)
Chem.	337.		Instrumental Methods of Analysis ..	(3)
Chem.	371.		Elements of Biochemistry	(3)
Chem.	391.		Introduction to High Polymers	(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.	111.		Homer	(3)
Gk.	116.		Plato	(3)
Gk.	21.		Ancient History	(3)
Lat.	22.		Ancient History	(3)

Six hours at 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

Lat.	66.		Horace	(3)
Gk.	21.		Ancient History	(3)
Lat.	22.		Ancient History	(3)

and twelve semester hours from the following:

Lat.	167.		Roman Prose Writers	(3)
Lat.	168.		Latin Drama	(3)
Lat.	211.		Readings	(3)
Lat.	169.		Satire	(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)
Educ.	330.		History of Education in Europe	(3)
Govt.	1.		Foundation of Government	(3)
Hist.	25.		European History	(3)
Phil.	14.		Logic and Scientific Method	(3)
Phil.	231.		Ancient Philosophy	(3)

Conservation. See Natural Resources, page 90.

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 112.

Economics.

Required Preliminary Courses

SOPHOMORE YEAR

Eco.	11.	12.	Political-Economic Thought	(6)
Eco.	3.	4.	Economics	(6)
Math.	21.		Analytic Geo. and Cal. I	(4)
Math.	6.		Finite Math.	(3)

Required Major Courses

JUNIOR YEAR

Eco.	306.		Intermediate Economic Theory	(3)
Eco.	307.	308.	History of Economic Thought	(6)
Eco.	45.		Statistical Method	(3)
Eco.	346.		Business Cycles and Forecasting	(3)
Fin.	129.		Money and Banking	(3)
Eco.	309.		Comparative Economic Systems	(3)

SENIOR YEAR

Eco.	333.		Labor Problems	(3)
Fin.	351.		Public Finance: Federal	(3)
Eco.	303.		Economic Development	(3)
Eco.	310.		Economic Evolution	(3)
Eco.	311.		Economics Resource Use	(3)

Recommended Electives

Acctg.	104.		Fundamentals of Accounting	(3)
Eco.	303.		Economic Development	(3)
Eco.	334.		Labor Legislation	(3)
Eco.	347.		National Income Analysis	(3)
Eco.	348.		Advanced Business Cycles	(3)
Govt.	357.		City Government	(3)
Govt.	360.		Public Administration	(3)
Hist.	327.	328.	Development of American Institutions	(3)
S. R.	42.		Principles of Sociology	(3)
S. R.	365.		Development of Sociological Theory	(3)
Fin.	130.		Money and Banking	(3)
Eco.	336.		Business and Government	(3)
Fin.	241.		International Trade and Finance	(3)
Fin.	332.		Monetary-Fiscal Policy	(3)
S. R.	362.		Social Problems	(3)

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.	104.		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.	241.	342.	International Trade and Finance	(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)

<i>Recommended Electives</i>		
Acctg.	115.	Cost Accounting (3)
Eco.	306.	Intermediate Economic Theory (3)
Eco.	346.	Business Cycles and Forecasting (3)

Accounting.*

<i>Required Preliminary Courses</i>		
Acctg.	1, 2.	Accounting (6)
Eco.	3, 4.	Economics (6)
Math.	21.	Anal. Geo. and Cal. I (4)
Math	6.	Finite Math. (3)

<i>Required Major Courses</i>		
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 Accounting (3)
Acctg.	315.	Advanced Accounting (3)
Acctg.	318.	Advanced Cost Budgeting and Analysis (3)
Acctg.	320.	Auditing (3)
Acctg.	325.	Controllorship (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.

<i>Recommended Electives</i>		
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)

Education. The four-year major in Education is being discontinued. Students desiring to study in the field of Education should consult the head of the department.

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)	
Engl.	11,	12.	Types of World Literature	(6)	(6)
Engl.	8,	9.	English Literature	(6)	

Required Major Courses

Engl.	323, 324.	Shakespeare and the Elizabethan Drama	(6)
and eighteen 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)

Plus six hours in literature or related courses approved by the head of the 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 interested 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.	<i>Brown and White</i>	(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.	16.	Law of the Press	(3)
Journ.	17.	Magazine Article Writing	(3)
Journ.	113.	Editing	(3)
Journ.	115.	Interpretive Writing	(3)
Journ.	118.	History of American Journalism	(3)
Journ.	120.	Journalism Proseminar	(3)
Gk.	21.	Ancient History	(3)
or			
Lat.	22.	Ancient History	(3)
Govt.	352.	Civil Rights	(3)
Phil.	14.	Logic and Scientific Method	(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 perception, 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 the structure.

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.

<i>Required Preliminary Courses</i>			
F.A.	1,	2.	Survey of Painting and Sculpture .....(6)
F.A.	31 or 32.		Elements of Art .....(3)
Phil.	14.		Logic .....(3)*
Phil.	or		
Phil.	15.		Ethics .....(3)*
Psych.	or		
Psych.	1.		Introduction to Psychology

<i>Required Major Courses</i>			
F.A.	3.		Pre-Renaissance Architecture .....(3)
F.A.	4.		Architects and Architecture .....(3)
F.A.	15.		Italian Ren. Art .....(3)
F.A.	16.		Art in the United States .....(3)
F.A.	19.		Nineteenth Century Art .....(3)
F.A.	20.		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 pairs 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)
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*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.

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

<i>Required Preliminary Courses</i>			
Eco.	3,	4.	Economics .....(6)
Govt.	3.		Foreign Governments .....(3)
Math.	21.		Anal. Geo. and Cal. I .....(4)
Math.	6.		Finite Mathematics .....(3)

<i>Required Major Courses</i>			
Eco.	303.		Economic Development .....(3)
Eco.	305.		*Economic Development of Latin America .....(3)
Eco.	45.		Statistical Method .....(3)
Hist.	49,	50.	*History of Latin America .....(6)
Hist.	365,	366.	*Modern Latin America .....(6)

Foreign Trade Option

Acctg.	104.	Fundamentals of Accounting .....(3)
Fin.	129.	Money and Banking .....(3)
Fin.	241, 342.	International Trade and Finance .....(6)
		Six hours of economics or finance in consultation with the adviser(6)

Public Administration Option

Acctg.	104.	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)

*For students concentrating in the Latin-American area.

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 or geophysics may be permitted to substitute certain additional courses in collateral sciences for some required geology courses.

An extended field trip may be held each semester for advanced undergraduates in conjunction with work in advanced required major courses.

Attendance at an approved summer field camp is most strongly recommended for all majors, particularly those preparing for graduate study or for the Natural Resources option. Satisfactory credit obtained therefrom will be accepted for Geol. 141.

Geological training may be utilized in government service, industry (especially the petroleum, mining, and ceramics industries), secondary school and college teaching, and in scientific journalism and documentation.

Natural Resources Option: Students interested in natural resources and their conservation may take the major in geology, slightly modified to permit taking collateral courses in biology and other pertinent fields.

Required Preliminary Courses
FRESHMAN YEAR

FIRST SEMESTER				SECOND SEMESTER			
Geol.	1	Principles of Geology	3	Geol.	12	Historical Geology	3
Chem.	4	General Chemistry	4	Chem.	5	General Chemistry	4
Math.	21	An. Geo. and Cal. I	4	Math.	22	An. Geo. & Cal. II	4

Required Major Courses
SOPHOMORE YEAR

Geol.	63	Intro. to Oceanography	3	Geol.	14	Earth Materials	1
Biol.	1	Introductory Biology	3			Laboratory	
or				Geol.	23	Structural Geology	3
Biol.	11	General Biology	4	Phys.	16	General Physics	3
Phys.	1	Mechanics of Mass	3	Phys.	17	Gen. Physics Lab	2
		Points					

JUNIOR YEAR

Geol. 311	Paleontology	3	Geol. 312	Strat. and Sedi-	
Geol. 333	Crystallography	3	Geol. 336	Min. Phase Relations	3
Chem. *	.....	3			

SENIOR YEAR

Geol. 141	Field Geology	3	Geol. 366	Geol. of N. America	3
Geol. 334	Theo. Petrology	4	Geol. **	.....	3

*Chem. 38, 95, or 150.

**Chosen with approval of major adviser from Geol. 357 (3), 281 (1-3), 282 (1-3), 337 (3), 339 (1-2), 351 (2), or 390 (2).

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. 33, 34.	Types of German Literature	(6)
Ger. 36.	Goethe's <i>Faust</i>	(3)
and at least two of the following:		
Ger. 32.	Conversation and Composition	(3)
Ger. 35.	German Poetry	(3)
Ger. 201.	The Classical Period	(3)
Ger. 202.	The German <i>Novelle</i>	(3)
Ger. 203.	Nineteenth Century German Drama	(3)
Ger. 204.	Medieval German Literature	(3)
Ger. 205.	Twentieth Century German Literature	(3)
Ger. 250.	Special Topics	(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.	Foundations of Government	(3)
Plus three hours from the following:			
Govt.	2.	American Political Ideas	(3)
Govt.	4.	Political Parties	(3)
Govt.	6.	Democracy	(3)

Required Major Courses

Govt.	3.	Foreign Governments	(3)
Govt.	101.	History of Political Thought	(3)
Govt.	51, 52.	American Government	(6)
Govt.	357.	City Government	(3)
Govt.	363, 364.	Contemporary Political Thought	(6)

Plus six hours from the following:

Govt.	351.	Constitutional Law	(3)
Govt.	352.	Civil Rights	(3)
Govt.	354.	Administrative Law	(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)

Plus six hours to be selected, with the approval of the department head, from the fields of *history or international relations* (6)

Recommended Electives

Majors in government are advised to enroll for certain courses in the fields of economics, journalism, philosophy, psychology, public finance, and social relations. The particular course selections should be made in consultation with the head of the department.

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 in the school of their choice.

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, and are required to write an acceptable senior paper. The senior paper will be due on the second Monday in April for those graduating in June, the third Monday in September for those graduating in October, and the second Monday in December for those graduating in January. 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.	327, 328.	Development of American Institutions	(6)
Hist.	329, 330.	American Foreign Policy	(6)
Hist.	345.	England, 1066-1603	(3)
Hist.	347, 348.	British Empire, 1603 to the Present	(6)
Hist.	351.	The Civilization of the Middle Ages	(3)
Hist.	352.	Renaissance and Reformation	(3)
Hist.	353, 354.	European History, 1648 to the Present	(6)
Hist.	355, 356.	Intellectual Expansion of Modern Europe	(6)
Hist.	365, 366.	Modern Latin America	(6)
Hist.	371, 372.	Special Topics in History	(6)

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)
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Required Major Courses

I. R.	341, 342.	International Relations	(6)
I. R.	351, 352.	International Organization	(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 multiplying 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.	51.	Advanced Algebra	(3)
Math.	54.	Higher Geometry	(3)
Math.	219.	Principles of Analysis	(3)
Math.	220.	Principles of Analysis	(3)
Math.	221.	Differential Equations	(3)
Math.	315.	Theory of Functions of a Complex Variable	(3)
Math.	340.	Higher Algebra	(3)
		Approved electives	(9)

The three 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 head of the department, to prepare for certain of the actuarial examinations.

Natural Resources. The interdepartmental major in Natural Resources is planned to give the student the basic preparation for a career in the management and conservation of our natural resources, or for graduate work leading to such a career. The major is under the direction of Professor Trembly of the department of biology.

Required Preliminary Courses

Biol.	11.	12.	General Biology	(8)
Chem.	4.	5.	General Chemistry	(8)
Geol.	1.		Principles of Geology	(3)
Math.	21.		Anal. Geo. & Cal. I	(4)
Math.	6.		Finite Mathematics	(3)
Phys.	1.		Mechanics of Mass Points	(3)

Required Major Courses

Biol.	35.	Microbiology	(3)
Biol.	306.	Ecology	(3)
Biol.	322.	Advanced Botany	(3)
Chem.	93.	Physical Chemistry	(3)
Chem.	235.	Analytical Chemistry	(3)
Geol.	23.	Structural Geology	(3)
Geol.	34.	Minerals and Rocks	(3)
Geol.	364.	Hydrometeorology	(3)
Geol.	374.	Geology of Soils	(3)
Phys.	16.	General Physics	(3)
Phys.	17.	General Physics Laboratory	(2)

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.

Philosophy. The major in philosophy is designed to strengthen in the student three functions or characteristics of mind typically implied by the term "philosophic": a capacity and disposition for certain sorts of analysis; a degree of and delight in intellectual perspective; a resourcefulness that grows out of candor guided by analysis and perspective.

Analysis, in contemporary philosophy, often concerns: (a) *languages* (English, mathematical notations, etc.), studied as media of thought which, by their very nature, determine in crucial ways our habits of mind;

(b) *knowledge*, its various general modes (sensory perception, ratiocination, moral awareness, aesthetic intuition, religious insight, etc.), being inventoried and appraised to determine their nature and reliability for designated purposes;

(c) *scientific methods* (in formal, natural and social sciences), the study of them directed toward ascertaining their proper forms, their interrelations, and their general limitations as techniques for obtaining and systematizing knowledge;

(d) *value judgments* (moral, aesthetic, political, etc.), these being scrutinized with respect to their genesis, criteria, employment and possible verification.

Philosophic perspective is gained, in part, by surveying critically the development of man's ultimate notions about himself, his culture, and the universe at large down to the present time. With the inevitable division of intellectual labor, manifest in the departmentalized university, it becomes necessary, too, to take stock of and try to correlate the fundamental assumptions and central concepts in terms of which specialized sciences proceed. Philosophy provides a forum in which this kind of comparative study can thrive, and where basic ideas and methods used in any specialized discipline can be considered for their possible use elsewhere.

Candor, a certain courage of the soul, is no special product of the philosophic craft; but it may, with luck, be in some measure nurtured as analysis adds precision and perspective provides hope or order in the life of mind.

Required Preliminary Courses

Phil.	14.	Logic and Scientific Method	(3)
Phil.	15.	Ethics: The Theory of Conduct	(3)

Required Major Courses

Phil.	231.	Ancient Philosophy	(3)
Phil.	235.	Modern Philosophy	(3)

and eighteen additional hours, at least twelve of which shall be chosen from the courses listed below. The other six may be taken from appropriate advanced courses in other fields as approved by the head of the department of philosophy.

Phil.	233.	Medieval Philosophy	(3)
Phil.	237.	Nineteenth Century Philosophy	(3)
Phil.	239.	Twentieth Century Philosophy	(3)
Phil.	241.	Evolution of Scientific Ideas	(3)
Phil.	244.	Found. of Infor. Theory	(3)
Phil.	254.	Adv. Logic	(3)
Phil.	261.	Philosophy of the Natural Sciences	(3)
Phil.	264.	Philosophy of Language	(3)
Phil.	263.	Special Topics in the Philosophy of Science	(3)
Phil.	271, 272.	Readings in Philosophy	(6)
Phil.	281.	Philosophy of the Social Sciences	(3)
Math.	303.	Mathematical Logic	(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.	4,	5.	General 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	Atomic or Solid State or Nuclear Physics	(3)
	364.		
Math.	219, 220.	Principles of Analysis	(6)
Math.	221.	Differential Equations	(3)

Psychology. The sequence of the basic courses in psychology and other sciences is designed to enlarge 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 emphasis is on quantitative and experimental analysis. The core curriculum of required courses is kept, purposely, small. Elective courses allow further exploration and deepening of knowledge in special areas of psychological theory and application. With this grounding a student majoring in psychology may contemplate graduate specialization in research and teaching or in a wide variety of applied fields, including clinical, engineering and industrial

psychology. Students interested in a medical career may profitably choose psychology as their major whether or not their interests lie primarily in problems of abnormal behavior.

Required Preliminary Courses

Biol.	1, 2	Elementary Biology	(6)
Chem.	4	General Chemistry	(4)
Math.	6	Finite Mathematics	(3)
Math.	21	Anal. Geo. and Cal. 1	(4)
Phil.	14	Logic	(3)
Phys.	1	Mech. of Mass Pts.	(3)
Phys.	16, 17	General Physics, Gen. Phys. Lab.	(5)
Psych.	1	Introduction to Psychology	(3)
Psych.	2	Introductory Psychology Laboratory	(1)
Psych.	20	Statistical Analysis and Experimentation ..	(4)

Required Major Courses

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)

Sufficient courses to bring the total number of hours in the major program to 24, to be selected from departmental courses numbered 100 or above, S.R. 1 or S.R. 201, with approval of head of the department. (8-10)

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 career goals 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 Literature before Seventeenth Century ..	(3)
Fr.	222.	Contemporary French Literature	(3)
Fr.	223, 224.	Proseminar	(6)

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.

<i>Required Preliminary Courses</i>		
Span.	1, 2.	Elementary Spanish .....(6)
Span.	11, 12.	Intermediate Spanish .....(6)
<i>Required Courses in Major</i>		
Eighteen hours from the following of which at least six shall be chosen from Spanish 221, 222, 223, 224, 231, 232.		
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.	221.	Spanish Drama of the Golden Age .....(3)
Span.	222.	Spanish Fiction of the Golden Age .....(3)
Span.	223, 224.	Proseminar .....(6)
Span.	231, 232.	Spanish-American Literature .....(6)

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.

<i>Required Preliminary Courses</i>		
Two of the following:		
S.R.	1.	Social Psychology .....(3)
S.R.	31.	Cultural Anthropology .....(3)
S.R.	61.	Principles of Sociology .....(3)
Psych.	1, 2.	Elementary Psychology .....(4)
Recommended: Economics 3, 4; Mathematics 6.		

<i>Required Major Courses</i>		
<i>Option in Social Psychology:</i>		
S.R.	201.	The Social Psychology of Groups .....(3)
S.R.	301.	Experimental Social Psychology .....(3)
S.R.	302.	Seminar in Social Psychology .....(3)
S.R.	394.	The Individual, Society and Culture .....(3)
S.R.	298.	Research Methods .....(3)
Six hours to be selected from approved courses in Psychology .....(6)		
One course from S.R. 231, 232, 235, 236, 331, or 333 .....(3)		
One course from S.R. 364, 365, 366, 367, or 368(3)		

Option in Cultural Anthropology:

S.R.	298.	Research Methods	(3)
12 hours from the following:			
S.R.	231.	Cultural Dynamics	(3)
S.R.	232.	Religion of Primitive Peoples	(3)
S.R.	235.	Peasant and Tribal Cultures of India	(3)
S.R.	236.	East Indian Cultures Abroad	(3)
S.R.	331.	History of Ethnological Theory	(3)
S.R.	333.	Primitive Political Systems	(3)
One course from S.R. 201, 301, 302, or 394			(3)
One course from S.R. 364, 365, 366, 367, or 368			(3)
Approved Electives			(6)

Option in Sociology:

S.R.	298.	Research Methods	(3)
12 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.	365.	Development of Sociological Theory	(3)
One course from S.R. 201, 301, 302, or 394			(3)
One course from S.R. 231, 232, 235, 236, 331, or 333			(3)
Approved Electives			(6)

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.	4,	5.	General 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 124-140.)

The number of credit hours needed for the B.A. in Applied Science is not fixed, but is approximately 30 less than the number needed to obtain the

B.S. 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.: 166
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 Points	3
Chem.	4	General Chemistry	4	Chem.	5	General Chemistry	4
P.E.	1	Physical Education	—	P.E.	2	Physical Education	—
17				17			

SECOND YEAR

Lang.			3	Lang.			3
Dist.			3	Ch.E.	70	Ind. Stoichiometry	3
Math.	23	Anal. Geom. & Calc. III	4	Math.	204	Linear Analysis	3
Chem.	51	Organ. Chem.	3	Chem.	52	Organ. Chem.	3
Phys.	3	Heat & Electricity	4	Chem.	55	Organ. Chem. Lab.	2
Ch.E.	10	Ch.E. Computation	1	Phys.	4	Electricity, Light, & Atomic Physics	4
18				18			

THIRD YEAR

Lang.			3	Lang.			3
Eco.	3	Economics	3	Eco.	4	Economics	3
Chem.	38	Analytical Chem.	3	Dist.			3
Chem.	91	Phys. Chem.	3	Chem.	190	Phys. Chem.	3
Math.	231	Statistical Inference	3	Chem.	192	Phys. Chem. Lab.	1
Mech.	1	Statics	3	Chem.	193	Phys. Chem. Lab.	1
18				C.E.	11	Eng. Graphics	2
				16			

FOURTH YEAR

Dist.			3	Dist.			9
Ch.E.	161	Unit Operations I	4	Ch.E.	162	Unit Operations II	3
E.E.	160	Elect. Circuits	3	Ch.E.	175	Chem. Eng. Pract.	1
E.E.	161	Elect. Prob.	1	Elect.			3
E.E.	162	Dynamo Lab.	1				
Mech.	11	Mech. of Materials	3				
Elect.			3				
18				16			

(Ch.E. 100. Eight (8) weeks industrial employment with report should precede fifth year. Consult head of the department).

ARTS - CHEMISTRY

Students desiring to major in Chemistry should see the Chemistry major programs in the College of Arts and Science and the College of Engineering, pages 79 and 117, respectively, of this catalog.

ARTS - CIVIL ENGINEERING

Credit hours collegiate work needed for B.A. and B.S.: 174
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
Phys.	1	Mech. of Mass Points	3	Dist.			3
Chem.	4	General Chemistry	4	Chem.	5	General Chemistry	4
P.E.	1	Physical Education	—	P.E.	2	Physical Education	—
17				17			

SECOND YEAR

Lang.			3	Lang.			3
Eco.	3	Economics	3	*Math.			3
Math.	23	Anal. Geom. & Calc. III	4	Dist.			3
Phys.	3	Heat & Electricity	4	Phys.	4	Electric Light & Atomic Phys.	4
Dist.			3	Eco.	4	Economics	3
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.	112	Adv. Mech. of Mat'ls.	3	C.E.	124	Applied Hydrology	2
C.E.	121	Fluid Mechanics	3	C.E.	154	Structural Analysis II.	3
C.E.	123	Fluid Mechanics Lab.	1	C.E.	239	Soil Mechanics	3
C.E.	150	Structural Anal. I	3	E.E.	160	Elec. Circuits	3
Mech.	102	Dynamics	3	E.E.	161	Elec. Problems	1
Geol.	1	Principles of Geology	3	E.E.	162	Dynamo Lab.	1
Met.	63	Eng. Met. & Processes	3	M.E.	160	Thermodynamics	3
				19	16		

Summer: C.E. 100. Eight (8) weeks industrial employment with report should precede fifth year. Consult head of the department.

*Approved by C.E. Department Head.

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.	4 General Chemistry	4	Chem.	5 General Chemistry	4
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	Eco.	4 Economics	3
Math.	208 Applied Math. II	3	Dist.	.....	3
Mech.	102 Dynamics	3	Math.	309 Theory of Probability..	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 Electronics	3
E.E.	104 Circuit Theory II	3	E.E.	231 Elec. & Mag. Fields ..	3
Elect.	.....	6	Elect.	.....	3
		17			17

(EE 100. Summer employment should precede fifth year. Consult Head of Department.)

ARTS - ENGINEERING MECHANICS

Credit hours collegiate work needed for B.A. and B.S.: 166

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.	4	General Chemistry 4	Chem.	5	General Chemistry 4
P.E.	1	Physical Education 4	P.E.	2	Physical Education 4
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.		6	Dist.		3
C.E.	11	Engineering Graphics 2	Math.	219	Principles of Analysis 3
Math.	204	Linear Analysis 3	C.E.	121	Mech. of Fluids 3
Mech.	102	Dynamics 3	C.E.	123	Fluids Lab. 3
			Mech.	10	Problem Comp. Lab. 1
17			Met.	91	El. Mat. Science 3
			19		

FOURTH YEAR

Dist.		3	Dist.		3
Math.	220	Principles of Analysis 3	Math.	208	Complex Variables 3
Mech.	301	Adv. Mech. of Materials 3	Math.	309	Theory of Probability 3
EE.	14	Circuit Theory I 3	Mech.	302	Adv. Dynamics 3
Elect.		6	Elect.		6
18			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	Diff. Eq. & Harm. Anal 3	Mech.	304	Mech. of Cont. II 3
Mech.	303	Mech. of Continua I 3	Mech.	306	Exp. Methods in Mech. 3
Phys.	340	Phys. Ther. Dynamics 3			Elect. 3
Phys.	191	Lab. Techniques 2			
Mech.	305	System Dynamics 3			

ARTS - ENGINEERING PHYSICS

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 ENGINEERINGCredit 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.	5	General Chemistry	4
Chem.	4	General Chemistry	4	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	4
Eco.	3	Economics	3			Atom. Phys.	4
I.E.	10	Problem Comp. Lab.	1	Met.	67	Metallurgy Lab.	2
			18	I.E.	11	Applied Prob. Lab.	1
				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	
I.E.	140	Mfg. Processes Lab.	1	I.E.	222	Operations Analysis	4
Mech.	1	Statics	3	Mech.	11	Mech. of Materials	3
Dist.			6	Mech.	13	Materials Test. Lab.	1
			17				17

FOURTH YEAR

I.E.	121	Analysis & Design I	5	I.E.	122	Analysis & Design II	4
E.E.	160	Elec. Circuits	3	Mech.	102	Dynamics	3
E.E.	161	Elec. Problems	1	M.E.	168	Elem. Mach. Design	4
E.E.	162	Dynamo Lab.	1	Elect.			6
Dist.			3				17
Psych.	1	Elem. Psych.	3				
Elect.			3				
			19				

SUMMER

(I.E. 100. Industrial employment should precede fifth year. Consult Head of Department.).

ARTS - MECHANICAL ENGINEERINGCredit hours collegiate work needed for B.A. and B.S.: 171
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.	4	General Chemistry	4	Chem.	5	General Chemistry	4
P.E.	1	Physical Education	—	P.E.	2	Physical Education	—
			17				17

SECOND YEAR

Lang.		3		Lang.		3	
Dist.		3		Dist.		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	4
M.E.	10	Anal. of Eng. Problems	1			Atomic Physics	4
			18	C.E.	11	Engr. Graphics	2
							18

THIRD YEAR

Lang.	.....	3	Lang.	.....	3
Dist.	.....	3	Dist.	.....	6
Math.	204 Linear Anal.	3	Met.	63 Engr. Mat. and Proc.	3
Mech.	1 Statics	3	Mech.	11 Mech. of Mater.	3
E.E.	160 Elect. Cir. and Appar.	3	Mech.	13 Mater. Test. Lab.	1
E.E.	161 Elect. Problems	1	Math.	208 Applied Math. II	3
E.E.	162 Dynamo Lab.	1			19

17

Summer School: IE 40 Machine Shop Practice (3)
(Preregister during Spring Pre-registration in M.E. Department)

FOURTH YEAR

M.E.	101 Mach. Design I	3	M.E.	102 Mach. 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 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 Head of Department)

Above curriculum is effective for the class entering in Fall 1963 and subsequent classes.

ARTS - METALLURGICAL ENGINEERING

Credit hours collegiate work needed for B.A. and B.S.: 169

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.	4 General Chemistry	4	Phys.	1 Mech. of Mass Points	3
Dist.	.....	3	Chem.	5 General Chemistry	4
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. III	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.	.....	3	Dist.	.....	6
Met.	230 Phys. Met. I	4	Met.	231 Phys. Met. II	4
Chem.	99 Analytic. Chem.	3	Ch.E.	60 Engr. in Chem. Mfg.	3
Mech.	1 Statics	3	Mech.	11 Mech. of Materials	3

16

19

FOURTH YEAR

Dist.	.....	3	Elect.	.....	9
Elect.	.....	3	Mech.	102 Dynamics	3
M.E.	166 Proc. of Mach. Des.	2	Chem.	195 Phys. Chemistry	3
Met.	105 Extractive Met. I	4	Met.	106 Extractive Met. II	3
Chem.	95 Phys. Chemistry	3			18
Math.	324 Prob. & Num. Anal.	3			

18

SUMMER

(Met. E. 100 — Industrial Employment should precede fifth year. Consult Head of Department).



Drown Memorial Hall houses the College of Business Administration

THE COLLEGE OF BUSINESS ADMINISTRATION

ADMINISTRATIVE OFFICERS

Harvey Alexander Neville, *President*

Glenn James Christensen, *Provost and Vice-President*

Charles Augustus Seidle, *Vice-President—Administration*

L. Reed Tripp, *Dean of the College of Business Administration*

Samuel Harold Missimer, *Director of Admission*

James Harold Wagner, *Registrar*

James Decker Mack, *Librarian*

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 67). 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 con-

centration 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 111 and 112, respectively.

Graduate programs leading to the degrees of Master of Business Administration and Master of Science in Management Science are outlined on pages 164 and 165. A graduate program for the Master of Science in Business Economics is outlined on page 189.

A five-year curriculum in industrial engineering and business administration is outlined on page 113.

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. 301	Bus. Policy	3
Acctg. 2	Accounting	3	or Eco. 313	Quant. Planning	
Eco. 11	Intro. to Pol.-Eco.			and Control	3
	Thought	3	Eco. 306	Intermed. Eco. Theory	3
Eco. 12	Intro. to Pol.-Eco.		Eco. 346	Business Cycles	
	Thought	3	or Eco. 333	Labor Problems	3
Eco. 3	Economics	3	Fin. 125	Corporation Finance....	3
Eco. 4	Economics	3	Fin. 129	Money and Banking ..	3
Mkt. 11	Marketing	3	Math. 21	Anal. Geom. &	
Engl. 1	Composition & Lit.			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 and the head of the department concerned.

III. Optional Courses (33 hours)

ENGLISH OR FOREIGN LANGUAGE OPTION (12 HOURS)

Students who present two units in one foreign language for entrance credit will not be required to take work in foreign languages. Foreign Careers students, however, will take at least 12 hours in an appropriate foreign language specialty. Students who present less than two units of a foreign language for entrance credit will be required to take six hours in one foreign language. Credit for less than six hours in an elementary language will not be accepted in partial satisfaction of this requirement.

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.

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.

SCIENCE OPTION (9 HOURS)

Not more than six hours in the Science Option may be taken in one department. The following courses are acceptable in satisfaction of the science requirement; Biol. 1, 2, or 13; Geol. 1 and 2; Chem. 15 and 16; Phys. 1 and 16.

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

FIRST SEMESTER			UNIFORM FRESHMAN YEAR		SECOND SEMESTER		
Course No.	Course Title	Cr. Hrs.	Course No.	Course Title	Cr. Hrs.	Course Title	Cr. Hrs.
Eco. 11	Intro. to Pol.-Eco.		Eco. 12	Intro. to Pol.-Eco.		Intro. to Pol.-Eco.	
	Thought	3		Thought	3		
Math. 21	Anal. Geom. & Calculus I	4	Math. 6	Finite Math.	3	Finite Math.	3
Engl. 1	English ¹	3	Engl. 2	English ¹	3	English ¹	3
P.E. 1	Two Optional Courses ²	6	P.E. 2	Two Optional Courses ²	6	Two Optional Courses ²	6
	Physical Education			Physical Education		Physical Education	
		16					15

¹For a statement of the freshmen English requirement see page 194.

²Optional Courses fall into three groups: English or Foreign Language, Arts, and Science. For a general statement concerning these groups see this page above.

Major in Accounting*

FIRST SEMESTER			SOPHOMORE YEAR		SECOND SEMESTER		
Course No.	Course Title	Cr. Hrs.	Course No.	Course Title	Cr. Hrs.	Course Title	Cr. Hrs.
Acctg. 1	Accounting	3	Acctg. 2	Accounting	3	Accounting	3
Eco. 3	Economics	3	Eco. 4	Economics	3	Economics	3
	Optional Courses ¹	9	Eco. 45	Statistical Method	3	Statistical Method	3
		15		Optional Courses ¹	6	Optional Courses ¹	6
							15

FIRST SEMESTER			JUNIOR AND SENIOR YEARS		SECOND SEMESTER		
Eco.	346	Business Cycles		Mkt.	11	Marketing	3
or				Fin.	125	Corporation Finance...	3
Eco.	333	Labor Problems	3	Eco.	306	Intermed. Eco. Theory	3
Fin.	129	Money and Banking ...	3			Optional Courses ¹	3
Law	1	Business Law	3			Free Electives ²	6
Eco.	301	Business Policy	—				
or							
Eco.	313	Quant. Planning					
		& Control ⁴	3				
		Optional Courses ¹	3				
		Free Elective ²	3				
<i>Required Courses in Major</i>							
Acctg.	13	Intermediate Acctg.	3	Acctg.	14	Intermediate Acctg.	3
Acctg.	115	Cost Accounting	3	Law	102	Business Law	3
		Major Program				Major Program	
		Elective ³	6			Electives ³	6
			30				30

¹Optional Courses fall into three groups: English or Foreign Language, Arts, and Science. For a general statement concerning these groups see page 106.

²Suggested Free Electives:

Fin.	323	Investments	3	Fin.	326	Prob. in Fin. Mgmt...	3
Eco.	352	Adv. Stat. Method	3				

³Electives in the Accounting Major may be chosen from the following in consul-

Acctg.	320	Auditing	3	Acctg.	318	Adv. Cost Budgeting	
						and Analysis	3
Acctg.	325	Controllership	3	Acctg.	304	Govt. & Inst. Acctg...	3
Acctg.	203	Fed. Tax Accounting...	3	Acctg.	204	Fed. Tax Accounting...	3
Law	204	Wills, Estates, & Trusts	3	Acctg.	315	Adv. Accounting	3

⁴Accounting majors are urged to take Eco. 313 either as a core course or as an elective.

*Candidates for the C.P.A. examination in New Jersey are required to have 8 credit hours of finance and 8 credit hours of business law. In addition, the New Jersey State Board requires 30 hours of accounting for candidates for the C.P.A. examination in that state. It is therefore recommended that students who anticipate becoming candidates for the C.P.A. examinations in New Jersey take 3 additional credit hours each of finance and business law courses and 6 additional credit hours in accounting, as part of their elective program.

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
						Optional Course ¹	3
			15				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.	301	Business Policy or	
Eco.	306	Inter. Eco. Theory	3	Eco.	313	Quantitative Planning	
		Optional Courses ¹	6			and Control	3
		Free Elective ³	3			Optional Course ¹	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			

¹Optional Courses fall into three groups: English or Foreign Language, Arts, and Science. For a general statement concerning these groups see page 106.

²Electives in the Economics major may be chosen from the following in consultation with advisor:

Fin.	241	Inter. Trade & Fin.	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.	305	Eco. Dev. of Latin Amer.	3
				Fin.	332	Monetary Fiscal Pol.	3

³Suggested Free Electives:

Phil.	14	Logic & Scient. Meth.	3	Math.	22	Anal. Geom. & Cal. II	4
Hist.	327	Intermed. Acctg.	3	Math.	23	Anal. Geom. & Cal. III	4
Acctg.	305	Dev. Amer. Inst.	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

FIRST SEMESTER			SOPHOMORE YEAR		SECOND SEMESTER		
<i>Course No.</i>	<i>Course Title</i>	<i>Cr. Hrs.</i>	<i>Course No.</i>	<i>Course Title</i>	<i>Cr. Hrs.</i>		
Acctg.	1	Accounting	3	Acctg.	2	Accounting	
Eco.	3	Economics	3	Eco.	4	Economics	
Law	1	Business Law	3	Eco.	45	Statistical Method.....	
		Optional Courses ¹	6			Optional Courses ¹	
			15			15	

FIRST SEMESTER			JUNIOR AND SENIOR YEARS		SECOND SEMESTER	
<i>Course No.</i>	<i>Course Title</i>	<i>Cr. Hrs.</i>	<i>Course No.</i>	<i>Course Title</i>	<i>Cr. Hrs.</i>	
Mkt. 11	Marketing	3	Fin. 125	Corporation Finance....	3	
Fin. 129	Money and Banking	3	Eco. 301	Business Policy	3	
Eco. 346	Business Cycles	3	Eco. 306	Int. Eco. Theory	3	
	Optional Courses ¹	6		Optional Course ¹	3	
	Major Program			Major Program		
	Elective ²	3		Elective ²	3	
	Free Elective ³	3		Free Electives ³	6	

Required Courses in Major

E.S.	347	Nat. Inc. Analysis.....	3	Eco.	302	Mgmt. Analysis	3
E.S.	352	Adv. Stat. Method.....	3	Eco.	333	Labor Problems	3
Eco.	313	Quant. Planning & Control	3	Eco.	348	Adv. Bus. Cycles	3
				30			

¹Optional Courses fall into three groups: English or Foreign Language, Arts, and Science. For a general statement concerning these groups see page 106.

²Electives in the Economic Statistics major may be chosen from among the following:

Fin.	241	Int. Trade & Fin.	3	Fin.	342	Int. Trade & Fin.	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				
Fin.	241	Int. Trade & Finance	3				

³Suggested 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

FIRST SEMESTER			SOPHOMORE YEAR			SECOND SEMESTER		
Course No.	Course Title	Cr. Hrs.	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			

FIRST SEMESTER			JUNIOR AND SENIOR YEARS			SECOND SEMESTER		
Course No.	Course Title	Cr. Hrs.	Course No.	Course Title	Cr. Hrs.	Course No.	Course Title	Cr. Hrs.
Mkt. 11	Marketing	3	Eco. 333	Labor Problems	3			
Fin. 125	Intermed. Eco. Theory	3	Eco. 301	Business Policy or	3			
Eco. 306	Corporation Finance	3	Eco. 313	Quant. Planning	3			
Fin. 129	Money and Banking	3		& Control	3			
	Optional Course ¹	3		Optional Courses ¹	6			
	Major Program			Major Program				
	Electives ²	6		Elective ²	3			
	Free Elective 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

¹Optional Courses fall into three groups: English or Foreign Language, Arts, and Science. For a general statement concerning these groups see page 106.

²Electives 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.	241	Inter. Trade & Fin.	3	Fin.	331	Bank Credit Mgmt.	3
Eco.	347	Nat. Inc. Analysis	3	Fin.	342	Inter. Trade & Fin.	3
Acctg.	305	Fin. Stat. & Reports		Fin.	352	Pub. Finance:	
		or				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

³Suggested 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

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	
		Foreign Language	3			Foreign Language	3	
Govt.	3	Foreign Govts.	3	Science		Science	3	
			15				15	

110 College of Business Administration: Courses of Study

FIRST SEMESTER			JUNIOR YEAR		SECOND SEMESTER		
Course No.	Course Title	Cr. Hrs.	Course No.	Course Title	Cr. Hrs.	Course Title	Cr. Hrs.
Fin. 129	Money and Banking ..	3	Fin. 125	Corporation Finance....	3	Corporation Finance....	3
Eco. 303	Eco. Dev.	3	Eco. 305	Eco. Dev. of Latin America	3	Eco. Dev. of Latin America	3
Hist. 49	Hist. of Lat. Amer.	3	or			Comp. Eco. Systems ..	3
	Major Prog. Elective ¹ ..	3	Eco. 309	Hist. of Lat. Amer.	3	Hist. of Lat. Amer.	3
Eco. 333	Labor Problems	3	Hist. 50	Statistical Method	3	Statistical Method	3
			Eco. 45	Major Prog. Elective ¹ ..	3	Major Prog. Elective ¹ ..	3

15

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FIRST SEMESTER			SENIOR YEAR		SECOND SEMESTER		
Course No.	Course Title	Cr. Hrs.	Course No.	Course Title	Cr. Hrs.	Course Title	Cr. Hrs.
Eco. 311	Eco. of Resource Use ..	3	Eco. 301	Business Mgmt.	3	Business Mgmt.	3
Eco. 346	Business Cycles	3	or			Quant. Planning	3
Fin. 241	Inter. Tr. & Fin.	3	Eco. 313	& Control	3	& Control	3
Hist. 365	Modern Lat. Amer.	3	Fin. 342	Inter. Tr. & Fin.	3	Inter. Tr. & Fin.	3
	Major Prog. Elective ¹ ..	3	Hist. 366	Modern Lat. Amer.	3	Modern Lat. Amer.	3
				Major Prog. Elective ¹ ..	3	Major Prog. Elective ¹ ..	3
				Free Elective	3	Free Elective	3

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¹Electives 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. 347	Nat'l Income Anal.	3	S.R. 366	Pop. Problems	3
Govt. 51	Am. Nat'l. Gov.	3	Govt. 360	Public Admin.	3
For. Lang. 341	F. L. of Area	6	Govt. 361	Comp. Ad. Systems	3
I.R. 361	Inter. Relat.	3	For. Lang. 352	F. L. of Area	6
I.R. 361	Inter. Law	3	I.R. 352	Inter. Organ.	3
S.R. 31	Cult. Anthro.	3	Fin. 326	Prob. of Fin. Mgmt....	3
Fin. 351	Publ. Fin. Fed.	3	Phil. 14	Logic & Sci. Meth.	3

Major in Management

FIRST SEMESTER			SOPHOMORE YEAR		SECOND SEMESTER		
Course No.	Course Title	Cr. Hrs.	Course No.	Course Title	Cr. Hrs.	Course Title	Cr. Hrs.
Acctg. 1	Accounting	3	Acctg. 2	Accounting	3	Accounting	3
Eco. 3	Economics	3	Eco. 4	Economics	3	Economics	3
			Law 1	Business Law	3	Business Law	3
			Mkt. 11	Marketing	3	Marketing	3
	Optional Courses ¹	9		Optional Course ¹	3	Optional Course ¹	3

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15

FIRST SEMESTER			JUNIOR AND SENIOR YEARS		SECOND SEMESTER		
Course No.	Course Title	Cr. Hrs.	Course No.	Course Title	Cr. Hrs.	Course Title	Cr. Hrs.
Eco. 45	Statistical Method	3	Eco. 346	Business Cycles	3	Business Cycles	3
Fin. 125	Corporation Finance	3	Fin. 129	Money & Banking	3	Money & Banking	3
Eco. 301	Business Policy	3		Optional Courses ¹	6	Optional Courses ¹	6
Eco. 306	Inter. Eco. Theory	3		Maj. Prog. Elective ² ..	3	Maj. Prog. Elective ² ..	3
	Optional Course ¹	3		Free Electives ³	6	Free Electives ³	6
	Major Prog. Elective ² ..	3					
	Free Elective ³	3					

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Required Courses in Major

Acctg. 305	Fin. Statements & Reports	3	Eco. 334	Labor Legislation	3
Eco. 313	Quant. Planning & Control	3	Fin. 326	Prob. in Fin. Mgmt....	3
Eco. 333	Labor Problems	3	Eco. 302	Management Analysis..	3

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¹Optional Courses fall into three groups: English or Foreign Language, Arts, and Science. For a general statement concerning these groups see page 106.

²Electives 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
			I.E. 115	Personnel Admin.	3
			I.E. 330	Industrial Relations	3

³Suggested Free Electives:

Acctg. 204	Fed. Tax Acctg.	3	Psych. 1	Elem. Psychology	3
S.R. 61	Princ. of Sociology	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.	Course No.	Course Title	Cr. Hrs.
Acctg. 1	Accounting	3	Acctg. 2	Accounting	3	Acctg. 3	Accounting	3
Eco. 3	Economics	3	Eco. 4	Economics	3	Eco. 3	Economics	3
Law 1	Business Law	3	Mkt. 11	Marketing	3	Law 1	Marketing	3
	Optional Courses ¹	6		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.	Course No.	Course Title	Cr. Hrs.
Eco. 45	Statistical Method	3	Eco. 346	Business Cycles	3	Eco. 45	Business Cycles	3
Fin. 129	Money & Banking	3	Fin. 125	Corporation Finance....	3	Fin. 129	Corporation Finance....	3
Eco. 306	Inter. Eco. Theory	3	Eco. 301	Business Policy	3	Eco. 306	Business Policy	3
	Optional Course ¹	3		Optional Courses ¹	6		Optional Courses ¹	6
	Major Program			Major Program			Major Program	
	Elective ²	3		Elective ²	3		Elective ²	3
	Free Electives ³	6		Free Electives ³	6		Free Electives ³	3

Required Courses in Major

Mkt. 113	Advertising	3	Mkt. 115	Retailing	3
Eco. 313	Quant. Planning		Mkt. 214	Sell. & Sales Mgmt.....	3
	& Control	3	Mkt. 312	Mkt. & Dist. Research	3
Eco. 333	Labor Problems	3			
30			30		

¹Optional Courses fall into three groups: English or Foreign Language, Arts, and Science. For a general statement concerning these groups see page 106.

²Electives 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. 342	Inter. Trade & Fin.....	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. 342	Inter. Trade & Fin.	3	Eco. 311	Economics Res. Use	3

³Suggested Free Electives:

Journ. 17	Magazine Article		Speech 31	Bus. & Prof. Speaking	3
	Writing	3	Journ. 27	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 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:

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.	104.	Fundamentals of Accounting	(3)
Acctg.	115.	Cost Accounting	(3)

The background courses required for the M.S. in Management Science candidates are:

Acctg.	104.	Fundamentals of Accounting	(3)
Acctg.	115.	Cost Accounting	(3)
Fin.	125.	Corporation Finance	(3)
Fin.	129.	Money and Banking	(3)
Math.	233.	Mathematical Statistics or	(3)
Eco.	45.	Statistical Method	(3)
Eco.	306.	Intermediate Economic Theory	(3)
Eco.	313.	Quantitative Planning and Control	(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 F. A. Bradford, Director of Graduate Programs, 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 Bradford 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 164-165.

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, 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.	104.	Fundamentals of Accounting	(3)
Acctg.	115.	Cost Accounting	(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 F. A. Bradford, 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.

It is suggested that Arts and Science students who are interested in this program confer with Professor Bradford for additional information. The graduate program leading to the degree of Master of Business Administration is outlined on page 164 .

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 this curriculum as outlined on page 124. 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 <i>Required Courses</i>		SECOND SEMESTER	
Law	1	Business Law	3	Law	102
Fin.	129	Money and Banking ..	3	Mkt.	11
Eco.	346	Business Cycles	3	Acctg.	318
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
Acctg.	320	Auditing	3	Acctg.	204
Acctg.	325	Controllershship	3	Law	204
				Business Law	3
				Marketing	3
				Adv. Cost	3
				Budgeting & Analysis..	3
				Adv. Accounting	3
				Fed. Tax Acctg.	3
				Wills, Estates & Trusts	3

Major in Economics

FIRST SEMESTER		FIFTH YEAR <i>Required Courses</i>		SECOND SEMESTER	
Law	1	Business Law	3	Eco.	306
Fin.	129	Money and Banking ..	3	Eco.	308
Eco.	307	Hist. of Eco. Thought ..	3	Fin.	125
Fin.	351	Pub. Fin.: Federal	3		
and twelve semester hours to be selected from the following in consultation with the advisor:					
Fin.	241	Inter. Trade & Fin.	3	Fin.	342
Eco.	347	Nat. Inc. Analysis	3	Eco.	348
Eco.	371	Readings in Eco.	3	S.R.	362
Eco.	352	Adv. Stat. Method	3	Eco.	372
S.R.	61	Sociology	3	Eco.	356
Eco.	334	Labor Legislation	3		
				Inter. Eco. Theory	3
				Hist. of Eco. Thought ..	3
				Corporation Finance....	3
				Inter. Trade & Fin.....	3
				Adv. Bus. Cycles	3
				Social Problems	3
				Readings in Eco.	3
				Bus. & Govt.	3

Major in Economic Statistics

FIRST SEMESTER		FIFTH YEAR <i>Required Courses</i>		SECOND SEMESTER	
Law	1	Business Law	3	Eco.	306
Fin.	129	Money and Banking ..	3	Eco.	348
Eco.	347	Nat. Inc. Analysis	3	Fin.	125
Eco.	352	Adv. Stat. Method	3		
and twelve semester hours to be selected in consultation with the advisor.					
				Inter. Eco. Theory	3
				Adv. Bus. Cycles	3
				Corporation Finance ..	3

Major in Finance

FIRST SEMESTER		FIFTH YEAR				SECOND SEMESTER		
Required Courses								
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.	241	Inter. Trade & Fin.	3	Fin.	342	Inter. Trade & Fin.....	3	
Fin.	371	Readings in Fin.	3	Fin.	324	Investments	3	
Fin.	332	Mon.-Fiscal Policy	3	Fin.	352	Pub. Finance:		
Eco.	301	Business Policy	3	State & Local				3
Acctg.	305	Fin. Statements & Reports or		Eco.	336	Bus. & Govt.	3	
Acctg.	13	Intermed. Acctg.	3	Acctg.	14	Intermed. Acctg.	3	
				Fin.	372	Readings in Fin.	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	Management Analysis..	3
Fin.	125	Corporation Finance ...	3	Eco.	313	Quant. Planning and Control	3
Eco.	301	Business Policy	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.	241	Inter. Trade & Fin.	3	Fin.	342	Inter. Trade & Fin.	3
Eco.	371	Readings in Eco.	3	Acctg.	318	Adv. Cost Budgeting	
Mkt.	217	Industrial Mkt.	3			& Analysis	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.	241	Inter. Trade & Fin.	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.	115	Personnel Admin.	3
Eco.	352	Adv. Stat. Method	3	Eco.	301	Business Mgmt.	3
Law	102	Business Law	3				



The James Ward Packard Laboratory houses the College of Engineering

THE COLLEGE OF ENGINEERING

ADMINISTRATIVE OFFICERS

Harvey Alexander Neville, *President*

Glenn James Christensen, *Provost and Vice-President*

Charles Augustus Seidle, *Vice-President—Administration*

Alan Shivers Foust, *Dean of the College of Engineering*

Charles Wilfrid Brennan, *Associate Dean of the College of Engineering*

Samuel Harold Missimer, *Director of Administration*

John Douglas Leith, *Dean of Students*

James Harold Wagner, *Registrar*

James Decker Mack, *Librarian*

The College of Engineering offers curricula in chemical engineering, chemistry, civil engineering, electrical engineering, engineering mechanics, engineering physics, general science and mathematics, 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.

Provision is made for a uniform freshman year in the College of Engineering. The student's tentative choice of a specialized 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 specialized 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 training, it affords preparation for careers as draftsmen, chiefs of party, shop foremen, or assistants in industrial laboratories or plants.

Since the University recognizes that an engineer can not be trained by purely academic process, the degree awarded upon graduation is Bachelor of Science in the particular division of engineering that has been studied, 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.

Five-year courses combining the liberal arts and engineering, business administration and industrial 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.

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 life and earth sciences, the humanities and the social sciences. A carefully developed program strengthening the earlier offerings in this area has been developed.

The general studies sequence starts in the freshman year with a study of English composition and literature and a study of history in the course "Development of Western Civilization." It continues with a broad course in economics, including its social aspects, which begins in the freshman year and continues later. This is followed by two courses selected from alternates, which are usually taken in the junior year. The first of these alternates is either biology or psychology, and the second either philosophy or literature. The first acquaints the student with an important life science, and the second strengthens his background in the humanities. The final two courses are elected by the student, under the guidance of his curriculum director, from the elective courses shown in the accompanying table. These courses present the student with two opportunities. First, the student may add to his general knowledge of areas of study outside his technical curriculum by electing courses in separate fields of study. Second, the student who prefers to learn more about one field of study may elect courses exclusively in that field to

gain the depth of knowledge that can come only from a longer acquaintance with a particular discipline. For example, by careful planning in his choice of alternate requirement, the student may have available as much as nine credit hours in biology, psychology, philosophy, or literature, if he so desires. Thus, in the final two courses the program allows for the student preference of either breadth or depth.

Several of these required or elective 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 for this program. They are designed to help it in its major aims: first to acquaint the student with that literary, social, political, and economic background which is our heritage, and second, to open intellectual doors in his mind and thus give him a sound start of self-education which will continue throughout his life.

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.

General Studies Courses

<i>Required Courses</i>	
English 1 and 2	Composition and Literature .....(6)
History 11 and 12	Development of Western Civilization .....(6)
Economics 3 and 4	Economics .....(6)
<i>Alternate Courses</i>	
Biology 13	Human Biology, or
Psychology 1	Introduction to Psychology .....(3)
Philosophy 100	Philosophy of Contemporary Civilization, or
Literature	(See courses listed under "Literature" below) .....(3)
<i>Elective Courses</i>	
(Six hours to be chosen without restriction — other than prerequisite and except in elementary foreign language — from the following:)	
<i>Life and Earth Sciences</i>	
Biology 1, 2.	Elementary Biology.
(A student may not take for credit both Biol. 1 and Biol. 13.)	
Biology 11, 12.	General Biology.
Biology 13.	Human Biology.
Biology 18.	Genetics (2 hrs.) (prerequisite: one semester of biology)
Biology 35.	Microbiology (prerequisite: a laboratory course in biology)
Biology 353.	Virology (prerequisite: a course in microbiology)
Geology 1, 2.	Principles of Geology.
Geology 12.	Historical Geology (prerequisite: Geol. 1 and consent of head of department)
Geology 63.	Introduction to Oceanography
Geology 311.	Paleontology (prerequisite: Biol. I)
Astron. 1.	Descriptive Astronomy.
Astron. 2.	General Astronomy.
Astron. 104.	Stellar Astronomy and Astrophysics.
Psych. 1.	Introduction to Psychology.
Psych. 101.	History and Systems of Psychology (prerequisite: Psych. 1 and 2).
Psych. 103.	Comparative Psychology (prerequisite: Psych. 1 and 2).
<i>History</i>	
Greek 21.	Ancient History.
Greek 202.	Greek Archaeology.
Latin 22.	Ancient History.
Latin 203.	Archaeology of Italy.
History, any course other than History 11 and 12.	

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Social Studies

Econ.	303.	Economic Development.
(prerequisite for this and following economics courses: Eco. 4)		
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.

Social Relations Any Course

Finance	241.	International Trade & Finance (prerequisite: Eco. 4).
Finance	342.	International Trade and Finance (prerequisite: Fin. 241).
Finance	351.	Public Finance—Federal (prerequisite: Eco. 4).

Literature

Classical	— Greek 50 — Greek Literature in English Translation.
	Latin 51 — Latin Literature in English Translation.
Foreign	— any literature course in a foreign language (i.e., must be beyond intermediate level).
English and American	— English 4, 5, 7, 8, 9, 11, 12, 18, 19, 20, 21, 35, 36 or any English literature course above 100.

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, all six hours must be in the 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 20-30, any course
Speech 61 (Dramatics)

Philosophy and Religion

Any course.

Government and International Relations

Any course.

THE UNIFORM FRESHMAN YEAR

An outline follows of the work of the freshman year, uniform for all engineering students. For schedules of the work of the upper three years, varying according to the several specialized curricula, see pages 123-140.

FIRST SEMESTER			FRESHMAN YEAR			SECOND SEMESTER		
Course	No.	Course Title	Cr. Hrs.	Course	No.	Course Title	Cr. Hrs.	
Chem.	4	Gen. Chemistry	4	Chem.	5	Gen. Chemistry	4	
*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	
P.E.	1	Physical Education	—	P.E.	2	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 may be assigned to 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 re-

quired. 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 67, 68.)

COMBINED ARTS AND ENGINEERING CURRICULA

Under the five-year plan the student registers 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 111 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 Philco Corporation, which comprises eleven 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. Philco Corp.
6. Junior I	7. Philco Corp.	8. Junior II
9. Senior I	10. Senior II	

During Period 7, while the student is with Philco Corporation, 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.

Curricula

THE CURRICULUM IN CHEMICAL ENGINEERING

Graduates in chemical engineering are expected to develop competence in all phases of the work conducted by manufacturing establishments in which chemical and certain physical changes of materials are accomplished during the manufacturing processes. The various phases of this work are research, development, design, construction, operation, plant management, and sales. A small number of the industries that utilize such processes are atomic energy, petroleum and petro-chemicals, rubber, soap, and foods in addition to the generally recognized chemical industries.

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 in any of the chemical and allied industries.

The aim of the curriculum is to develop expertness in the sciences, the processes, and the unit operations which must be integrated into a chemical manufacturing operation. Some familiarity with factory methods under actual working conditions is acquired through contact with operations in nearby plants. Frequent visits are made to manufacturing plants in the immediate vicinity and nearby centers of activity in the chemical industry.

The program is also designed to prepare a student for graduate study in chemical engineering. 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. By proper election of technical option courses, the graduate can prepare for graduate study in chemistry.

(Effective for the Class of 1966)

FIRST SEMESTER			FRESHMAN YEAR		SECOND SEMESTER		
			See page 120				
			(34 hrs.)				
FIRST SEMESTER			SOPHOMORE YEAR		SECOND SEMESTER		
Course No.	Course Title	Cr. Hrs.	Course No.	Course Title	Cr. Hrs.	Course Title	Cr. Hrs.
Chem. 51	Org. Chem.	3	Ch.E. 70	Ind. Stoichiometry ...	3	Ind. Stoichiometry ...	3
Eco. 4	Economics	3	Chem. 52	Org. Chem.	3	Org. Chem.	3
Math. 23	Anal. Geom. & Calc. III	4	Chem. 55	Org. Chem. Lab.	2	Org. Chem. Lab.	2
Mech. 1	Statics	3	C.E. 11	Engineering Graphics....	2	Engineering Graphics....	2
Phys. 3	Heat & Electricity	4	Math. 204	Linear Analysis	3	Linear Analysis	3
			Phys. 4	Electricity, Light, & Atomic Physics	4	Electricity, Light, & Atomic Physics	4

FIRST SEMESTER			JUNIOR YEAR		SECOND SEMESTER		
Ch.E.	161	Unit Ops. I	4	Ch.E.	162	Unit Ops. II	3
Chem.	38	Anal. Chem.	3	Ch.E.	175	Ch. Eng. Pract.	1
Chem.	91	Phys. Chem.	3	Chem.	190	Phys. Chem.	3
Math.	231	Statistical Inference	3	Chem.	192	Phys. Chem. Lab.	1
Mech.	11	Mech. of Mat.	3	Chem.	193	Phys. Chem. Lab.	1
Ch.E.	10	Ch.E. Computation	1	E.E.	160	Elect. Circ.	3
			17	E.E.	161	Elect. Probs.	1
				E.E.	162	Dynamo Lab.	1
						General Study ^a	3

PREPARATION FOR

Medicine

Graduate study or research in chemistry

Teaching, especially in public schools

Metals industries

ELECTIVE SEQUENCE IN

Biology

Physics and mathematics

Education

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 extra courses may be utilized as electives.

Seniors in the curriculum in chemistry may arrange to make the supervised visits to industrial plants, which are required in the engineering curriculum.

(Effective for the Class of 1966)

FIRST SEMESTER			FRESHMAN YEAR		SECOND SEMESTER		
			Sec Page 120				
FIRST SEMESTER			SOPHOMORE YEAR		SECOND SEMESTER		
Course	No.	Course Title	Cr. Hrs.	Course	No.	Course Title	Cr. Hrs.
Math.	23	Anal. Geom. & Calc. III	4	Eco.	4	Economics	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.	6	German	3
			16		15		
FIRST SEMESTER			JUNIOR YEAR		SECOND SEMESTER		
Chem.	91	Phys. Chemistry	3	Chem.	190	Phys. Chemistry	3
Chem.	302	Inorganic Chemistry	3	Chem.	192	Phys. Chem. Lab.	2
Chem.	358	Adv. Organic Chem.	3		193		
Ger.	27	Scientific German	3	Chem.	235	Analytical Chem.	3
		General Study ²	3	Ch.E.	70	Ind. Stoichiometry	3
		Elective	3		or 160	Unit Ops. Survey	3
			18		17		
SUMMER							
Ch.E. 100 Eight (8) weeks industrial employment with report.							
FIRST SEMESTER			SENIOR YEAR		SECOND SEMESTER		
Chem.	194	Phys. & Electrochem.	3	Chem.	337	Instrumental Methods of Analysis	3
Chem.	197	Electrochem. Lab.	1	Chem.	179	Hist. & Lit. Chem.	1
Chem.	236	Analytical Chem.	3	Chem. ¹	175	Research Lab.	3
		General Study ²	3	Chem.	352	Heterocyclics	3
		Electives	6			General Study ²	3
			16		16		

¹Optional—consent of Head of Department required.²For an elucidation of this requirement see page 118.

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 industry which prefer a broad, fundamental education to a more specialized training. The curriculum, however, develops depth in the various professional areas of civil engineering.

The field of civil engineering 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, highway engineering, geology, soil mechanics, structural theory and design, foundation engineering, fluid mechanics, 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 special five and one-half year combined program leading to M.S. in Bus. Adm. can be arranged.

Engineers, through their professional societies, have insisted that the engineering student be trained as a professional man rather than a technician, with a sound understanding of his place in society. This training is provided by the humanistic-social courses extending through the four years and selected with the advice and approval of the curriculum director.

(Effective for the Class of 1966)

FIRST SEMESTER				FRESHMAN YEAR				SECOND SEMESTER			
				See Page 120							
FIRST SEMESTER				SOPHOMORE YEAR				SECOND SEMESTER			
<i>Course No.</i>		<i>Course Title</i>	<i>Cr. Hrs.</i>	<i>Course No.</i>		<i>Course Title</i>	<i>Cr. Hrs.</i>	<i>Course No.</i>		<i>Course Title</i>	<i>Cr. Hrs.</i>
C.E.	10	Problem Comp. Lab.	1	C.E.	12	Applied Engg.					
C.E.	11	Engineering Graphics	2			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				
Eco.	4	Economics	3	Phys.	4	Electricity, Light & Atomic Physics	4				
										Approved Math. Elect.	3

SUMMER

C.E. 41 Engineering Surveys (3)

FIRST SEMESTER			JUNIOR YEAR		SECOND SEMESTER		
C.E.	112	Adv. Mech. of Mat. ..	3	C.E.	124	Applied Hydrology	2
C.E.	121	Mech. of Fluids	3	C.E.	154	Structural Analysis II..	3
C.E.	123	Fluid Mechanics Lab...	1	C.E.	239	Soil Mechanics	3
C.E.	150	Structural Analysis I ..	3	E.E.	160	Elec. Cir. & Appr.	3
Mech.	102	Dynamics	3	E.E.	161	Elec. Problems	1
Met.	65	Engr. Mat'ls & Proc. ..	3	E.E.	162	Dynamo Lab	1
Geol.	1	Principles of Geology ..	3	M.E.	160	Thermodynamics	3
						General Study ²	3
			19				19

SUMMER

C.E. 100 Eight (8) Weeks Industrial Employment with Report (-)

FIRST SEMESTER			SENIOR YEAR		SECOND SEMESTER		
C.E.	102	Proseminar	1	C.E.	155	Structural Design	3
C.E.	125	Hydraulic Engineering..	2	C.E.	162	Sanitary Engineering...	3
C.E.	145	Transport. Engrg. I	3			Adv. Civil Engineering ¹	3
C.E.	151	Structural Theory	3			Approved Elective	6
C.E.	153	Reinf. Concrete Theory	3			General Study ²	3
C.E.	201	Foundation Engineering	3				
		General Study ²	3				
			18				18

¹Any advanced civil engineering course approved by Department Head.²For an elucidation of this requirement see page 118.

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, conversion, transmission, and distribution of electric power, and electronic 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 semiconductors, electron tubes, electrical machines, and magnetic components. Mathematics provides the basis for the analytical studies related to the models of the devices, networks and 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 electrical technology a student may eventually choose, 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 technology in general and with electrical technology in particular. This is the philosophy upon which the curriculum is based.

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.

(Effective for the Class of 1966)

FIRST SEMESTER			FRESHMAN YEAR		SECOND SEMESTER	
			See Page 120			
FIRST SEMESTER			SOPHOMORE YEAR		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. 204	Linear Analysis	3	
Mech. 1	Statics	3	Mech. 11	Mech. of Materials	3	
Met. 63	Engr. Mat. & Proc.	3	Mech. 13	Materials Testing Lab. 1		
Phys. 3	Heat & Electricity	4	Phys. 4	Electricity, Light, & Atomic Physics	4	
			E.E. 14	Circuit Theory I	3	
						17
						16
FIRST SEMESTER			JUNIOR YEAR		SECOND SEMESTER	
E.E. 104	Circuit Theory II	4	E.E. 105	Electronic Circuits	4	
E.E. 101	Analog & Dig. Comp. 2		E.E. 106	Elect. Machines I	5	
Math. 208	Applied Mathematics II ..	3	Math. 309	Theory of Probability 3		
Mech. 102	Dynamics	3	E.E. 231	Elec. & Mag. Fields ..	3	
E.E. 103	Phys. Electronics	3		*General Study	3	
	*General Study	3				
						18
						18
			SUMMER			
			E.E. 100 Summer Employment			
FIRST SEMESTER			SENIOR YEAR		SECOND SEMESTER	
			POWER	OPTION		
E.E. 107	Elect. Machines II	4	E.E. 134	Power System Analysis II	4	
E.E. 133	Power System Analysis I	4		Approved Elective	3	
M.E. 220	Thermodynamics	3	E.E. 152	Senior Lab.	2	
E.E. 111	Proseminar	1	M.E. 161	M.E. Laboratory	1	
	*General Study	3	C.E. 121	Mechanics of Fluids ..	3	
	Approved Elective	3	C.E. 123	Fluid Mechanics Lab. 1		
				*General Study	3	
						17
						18
			ELECTRONICS OPTION			
E.E. 111	Proseminar	1	E.E. 245	Electromagnetic Theory 3		
E.E. 151	Senior Lab.	2	E.E. 152	Senior Lab.	2	
M.E. 220	Thermodynamics	3		Approved Electives	3	
	*General Study	3		*General Study	3	
	Approved Electives	9				
						17
						18

*For an elucidation of this requirement see page 118.

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. They are intended to enable the student to correlate his theoretical training with engineering practice in a specific field. They may also be used by those men more theoretically inclined to carry an intensive study of applied mathematics.

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.

(Effective for the Class of 1966)

FRESHMAN YEAR

See Page 120

FIRST SEMESTER			SOPHOMORE YEAR		SECOND SEMESTER		
Course No.		Course Title	Cr. Hrs.	Course No.		Course Title	Cr. Hrs.
Eco.	4	Economics	3	C.E.	11	Eng. Graphics	2
Math.	23	Anal. Geom. & Calc. III	4	Math.	221	Diff. Equations	3
Mech.	1	Statics	3	Math.	204	Linear Analysis	3
Phys.	3	Heat & Electricity	4	Mech.	11	Mech. of Materials	3
Met.	91	El. of Mat. Science	3	Mech.	13	Materials Testing Lab.	1
				Phys.	4	Electricity, Light & Atomic Physics	4
				Mech.	10	Prob. Computation Lab.	1
			17				17

FIRST SEMESTER			JUNIOR YEAR		SECOND SEMESTER		
Math.		Course Title	Cr. Hrs.	Math.		Course Title	Cr. Hrs.
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	C.E.	121	Mechanics of Fluids	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	Diff. Eq. & Harm. Anal.	3	Mech.	304	Mech. of Continua II. 3
Mech.	303	Mech. of Continua I.....	3	Mech.	306	Exper. Methods in Mech 3
Mech.	305	System Dynamics	3			Electives 6
Phys.	340	Physical Thermodyn.....	3			*General Study 6
		Electives	3			
Phys.	191	Lab. Techniques	2			
			17			
						18

*Electives in junior and senior years consist of 14-15 hours and should include a group option, such as listed below, intended to enable the student to correlate his theoretical training with engineering practice in a specific field, or to carry a more intensive study of mathematics. 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. STRUCTURAL ENGINEERING

C.E.	150.	Structural Analysis I	(3)
C.E.	154.	Structural Analysis II	(3)
C.E.	151.	Structural Theory	(3)
C.E.	153.	Reinf. Concrete Theory	(3)
			12

B. MACHINE DESIGN

M.E.	101.	Machine Design I	(3)
M.E.	102.	Machine Design II	(3)
M.E.	103.	Machine Design III	(5)
			11

C. HEAT AND FLUID FLOWS

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.

D. METALLURGICAL ENGINEERING

Met.	230.	Physical Metallurgy I	(4)
Met.	231.	Physical Metallurgy II	(4)
Met.	323.	Mechanical Metallurgy	(3)
Met.	352.	Ferrous Metallurgy	(3)
			14

E. MATHEMATICS

Math.	219.	Principles of Analysis	(3)
Math.	220.	Principles of Analysis	(3)
Math.	320.	Ordinary Diff. Equations	(3)
Math.	340.	Higher Algebra	(3)
			12

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 any of the engineering curricula, and some further engineering study is required in addition to the work in physics during the final two years. The training is thus consciously practical.

The complete curriculum is not dictated. A liberal number of electives, particularly 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.

FIRST SEMESTER			FRESHMAN YEAR		SECOND SEMESTER		
			See Page 120.				
FIRST SEMESTER			SOPHOMORE YEAR		SECOND SEMESTER		
Course	No.	Course Title	Cr. Hrs.	Ger		German	3
Ger.				or		Eng. Graphics 2	2
or		German	3	C.E.	11	Electricity, Light, Atomic Physics	4
Mer.	91	El. of Mat. Science	3	Phys.	4	Differential Eq.	3
Phys.	3	Heat and Electricity	4	Math.	221	Electrostatics	3
Math.	23	Anal. Geom.&Cal. III	4	Phys.	32	Elect. Phenomena	1
Mech.	1	Statics	3	Phys.	90	*General Study	3
Eco.	4	Economics	3				
			17			16 or 17	
FIRST SEMESTER			JUNIOR YEAR		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	Partial Diff. Eq.	3	Phys.	254	Optics Lab.	3
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							
FIRST SEMESTER			SENIOR YEAR		SECOND SEMESTER		
Phys.	369	Int. Mod. Th. II	3	Phys.	171	Proseminar	1
Phys.	340	Thermodynamics	3	Phys.	363	Phys. of Solids	3
Phys.	270	Mod. Phys. Lab.	1	or			3
Phys.	192	Advanced Lab.	1	Phys.	365	Phys. of Fluids	3
Phys.	362	At. & Mol. Struct.	3			Electives	3
or						*General Study	3
Phys.	364	Nuclear Physics	3				16
		Elective	3				
		*General Study	3				
			17				

*See page 118 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 ELECTRICAL ENGINEERING AND ENGINEERING PHYSICS

This curriculum is designed to meet the needs of those who plan a career in electronics and communications research and development. It differs from the standard four-year Electronics Option in Electrical Engineering

in that the five-year two-degree program includes additional courses in mathematics and physics. It differs from the standard four-year curriculum in Engineering Physics in that it includes additional courses in electronic circuits, microwaves, and communication networks.

For men planning careers in the electronics communications area, it is believed that the greater breadth of training afforded by this combined program is preferable to early specialization in either field alone.

It is expected that students undertaking this combined program will make every effort to complete the five years. 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 127.

SOPHOMORE YEAR

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. & Cal. III	4	Math. 204	Linear Analysis	3
Mech. 1	Statistics	3	Phys. 32	Electrostatics	3
Met. 91	El. of Mat. Science	3	Phys. 4	Electricity, Light & Atomic Physics	4
Phys. 3	Heat and Electricity	4	Phys. 90	Electrical Phenomena	1
		16	E.E. 14	Circuit Theory I	3

17

JUNIOR YEAR

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

FIRST SEMESTER

SENIOR YEAR

SECOND SEMESTER

E.E. 151	Senior Lab.	2	E.E. 152	Senior Lab.	2
E.E. 111	Proseminar	1	E.E. 245	Electromag. Theory	3
	Appr. Electives	6		Appr. Electives	6
Phys. 213	Electromagnetism	3	Phys. 268	Intr. Mod. Phys.	3
Phys. 215	Particles & Fields	3		Th. 1	3
	*General Study	3		*General Study	3
		18			17

18

17

FIRST SEMESTER

FIFTH YEAR

SECOND SEMESTER

Phys. 340	Phys. Thermodynamics	3	Phys. 252	Optics	3
Phys. 362	Atom. & Mol. Struct.	3	Phys. 254	Optics Lab.	2
or		3	Phys. 363	Phys. of Solids	3
Phys. 364	Nuclear Physics	3	Phys. 171	Proseminar	1
Phys. 369	Intr. Mod Phys.	3	Ger.	German or Approved Elect.	3
	Th. II	3		Electives	6
Phys. 192	Advanced Lab.	1			18
Phys. 270	Mod. Phys. Lab.	1			
Ger.	German Elective Ap.	3			
	Elective	3			

17

*For an elucidation of this requirement see page 118.

¹ Students planning graduate study should elect German. For others Math. 224 and Mech. 302 are suggested.

SUMMER
I.E. 40 Machine Shop Practice (3)

FIRST SEMESTER			JUNIOR YEAR		SECOND SEMESTER		
E.E.	160	Elec. Cir. & Appar.	3	I.E.	122	Analysis & Design II	4
E.E.	161	Elec. Problems	1			Operations Analysis	
E.E.	162	Dynamo Lab.	1	M.E.	168	& Design	4
I.E.	140	Mfg. Proc. Lab.	1			Elements of Mech.	
I.E.	121	Analysis and Design I	5	Mech.	102	Design	4
I.E.	221	Industrial Statistics	4	I.E.	222	Elem. Psych.	3
		General Study*	3	Psych.	1	Dynamics	3
			18				18

SUMMER
I.E. 100 Industrial Employment

FIRST SEMESTER			SENIOR YEAR		SECOND SEMESTER		
Acctg.	104	Fund. of Acctg.	3	Acctg.	115	Cost Accounting	3
M.E.	160	Thermodynamics	3	M.E.	161	Engineering Lab.	1
		Approved Technical		Ch.E.	60	Unit Oper. Survey	3
		Electives	9	I.E.	152	I.E. Project	2
		General Study*	3			Approved Technical	6
			18			Electives	6
						General Study*	3
							18

*For an elucidation of this requirement see page 118.

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 112-114 under Business Administration.

SUMMER
I.E. 40 Machine Shop Practice (3)

FIRST SEMESTER			JUNIOR YEAR		SECOND SEMESTER		
I.E.	121	Analysis and Design I	5	I.E.	122	Analysis & Design II..	4
I.E.	221	Industrial Statistics	4	I.E.	222	Operations	
E.E.	160	Elec. Cir. & Appar	3			Analysis & Design ..	4
E.E.	161	Elec. Problems	1	M.E.	168	Elements of	
E.E.	162	Dynamo Lab.	1			Mech. Design	4
I.E.	140	Mfg. Proc. Lab.	1	Mech.	102	Dynamics	3
Psych.	1	Elem. Psychology	3	Eco.	333	Labor Problems	3
			18				18

NOTE A: Those students who will major in Accounting in the fifth year will take Acctg. 104 and Acctg. 115 in the junior year in place of Eco. 333 and M.E. 168; and Eco. 333 and M.E. 168 will be taken in the senior year in place of Mkt. 111 and Fin. 125; and Acctg. 13 and Acctg. 14 will be taken in place of Acctg. 104 and 115; and Mkt. 11 and Fin. 125 will be taken in the fifth year.

SUMMER

I.E. 100 Industrial Employment

FIRST SEMESTER			SENIOR YEAR		SECOND SEMESTER		
Acctg.	104	Fund. of Acctg.	3	Acctg.	115	Cost Accounting	3
M.E.	160	Thermodynamics	3	M.E.	161	Engineering Lab.	1
Mkt.	11	Marketing	3	Fin.	125	Corporation Finance	3
		Approved Technical		Ch.E.	60	Unit Oper. Survey	3
		Electives	6	I.E.	152	I.E. Project	2
		English Elective	3			Approved Technical	
						Elective	3
						English Elective	3
			18				18

NOTE B: Those students who will major in Economics, Economic Statistics, or Management in the fifth year will take E.S. 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, satellite 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 thermodynamics, 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.

(Effective for the Class of 1966)

FIRST SEMESTER			FRESHMAN YEAR		SECOND SEMESTER		
			See Page 120.				
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	
C.E.	11	Engr. Graphics	2			Atom, Phys.	4
M. E.	10	Anal. of Eng. Problems	1	Met.	63	Engr. Mat. and Proc.	3
						General Study ¹	3
			17				17

SUMMER							
I.E. 100 Summer Employment							
FIRST SEMESTER			JUNIOR YEAR		SECOND SEMESTER		
M.E.	104	Thermodynamics I	4	M.E.	105	Thermodynamics II ...	4
M.E.	101	Machine Design I	3	M.E.	102	Machine 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	Applied Math. II	3
Math.	204	Linear Analysis	3			General Study ¹	3
			19				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	Machine 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		

Except for the replacement of M.E. 310, Projects (6) in the senior year by six hours of Approved Technical Electives, the classes of 1965, 1964 and 1963 will follow the curriculum in Catalogues for 1961, 1960 and 1959 respectively.

¹For an elucidation of the General Study requirement see page 118.

²The Approved Technical Electives must represent a coherent group of approved courses such as 200 or 300-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.

(Effective for the Class of 1966)

FIRST SEMESTER			FRESHMAN YEAR			SECOND SEMESTER		
			See Page 120.					
FIRST SEMESTER			SOPHOMORE YEAR			SECOND SEMESTER		
<i>Course No.</i>	<i>Course Title</i>	<i>Cr. Hrs.</i>	<i>Course No.</i>	<i>Course Title</i>	<i>Cr. Hrs.</i>	<i>Course Title</i>	<i>Cr. Hrs.</i>	
Eco. 4	Economics	3	Math. 204	Linear Analysis	3	Linear Analysis	3	
Math. 23	Anal. Geom. & Calc. III	4	Mech. 11	Mech. of Materials	3	Mech. of Materials	3	
Mech. 1	Statics	3	Mech. 13	Materials Testing Lab. I	1	Materials Testing Lab. I	1	
Phys. 3	Heat and Elec.	4	Phys. 4	Elec., Light and		Elec., Light and		
C.E. 11	Engr. Graphics	2		Atom. Phys.	4	Atom. Phys.	4	
M.E. 10	Anal. of Engr. Problems	1	Met. 63	Engr. Mat. and Proc.	3	Engr. Mat. and Proc.	3	
			E.E. 14	Circuit Theory I	3	Circuit Theory I	3	
			17			17		

SUMMER

I.E. 40 Machine Shop Practice (3)

FIRST SEMESTER			JUNIOR YEAR			SECOND SEMESTER		
<i>Course No.</i>	<i>Course Title</i>	<i>Cr. Hrs.</i>	<i>Course No.</i>	<i>Course Title</i>	<i>Cr. Hrs.</i>	<i>Course Title</i>	<i>Cr. Hrs.</i>	
M.E. 104	Thermodynamics I	4	M.E. 105	Thermodynamics II	4	Thermodynamics II	4	
E.E. 104	Circuit Theory II	4	E.E. 106	Elec. Machines I	5	Elec. Machines I	5	
Mech. 102	Dynamics	3	C.E. 121	Mech. of Fluids	3	Mech. of Fluids	3	
Math. 208	Applied Math. II	3	C.E. 123	Fluid Mech. Lab.	1	Fluid Mech. Lab.	1	
	General Study*	3	Met. 67	Met. Lab.	2	Met. Lab.	2	
						General Study*	3	
			17			18		

SUMMER

M.E. 100 Summer Employment

FIRST SEMESTER			SENIOR YEAR			SECOND SEMESTER		
<i>Course No.</i>	<i>Course Title</i>	<i>Cr. Hrs.</i>	<i>Course No.</i>	<i>Course Title</i>	<i>Cr. Hrs.</i>	<i>Course Title</i>	<i>Cr. Hrs.</i>	
M.E. 101	Machine Design I	3	M.E. 102	Machine Design II	3	Machine Design II	3	
M.E. 108	Laboratory I	2	M.E. 109	Laboratory II	2	Laboratory II	2	
M.E. 321	Heat Transfer	3	E.E. 105	Electronic Circuits	4	Electronic Circuits	4	
Math. 221	Diff. Equations	3	Math. 309	Theory of Probability	3	Theory of Probability	3	
E.E. 103	Physical Electronics	3	E.E. 231	Elec. & Mag. Fields	3	Elec. & Mag. Fields	3	
	General Study*	3				General Study*	3	
			17			18		

*For an elucidation of the General Study requirement see page 118.

FIRST SEMESTER			FIFTH YEAR			SECOND SEMESTER		
<i>Course No.</i>	<i>Course Title</i>	<i>Cr. Hrs.</i>	<i>Course No.</i>	<i>Course Title</i>	<i>Cr. Hrs.</i>	<i>Course Title</i>	<i>Cr. Hrs.</i>	
M.E. 103	Machine Design III	5	M.E. 342	Elem. Mech.		Elem. Mech.		
E.E. 107	Elec. Machines II	4		Vibr. Anal.	3	Vibr. Anal.	3	
E.E. 133	Power Systems Anal. I	4	Mech. 302	Adv. Dynamics	3	Adv. Dynamics	3	
E.E. 111	Proseminar	1	E.E. 112	Control Systems	3	Control Systems	3	
	Elective	3	E.E. 134	Power System Anal. II	4	Power System Anal. II	4	
			E.E. 152	Senior Laboratory	2	Senior Laboratory	2	
						Elective	3	
			17			18		

THE CURRICULUM IN METALLURGICAL ENGINEERING

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 metallurgical engineering is designed to train graduates for research, development, operations, management and sales careers in industry or for graduate study in 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 second 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.

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 the senior year. In this option, students are required to take Met. 318, Theoretical Physical Metallurgy (3); Met. 340, Research Techniques (2-3); and Met. 191, Experimental Metallurgy (3). The option is limited to a small group of selected students.

FIRST SEMESTER			FRESHMAN YEAR			SECOND SEMESTER		
			See Page 120					
FIRST SEMESTER			SOPHOMORE YEAR			SECOND SEMESTER		
Course	No.	Course Title Cr. Hrs.	Course	No.	Course Title Cr. Hrs.	Course	No.	Course Title Cr. Hrs.
Chem.	39	Analytical Chem. 3	Eco.	4	Economics	3		
Math.	23	Anal. Geom. & Calc. III 4	Ch.E.	60	Unit Operations	3		
Mech.	1	Statics	Mech.	11	Mech. of Materials 3			
Phys.	3	Heat & Electricity 4	Phys.	4	Electricity, Light, & Atomic Physics 4			
Met.	91	El. of Mat. Science 3	Met.	10	Met. Laboratory	2		
			C.E.	11	Eng. Graphics	2		

FIRST SEMESTER			JUNIOR YEAR		SECOND SEMESTER		
Met.	230	Physical Met. I	4	Met.	231	Phys. Metallurgy II	4
Met.	105	Extractive Met. I	4	Met.	106	Extractive Met. II	3
Chem.	95	Physical Chem.	3	Chem.	195	Physical Chem.	3
M.F.	166	Proced. of Mech. Des. 2		Mech.	102	Dynamics	3
Math.	224	Prob. & Numer. Anal. 3				Elective	3
		General Study*	3			General Study*	3
			19				19

FIRST SEMESTER			SENIOR YEAR		SECOND SEMESTER		
Met.	310	Met. Thermodynamics..	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
		Tech. Elective	3	E.E.	161	Elec. Problems	1
		General Study*	3	E.E.	162	Dynamo Lab.	1
Met.	101	Professional Devel.	1			General Study*	3
						Tech. Elective	3
			16				17

*For an elucidation of this requirement see page 118.

SENIOR YEAR RESEARCH OPTION							
Met.	323	Mechanical Met.	3	Met.	358	Selection of Materials 3	
Met.	310	Met. Thermodynamics 3		Met.	338	Met. Colloquium	2
Met.	352	Physical Met. III	3	Met.	191	Experimental Met.	3
Met.	318	Theoret. Phys. Met.	3	E.E.	160	Elec. Cir. & Appar.	3
Met.	340	Research Techniques .. 2		E.E.	161	Elec. Problems	1
		General Study*	3	E.E.	162	Dynamo Lab.	1
Met.	101	Professional Devel.	1			General Study*	3
			18				16

SENIOR YEAR INDUSTRIAL METALLURGY OPTION							
Met.	323	Mechanical Met.	3	Met.	358	Selection of Materials 3	
Met.	310	Met. Thermodynamics 3		Met.	338	Met. Colloquium	2
Met.	352	Physical Met. III	3	Met.	325	Industrial Met	8
E.E.	160	Elec. Cir. & Appar.	3			General Study*	3
E.E.	161	Elec. Problems	1				
E.E.	162	Dynamo Lab.	1				
Met.	101	Professional Devel.	1				
		General Study*	3				
			18				16

*For an elucidation of this requirement see page 118.
(Effective for the Class of 1966)

THE CURRICULUM IN GENERAL SCIENCE AND MATHEMATICS

The curriculum in general science and mathematics is designed to qualify men for teaching science in the secondary schools. The program provides both depth and breadth of preparation. The common core represents a comprehensive background in the sciences and mathematics while the option provides for specialization.

General science and mathematics majors are required to select one of the following options. These options include: (1) geography, earth, and space science; (2) biology; (3) chemistry; and (4) physics and mathematics.

Work in the major teaching subjects is continuous through all four years. The freshman year is identical with that required of all engineering students. The sophomore year emphasizes preparation in the common core. The general studies requirements of the engineering college must also be

completed. The junior and senior years provide for the study of educational fundamentals and practical experience in nearby public schools.

(Discontinued in present form, September 1963.)

Each student in the program will schedule all courses in the **Common Core** and at least one of the **Options**.

COMMON CORE

FIRST SEMESTER			FRESHMAN YEAR			SECOND SEMESTER		
Uniform Freshman Engineering, page 120.								
FIRST SEMESTER			SOPHOMORE YEAR			SECOND SEMESTER		
Course	No.	Course Title	Cr. Hrs.	Course	No.	Course Title	Cr. Hrs.	
Geol.	1	Principles of Geology.....	3	Geol.	34	Minerals and Rocks	3	
Biol.	1	Elementary Biology	3	Biol.	2	Elementary Biology	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	
		General Study*	3	Psych.	1	Intro. to Psych.	3	
			17				16	
FIRST SEMESTER			JUNIOR YEAR			SECOND SEMESTER		
Math.	51	Adv. Algebra	3	Math.	54	Higher Geometry	3	
Educ.	1	Intro. to Education	3	Geol.	12	Historical Geology	3	
Educ.	20	Educ. Psychology	3	Biol.	14	Comparative Anatomy..	3	
		General Study*	3	Astr.	2	General Astronomy	3	
		Options & Electives	6				Options & Electives ..	6
			18				18	
FIRST SEMESTER			SENIOR YEAR			SECOND SEMESTER		
Chem.	38	Anal. Chem.	3	Phil.	261	Phil. of Nat. Sc.	3	
Educ.	353	Obs. Sec. Sch. Teach...	3	Educ.	352	Prin. H. S. Teach	3	
		Educ. Elective	3	Educ.	354	Pract. Teaching	3	
		General Study*	3				General Study*	3
		Options & Electives	6				Options & Electives	6
			18				18	

²For an elucidation of this requirement see page 118.

OPTIONS (Minimum requirements)

GEOGRAPHY, EARTH AND SPACE OPTION

Astr. 104.	Stellar Astronomy and Astrophysics	(3)
Geol. 23.	Structural Geology	(3)
Geol. 311.	Paleontology	(3)
	Geology elective	(3)

BIOLOGY OPTION

Biol. 35.	Microbiology	(3)
Biol. 306.	Ecology	(3)
Biol. 322.	Advanced Botany	(3)
Biol. 320.	Physiology	(3)
Biol. 353.	Virology	(3)

CHEMISTRY OPTION

Chem. 51.	Organic Chemistry	(3)
Chem. 53.	Organic Chemistry Laboratory	(2)
Chem. 91.	Physical Chemistry	(3)
Chem. 192.	Physical Chemistry Laboratory	(1)
Chem. 193.	Physical Chemistry Laboratory	(1)
Chem. 302.	Principles of Inorganic Chemistry	(3)

PHYSICS AND MATHEMATICS OPTION

Phys. 32.	Electricity and Electronics	(3)
Phys. 266.	Atomic and Nuclear Physics	(3)
Math. 219.	Principles of Analysis	(3)



The University Library

THE GRADUATE SCHOOL

ADMINISTRATIVE OFFICERS

Harvey Alexander Neville, *President*
 Glenn James Christensen, *Provost and Vice-President*
 Charles Augustus Seidle, *Vice-President—Administration*
 Robert Daniel Stout, *Dean of the Graduate School*
 Samuel Harold Missimer, *Director of Admission*
 James Harold Wagner, *Registrar*
 James Decker Mack, *Librarian*

EXECUTIVE COMMITTEE OF THE GRADUATE FACULTY

Dean Stout, *Chairman (ex officio)*, Professors Ryan, Conard, Tresolini, Jensen, and Emrich.

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, education, electrical engineering, English, geology, government, history, industrial engineering, information sciences, international relations, mathematics, mechanical engineering, metallurgical engineering, philosophy, physics, political science, and psychology. In the fields of Greek, Latin, German, French, social relations, 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, chemical engineering, chemistry, civil engineering, education, electrical engineering, English, geology, history, mathematics, mechanical engineering, metallurgical engineering, 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 head 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 head 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.

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 head 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

The tuition in the Graduate School is \$550 per semester or \$46 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 will be \$400 a semester or \$35 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 153.)

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 or the minimum fee of \$100.

A graduate student in residence or using the facilities of the University must register and pay a minimum tuition or dissertation fee of \$100 per semester.

For a doctoral dissertation prepared in absentia a reading fee of \$100 is charged to a graduate student who has not paid a dissertation fee of at least \$100 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.

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.

Health and Accident Insurance

The University offers graduate students a choice between two types of insurance policies covering accident or illness. One type covers both accident and illness, and the other covers accident only. Either type is available at nominal cost at the Bursar's office.

The Health Service of the University recommends these policies highly to present and prospective students. 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 sickness or injury are required to carry both health and accident insurance on the twelve-month basis.

Refunds

A graduate student who formally withdraws from the University or who, on the advice of his department head 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 head 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 deficiencies 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 Faculty the program of courses he proposes to take to satisfy the requirements. This program must have the approval of the head 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 heads 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 Faculty 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 157 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 head 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. A thesis may be required by the major department. If required, the thesis shall not count for more than six semester hours. The credit to be allowed shall be fixed by the head 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 head of the major department, shall be placed in the hands of the Dean of the Graduate School with a receipt for \$8.00 to cover the fee for microfilming, at least three weeks before the day on which the degree is 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 and in all "300" courses in his major field. No course in which the grade earned is less than C is credited toward the degree.

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 resident graduate study. In no case is the degree awarded to one who has spent less than two full academic years in resident 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 Faculty 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 Faculty. 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 Faculty 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 faculty 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 faculty 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 Executive Committee of the Graduate Faculty 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 head of his major department, should be planned to lead 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 Executive Committee of the Graduate Faculty.

While there is no definite requirement as to the number of courses to be taken, two years devoted to formal courses is the customary minimum. In no instance, however, is the degree awarded merely for the faithful completion of any program of courses.

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 Faculty. In certain fields, the candidate, with permission of the head 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. The language

requirement must be satisfied before the student presents himself for the general examination described below.

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 examination for the doctorate is designed to test both the student's capacity and his proficiency in his field of study. The examination is not necessarily confined to the content of courses that have been taken at Lehigh University or elsewhere. It is held ordinarily not earlier than toward the close of the second year of work, not later than seven months prior to the time when the candidate plans to receive the degree. The student's special committee is in charge of the examination, which may be both written and oral.

The Dean of the Graduate School should be notified in advance when the general examination has been scheduled by the candidate's department head. No student is permitted to take this examination who has not been admitted to candidacy for the doctorate or who has not satisfied the language requirements.

Should a candidate fail in the general examination, 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 Faculty. 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 twenty-five dollars (\$25). The publication fee is used by the University to defray the cost of publishing the dissertation on microfilm (through Univers-

ity 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 ten dollars (\$10) 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 head of the Department of Education.

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. Larger rosters may be taken only on the specific approval of the Graduate Faculty, and such approval may be expected only under exceptional circumstances. 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 head of his major department and of the head 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.

Evening Classes and Summer Sessions

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 1963, 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 in additional subjects as the demand warrants.

The University offers each summer a limited number of courses which may be taken for the usual graduate credit. The courses offered vary from year to year. Information as to the offerings for any particular year may be obtained by writing to the Director of Summer Sessions for the Summer Sessions Announcement.

Interdisciplinary Centers

CENTER FOR THE INFORMATION SCIENCES

The Center for the Information Sciences, established in April 1962 as a division of the University Library, 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.

The Center is assisted by an Advisory Committee composed of representatives of the departments of Electrical Engineering, Industrial Engineering, Philosophy, and Psychology, the Computing Laboratory, the Director of the Institute of Research, and the Dean of the Graduate School.

In 1963, a Division of the Information Sciences was established within the College of Arts and Science, as the instructional section of the Center. The first undergraduate course was offered in 1963, and in 1964 an initial graduate curriculum will be offered. Research in various aspects of the subject are presently being carried out in cooperation with the Departments of Industrial Engineering, Philosophy, and Psychology, and the Division of Social Relations.

MARINE SCIENCE CENTER

We are just at the threshold
of our knowledge of the Oceans.
... (this) Knowledge is more than
a matter of curiosity.
Our very survival
may hinge upon it.

— John F. Kennedy
29 May 1961

The Marine Science Center is an interdepartmental research institute. Its purpose is to encourage interdisciplinary research on problems of oceanography. Faculty members from the departments of geology, biology, and chemistry carry out research activities in the Center. Fellowships and assistantships are available for graduate study in various fields of marine science.

The laboratories of the Marine Science Center are in Williams Hall. These include facilities for modern research in marine chemistry, biology, and microbiology. Field activities of the Center are carried out in cooperation with the Bermuda Biological Station, the Chesapeake Biological Laboratory, Woods Hole Oceanographic Institute, and Narragansett Marine Laboratory.

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 inter-departmental 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 125 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, Magnetic Materials, Crystal Growing and Zone Processing, Manufacturing Processes, and Microwave Measurement; and in three interdisciplinary laboratories of the Center housed in Coxe Building i.e., Advanced Materials Preparation, Mechanical Behavior 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 receive M.S. or Ph.D. degrees in the traditional discipline of their choice, i.e., Chemistry, Physics, Metallurgy, 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. Materials Fellowships and graduate research assistantships are provided by the Center to financially assist able students.



The University Library on a spring day.

DESCRIPTON 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 Students.

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

ACCOUNTING

ACCOUNTING

Professors Trumbull, Koch, Moore

Associate Professor Kubelius

Assistant Professors Brady, Kraus, Brockway

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. 104. Fundamentals of Accounting (3)

An intensive course in the principles and practices of accounting, covering the fundamentals in one semester. Especially designed for engineering and other non-business students. First and second semesters.

Acctg. 115. Cost Accounting (3)

The principles and methods used to determine unit costs of product or services. Material, labor, and overhead costs, methods of distributing overhead, and the application of cost principles to job order and process production. **Prerequisite:** Acctg. 2 or 104. 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. 204. Federal Tax Accounting (3)

A continuation of Acctg. 203. **Prerequisite:** Acctg. 203. Second 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 1964-65.

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 104. First and second semesters. Mr. Trumbull

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. Mr. Trumbull

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. Mr. Koch

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. Mr. Moore

Acctg. 325. Controllershship (3)

Analysis of the controllershship 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.

For Graduates

Acctg. 422. Managerial Accounting (3)

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 and second semesters. Mr. Moore

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, Kubelius

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, Kubelius

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

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:** Consent of the instructor. First semester.

Mr. Kubelius

ASTRONOMY

See *Mathematics and Astronomy* (page 257).

ATHLETICS

See *Division of Athletics and Physical Education* (page 297).

BIOLOGY

Professor Parker, Trembley, Benz

Associate Professors Owen, Barber, Malsberger

Assistant Professors Herman, Whitehouse

No student may normally take for credit more than one of the following courses: **Biol. 1** Biology (3), **Biol. 11** General Biology (3), and **Biol. 13** Human Biology (3). Under special circumstances, a student may petition for an exception to this policy.

Biol. 1. Elementary Biology (3)

A general survey of biological types and principles for students who do not intend to major in biology. Two lectures and one laboratory period per week. First semester.

Biol. 2. Elementary Biology (3)

A continuation of Biol. 1. **Prerequisite:** Biol. 1. Second semester.

Biol. 11. General Biology (4)

A foundation course for majors in biology. A comprehensive survey of biological types and principles. Three lectures and one laboratory period per week. **Prerequisite:** Chem. 4, previously or concurrently. First semester.

Biol. 12. General Biology (4)

A continuation of Biol. 11. **Prerequisite:** Biol. 11. Second semester.

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. **Prerequisite:** Chem 4. First and second semesters.

Biol. 14. Comparative Vertebrate Anatomy (3)

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. One lecture and two laboratory periods each week. **Prerequisite:** Biol. 12 or equivalent. Second semester.

Biol. 18. Genetics (2)

A study of the basic laws governing inheritance in plants and animals, chromosome behaviour, nature of genes. The relation of environmental modifica-

tions, hybrid variation, and mutations to the mechanics of evolution. **Prerequisite:** One semester of biology. First 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 head of the department. First semester. Staff

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 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 head 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. 12 or equivalent. 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. 14 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:** Biol. 12, Chem. 52, or consent of the head of the department. Two lectures and one laboratory period per week. First semester. Mr. Barber

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. 356. Industrial Microbiology (3)

An advanced course in the commercial utilization of microorganisms in indus-

trial processes for the production of organic solvents and organic acids. Two lectures and one laboratory period per week. **Prerequisites:** One semester each of microbiology and analytical chemistry. First semester. Mr. Parker

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 usually taken by an undergraduate majoring in the field. Students who desire to do graduate work in microbiology must offer as a prerequisite satisfactory undergraduate preparation and sufficient preparation in analytical chemistry and organic chemistry. Ability to undertake graduate work must be demonstrated by previous scholastic record and examinations.

Candidates for admission to graduate study should take the Graduate Record Examination in Verbal and Mathematical Aptitude and the Advanced Examination in Biology.

Many of the following graduate courses are given irregularly upon demand. Consultation with the instructor is advised to assure suitable preparation.

Biol. 404. Advanced General Physiology (3)

A seminar on the recent advances in general physiology, including an introduction to current literature on selected topics as contractility, permeability, and excitation. Laboratory experiments in metabolism and electrophysiology. **Prerequisite:** Biol. 320 or equivalent. 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. Staff

Biol. 406. Biological Seminar (1)

An advanced seminar in current developments including departmental research. Required for all candidates for graduate degrees in the department. 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. 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. 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 antibodies. **Prerequisite:** Biol. 353, Chem. 371 or equivalent. Second 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 head of department. 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 head of department. Mr. Herman

Biol. 420. Physiology of Bacteria (3)

Fundamentals of bacterial physiology such as growth, enzymes, nutrition, respiration, and metabolism. The effects of chemical and physical environments. Bacterial genetics. Lectures and laboratory work together with research problems consistent with current interests. **Prerequisite:** Chem. 371 or consent of instructor. Mr. Malsberger

Biol. 430. Antibiotic Substances (3)

Fundamentals of the interrelationships among microbial populations; prepara-

tion and evaluation of penicillins, streptomycins, and tetracycline antibiotics. Two lectures and one laboratory period per week. Second semester. Mr. Parker

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. First semester. Staff

BUSINESS ADMINISTRATION

The College of Business Administration offers three degrees at the master's level, the M.B.A., the M.S. in Management Science, and the M.S. in Business Economics under the jurisdiction of the Department of Economics. The Master of Science in Business Economics is an advanced degree in economics designed to be of special interest to students desiring to enter the rapidly growing field of business economics. A more detailed statement of the aims and purposes of this degree plus a description of the requirements for its fulfillment will be found on page 189 of this Catalog under the heading of Economics.

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 comparatively little 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 full-time 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)	Eco. 306 —Intermediate Economic Theory (3)
Fin. 125 —Principles of Corporation Finance (3)	Fin. 129 —Money and Banking (3)
Law 1 —Business Law (3)	Mkt. 11 —Marketing (3)
Acctg. 104 —Fundamentals of Accounting (3)	Acctg. 115 —Cost Accounting (3)
Eco. 45 —Statistical Method (3)	Eco. 346 —Business Cycles and Forecasting (3)

*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.

Credit Courses**

Required Courses (18 hours)

Fin. 421 —Financial Management (3)	Eco. 433 —Labor Management Economics (3)
Acctg. 422 —Managerial Accounting (3)	Mkt. 450 —Marketing Management (3)
Eco. 431 —Managerial Economics (3)	Eco. 454 —Forecasting (3)

Elective Courses (12 hours)

Law 401 —Legal Problems of Business (3)	Fin. 443 —Financial Market Analysis (3)
Fin. 441 —Foreign Trade Management (3)	Eco. 415 —Operations Research (3)
Eco. 490 —Thesis (6)	
PLUS Appropriate 300-level courses in Accounting, Economics, and Finance (to be approved by the director of the Graduate Program)	

**Descriptions of these courses will be found under Accounting, Economics, and Finance elsewhere in this Catalog.

Background courses other than Eco. 3 plus credit courses listed above 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 MANAGEMENT SCIENCE

This program is designed to provide a rigorous quantitative preparation in business education which we believe to be highly desirable for some of today's executives, 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)	I.E. 407 —Operation Analysis (3)
Fin. 421 —Financial Management (3)	Eco. 471 —Special Topic Study (3)
or	I.E. 425 —Production Systems (3)
Acctg. 422 —Managerial Accounting	or
Eco. 432 —Micro-Economics (3)	I.E. 408 —Industrial Inf. Systems
Math. 233 —Mathematical Statistics (3)	Math. 234 —Mathematical Statistics (3)
Eco. 490 Thesis (6)	
or	
Two courses from the following:	
Eco. 346 —Business Cycles	E.E. 412 —Information Theory II
I.E. 410 —Design of Experiments	Mkt. 450 —Marketing Management
I.E. 440 —Application of Automation	Fin. 421 —Financial Management
Math. 204 —Linear Analysis	Acctg. 422 —Managerial Accounting
Math. 421 —Probability	I.E. 425 —Production Systems
E.E. 411 —Information Theory I	I.E. 408 —Industrial Information Systems
Eco. 433 —Labor Management Economics	Eco. 454 —Forecasting

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 Professor F. A. Bradford, Director of the Graduate Programs, College of Business Administration.

CHEMICAL ENGINEERING

Professors Wenzel, Foust
Associate Professors Clump, Moyle, Schiesser
Messrs. Geist, McKinley, Wilson, Durkee,
Lange, Piacentini, Wolfe

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)

A comprehensive study of the unit operations and equipment common to the chemical and metallurgical process industries. Planned to acquaint non-chemical engineers with the theory and application of heat, mass and momentum transfer operations, including laminar and turbulent flow of real fluids, conduction, convection, radiation, extraction, and distillation. **Prerequisite:** Phys. 4, previously or concurrently. Both semesters.

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. 12; Phys. 3. 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. 161. Unit Operations I (4)

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. 162. Unit Operations II (3)

Applications of heat, mass, and momentum transfer, and combination of these in simultaneous transport during chemical processing operation. **Prerequisite:** Ch.E. 161. 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. 162. Second semester.

Ch.E. 175. Chemical Engineering Practice (1)

Seminars on the chemical industry, and visits to chemical manufacturing plants. **Prerequisite:** Junior standing in chemical engineering. Second semester

Ch.E. 176. Chemical Engineering Projects (2)

Special study of a particular problem involving laboratory and library work. Topics include equipment design, construction, and testing; research in unit operations, unit processes, thermodynamics, and kinetics; data correlation. Weekly conferences and reports. **Prerequisite:** Ch.E. 162. First and second semesters. Staff

Ch.E. 177. Unit Operations Laboratory (2)

One six-hour period per week. **Prerequisite:** Ch.E. 162. First and second semesters.

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.

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. 162, 200 or equivalent, previously or concurrently. First semester.

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.

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.

Mr. Clump

For Graduates

The importance of graduate training in Chemical Engineering for those students who wish to continue in technical or engineering work is definitely recognized by most of the larger corporations, which generally prefer a student with a master's or doctor's degree for such work. The opportunities are proportionately greater, and graduate training enables the man to advance faster and farther in research, development, or design.

There is little or no time for specialization in particular industries during the four-year undergraduate curriculum, and such specialization is considered undesirable since it may limit the field in which the student may become a useful engineer. A considerable portion of the training to the master's degree is also devoted to fundamentals, but a limited amount of work in application to special industries is possible in the research courses.

Students expecting to take work towards a master's or doctor's degree are required to present substantially the equivalent of the undergraduate curriculum of this University for unqualified admission. Occasionally minor deficiencies can be made up during graduate work. Students with major deficiencies should enter the undergraduate curriculum in Chemical Engineering.

For a master's degree, Ch.E. 302 or equivalent, Ch.E. 400, 415, and six hours of research with a suitable report are required. Collateral work can be taken in chemistry, physics, mathematics, or other fields of engineering, with emphasis in the direction of the student's interest. Candidates for the doctorate will take additional courses in their field of interest and fulfill the general requirements of the Graduate School.

Subject to proper approval, a graduate major in Chemical Engineering may include two courses chosen from the following: Chem. 440, 441; M.E. 420, 421, 423.

The Chemical Engineering laboratories provide facilities and equipment suited to research in the Unit Operations, Thermodynamics, Reaction Kinetics, and Systems Dynamics.

A number of industrial and academic research fellowship appointments are available for graduate students in the Department. They are available under conditions given elsewhere in the Catalog.

Ch.E. 400. Chemical Engineering Thermodynamics I (3)

Applications of thermodynamics in Chemical Engineering. Topics include pre-

diction 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. Mr. Wenzel

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. Messrs. Stein, Moyle

Ch.E. 411 Combustion (3)

The kinetics of combustion and explosion are reviewed. Hydrogen-oxygen mixtures are considered as a simple example. Fluid dynamic and thermodynamic relations governing the propagation of deflagration and detonation waves are derived. First semester, alternate years. Messrs. Moyle, Stein

Ch.E. 415. 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. 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. Moyle

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. 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. Mr. Schiesser

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.

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.

Mr. Schiesser

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. 460. Chemical Engineering Calculations (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. Solutions in series, separation of variables, integral transforms and numerical solutions. **Prerequisite:** A course in advanced calculus. First semester, alternate years.

Mr. Schiesser

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.

CHEMISTRY

Professors Amstutz, Zettlemoyer
Research Professor Myers

Associate Professors Billinger, Daen, Fish, Merkel, Sprague, Sturm, Young

Assistant Professors Borowitz, Diefenderfer, Kraihanzel, Lovejoy

Assistant Research Professor Chessick

Messrs. Baker, Blankinship, Brinn, Dougherty, Flinchbaugh, Jeffers, (Miss) Kelsey, Kirby, Lazarus, Lookingbill, Losee, Miller, Ohnmacht, Poist, Schultz,
(Mrs.) Voorhees

Chem. 4. General Chemistry (4)

The principles and applications of general chemistry; descriptive chemistry of the non-metals and their important compounds. One demonstration lecture, two recitations, one laboratory period. First and second semesters

Mr. Sprague and Staff

Chem. 5. General Chemistry (4)

Continuation of Chem. 4. Principles and applications of general chemistry; descriptive chemistry of the metals and their compounds. One demonstration lecture, two recitations, one laboratory period. **Prerequisite:** Chem. 4. First and second semesters.

Mr. Sprague and Staff

Chem. 15. Elementary Chemistry (3)

An abridgement of Chem. 4. For students not majoring in science or engineering. Two lecture-recitations, one laboratory period. First semester.

Mr. Billinger

Chem. 16. Elementary Chemistry (3)

Continuation of Chem. 15; an abridgement of Chem. 5. Two lecture-recitations, one laboratory period. **Prerequisite:** Chem. 15 or Chem. 4. Second semester.

Mr. Billinger

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. 5. 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. 5. 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. 5. 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; experimental basis and formulation of First and Second Laws of thermodynamics and applications. **Prerequisites:** **Chem. 4 and 5, Math. 13 previously or concurrently.** First 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. 5; Math. 23, previously or concurrently.** First semester.

Messrs. Sturm and Lovejoy

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 head of department.** Second semester.

Staff

Chem. 179. History and Literature of Chemistry (1)

A systematic study of the reference books, journals and general treatises with training in the use of the library. Chronological development of the science with assigned readings and reports. Second semester.

Mr. Billinger

Chem. 190. Physical Chemistry (3)

A continuation of Chem. 91. Development and application of free energy functions, homogeneous and heterogeneous equilibria: Third Law; elements of statistical mechanics; surface chemistry; chemical kinetics; the solid state; introductory electrochemistry. **Prerequisite:** **Chem. 91.** Second semester. Messrs. Daen, Sturm

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.** Second semester.

Messrs. Daen, Sturm, Lovejoy

Chem. 193. Physical Chemistry Laboratory (1)

Physical chemical measurements. To accompany Chem. 192. **Prerequisite:** **Chem. 91, previously or concurrently.** Second semester. Messrs. Sturm, Daen, Lovejoy

Chem. 194. Physical Chemistry (3)

A continuation of Chem. 190. Thermodynamics of electrolytic solutions; chemical kinetics and photo-chemistry; recent developments in physical chemistry. **Prerequisite:** Chem. 190. Mr. Zettlemoyer

Chem. 195. Physical Chemistry (3)

A continuation of Chem. 95 which integrates the molecular and macroscopic viewpoints. Nuclear, atomic and molecular structure; statistical thermodynamics; the solid state; topics in surface chemistry. **Prerequisite:** Chem. 95. Second semester. Messrs. Zettlemoyer and Lovejoy

Chem. 197. Senior Physical Chemistry Laboratory (1)

Experimental studies in physical chemistry. High vacuum techniques, light-scattering by polymers, emf measurements, molecular spectroscopy. **Prerequisite:** Chem. 193, pre- or co-requisite Chem. 194. Second semester. Mr. Lovejoy

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. Mr. Fish

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, Diefenderfer

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 the 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 compounds. **Prerequisite:** Chem. 91 or its equivalent. First or second semester. Mr. Myers

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 organo-metallic chemistry and to acid-base behavior in non-aqueous solvents. **Prerequisite:** Chem. 302 or its equivalent. First or second semester. Mr. Sprague

Chem. 306. Inorganic Preparations (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. Sprague, Kraihanzel

Chem. 310. Instrumentation Principles I (3)

A study of electrical, electronic and optical principles in modern instrumenta-

tion 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. 334. X-ray Methods (3)

The application of x-ray diffraction and fluorescence methods to problems of crystal structure and analysis. Lectures and laboratory work. **Prerequisite: Consent of head of department.** First semester.

Mr. Sprague

Chem. 337. Instrumental Methods of Analysis (3)

Theory and application of modern optical and electrical instruments to the solution of analytical, organic and other chemical problems. One conference and two laboratory periods per week. **Prerequisite: Six hours of analytical chemistry.** Second semester.

Mr. Diefenderfer

Chem. 339. Instrumental Methods of Analysis (2)

Similar to Chem. 337. Lecture and conference only. **Prerequisite: Six hours of analytical chemistry.** 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 organic theories of structure and reaction mechanisms. **Prerequisite: Chem. 358.**

Messrs. Amstutz, 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. Borowitz

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, Borowitz

Chem. 371. Elements of Biochemistry (3)

A general study of carbohydrates, proteins, lipids, nucleic acids and other substances and their importance in life processes. **Prerequisite: One year of organic chemistry.** First semester.

Mr. Merkel

Chem. 372. Advanced Biochemistry (3)

A study of selected topics in the field of biochemistry. **Prerequisite:** Chem. 371. Second semester. Mr. Merkel

Chem. 377. Biochemical Preparations (1-3)

The synthesis and study of important biochemicals by the techniques and processes of special value in this field. **Prerequisite:** Chem. 371, previously or concurrently. First semester. Mr. Merkel

Chem. 378. Biochemical Preparations (1-3)

A laboratory course involving the preparation or isolation, purification and identification of chemicals of biological origin. **Prerequisite:** Chem. 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.

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.

Chem. 391. Introduction to High Polymers (3)

Elements of the structure, properties and preparation of high polymeric materials. Topics such as crystallinity in polymeric systems, stereospecific materials, characterization methods, rheological behavior, electrical properties, etc. **Prerequisite:** One year of physical and one year of organic chemistry. Mr. Daen

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 148) 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. In addition to the exceptionally well-equipped laboratories for academic research, special laboratories are maintained for cooperative research.

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. Myers, Sprague, Kraihanzel

Chem. 401. Inorganic Chemistry Research (1-4)

Continuation of Chem. 400. Second semester.

Messrs. Myers, Sprague, Kraihanzel

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. First or second semester.

Mr. Kraihanzel

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. Sprague, Myers, Kraihanzel

Chem. 430. Quantitative Analysis Research (1-4)

Investigation of problems in analytical procedures. First semester.

Messrs. Diefenderfer, Fish

Chem. 431. Quantitative Analysis Research (1-4)

Continuation of Chem. 430. Second semester.

Messrs. Diefenderfer, Fish

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.

Mr. Fish

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. Fish, Diefenderfer

Chem. 439. Seminar in Physical Chemistry (1-6)

Reports and discussions of recent developments in physical chemistry.

Messrs. Zettlemyer, Sturm, Daen, Chessick, Lovejoy

Chem. 440. Chemical Thermodynamics (3)

Principles and applications of chemical thermodynamics. Development of First and Second Laws; properties of state functions; applications of thermodynamics to gases, phase equilibria, chemical reactions and surface phenomena with emphasis on real systems. Third Law. Selected special topics. **Prerequisite:** One year of physical chemistry. First semester. Messrs. Daen, 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, Zettlemoyer

Chem. 442. Elements of Theoretical Chemistry (3)

An introduction to fundamental chemical physics. Quantum chemistry of simple systems; chemical bonding; approximation methods. Elementary statistical thermodynamics. Molecular structure and spectroscopy. Kinetic processes; rate laws and mechanism; kinetic theory and transition state interpretations. **Prerequisite:** One year of physical chemistry. Second semester. Messrs. Daen, Lovejoy, Sturm

Chem. 449. Seminar in Analytical Chemistry (1-6)

Reports and discussions of recent developments in analytical chemistry. Messrs. Fish, Diefenderfer

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, Borowitz

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, Borowitz

Chem. 460. Organic Chemistry Research (1-4)

Investigation of a problem in organic chemistry. First semester. Messrs. Amstutz, Young, Borowitz

Chem. 461. Organic Chemistry Research (1-4)

Continuation of Chem. 460. Second semester. Messrs. Amstutz, Young, Borowitz

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. Amstutz, Young, Borowitz

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. Borowitz

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. 371 and Biol. 35 or their equivalents.

Chem. 490. Physical Chemistry Research (1-4)

Investigation of a problem in physical chemistry. First semester.

Messrs. Zettlemoyer, Chessick, Sturm, Daen, Lovejoy

Chem. 491. Physical Chemistry Research (1-4)

Continuation of Chem. 490. Second semester.

Messrs. Zettlemoyer, Chessick, Sturm, Daen, Lovejoy

Chem. 494. Quantum Chemistry (3)

Principles and applications of quantum mechanics to chemical problems. Applications to chemical bonding, molecular structure, reactivity and spectroscopy.

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. 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. Zettlemoyer, Daen, Sturm, Lovejoy

CIVIL ENGINEERING

Professors Eney, Beedle, Hulsbos, Hough
Associate Professors Liebig, Driscoll, Herbich, Ostapenko, Leonard
Galambos, Van Horn

Assistant Professors Dinsmore, Tall, Lu, Brune, Isaacs, B. T. Yen
Messrs. Cooper, Estuar, Fisher, Guilford, Hansell, Hanson, Lay, Slutter, Yura,
Adams, Badalian, Gaedeke, Gilkey, Goldstein, Kerfoot, Schneck, Smith,
Talian, Vesilind

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. Second semester.

C.E. 11. Engineering Graphics (2)

Use of drawing instruments; freehand lettering and shape description; theory of orthographic projection, revolution, and pictorial representation; dimensioning; developments and intersections; 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 optimum precision. Elements of photogrammetry. **Prerequisites:** Plane trigonometry, C.E. 11. Second semester.

C.E. 41. Engineering Surveys (3)

Applications of surveying to route location, topography, highways, construction. 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. 124. Applied Hydrology (2)

The hydrologic cycle. Flow measurement and interpretation of stream-flow data. Frequency and Duration Studies, Hydrographs of runoff. Stream-flow Routing. Applications of Hydrologic techniques with statistical analysis. **Prerequisite:** C.E. 121. Second semester.

C.E. 125. Hydraulic Engineering (2)

Flow in pressure conduits in series, parallel and network arrangements; uniform and non-uniform flow in open channels; pumping; design of sanitary and storm sewage systems; consideration of engineering economy as applied to hydraulic projects. **Prerequisites:** C.E. 121, 123. First 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. Electronic computer applications. **Prerequisite:** Mech. 11. First semester.

C.E. 151. Structural Theory (3)

Introductory course in the theory of structural steel design, including riveted and welded connections, pins, tension members, columns, and beams. **Prerequisites:** C.E. 112; C.E. 150. First semester.

C.E. 153. Reinforced Concrete Theory (3)

Introduction to the theory and design of simple reinforced concrete structures. Laboratory work includes the preparation of concrete mixtures and tests of control cylinders, beams, and columns. **Prerequisites:** C.E. 112; C.E. 150. First semester.

C.E. 154. Structural Analysis II (3)

Elastic analysis of statically indeterminate beams, frames, and trusses by methods of energy, column analogy, 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, 201. 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 plastic mechanism. Plastic analysis and design of beams, columns, connections and rigid frames. **Prerequisite:** C.E. 154. Second 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. 5, 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 head. First semester.

Messrs. Leonard, Hanson

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.

Messrs. Leonard, Lu

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.
Mr. Lu

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. 124; C.E. 125 previously or concurrently; or consent of department head. First or second semester.
Messrs. Herbich, Isaacs

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. 125 or consent of department head. Second semester.
Messrs. Herbich, Isaacs

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. 206, C.E. 121. Second semester.
Messrs. Herbich, Warnock

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. Eney, Liebig

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. Isaacs

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 head of department. Second semester.
Mr. Eney and staff

For Graduates

The Department offers advanced work in structural engineering and hydraulics, leading to the M.S. and Ph.D. degrees. A master's degree can also be earned in sanitary engineering, and in soil mechanics.

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. for either an M.S. or a Ph.D.: Mech. 402, Advanced Analytical Mechanics; Mech. 404, Advanced Vibration Analysis; Mech. 411, 412, Theory of Elasticity & Plasticity; Mech. 415, Structural Mechanics & Elastic Stability; Mech. 416, Theory of Plates & Shells; Mech. 421, Hydrodynamics; Mech. 422, Advanced Mechanics of Compressible Fluids.

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. First 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. Mr. Eney

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 1964). 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. Hulsbos

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. Hulsbos

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. Transportation of sediment. Supervised problems. Second semester of alternate years. (Offered Spring 1964). Messrs. Herbich, Isaacs

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 head. First or second semester. Messrs. Herbich, Isaacs

C.E. 422. Hydraulic Research (2-5)

Individual research problems with reports. First and second semesters. Messrs. Herbich, Isaacs

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 head. First semester of alternate years. (Offered Fall 1965). Mr. Herbich

C.E. 440. Soils Research (2-5)

Individual research problems relating to soil mechanics, with report. **Prerequisite:** A course in soil mechanics. First or second semester. Mr. Leonard

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; frost action; application of hydro-mechanics to soil engineering problems. **Prerequisite:** An undergraduate course in soil engineering. First semester. Mr. Leonard

C.E. 444. Advanced Soil Engineering II (3)

Fundamental and advanced theories of soil mechanics applicable to earth structures and foundation design; detailed study of stress-strain and strength characteristics of cohesive and non-cohesive soils under various loading conditions; case histories of some applications. **Prerequisite:** C.E. 443. Second semester.

Mr. Leonard

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.

Messrs. Hough or Leonard

C.E. 446. Earth Structures (3)

Current theory and practice relating to the design of large embankments, earth dams, earth slopes and base courses. Stresses in slopes and embankment foundations; slope analysis theories; pretreatment of foundation soils; loads on conduits and structures in embankments; evaluation of base courses; soil compaction; selection of material; and constructions. **Prerequisite:** Consent of instructor. Second semester.

Messrs. Hough or Leonard

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.

Mr. 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.

Mr. 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 at thin-walled members; inelastic instability; special problems in stability. Desirable preparation: Math. 221 and Mech. 415. Second semester.

Mr. Galambos

C.E. 456. Graduate Seminar (1-3)

Study of current topics in the field of civil engineering. (Offered on sufficient demand.)

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. Beedle, Galambos, Driscoll, Ostapenko or Lu

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 1965).

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 1964).

Mr. Isaacs

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 1965).

Mr. Isaacs

CLASSICAL LANGUAGES

Associate Professors Maurer, Feaver
Mrs. 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. Second-Year Greek (3)

Xenophon: *Anabasis*, and other works. Grammar review. **Prerequisites:** Gk. 1. and 2, or one year of entrance Greek. First semester.

Gk. 4. Second-Year 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.

Gk. 111. Homer (3)

Rapid reading of considerable portions of the *Iliad* or the *Odyssey*. Homeric language, syntax, and metre. **Prerequisites:** Gk. 4 and consent of head of department. First semester.

Gk. 116. Plato (3)

The Republic, and other dialogues. Lectures on classical philosophy. **Prerequisites:** Gk. 4 and consent of head of department. 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

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 head 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 head of department. Second semester.

Mr. Maurer

ECONOMICS

Professors Bratt, Loomba

Associate Professors Urban, Balabkins, Bryski, Firestone, Krupp, Snider

Assistant Professors Cohen, Hanga, Kalish, Pillsbury

Messrs. Hall, Keefe, Keddie, Moroney, Orsagh, Reilly, Winch, Coschigano,
D'Attilio

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, labor problems, social security, international trade, and alternative economic systems. 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.

All of the following courses in economics have as a prerequisite a one-year course in the principles of economics.

For Advanced Undergraduates and Graduates

The Department 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. There were nine candidates enrolled in the Department in the 1963-64 academic year. The first offering was made in 1962. 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 for advanced work. All candidates will be required to take the Admission Test for Graduate Study in Business. The qualifications of each candidate will be considered on his particular merits. The great demands in industry for trained and capable analysts necessitates a high degree of selectivity in accepting candidates.

The Master of Science in Business Economics is the degree offered in this program. Flexibility, where it appears desirable for the individual's development, will be clearly recognized. In general the course of study for 1963-64 is as follows.

THE M.S. IN BUSINESS ECONOMICS**Course of Study**

Eco. 347	National Income Analysis	(3)	Eco. 454	Forecasting	(3)
Eco. 352	Advanced Statistical Method	(3)	Eco. 434	Metropolitan Market Analysis	(3)
Eco. 415	Operations Research	(3)	Eco. 453	Time Series Analysis	(3)
Eco. 432	Micro-Economics	(3)	Acctg. 305	Financial Statements and Reports	(3)
Fin. 443	Financial Market Analysis	(3)	Eco. 471	Special Topic Study	(3)

Eco. 301. Business Policy (3)

Analysis of management problems in business enterprise. Designed to provide the student with an understanding of the over-all problems and functions of management. Case method. **Prerequisite:** Senior standing in the College of Business Administration or Senior Arts major in business. First and second semester.

Mr. Urban

Eco. 302. Management Analysis (3)

Discussion and resolution of problems of management at various levels and stages of operation. Particular stress on use of quantitative techniques available for decision-making in the narrower functions of management. **Prerequisite:** **Eco. 45 and Senior standing in the College of Business Administration.** Second semester. Mr. Loomba

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. Firestone, Moroney, Orsagh, Pillsbury

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. Firestone

Eco. 308. History of Economic Thought (3)

Continuation of Eco. 307.

Mr. Firestone

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. Mr. Kalish

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 head of department.** First semester. Mr. Keddle

Eco. 313. Quantitative Planning and Control (3)

The theory of quantitative methods of analysis and their application to economic and operational problems of management. **Prerequisite:** **A course in statistics.** First and second semester. Mr. Loomba

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. Mr. Keddle

Eco. 334. Labor Legislation (3)

State and federal labor legislation. Background, experience, and economic impact. Second semester. Mr. Bryski

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. 346. Business Cycles and Forecasting (3)

The nature of the business cycle and the application of statistics to business trends, with special attention to forecasting and business barometers. **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. **Prerequisite:** Eco. 346. First semester. Mr. Bratt

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. Orsagh

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 head. First semester.

Messrs. Bratt, Loomba, Keddle, Firestone, Moroney, Orsagh, Urban

Eco. 372. Readings in Economics (3)

Continuation of Eco. 371. Second semester.

Messrs. Bratt, Loomba, Keddle, Firestone, Moroney, Orsagh, Urban

For Graduates**Eco. 415. Operations Research (3)**

Formulation, analysis, and application of different classes of operations research models, including allocation, inventory, waiting-time, and replacement models. First semester. Mr. Loomba

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:** Consent of the instructor. First and second semesters. Mr. Urban

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.

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:** Consent of the instructor. First and second semesters.

Mr. Bryski

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. 453. Time Series Analysis (3)

Statistical measurement of economic change and its economic significance. Second semester.

Mr. Bratt

Eco. 454. Forecasting (3)

The problem of predicting cyclical changes and long-term prospects for growth is of vital importance in most lines of business today. It is desirable that business men in managerial positions have some knowledge of the basic methods used in arriving at such predictions. This course provides a study of the methods of business forecasting with special attention to secular and cyclical forecasting. **Prerequisite:** E.S. 346 or equivalent. Second semester.

Mr. Bratt

Eco. 471. Special Topic Study (3)

An extended study of an approved topic in the field of business economics.

Staff

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. Messrs. Snider, Reilly

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 head of department.** First semester. Mr. Reilly

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. Snider

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. Reilly

EDUCATION

Professors Stoops, Cartwright

Associate Professors Bream, Mazurkiewicz

Assistant Professors O'Neal, Scanlan, Hagstrom, Sam

Messrs. Bartholomew, Bender, Bingeman, Hilaire, McKeegan, Meade,

Oswalt, Sandel, Shuman, Strome, Versacci

Educ. 10. Introduction to Education (3)

This course is designed for all University undergraduates. It presents a broad survey of problems and practices of both public and private schools from the kindergarten through the graduate school. Included are history, social and legal foundations, purposes, curriculum, administration, and methods of teaching. Systems of education abroad are also considered. Can be used for purpose of teacher certification. First and second semesters. Messrs. Stoops, Cartwright

For Advanced Undergraduates and Graduates

Educ. 301. Introduction to Educational Practice (3)

This course is designed for students who are about to begin teaching at the elementary or secondary level. It is a survey of the work of the teacher and his role in public school problems; the aims, organization, and materials of public

education; the social and legal foundations of public education; board, administration, and teacher relationships; and the forces which affect public policy in education including professional and lay organizations. Required for the Pennsylvania College Provisional Certificate. First semester. Messrs. Stoops, Cartwright

Educ. 320. Educational Psychology (3)

An introductory course furnishing a psychological foundation immediately related to educational problems and practice. Practical problems involving analysis of designated material are assigned regularly for solution and report. Required for the College Provisional Certificate. First semester. Mr. Scanlan

Educ. 352. Methods of High School Teaching (3)

Basic methods of secondary instruction, including the objectives of education in relation to the curriculum; socialized procedure; problem-project method; contract plans; types of teaching related to different fields; directed study; organization of courses around criticized objectives; and the conduct of classes along the lines of individualized instruction. Recommended for the college provisional certificate. Second semester. Mr. Hagstrom

Educ. 360. Personnel Practices in Business and Industry (3)

A study of the techniques and principles used in the understanding and treatment of industrial problems confronting the line organization. Personnel administration as both a line and staff function. Case studies used for discussion of employee services, wage administration, and building, training and maintaining the labor force. **Prerequisite:** Consent of head of department. Mr. Brennan

Educ. 390. Audio-Visual Education (3)

Types of visual aids, the special value of each, their use in different subjects, the psychological basis for the use of such material and the standards for the selection of visual sensory aids. Required for the permanent college certificate. First semester. Messrs. Bream, McKeegan

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. Bream, O'Neal, Sam

For Graduates

The Department is interested in the training of 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 training 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 while, at the same time, discontinuing 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 Education and other 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 Department 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 sixth-year specialist program. 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 Department 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 four areas: (1) administration, (2) reading, (3) curriculum development, and (4) guidance and counseling. 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.

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. Scanlan

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. Hagstrom

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.

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. Bream

Educ. 407. Philosophical Foundations of Education (3)

A critique of the aims of elementary and secondary education in the modern 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 democratic social progress. Second semester.

Mr. Bream

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. First or second semester.

Messrs. Bream, Stoops

Educ. 410. Structure and Syntax of the Academic Disciplines (3)

Professors from other departments of the University are presented in discussions coordinated by the Department 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. 421. Analytic and Remedial Reading Procedures and Practices (3)

A laboratory course in remedial procedures and practices in the teaching of reading. Provision is made for clinical practice with individual and small groups of children on the elementary or secondary level. Emphasis is placed upon the development of practical and informal techniques and materials for diagnosing reading difficulties and instructing retarded readers. **Prerequisite: Educ. 447A or 448.** First semester.

Mr. Mazurkiewicz

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.

Messrs. Oswalt, Scanlan

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.

Messrs. Oswalt, Scanlan

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.

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.

Messrs. Mazurkiewicz, Versacci

Educ. 426. Special Problems in Education (3)

Intensive study in an area of education not adequately covered in currently listed offerings. The field of research will be varied to meet the special needs of advanced students of unusual ability and adequate preparation. First and second semester.

Mr. Stoops 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.

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 and by the University. **Prerequisite: Ed. 427.** First and second semester.

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. Mazurkiewicz

Educ. 434. Mathematics in Elementary Education (3)

Mr. Sam

Educ. 435. Social Studies in Elementary Education (3)

Mr. Hagstrom

Educ. 436. Science in Elementary Education (3)

Mr. Sam

Educ. 437. Language Arts in Elementary Education (3)

Mr. Sam

Educ. 438. Fine Arts in Elementary Education (3)

Staff

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. Second semester.

Messrs. Sam, Sandel

Educ. 444. The Elementary School Curriculum (3)

Problems of curriculum development in the first six grades; subject matter placement, program-making for difficult types of schools, regular vs. special subjects, articulation, and similar problems. Second semester.

Mr. Bream

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.

Messrs. Hilaire, Mazurkiewicz

Educ. 449. Children's Literature in Reading Instruction

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.

Mr. Mazurkiewicz

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. Second semester.

Messrs. Nancarrow, O'Neal

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.

Mr. Bream

Educ. 460. Group Processes and Group Guidance (3)

Aimed at achieving competence in using effective group techniques and appropriate resources in promoting individual and group development. Evidence furnished by experimental studies in group processes is analyzed and applied. Procedures and content are designed to facilitate behavioral changes. Second semester.

Messrs. Bream, Scanlan

Educ. 461. Organization of Units of Learning (3)

A practical course for the teacher in service, offering opportunity for cooperative planning of courses and teaching-learning units. Applies the principles of curriculum construction to the selecting, assembling, and organizing of learning enterprises. The teacher is advised to work with his class in his field of special interest. Second semester.

Mr. Bream

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. Mr. Bream

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.

Messrs. Cartwright, Stewart

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.

Messrs. Cartwright, Nancarrow

Educ. 468. Vocational and Technical Education (3)

The social basis for vocational education; present practices and trends in the major types of vocational education; recommendations for organization and administration; teaching problems; student employment; laws and regulations. First or second semester.

Mr. Shuman

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.

Messrs. Mazurkiewicz, Versacci

Educ. 472. Educational Tests and Measurements (3)

Selection of educational tests, organization of a testing program, use of tests in classifications, construction of classroom tests, use of tests in improving teaching, and diagnosis of pupil difficulties. Students will be sectioned on the basis of interest in elementary or secondary education. For advanced work in this field attention is called to the seminar and individual research courses. First or second semester.

Messrs. Meade, Scanlan

Educ. 473. Educational Statistics (3)

Designed to give teachers and administrative officers the techniques necessary to enable them to gather data and present the results of their work in their classrooms and schools. Provides a practical knowledge of the simple statistical methods for use in handling common problems and in understanding educational literature. First semester.

Mr. Scanlan

Educ. 474. Seminars in School Building (3)

Mr. Cartwright

Educ. 475. Seminar in Business Management (3) Messrs. Cartwright, Bingeman

Educ. 476. Seminar in School Finance (3) Messrs. Cartwright, Bingeman

Educ. 477. Seminar in School-Community Relations (3)

Messrs. Cartwright, O'Neal

Educ. 478. Seminar in School Personnel Problems (3)

Messrs. Cartwright, O'Neal

Educ. 479. Seminar in School Law (3) Messrs. Abbot, Cartwright, Stoops

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. Mr. Scanlan

Educ. 483. Techniques of Counseling (3)

An intensive examination of personnel techniques, including interviews, rating scales, and counseling, by such means as lectures, demonstrations, and case histories. Case studies of selected students are required. Required for guidance counselor's certificate. First or second semester. Messrs. Bender, Scanlan,

Educ. 484. Occupations (3)

Trends in supply and demand of workers in various occupations; requirements for occupations; sources of descriptive materials; testing for occupational aptitude. Required for guidance counselor's certificate. First and second semester.

Mr. Scanlan

Educ. 485. Elementary School Principal's Clinic (3-6)

Mr. Sam

Educ. 486. Secondary School Principal's Clinic (3-6)

Mr. O'Neal

Educ. 487. School Psychologist's Clinic (3-12)

Mr. Scanlan

Educ. 488. School Superintendent's Clinic (3-6)

Mr. Cartwright

Educ. 489. Reading Specialists Clinic (3-12)

Mr. Mazurkiewicz

Educ. 491-492. Seminars (3-6)

One seminar is organized in each half-year, provided three or more students select such work. These courses do not duplicate courses of individual research. It is the purpose of seminar courses to provide for cooperative study of special problems in the field of elementary and secondary education. First and second semester. Messrs. Bream, Mazurkiewicz, O'Neal, Scanlan

Educ. 493. Research (3)

Section A for students with appropriate preparation for pursuing independent investigation, and Section B for students in need of training in the methods of educational research. First and second semester. Mr. O'Neal

Educ. 494. Field Work (3)

For students who have shown interest in an ability to make an analytic study of a problem as found in a school setting. First or second semester.

Mr. Cartwright and staff

Educ. 496. Advanced Seminars in Education (3)

Primarily for Doctoral Candidates. First or second semester.

Mr. Stoops and staff

Educ. 498. Internship (3)

A follow-up of Educ. 497 designed to give a limited number of advanced students an opportunity to obtain practical experience as assistants in selected school systems. Conference hours for students and staff members will be devoted to discussion of work and problems encountered by students in their internships. Each student is required to submit a report describing and appraising experience gained in this internship. 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; and Section E, reading specialists. Second semester.

Mr. Bingeman and Staff

ELECTRICAL ENGINEERING

Professor Karakash, Visiting Professor Dahlke
Associate Professors Larky, McCracken, Pearce, Teno
Research Associate Professor Eberhardt
Assistant Professor Ramachandran
Messrs. Hertlein, Hollabaugh, Knerr, Nehf, Sigley, 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, previously or concurrently.

E.E. 100. Summer Work

During the vacation following the junior year, each student in electrical engineering is required to spend at least eight weeks getting experience in some approved industrial organization. A written report on the experience gained therein, is due on or before January 8.

E.E. 101. Analog and Digital Computation (2)

Principles of analog and digital computation. Concepts of computation processes. 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 (4)

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 meeting for discussion of topics on theoretical and applied electricity. Presentation of papers. **Prerequisite:** Senior standing.

E.E. 112. 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. 133. Power System Analysis I (4)

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. 134. Power System Analysis II (4)

Steady state and transient power limits of transmission systems; electro-mechanical characteristics of electrical machines and networks. **Prerequisite:** E.E. 133. Second semester.

E.E. 141. Logic and Switching Theory (3)*

Switching algebra; n -variable theorems and related active, semi-conductor and magnetic embodiments. Combinational logic; minimization methods using algebra, tables, maps, hypercubes. Module two algebra; theorems and sequential machines favoring shift-register techniques. Coding theory; decimal-binary, complementing, etc. Symmetric functions and simplicial decomposition. **Prerequisites:** E.E. 101, 104, and 105. First semester

E.E. 144. 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. 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. Dynamo 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;

*Departmental Electives

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. 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. 245. Electromagnetic Theory (3)

Maxwell's equations: Poynting's theorem; transmission; reflection, and refraction of waves. Transmission lines; rectangular and cylindrical waveguides.

E.E. 246. 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. 303. Vacuum and Gaseous Electronics (3)*

Electron emission under combined thermal and field emission conditions. Phenomena related to ultra-high vacuum production. Thermal and non-thermal plasma discharges. Plasma diagnostics; electrical characteristics, Langmuir probes; microwave and optical techniques. Introduction to masers.

E.E. 304. Semiconductor Device Theory (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. 342. Communication Theory (3)*

Information theory concepts for binary symmetric channels. Transmission theory for unilateral active multi-port networks using Fourier series and integrals. Modulation, the analog and digital coding of information. Demodulation, decoding, and system performance measures. Second semester.

E.E. 350. Special Topics (3)

Selected topics in the field of electrical engineering not included in other courses.

*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 training equivalent to that required for the B.S. in E.E. at Lehigh University. Subject to approval, up to six credit hours at the "400" level may be allowed for a thesis, toward the requirements for the M.S. degree. Subject to approval, a graduate course program may include as part of the "major," courses chosen from among the following: Math. 405, 406, 416, 421, 431, 453; Phys. 420, 421, 422, 423, 428, 429; Mech. 402, 411, 412, 421, 422; I.E. 410.

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. Stu-

dents 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. Electro-mechanical and electronic equipment is available for transient generation and observation. 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)

Theoretical foundations of present-day solid-state devices. Thermal, photo and magnetic effects. Advanced transport theory of semiconductors. (Can be repeated for credit.)
Messrs. Ramachandran, Leenov

E.E. 410. Electron Tube Theory (3)

Electron ballistics. Electron beams. Interaction of electromagnetic fields and electron streams. Transit time effects and noise. Klystrons. Traveling-wave amplifiers.
Mr. Eberhardt

E.E. 411. Information Theory I (3)

Algebra of sets; topologies and transformations, structure, basis, sub-basis, equivalence and closure; metric spaces, Hamming distances, error detection and correction potentiality. Measure; axioms of probability, conditional probability and Markoff processes, expectations, moments, characteristic functions, bivariate distributions and risk theory, probability computers. Information measure, entropy expectation and its maximizing, self- and mutual information, channel capacity, rate, redundancy, and efficiency; symmetric and erasure channels. Encoding, separable codes, coding theorems of Feinstein and McMillan, linear coding. First semester. (Offered alternate years.)
Mr. McCracken

E.E. 412. Information Theory II (3)

Continuous channels without memory, coordinate transformation and noise whitening, Gaussian channels. Band limited signals, sampling, vector, linear, normed, pre-Hilbert complexified and Hilbert spaces, minimum distances decoding and error-probability bounds. Transitional entropy, product spaces, cylinder sets, Borel fields, recurrent transformations. Fundamental theorems and decision schemes. Group codes and finite-state switching circuits. Second semester (Offered alternate years.)
Mr. McCracken

E.E. 413. Active Networks (3)

Vacuum tube and transistor circuits. Monostable, bistable, and astable transistor circuits and logic elements. Application to analogue and digital computer systems. Second semester. (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.)
Mr. Teno

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.)
Mr. Teno

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.)

Mr. Teno

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 sub-transient reactances; electrical and mechanical transients; calculation of voltage, current, mechanical oscillations, hunting, forces and torques; operation of ma-

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. Microwaves (3)

Electromagnetic propagation along periodic structures. Propagation in inhomogeneously filled waveguides. Active elements; mechanisms of tubes, tunnel diodes, parametric amplifiers, masers and lasers.

Mr. Eberhardt

E.E. 450. Special Topics (3)

Selected topics in the field of electrical engineering not covered in other courses. Topics considered in 1963-64: Digital magnetic device theory; theory of noise and noisy networks.

ENGLISH

Professors Severs, Strauch
Associate Professors Hook, Armstrong, Dilworth, Hartung
Assistant Professors Rights, Criswell, Frakes, Greene,
Hertz, Vickrey, Hopkins
Messrs. Baker, James, Marx, Burger, Digel, Cook, Brown, Curry,
Johnstone, Keiser, Moisiades, Schwork, Shenk, Ross,
Beidler, Weinberger, Layden, Zabawa, Mrs. Shenk

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. 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 head 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 head 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 head 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 head of department. First semester.

Engl. 182. Undergraduate Thesis (3)

Continuation of Engl. 181. **Prerequisite:** Consent of head 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 head of department. First semester.

Engl. 184. Readings in English Literature (3)

Continuation of Engl. 183. **Prerequisite:** Consent of head 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.

Candidates for the master's degree majoring in English literature 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 expected to master the subject matter of the entire field of English and American literature. Other requirements for the doctorate will be found in the section of this Announcement headed "Degrees," page 148.

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.

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. Rights

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. Dilworth

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, Hertz

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, Hertz

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. Mr. Severs

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)

Continuation of Engl. 337. 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 semester. Mr. Hertz

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. Mr. Frakes

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. Mr. Frakes

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 the conflict between the values of the frontier and the values of civilization as expressed in two themes: (1) the search for justice and (2) New World Innocence vs. Old World Experience. These themes will be considered with literary specimens drawn from a wide range of periods and movements: Franklin, Crèvecoeur, the Romantics, Twain and Southwestern humor, Dreiser, Faulkner, Cozzens, etc. First or second semester.

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. Hopkins

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. Mr. Hertz

Engl. 487. Literary Criticism (3)

Continuation of Engl. 486. Second semester.

Mr. Hertz

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, 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), Shakespeare for Teachers (Mr. Hook), Wordsworth (Mr. Severs). First semester.

Engl. 497. Graduate Seminar (3)

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

Assistant Professors Rights, Wright

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 41. Broadcasting in America (3)

The exposition and analysis of the origin and growth of broadcasting, the forces which regulate, control, and shape it, and the influences which it wields. Four basic divisions in the course are: history of broadcasting, regulation of broadcasting, economics of broadcasting, and control and influence of broadcasting. Lecture and field trips. First semester.

Speech 51. Radio Workshop (3)

This course is designed to give the student basic training in the skills and techniques necessary to the effective employment and appreciation of the radio and television media. These skills range from simple manual ones to those requiring high intellectual and artistic abilities including operation of technical equipment, radio speech, various types of writing for radio and television, and the production of programs for radio and television. **Prerequisite:** Consent of head of department of English. Second semester.

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

Visiting Associate Professor Sullivan

Mr. Horine

Journalism majors must successfully complete at least four credits in 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, 16, 17, 113, 115, 118, 120 and the following courses: Gk. 21 or Lat. 22, Govt. 352, Phil. 14 and 15.

Journ. 1-10. Brown and White (1)

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 head 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. 16. Law of the Press (3)

Constitutional development of freedom of the press; law of and defenses in libel; rights and responsibilities of the press. Second semester.

Journ. 17. Magazine Article Writing (3)

Writing and marketing non-fiction magazine articles. First semester.

Journ. 21. Creative Writing (3)

The study and writing of essays and short-stories (and verse, if requested), 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 head of department. First semester.

FINANCE

Professors Bradford, Jensen, Schwartz
Associate Professor Krouse

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. 241. International Trade and Finance (3)

Economic, commercial and financial relations of nations, including economic

organizations, basic principles and practices of international trade, finance, and investment. First semester. Mr. Jensen

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. Mr. 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. Mr. Schwartz

Fin. 342. International Trade and Finance (3)

Continuation of Fin. 241. **Prerequisite:** Fin. 241 or consent of head of department. 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. Mr. 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. Schwartz

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 by the regularly rostered courses. **Prerequisite:** Preparation in finance acceptable to the department head. First semester. Mr. Bradford

Fin. 372. Readings in Finance (3)

Continuation of Fin. 371. Second semester.

Mr. Bradford

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. Schwartz, Krouse

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. 443. Financial Market Analysis (3)

Methods of analysis of the U. S. capital and money markets from a forecasting point of view. Economic accounting concepts of funds flows; institutions of the markets; factors affecting interest rates; the role of credit and fiscal policy. First and second semesters. Mr. Bradford

FINE ARTS

Professor Quirk
Assistant Professor Redd

F.A. 1. Survey of Painting and Sculpture (3)

A basic history of man's artistic expression in painting and sculpture from pre-historic times through the High Renaissance. Lectures. First semester.

F.A. 2. Survey of Painting and Sculpture (3)

Manneristic, baroque, rococo, Nineteenth Century and Contemporary expression. Lectures. Second semester.

F.A. 3. Pre-Renaissance Architecture (3)

A study of man's expression through architecture from prehistoric through the Romanesque period. Conditioning influences, evolution of styles, the development of organic and inorganic types, are studied 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.

F.A. 16. Art in the United States (3)

A survey of architecture, painting, and sculpture; including colonial America, traditional influences, periods, and styles. The evolution of American Art. Con-

temporary expression and the understanding of art in relation to its time. Lectures. Second semester.

F.A. 19. Nineteenth Century Art (3)

Painting and sculpture from Neoclassicism through the developments of Romanticism, Naturalism, Impressionism, and Expressionism from Goya to Van Gogh. Lectures. Second semester. Odd-numbered years.

F.A. 20. Form and Milieu in Twentieth Century Art (3)

The developments of modern art through various schools and movements from 1890 to the present, showing their relationship to their environment. Second semester. Even-numbered 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 designed to accent an area of optional specialization. Assignments in complimentary areas, research and experimentation in combined media. **Prerequisites:** F.A. 31 or 32, or consent of head 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 head 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 head 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 visual satisfaction. For beginners and trained students. **Prerequisites:** Either engineering drawing, architectural drawing, or field experience; or consent of head 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 head 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 head of department. Second semester.

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 several nearby offices, units from the permanent collection of Student paintings may be seen.

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 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.

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 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 85 and 109

FRENCH

See Romance Languages, page 293

GEOLOGY

Professors Ryan, Gallagher, Jenkins
Associate Professors Whitcomb, Chave
Assistant Professors Simpson, Myers, Neumann
Visiting Lecturers Dr. Kullerud, Mr. Adair
Messrs. Gard, Glass, Haselton, Kaliser, Loder, Nagle

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 for non-major students. A summary of earth history considering the development of the continents, life of the past, economic products, and weather factors. Field trips. **Prerequisite:** Geol. 1. First and second semesters.
Mr. Whitcomb

Geol. 12. Historical Geology (3)

The development of the continents and life forms; evolution based on the remains of animal and plant life preserved on the rocks. Lectures, laboratory, and field trips. **Prerequisite:** Geol. 1. Second semester.
Mr. Whitcomb

Geol. 14. Earth Materials Laboratory (1)

Megascopic identification and description of common minerals and rocks. Laboratory. Second semester.

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 or 6. Second semester.
Mr. Simpson

Geol. 63. Introduction to Oceanography (3)

A survey of the physical, chemical, biological, and geological nature of the oceans. Two lectures, one recitation. **Prerequisite:** A laboratory course in science (Biol., Chem., Geol., Phys., or Psych.) First semester.
Mr. Neumann

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.
Mr. Ryan

For Advanced Undergraduates and Graduates**Geol. 201. Earth Sciences I — Geology (3)**

Rigorous treatment of earth materials, internal and external geological forces and the history of the earth; fundamentals common to contemporary and ancient thought, changing concepts, interdisciplinary ties and dependencies. Lectures, readings in classical and current literature, laboratory experiments and field demonstrations. **Prerequisite:** Certificate in a science or teachers with one year each of college-level chemistry, mathematics and physics, or consent of head of department.

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:** Certificate in a science or teachers with one year each of college-level chemistry, mathematics and physics, or consent of head of department.

Geol. 281. Geological Research (1-3)

Independent investigation of a special problem in the field, laboratory, or library. **Prerequisite:** Consent of head 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 head 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 head 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. 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. 1 or 11. First semester.

Mr. Whitcomb

Geol. 312. Stratigraphy (3)

Study of sedimentary rocks: correlation, distribution, the facies concept, environmental reconstruction. **Prerequisite:** Geol. 333 or consent of head of department. Second semester.

Mr. Chave

Geol. 313. 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. 12. First semester. Mr. Neumann

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. Theoretical Petrology (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. Myers

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. 312 or consent of head 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. Neumann

Geol. 351. Geology of Fuels (2)

The geology and geochemistry of oil, gas, and coal. **Prerequisite:** Geol. 312 or consent of head 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. **Prerequisites:** Geol. 12 and 14. First or second semester.
Mr. Myers

Geol. 366. Geology of North America (3)

The evolution of the North American continent; petrologic, stratigraphic and tectonic synthesis. **Prerequisite:** Senior standing or consent of head of department. Second semester.
Mr. Ryan and staff

Geol. 390. Problems of Geology (3)

History and present status of controversial basic geologic problems. **Prerequisite:** Geol. 312 or consent of head 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 of the fields previously listed.

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.

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 year 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 148.

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. Magnetism 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. Mr. Whitcomb

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. 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. 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

Geol. 462. Paleocology (3)

Reconstruction of paleoenvironments based on principles of paleocology 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

GERMAN

Professor Wood

Associate Professors Tremper, Ubben

Assistant Professors Gardner, Visiting Assistant Professor Wittman

Mr. Lovell

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. 6. Elementary German for Science Students (3)

A course paralleling Ger. 2, but using, to the extent that suitable material is available, reading texts more directly related to the professional objectives of science and engineering. **Prerequisite:** Ger. 1 or the equivalent. 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 of a more advanced type than that read in Ger. 6, with

stress on chemistry and physics. **Prerequisites:** Ger. 2, 6, or 11, or three units of entrance German; sophomore standing or consent of the head of the department. First and second semesters.

Ger. 31. Conversation and Composition (3)

Remedial exercises in grammar; phonetics; conversation and composition stressing situations taken from daily life. **Prerequisites:** Ger. 12, or Ger. 11 and 27, 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. 33. Types of German Literature (3)

Lectures and reading assignments on the development of German literature from the beginning through the Classical Period; reading of texts representative of various periods and individual writers. **Prerequisites:** Ger. 12, or Ger. 11 and 27, or three units of entrance German. First semester.

Ger. 34. Types of German Literature (3)

Continuation of Ger. 33, covering developments from the end of the Classical Period to approximately the downfall of Naturalism. **Prerequisites:** Ger. 12, or Ger. 11 and 27, or three units of entrance German.

Ger. 35. German Poetry (3)

A study of selected lyric and narrative verse. **Prerequisites:** Ger. 12, or Ger. 11 and 27, or three units of entrance German. First semester.

Ger. 36. Goethe's Faust (3)

Study of Part I; lectures on the origin and development of the Faust story; collateral reading. **Prerequisites:** Ger. 31, 33, 34 or 35; or three units of entrance German and consent of the head of the 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. 201. The Classical Period (3)

Selected works from the Classical Period.

Mr. Wood

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. 204. Medieval German Literature (3)

Study of the Middle High German Period, with reading of selected works in New High German translation.

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. 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.

RUSSIAN

Mr. Lovell, Mr. Samtins

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.

GOVERNMENT

Professors Schulz, Tresolini, Yates
Assistant Professor Patterson

Govt. 1. The Foundations of Government (3)

A survey of the basic principles and problems of governmental organization and operation, with emphasis on controversial issues and on the relevant political institutions and practices, both contemporary and past, of American, European, and Asiatic peoples. First and second semesters.

Govt. 2. 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. 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. **Prerequisite:** Sophomore standing. First and second semester.

Govt. 4. Political Parties (3)

The organization, functions, and techniques of political parties; pressure groups and pressure politics; nomination and election methods. 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. 51. American National Government (3)

Constitutional principles; organization and operation of the national government; the party system, citizenship, and civil rights. **Prerequisite:** Sophomore standing. First semester.

Govt. 52. 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. **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. 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. City Government (3)

The machinery and processes of city government in the United States; city-state and federal-city relations; the problems of metropolitan areas; the forms of city government, with special emphasis on the operation of the council-manager plan. First semester.

Mr. Schulz

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. Patterson

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. Patterson

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. Schulz

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. Schulz

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 head 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. At least twelve hours are to be selected from the following courses, viz., Govt. 451 and 452, American Political Institutions, Govt. 453 and 454, Public Law, Govt. 463 and 464, Political Theory, and Govt. 471 and 472, Foreign Governments. Appropriate courses in other fields, among them economics, history, philosophy, social psychology, and sociology, may be selected to meet the total of hours required for the master's degree.

Govt. 451. American Political Institutions (3)

The federal and state constitutions; congress and state legislatures; the presidency; state governors; the judicial system; political parties; nomination and election methods; local government; the council-manager plan. First semester.

Mr. Patterson

Govt. 452. American Political Institutions (3)

Continuation of Govt. 451. 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 state, its organization, and its functions. Authority, law, and liberty; the issue of state sovereignty; doctrines with respect to the legitimate objectives of government and the proper sphere of political authority. First semester.

Mr. Schulz

Govt. 464. Political Theory (3)

Continuation of Govt. 463. Second semester.

Mr. Schulz

Govt. 471. Foreign Governments (3)

The theory and development of constitutions, governments, and parties in Great Britain and the Commonwealth countries. First semester.

Mr. Barry

Govt. 472. Foreign Governments (3)

The nature and development of government systems in France, Italy, Germany, the U.S.S.R., and countries of Central Europe. 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

DIVISION OF SOCIAL RELATIONS

Associate Professor Williamson

Assistant Professor Schwartz

Mr. Baker

S.R. 1. 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. First 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. First and second semester.

S.R. 61. 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. First and second semester.

S.R. 63. Social Problems (3)

Social disorganization of contemporary society, including delinquency and crime, poverty and dependency, the handicapped, mental disorders, alcoholic and drug addiction, population problems, and community disorganization. First semester.

For Advanced Undergraduates and Graduates**S.R. 201. 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. 1 or consent of head of department.** First semester. Mr. Baker

S.R. 231. 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 head of department.** First semester. Mr. Schwartz

S.R. 232. Religion of Primitive Peoples (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 head of department.** Second semester. Mr. Schwartz

S.R. 235. Peasant and Tribal Cultures of India (3)

Analysis of Indian civilization as revealed in the archaeological record and in peasant and tribal communities. Emphasis upon characteristic institutions of Indian culture including caste, jajmani system, the extended family, and other selected topics. Hinduism in relation to the other aspects of culture. Discussion of major issues in contemporary research. **Prerequisite: S.R. 31 or consent of head of department.** First semester. Mr. Schwartz

S.R. 236. East Indian Culture Abroad (3)

Comparative analysis of peasant East Indian cultures in Trinidad, British Guiana, Surinam, Martinique, Mauritius, Africa, Fiji, Indonesia, Canada and the United States. Emphasis upon the problems involved in the transplantation of East Indian culture in each of these cultural environments; the degree to which East Indian culture has been perpetuated; and the stability of diagnostic institutions such as caste, the jajmani system, panchayat organization, and the extended family. Interpretation of the general theory of culture change. The theory of plural societies. **Prerequisite:** S.R. 31 or consent of head of department. Second semester. Mr. Schwartz

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. 1, 31, or 61. 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. 1 or consent of head of department. First semester. Mr. Baker

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. 1 or consent of head of department. Second semester. Mr. Baker

S.R. 331. History of Ethnological Theory (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. Schwartz

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. Schwartz

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. 365. 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 head of department. First or second semester.

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. 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 head 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. 61 or 63 or consent of head of department. Second semester.

S.R. 371. Special Topics in Social Relations (3)

An opportunity for advanced work through supervised reading and research. **Prerequisite:** Consent of head of department. First semester.

S.R. 372. Special Topics in Social Relations (3)

Continuation of S.R. 371. Second semester.

S.R. 394. The Individual Society and Culture (3)

This course will explore the interdisciplinary implications of the materials and methods of social psychology, sociology, and anthropology. **Prerequisite:** one course in Social Relations. Second semester
Staff

GREEK

See Classical Languages
See Classical Languages, page 186

HISTORY

Professors Harmon, Cowherd
Associate Professors Cary, Dowling, Kyte
Assistant Professors Haight, Fischman
Messrs. Kane, Fortin, Myers, Powell, Stenberg

Hist. 11. Development of Western Civilization (3)

The roots of Western Civilization; the evolution of economic, social, and political institutions; the impact of scientific and technological developments; the influence of major trends of thought. Required of all freshman engineering students. First semester.

Hist. 12. Development of Western Civilization (3)

The modern Western world; the rise of the nation-state; the occident and the orient; the rise and decay of the older imperialisms; the role of science and idealism in both peace and war in the twentieth century. Required of all freshman engineering students. 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)

The history of the rise and growth of English political and social institutions prior to 1603. First semester.

Hist. 16. English History (3)

The history of the development of English political and social institution from the death of Elizabeth to the present. Emphasis is placed upon the political intellectual legacy bequeathed to the modern world as a result of this development. Second semester.

Hist. 25. European History (3)

A rapid survey of some of the major historic forces 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. 29. Modern Europe (3)

The study of revolution and reaction in western Europe between 1789 and 1870.

Emphasis is laid upon the birth, growth, and spread of nineteenth-century liberal doctrines as well as upon the attempts made to stifle that growth by every political and diplomatic means available. Summer session.

Hist. 30. 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. Summer session.

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. Kyte, 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. Kyte, 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 cultural 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. Special emphasis will be placed on economic and political developments. Mr. Dowling

Hist. 323. American Constitutional History (3)

The major problems involved in the growth of the powers of the national government. Mr. Harmon

Hist. 324. American Constitutional History (3)

Continuation of Hist. 323. Summer session. Mr. Harmon

Hist. 327. Development of American Institutions (3)

The colonial origin and national expansion of social, cultural, religious, and economic institutions to 1865. Mr. Dowling

Hist. 328. Development of American Institutions (3)

Continuation of History 327. Developments from the Civil War to the present, with emphasis on industrialization, urbanization, the populist and progressive movements, and social changes as factors in institutional developments.

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. Harmon

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. Harmon

Hist. 333. A Pro-Seminar in United States and Pennsylvania History for Teachers (3)

This course is designed to meet the certification requirement for the Pennsylvania State Council of Education, that all teachers in the public schools should have a course in United States history in which particular emphasis is placed upon the history of Pennsylvania. The following topics will be stressed in the pro-seminar: American colonization; racial origins; the beginnings of agriculture, industry and commerce; the expansion of the frontiers; the movement for independence; constitution-framing; the party system of government; cultural tendencies and progress toward social betterment; the problem of states' versus national rights; the era of great industry. Summer session.

Mr. Harmon

Hist. 345. England, 1066-1603 (3)

The foundation and growth of English political, religious, and economic institutions from the Norman Conquest to 1603.

Mr. Cowherd

Hist. 347. The British Empire, 1603-1848 (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 since 1848 (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. 351. The Middle Ages (3)

Consideration will be given to political institutions, economic activity, and cultural and intellectual developments in Medieval Europe to the early Renaissance.

Hist. 352. The Renaissance and Reformation (3)

Within the political and economic framework of the era, study will be made of the culture of the Renaissance, and the religious conflicts resulting from the crisis in the sixteenth century Church.

Hist. 353. European History, 1648 to 1848 (3)

The conditions and forces that led from the absolutism of Louis XIV to the

Revolutions of 1848. Special attention will be placed upon the French Revolution and its impact upon Europe. Mr. Haight

Hist. 354. European History since 1848 (3)

Liberalism, socialism, and nationalism which produced the revolutions of the mid-nineteenth century and the mass conflicts of the twentieth century.

Mr. Haight

Hist. 355. The Intellectual Expansion of Modern Europe, 1300 to 1789 (3)

A study of the heritage bequeathed to modern Europe by the cultural achievements and traditions of the Renaissance and Reformation. Special attention will be paid to scientific and technological development and to the growth of political thought and theory during these centuries.

Mr. Haight

Hist. 356. The Intellectual Expansion of Modern Europe, 1789 to the Present (3)

A continuation of the preceding course from 1700 to the present, with special attention paid to the effect upon modern thought of the industrial revolution and the rapid advancement in technology.

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 head of department.

Mr. Fischman

Hist. 366. Modern Latin America (3)

Continuation of Hist. 365. **Prerequisite:** Hist. 49, 50, or consent of head of department.

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 best seem fit to meet the needs of students of unusual ability and adequate preparation. **Prerequisite:** Consent of head of department. First semester.

Hist. 372. Special Topics in History (3)

Continuation of Hist. 371. **Prerequisite:** Consent of head of department. Second semester.

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

Britain
Colonial America
United States

Secondary

Medieval-Renaissance
Modern Europe to 1815
Modern Europe since 1815
Latin-America

Hist. 401. Methods in Historical Research (3)

Techniques of research along the lines of historical method: 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 aims, methods, and accomplishments of some of the most renowned historians of Europe and America. Second semester. Mr. Kyte

Hist. 403. Modern Europe, 1789-1870 (3)

The French Revolution; Era of Metternich; Congress of Vienna and reconstruction of Europe; industrial revolution and subsequent social reforms; France and Germany; democracy and nationalism; Second French Empire; unification of Italy and Germany. First semester. Mr. Haight

Hist. 404. 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; thirst for power; 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.

Hist. 411. England under the Tudors (3)

An intensive study of political, institutional, and social history during the period 1485-1603. First semester.

Mr. Cowherd

Hist. 412. England under the Stuarts (3)

An intensive study of religious, political, institutional, and social history during the period 1603-1760. Second semester.

Mr. Cowherd

Hist. 413. Modern England—The Age of Reform, 1760-1870 (3)

A study of industrial England, liberal and humanitarian reforms, and the growth of colonial self-government. First semester.

Mr. Cowherd

Hist. 414. Modern England—The Age of Conflict, Since 1870 (3)

The growth of socialism, the rise of the Labor Party, the expansion of empire, formation of the Commonwealth, and the origins and consequences of two World Wars will be studied. 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.

Hist. 421. English Colonization in North America in the Seventeenth Century (3)

The activities of the overseas trading companies, proprietors, and royal governors, and the founding and development of the English colonies in the West Indies and along the shores of North America. First semester.

Messrs. Kyte, Cary

Hist. 422. America in the Eighteenth Century (3)

A continuation of Hist. 421, with emphasis upon 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. Second semester.

Messrs. Kyte, 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. Second semester.

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.

Hist. 428. The United States, 1877-1914

Research in selected topics related to late nineteenth-century industrialism, organized labor, agriculture and the West, American imperialism, Populism and Progressivism. First semester.

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.

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.
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.
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.

Hist. 482. Graduate Seminar (3)

A continuation of Hist. 481. Second semester.

HONORS SEMINARS

Honors Seminars are open to students admitted to the Interdepartmental Honors Program (see page 68), 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

Associate Professors Monro, Kane, Brennan, W. A. Smith, Loomba

Messrs. G. L. Smith, Noonan, Miss Moran, Messrs. Bradley,
Sachse, Burbridge, Widmer

I.E. 10. Problem Computation Laboratory (1)

Preparation of problems for computer programming with emphasis on industrial engineering problems; techniques of programming for computers. 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. Machine Shop Practice (3)

A course given for three weeks during the summer following the sophomore year in conjunction with the Bethlehem Vocational High School. The theory of metal removing and welding processes are covered in lecture with laboratory practice in the operation of various hand tools, machines, and welding equipment. 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. 233. 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, Met. 63.

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)

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. 4. 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.

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, linear programming. **Prerequisite:** Math. 231. Second semester.

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. Smith, Richardson

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 production 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. 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. 166. Mr. Brennan

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, Monro

For Graduates

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.

A major 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. 411, Input and Processing of Information; Psych. 412, Human Skills and Training. As part of a purposeful major program, collateral courses may be taken in other branches of engineering, mathematics, economics, and psychology.

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, an LGP-30 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.

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. Willner

I.E. 408. Industrial Information Systems (3)

Information processing for manufacturing control; analysis and design of integrated data processing systems; feasibility studies and cost evaluation. Lectures, tours, guest lecturers, student projects on computer. **Prerequisite: I.E. 308.**

Mr. Smith

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

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. 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. Willner

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 sub-functions, with emphasis on problem identification and definition; selection of techniques of analysis; procedures for evaluation of proposed solutions. Staff

INTERNATIONAL RELATIONS

Professor Joynt
Associate Professors Dunlap, Braddick
Assistant Professor Smolansky

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.

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.

I.R. 11. The Diplomacy of Europe 1815-1919 (3)

The development of alliances and other associations of nations, with resultant tensions and frictions; the causes of successive wars; the character of peace settlements; the formation of international institutions. First semester.

I.R. 12. The Diplomacy of Europe Since 1919 (3)

Continuation of I.R. 11. Second semester.

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.

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.

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.

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.

For Advanced Undergraduates and Graduates**I.R. 312. World Affairs Since 1919 (3)**

The peace treaties of 1919; ideals and realities of the League of Nations; efforts to effect disarmament; resurgence of power politics as displayed by the German-Italian-Japanese Axis; appeasement; frustration; the war of 1939-1945; post-war occupation of Axis countries; problems of reconciliation of conflicting objectives and interests among the victors.

Messrs. Joynt, 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.**

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.

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 head of department. Mr. Dunlap

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 head of department. Second semester. Mr. Joynt

I.R. 351. International Organization (3)

Constitutional and political character of successive agencies of international organization, with emphasis upon the League of Nations. First semester. Mr. Braddick

I.R. 352. International Organization (3)

Continuation of I.R. 351, with emphasis upon the United Nations. Second semester. Mr. Braddick

I.R. 361. International Law (3)

Consideration of the principles and rules generally recognized as binding upon the community of nations in time of peace; recognition of the existence and termination of states; nationality, and protection of persons; acquisition and loss of territory; control over territorial waters; piracy; asylum; state responsibility and international claims. Mr. Dunlap

I.R. 362. International Law (3)

Principles applicable to the conduct of hostilities in wartime; rules of war; treatment of prisoners; transfer of property; establishment and disposition of "war guilt"; recognition of governments instituted by force; problems of neutrality. Second semester. 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 head of department. First semester. Staff

I.R. 372. Readings in International Relations (3)

Continuation of I.R. 371. **Prerequisite:** Consent of head 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 head of department.

I.R. 382. Special Topics (3)

A continuation of I.R. 381. **Prerequisite:** Consent of head of department.

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. Mr. Joynt

I.R. 452. Seminar in International Organization (3)

Continuation of I.R. 451, with emphasis upon the United Nations. Second semester. Mr. Joynt

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.

Messrs. Dunlap, Braddick

I.R. 462. Seminar in International Law (3)

Continuation of I.R. 461. Second semester. Messrs. Dunlap, Braddick

I.R. 471. Special Topics (3)

Selected topics in the field of international politics not covered in other courses. **Prerequisite:** Consent of head of department. Messrs. Joynt, Smolansky, Braddick

I.R. 472. Special Topics (3)

Continuation of I.R. 471. **Prerequisite:** Consent of head of department. Second semester. Messrs. Joynt, Smolansky, Braddick

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MATHEMATICS

Professors Pitcher, Raynor, Shook, Wilansky, Hsiung, Hailperin
Associate Professors Cutler, Latshaw, Beale, Van Arnam, Ghosh
Assistant Professors Khabbaz, Stengle, King, Wong, Lappan
Petrich, Rajagopalan, Ruckle, Schechter

Merrs. Gulden, Rayna, Mrs. Gravez, Messrs. Sloyer, Liaison
Messrs. Rhodes, Shahin, Pollak, Cozzolino, Fleischman, Snyder, Beamer,
Beidler, Bonner, Ferrentino, Goff, Hazzard, Kern, Leroy, McMillan,
Mugridge, Oexmann, Weston, Badger, Chase, Cheung, Hartmann, Kirch,
Klingman, Leonard, McNelis, Naeem, Powell, Zafarullah

MATHEMATICS

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. 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)

Multiple integrals; partial derivatives; line and surface integrals; approximations; Taylor's Theorem; series; differential equations. **Prerequisite:** Math. 22. First and second semesters.

Math. 51. Advanced Algebra (3)

Number systems; properties of integers; theory of polynomial functions and equations; determinants and systems of linear equations; elimination theory. **Prerequisite:** Math. 21 or consent of head of department. First semester.

Math. 54. Advanced Geometry (3)

An introductory course in projective geometry and non-euclidean geometry. **Prerequisite:** Math. 22 or consent of head of department. Second semester.

Math. 102. Finite Differences (3)

Definition of differences of various orders; the operators Δ and E ; interpolation formulas for both equal and unequal intervals; central difference interpolation formulas; inverse interpolation; finite summation; differences of zero; relations between the operator Δ and D ; differences of a product; finite summation by parts; some modern extensions and special devices for interpolation and summation; numerous examples illustrating the use of the theory. **Prerequisite:** Math. 23. First or second semester. Mr. Beale

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. 123. Probability (3)

A course designed primarily for students majoring in actuarial science. **Prerequisite:** Math. 23. First semester. Mr. Beale

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 head 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. 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 and convergence. Continuation of Math. 219. Functions of several variables; line and surface integrals; implicit functions; Fourier series. **Prerequisite:** Math. 219. First and second semesters.

Messrs. Laison, Lappan, Wilansky

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. Messrs. Laison, Lappan, Wilansky

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 semester.

Mr. Latshaw

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.

Messrs. Ghosh, Pollak

Math. 233. Mathematical Statistics I (3)

Probability, Bayes Theorem; probability distributions, moments, Chebyshev's inequality, characteristic functions, central limit theorem; distributions in n -dimensions, multivariate normal distribution; sampling distributions, central and non-central chi-square, t and F , order statistics. **Prerequisite:** Math. 23 or nine semester-hours of calculus. Second semester. Staff

Math. 234. Mathematical Statistics II (3)

Testing of hypotheses, power function, Neyman-Pearson lemma, likelihood ratio principle, regression, least square principle, Gauss-Markov Theorem; theory of estimation, consistency, unbiasedness, sufficiency, efficiency Cramer-Rao inequality, confidence intervals; non-parametric methods, Kolmogorov-Smirnov test, Wilcoxon-Mann-Whitney test, contingency tables and chi-square; analysis of variance. **Prerequisite:** Math. 233. First semester. Messrs. Ghosh, Sloyer

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. First and second semesters. Messrs. Shahin, Wong

Math. 303. Mathematical Logic (3)

An introductory course in symbolic logic on a mathematically mature level, designed to emphasize the principles of reasoning used in mathematics and to acquaint the student with symbolic logic as a mathematical theory. Some applications of propositional logic to switching circuit analysis and design are discussed. First or second semester. Messrs. Hailperin, Rayna

Math. 304. Axiomatic Set Theory (3)

A development of set theory from the Zermelo postulates; relations and functions; finite cardinal and ordinal arithmetic; rational and real numbers; transfinite arithmetic; axiom of choice. **Prerequisite:** Math. 219. First semester.

Messrs. Hailperin, Rayna

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, Wilansky

Math. 308. Algebraic Topology I (3)

Fundamental groups; simplicial complexes and simplicial homology theory; fixed-point theorems; products; introduction to general homology theories. **Prerequisite:** Math. 307. Second semester.

Messrs. Gulden, Pitcher, Sloyer

Math. 309. Theory of Probability (3)

Discrete and continuous sample spaces; random variables; conditional probability and statistical independence; binomial, Poisson and normal distributions; limit theorems; random walk problems; Markov chains; time-dependent stochastic processes. The theory will be applied to problems in statistics, physics, and biology. **Prerequisite:** Math. 23 or nine semester-hours of differential and integral calculus. First or second semester.

Messrs. Ghosh, Latshaw

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 semester.

Messrs. Hsiung, King, Lappan, Raynor

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. Stengle, Wong

Math. 322. Differential Equations and Harmonic Analysis (3)

Partial differential equations; Fourier series, cylindrical and spherical harmonics. **Prerequisite:** Math. 221 or consent of the head of the department. Second semester.

Messrs. Cutler, Shook, Stengle

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.

Mr. Schechter

Math. 340. Higher Algebra (3)

Theory of matrices and linear transformations; linear spaces; bilinear and quadratic forms. **Prerequisite:** Consent of the head of department. First semester.

Messrs. Rayna, Raynor, Ruckle

Math. 341. Higher Algebra (3)

Some basic concepts of higher algebra, groups, rings, fields, lattices; algebra of classes; Boolean algebra. **Prerequisite:** Math. 340. Second semester.

Messrs. Khabbaz, Petrich, Rayna

Math. 350. Special Topics (3)

A course covering special topics not sufficiently covered in the general courses. **Prerequisite:** Consent of the head of department. First or second semester. May be repeated for credit. Staff

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. May be repeated for credit. **Prerequisite:** Consent of the head of the department. First or second semester

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 I (3)

Fundamentals of algebra, axiomatic method, set theory, notions of group, ring, integral domain, and field. **Prerequisite:** Same as Math. 381.

Math. 383. Algebra II (3)

Vector spaces over a field, bases, dimension, linear equations, and determinants. **Prerequisite:** Math. 382.

Math. 384. Number Theory (3)

Divisibility, congruences, quadratic residues, primitive roots, diophantine equation. **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 have included at least 36 semester hours of mathematics, of which at least 12 hours required the elementary calculus sequence as prerequisite.

The 30 semester hours required for the M.S. degree must include (with the exceptions noted below) the following courses: four of the five courses

Math. 307, 315, 322, 340, 341; also, Math. 401, 423, 443, and a thesis. 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 freedom of election of courses within the required 30 semester hours.

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, geometry, mathematical logic, 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, differentiability, integrability. **Prerequisite:** Math. 307. Second semester.

Messrs. Pitcher, Rajagopalan, Wilansky

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. Pitcher, Rajagopalan, Wilansky

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. Shook, Stengle, Wong

Math. 406. Partial Differential Equations (3)

Continuation of Math. 405. **Prerequisite:** Math. 405. Second semester.

Messrs. Shook, Stengle, Wong

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, Wong

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 head 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 head 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. Messrs. King, Lappan

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. Messrs. Ghosh, Pollak

Math. 423. Differential Geometry (3)

The differential geometry of curves and surfaces in Euclidean space, including problems in the large. First semester. Messrs. Cutler, Hsiung

Math. 424. Differential Geometry (3)

Continuation of Math. 423. Riemannian geometry and geometry of differentiable manifolds. **Prerequisite:** Math. 423. Second semester. Messrs. Cutler, 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. Messrs. Gulden, Ruckle, Wilansky

Math. 444. Algebraic Topology II (3)

A continuation of Math. 308, with such topics as general homology theories, axioms for homology and cohomology, homotopy groups, homological manifolds, fibre spaces. **Prerequisite:** Math. 308. First semester. Messrs. Gulden, Pitcher

Math. 449. Topics in Algebra I (3)

The development of a topic in algebra such as the structure of rings including the theory of rings with minimum conditions, the structure of algebras, linear and multilinear algebra, group theory, homological algebra, Galois theory, valuation theory, lattice theory. **Prerequisite:** Math. 340 and 341. First semester.

Messrs. Khabbaz, Petrich, Rayna

Math. 450. Topics in Algebra II (3)

Continuation of Math. 449, either with emphasis on recent developments or through the development of another topic. **Prerequisite:** Math. 449 or consent of head of department. Second semester.

Messrs. Khabbaz, Petrich

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, Lappan

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

MECHANICAL ENGINEERING

Professor Long, Erdogan

Associate Professors Benner, Eppes, Jackson, Owczarek

Assistant Professors Progelhof, Terry

Messrs. Lucas, Morgan, Nevis, Roberts

M.E. 10. Analysis of Engineering Problems (1)

Elementary analyses of problems in the field of mechanical engineering. Methods and techniques of solution. Use of digital computers. **Prerequisite:** Consent of head 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. Machine 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. Machine Design II (3)

Continuation of M.E. 101. **Prerequisite:** M.E. 101.

M.E. 103. Machine 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. 208.*

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. 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

**This prerequisite applies to class entering Fall 1962, and subsequent classes.*

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 head 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.

Messrs. Owczarek, Progelhof

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. Progelhof

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. 340. Advanced Machine 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, Long

M.E. 342. Elementary Mechanical Vibration Analysis (3)

Analysis of physical systems and setting up equations: development of significant engineering relationships. Emphasis on engineering application. **Prerequisites:** Math. 221*; Math. 208*. Second semester. Mr. Erdogan

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

**This prerequisite applies to class entering Fall 1962, and subsequent classes.*

For Graduates

For the master's degree a thesis will normally 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. 403. Advanced Mechanical Engineering Laboratory (3)

The planning, design, execution and reporting of experimental tests and investigations in mechanical engineering. **Prerequisite: Adequate preparation in thermodynamics and laboratory courses.** Staff

M.E. 404. Advanced Mechanical Engineering Laboratory (3)

Continuation of M.E. 403.

Staff

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. Eppes, Owczarek, Progelhof

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. Mr. Owczarek

M.E. 434. Internal Combustion Engines (3)

History; laws of mixing, carburetion, atomization, combustion, and chemical equilibrium; heat losses; friction losses; governing; gas engine cycles; engine types. Messrs. Eppes, Jackson

M.E. 436. Jet Propulsion (3)

Study of jet propulsion engines. Theory, design, operation and performance analysis of rockets, ramjets, and gas turbines. Application to industrial installations, aircraft propulsion, and space flight. Messrs. Eppes, Jackson

M.E. 437. Fluid Machinery (3)

Generalized treatment of various types of fluid handling machinery from the principles of thermodynamics and fluid mechanics. Fans, blowers, compressors, pumps, turbines, ejectors. Compressible and incompressible fluids. Design problems.

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.

Mr. Owczarek

M.E. 440. Dynamics of Machinery (3)

Analysis of dynamic loads and the resulting stresses in machinery. Balancing of rotors. Force analysis of internal combustion engines. Dynamics of control mechanisms.

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, Erdogan, 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. 450. Special Topics in Mechanical Engineering (3)

An intensive study of some field of mechanical engineering not covered in more general courses.

Staff

M.E. 451. Seminar in Mechanical Engineering (1-3)

Critical discussion of recent advances in mechanical engineering.

Staff

MECHANICS

Professor Beer

Associate Professors de Neufville, Osborn, Paris, Sih

Assistant Professors Sarubbi, Taylor, Warnock

Messrs. Karna, Lennox, Pagano, Perna, Setzer

Hartranft, Kassir, Naik, Perlman, Rice

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 structures; internal forces in beams; friction; moments and products of inertia; method of virtual work. **Prerequisites:** Math. 22 and Phys. 1. First semester.

Mech. 10. Problem Computation Laboratory (1)

Techniques of programming for computers; preparation of problems in mechanics for computer programming. **Prerequisite:** Mech. 1. Second semester.

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. Second semester.

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.

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. Staff

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. **Prerequisites:** Mech. 11; Math. 206 or 221, previously or concurrently. First semester.

Messrs. Osborn, Sih

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)

Fundamentals of fluid dynamics; their application to two- and three-dimensional potential flow problems with fixed and with moving boundaries. Vortex tubes and vortex sheets. Use of complex variables in two-dimensional problems, including conformal mapping, Schwarz-Christoffel transformation and Kirchhoff's free streamlines. **Prerequisites:** C.E. 121; Math. 206, or Math. 204 and 221; Math. 208 or 315, previously or concurrently. First semester.

Messrs. de Neufville, Warnock

Mech. 304. Mechanics of Continua II (3)

Fundamental principles of the mechanics of deformable bodies. General homogeneous deformation; stress and strain tensors; compatibility equations; conservation laws; strain-energy functions. Principle of invariance and material symmetry. Application of complex variable methods to plane extension, plate bending and torsion problems. **Prerequisite:** Mech. 301; Mech. 303. Second semester. Mr. Sih

Mech. 305. System Dynamics (3)

Application of Lagrange equations to the dynamics of linear systems; total energy, Rayleigh's principle, dissipation function, structural damping. Use of convolution integrals and Laplace transforms in the study of transient response. Non-linear discrete systems; introduction to the response of systems to random inputs. **Prerequisites:** Mech. 302; Math. 204, 208 and 221. First semester.

Messrs. Beer, Osborn, Paris

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. Paris, 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. 303. Second semester.

Mr. de Neufville

Mech. 350. Special Topics (3)

A study of some field of Engineering Mechanics not covered in the general courses. **Prerequisite:** Consent of head 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; non-holonomic systems; principle of least constraint; Hamilton's canonical equations; principle of least action; general methods of integration of the dynamical equations; integral invariants; Poisson brackets. **Prerequisite:** Mech. 302 or consent of head of department. First semester. Mr. Beer

Mech. 404. Advanced Vibrations Analysis (3)

A study of the theory of vibrating systems and of the applications of this theory to mechanical and structural design. **Prerequisite:** Math. 206 or 221. Second semester. Mr. Osborn

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 head of department. Second semester. Mr. Beer

Mech. 411. Theory of Elasticity (3)

Theory of stress and strain; generalized Hooke's Law; equations of equilibrium and compatibility; strain-energy function; applications to bending and torsion. **Prerequisites:** Mech. 301; Math. 206 or 221. First semester. Mr. Taylor

Mech. 412. Theory of Elasticity and Plasticity (3)

Continuation of Mech. 411, with an introduction to the theory of plasticity. **Prerequisite:** Mech. 411. Second semester. Mr. Taylor

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; complex variable methods of stress analysis of cracks for extension and bending of plates, for torsion and flexure of bars, and for thermal stress problems; visco-elastic, anisotropic, and non-homogenous effects. **Prerequisites:** Mech. 301, Math. 208 or 315; or consent of head of department. Messrs. Paris, Sih

Mech. 415. Structural Mechanics and Elastic Stability (3)

Elastic behavior of structures and their components; problems in stability, torsion, and bending; numerical and finite difference procedures. **Prerequisites:** Math. 206 or 221. First semester. Messrs. Galambos, Osborn

Mech. 416. Theory of Plates and Shells (3)

Analysis and design; applications to both reinforced concrete and steel construction. Desirable preparation: Math. 221. Second semester. Mr. Ostapenko

Mech. 421. Hydrodynamics (3)

Mathematical theory of fluids; potential; two-and three-dimensional flow problems. **Prerequisite:** Mech. 303. Second semester. Messrs. Beer, de Neufville

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 head of department. Second semester.

Messrs. Owczarek, Taylor

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

METALLURGICAL ENGINEERING

Professors Libsch, Conard, Stout

Associate Professor Kraft

Assistant Professors Tarby, Wood, Pense, Hahn, Krauss

Lecturers Caffrey, Jaccodine

Messrs. Albright, DePaul, Moll, Thompson, Torok, Levy, Vlad

Met. 10. Metallurgy Laboratory (2)

Elementary analysis of metallurgical problems in programming for 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:** Chem. 5 or 16; Phys. 16 or 1. First and second semesters.

Met. 67. Metallurgical Laboratory (2)

Laboratory study of the structure, properties, and processing of metals and alloys. Microscopic examination, temperature measurement, hardness testing, equilibrium diagrams, cold deformation and annealing, age hardening, casting, heat treatment of steel, hardenability, effect of heat treatment on tensile properties and notch toughness of steel. Lecture and laboratory. **Prerequisites:** Met. 63; Phys. 3. First and second semesters.

Met. 91. Elements of Materials Science (3)

Introductory study of the relationship between structure (on the electronic, 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. **Pre-**

requisites: Chem. 5 or 16 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 metallurgical engineering 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: Senior standing.** First semester.

Met. 105. 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. A three-day inspection trip is required. **Prerequisite: Ch.E. 60.** First semester.

Met. 106. Extractive Metallurgy II (3)

Continuation of Met. 105. Refining primary metals and scrap. Instrumentation and control of processes, flow sheets, and program analysis. Lectures and laboratory, plant trips. **Prerequisite: Met. 105.** Second semester.

Met. 191. Experimental Metallurgy (3)

Application of research techniques to a project in metallurgy selected in consultation with the head of the department. **Prerequisite: Met. 340.** Second semester.

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. Approved 1964-65 and 1965-66; experimental.

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.** Mr. Libsch

Met. 278. Metallurgical Reports (3)

An opportunity for the advanced student to develop the ability to find and collate available published information on a metallurgical subject in order to present oral reports and a comprehensive written survey. **Prerequisite: Senior standing.**

Met. 310. 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. 106, 231, Chem. 195.** First semester.

Mr. Tarby

Met. 318. Theoretical Physical Metallurgy (3)

Atomic structure. Theories of alloying and transformation. Dislocations. **Prerequisites:** Met. 231 or equivalent. First semester. Mr. Conard

Met. 323. Mechanical Metallurgy (3)

Deformation and fracture of metals. Theoretical considerations and their application to service and processing. Lectures and laboratory exercises. **Prerequisites:** Mech. 11; Met. 231; M.E. 166 and Met. 352 previously or concurrently. First semester.

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 November 1 of the previous semester. Second semester. Mr. Tarby

Met. 334. Electron Microscopy (3)

Study of theory and application of electron diffraction and microscopy; methods for investigation of the structure of 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 head 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 head of department.

Met. 340. Research Techniques (2-3)

Study, analysis, and application of experimental techniques in metallurgical research. Analysis of experimental data and methods of presentation. Design of experimental programs. Recitations and laboratory. First semester.

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 judgment of engineering problems involving metallurgy. Lectures, problems. **Prerequisite:** Met. 352 or consent of head of department. Second semester. Mr. Libsch

For Graduates

The foundation for successful graduate work in Metallurgy 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.

Programs of graduate study may lead to the Master of Science or Doctor of Philosophy 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 155).

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 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 included in recent doctoral research include: kinetics of solid state transformations, design of magnetic and thermoelectric alloys, mechanisms of deformation and recrystallization, equilibrium diagram investigations, correlation of structure with properties, controlled solidification, and properties of high temperature materials.

Chem. 334 and Phys. 363 may be included in a graduate major in Metallurgy at the appropriate level.

A number of research fellowships and assistantships are available to aid students of outstanding promise in research, either through the Department or through the Materials Research Center.

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 aero-

space technologies. This course may be repeated for credit beyond three hours with permission of the instructor. **Prerequisites:** Met. 231 and Met. 310 or consent of head 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 head of department. Mr. Kraft

Met. 407. Theory of Alloy Phases (3)

Consideration of the application of the principles of thermodynamics and physical metallurgy to the explanation of structure, physical properties and the 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, Chem. 195. 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 head of department. Staff

Met. 410. The Physical Chemistry of Metals I (3)

The principal fields of physical chemistry in their relation to metallurgical processes. Thermodynamics and kinetic aspects of extraction, alloying and surface reactions. **Prerequisites:** Undergraduate course in physical chemistry; Met. 106 and 231. Messrs. Hahn and 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. 318 or Physics 363; Chem. 195; or Consent of head of department. Messrs. Conard and Kraft

Met. 413. Advanced Mechanical Metallurgy (3)

Mechanical behavior of metals and alloys from theoretical and experimental viewpoints. **Prerequisites:** Met. 231, 323.

Met. 414. The Physical Chemistry of Metals II (3)

Continuation of Met. 410. **Prerequisite:** Met. 410. Messrs. Hahn and 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. **Prerequisites:** Met. 230 and 231. Mr. Conard

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, especially for automotive, airplane, and special machinery parts. **Prerequisites:** Met. 231, 352.

Met. 421. Surface Treatment of Metals (3)

Study of metallic surfaces, primarily steel; 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:** Chem. 334. 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 head of department. Mr. Libsch

MUSIC

Professor R. B. Cutler
Associate Professor 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 head 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 head 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. 21. Symphony (3)

A study of the style and structure of major orchestral works from the mid-eighteenth century to the present. **Prerequisite:** Mus. 20, or consent of head of department.

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:** Mus. 20, or consent of head of department.

Mus. 23. Chamber Music (3)

A survey of works for smaller instrumental ensembles from the forerunners of Haydn to Stravinsky. **Prerequisite:** Mus. 20, or consent of head 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:** Mus. 20, or consent of head of department.

Mus. 27. Opera (3)

A critical study of representative works of the musical theater emphasizing the contributions of music to a total dramatic effect. **Prerequisite:** Mus. 20, or consent of head 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 head of department.

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 an instrument or uniform.

Students serving in the band receive the following awards: a charm for one year of satisfactory service; for two years of service, a sweater; 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 or sectional rehearsals.

Members will purchase their own blazers and trousers which are worn for all performances.

PHILOSOPHY

Associate Professors Haynes, Hillman

Assistant Professor McCue

Mr. Melchert

The Department of Philosophy offers advanced work in the area of systematics, with particular emphasis on mathematical logic, scientific methodology, epistemology, philosophy of science and philosophical analysis. This program leads to the M.A. degree, and constitutes a firm foundation for the projected course of studies leading to the Ph.D. degree.

Candidates 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 the general field of systematics. Each candidate will select the plan better suited to his needs and abilities with the advice and approval of the head of the department.

Adequate preparation for graduate study in the departmental program should include undergraduate courses in symbolic logic, philosophy of

science, philosophy of language and methodology. Alternatively, students with a sound background in a systematic discipline may also be admitted to the graduate program.

The Department of Philosophy has strong research interests in mathematical logic, philosophy of science, logico-mathematical theories of information storage and retrieval, system-construction and model theory. Opportunities exist for well-qualified graduate students to participate in sponsored research programs in these areas, and familiarity with computer programming will be an asset to any student so interested.

The Department of Philosophy is closely linked to the Center for the Information Sciences with respect both to research activities and to formal course offerings. A training in systematics thus qualifies a student not only for further advanced work culminating in the Ph.D. degree but also for careers in research and industry.

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. 231. 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.

Mr. McCue

Phil. 233. Medieval Philosophy (3)

A history of philosophy from Augustine to the Renaissance, with particular attention to the philosophical work of Augustine, Averroes, Aquinas, Roger Bacon, Duns Scotus, William of Occam, and Nicholas of Cusa. Consideration will be given to the bearing of the ideas of these thinkers on the central issues of medieval philosophical theology — God, the universe, will, and knowledge. Second semester. (Offered as required.)

Mr. McCue

Phil. 235. 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.

Mr. McCue

Phil. 237. 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. 239. 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. 241. The Evolution of Scientific Ideas (3)

A study of certain major developments in the history of the natural sciences. Among the topics studied: ancient cosmology and astronomy, the Copernican revolution, the development of classical mechanics and its introduction into astronomy, the development of chemistry from alchemy and technology, the introduction of evolutionary ideas in biology. Attention will be given to the ways in which the sciences originate and develop, to the changing conception of the nature of scientific explanation, and to some of the broader cultural effects of the developing sciences. First and second semesters. Mr. McCue

Phil. 244. Foundations of Information Theory (3)

A study of issues crucial to the development of communications and information theory. Topics will include: theory of signs, logical syntax of language, recent developments in mathematico-linguistic techniques, mechanical translation, information retrieval. First or second semester. (Offered as required.) Mr. Hillman

Phil. 254. Advanced Logic (3)

Theory of formal languages; critique of mathematical reasoning and the foundations of mathematics; theory of aggregates and transfinite numbers; Logistic, Formalism and Intuitionism; alternative logics; completeness and consistency; applications to the theory of digital computers and artificial intelligence. **Prerequisite:** Phil. 14 or consent of head of department. First or second semester. Mr. Hillman

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. Mr. Hillman

Phil. 263. Special Topics in the Philosophy of Science (3)

A critical study of selected philosophical problems posed by research into the foundations either of mathematics and mechanics, or of life and social science. First or second semester. (Offered as required.) Staff

Phil. 264. Philosophy of Language (3)

A study of current methods in logic and their applications to the problems of philosophical analysis. Topics to be treated include: the semantic conceptions of truth and meaning; logical truth and necessity; the empiricist criterion of significance; ontological commitments; the problems of reference; counterfactuals. **Prerequisite:** Phil. 14 or consent of head of department. First or second semester. Mr. Hillman

Phil. 271. Readings in Philosophy (2 or 3)

A course of readings in any of the various fields of philosophy; designed for the student who has a special interest in work not covered by the regularly rostered courses. **Prerequisite:** Consent of head of department. First semester. Staff

Phil. 272. Readings in Philosophy (2 or 3)

Continuation of Phil. 271. **Prerequisite:** Consent of head of the department.
Second semester. Staff

Phil. 281. 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. 393. Logico-Mathematical Theories (3)

The function of theories in the systematization, explanation and prediction of empirical phenomena; techniques of theory-construction; logical and mathematical characteristics of specimen theories; strategies of empirical verification. Particular attention to the problems of theory construction for systems of information storage and retrieval. Computer applications to be discussed. First semester.

Mr. Hillman

Phil. 439. Epistemology (3)

Selected topics in the theory of knowledge; perception, the empirical foundations of knowledge, the *a priori*, truth, skepticism and the status of concepts, propositions, universals, reference and meaning; positivism, phenomenalism, realism and phenomenology. First semester.

Mr. Melchert

Phil. 441. Early Logic and Methodology (3)

A study of the formalization of logic by Aristotle and the Stoics, and of the scientific methodology developed on the basis of this logic. Special attention will be given to the following topics: the influence of Aristotle's metaphysics upon his formal logic and upon his view of the structure and method of science; the problem of induction in Aristotelian science; the meaning and role of causality in Aristotelian scientific explanation. First semester.

Mr. McCue

Phil. 454. Metamathematics (3)

A study of problems concerning the foundations of mathematics. Topics to be treated include: the arithmetization of analysis, the programs of Russell, Whitehead, Hilbert and Brouwer, Gödel incompleteness theorems, the concept of truth in formalized languages, primitive, partial and general recursive functions, decision problems and procedures. Second semester.

Mr. Hillman

Phil. 464. Semantics (3)

A critical study of philosophical method and practice. Topics to be treated include: Russell, Wittgenstein and logical atomism, logical positivism, the rejection of metaphysics, reductive analysis, linguistic and therapeutic analysis, contemporary movements. Second semester.

Staff

Phil. 471. Graduate Thesis (3)

First semester

Phil. 472. Graduate Thesis (3)

Second semester.

Phil. 490. Special Topics (3)

An intensive study of selected topics not covered in more general courses. Second semester.

Staff

DIVISION OF THE INFORMATION SCIENCES

Associate Professor Robert S. 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-discipline 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.

The minimum program for the Master of Science in the Information Sciences consists of twenty-four hours of approved course work and completion of a satisfactory thesis. A group of three courses and the thesis constitute the Core Program (15 hours). Beyond this basic group of courses, for the additional 15 hours, student schedules are planned on an individual basis to fit previous academic experience and career goals. Three options are open for specialization, dependent on background, ability, and interests:

- | | |
|---------------------|--|
| Systems | — the integration of machine and human capabilities and techniques. |
| Behavioral | — the study of the environment (social and psychological) of technical and scientific communication. |
| Logico-Mathematical | — theoretical and systematic consideration of information systems and processes. |

Core Program, required of all graduate students.

- I.S. 311. General Linguistics. (3)
- I.S. 412. Syntactic Concepts. (3)
- I.S. 421. Analysis of Information. (3)
- I.S. 481. Thesis. (3)
- I.S. 482. Thesis. (3)

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. 202. The Information Sciences (3)

Introduction to the study of the properties, behavior, and flow of information. Topics will include: environmental aspects of information systems and com-

munication; the organization of information; language analysis; man-system relationships. Not available for graduate credit in the Information Sciences. Second semester.

I.S. 311. General Linguistics. (3)

Introduction to the study of language at various levels: morpheme, word, phrase, clause, sentence, with special attention to problems of the information sciences. First semester.

I.S. 412. Syntactic Concepts (3)

Application of various approaches in structural linguistics to the information sciences: transformations, kernels, predictive syntactic analysis. Elements of language data processing. **Prerequisite:** I.S. 311.

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)

PHYSICS

Professors Emrich, Curtis, Havas, McLennan

Associate Professors Sawyer, Spatz, Wheeler, Grismore. W. R. Smith,
Van Sciver, Folk

Assistant Professors Holland, Fouchaux, Radin

Messrs. Ammirati, Anderson, Baum, Beck, Dufty, Feye, Gilbert, Goldberg, Grant,
Herb, Herman, Hoffman, Kunz, Lampson, Morrill, Nee, Rea, Roeder, Shea,
Van Dyke

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. Lecture demonstrations and recitations. **Prerequisite:** Phys. 1. Second semester.

Phys. 17. General Physics Laboratory (2)

A laboratory course in general physics to accompany Phys. 16. **Prerequisite:** Phys. 16, preferably concurrently. Second semester.

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. W. R. Smith

Phys. 90. Electrical Phenomena (1)

Laboratory studies of elementary electric and magnetic effects. Elementary laboratory techniques. **Prerequisite:** Phys. 4, preferably concurrently. Second semester. Mr. Wheeler

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. Holland

Phys. 191. Laboratory Techniques (2)

Thermometric, calorimetric and vacuum techniques. Advanced electrical measurements. **Prerequisite:** Phys. 4 or 17. First semester. Messrs. Holland, Wheeler.

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. Messrs. Fouchaux, Grismore. Holland

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. W. R. Smith

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. Havas

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 head of department. Second semester. Messrs. Curtis, Van Sciver

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, Holland

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 head of department. Second semester.

Mr. Havas

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. (Will be offered in second semester only 1964-65).

Mr. Grismore

Phys. 340. Heat, Thermodynamics and Pyrometry (4)

Basic principles of heat, thermodynamics and kinetic theory of gases with emphasis on physical systems, supplemented by practical exercises in the use of thermocouples, resistance thermometers, pyrometers, and similar instruments. One laboratory and three class periods a week. First semester.

Messrs. Radin, Holland

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 head of department. Second semester.

Messrs. Curtis, Holland, 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.

Messrs. Folk, 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. First semester.

Mr. McLennan

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 mathe-

matics 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. The program will vary considerably in order to meet the particular needs and interests of individual students. 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. Van Sciver

Phys. 422. Advanced Theoretical Physics (3)

Continuation of Phys. 420 and 421. **Prerequisite:** Phys. 421 or equivalent. First semester.

Mr. Folk

Phys. 423. Advanced Theoretical Physics (3)

Continuation of Phys. 422. **Prerequisite:** Phys. 422. Second semester

Mr. Havas

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.

Mr. McLennan

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, 1963-64.)

Mr. McLennan

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. 434. Solids and Radiation (3)

Phenomena in solids resulting from interaction with electromagnetic radiation or charged particles. Current theories of energy absorption, transport, and emis-

sion. **Prerequisite:** Phys. 363 or equivalent. First semester, alternate years. (Not offered 1964-65).
Mr. Van Sciver

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.
Messrs. McLennan, Radin

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 1963-64).
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 1964-65.)
Mr. Folk

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.
Messrs. Curtis, Van Sciver

Phys. 475. Seminar in Modern Physics (3)

Discussion of important advances in theoretical physics. First or second semester.
Mr. Havas

Phys. 481. 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. 482. Basic Physics II (3)

Continuation of Phys. 481. Summer session.

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

PSYCHOLOGY

Research Professor Brozek
Associate Professors Brody, Craig, Millon, Wuest
Lecturers Fiedler, Orr, Shettel
Messrs. Morganstein, Taub, Trexler

Psych. 1. Introduction to Psychology (3)

Principles of psychology as a science of behavior. Techniques of investigation. Special fields and practical applications of psychology to individuals and groups. A foundation course for students taking further work in psychology when supplemented by Psych. 2. Three hours of lectures. First and second semesters.

Psych. 2. Introductory Psychology Laboratory (1)

Laboratory work supplementing Psych. 1. One 3-hour session per week. **Prerequisite:** Psych. 1, previously or concurrently. First and second semesters.

Psych. 20. Statistical Analysis and Experimentation (4)

An integrated presentation of the basic methods of collecting and evaluating experimental data in psychology. The laboratory part of the course provides an opportunity for supervised statistical computations and for the planning and execution of experiments. Three hours of lectures and one 3-hour laboratory per week. **Prerequisites:** Psych. 1 and 2. First and second semesters.

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 and 2. 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. **Prerequisites:** Psych. 1 and 2. Second semester. Offered in 1964-65 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 and 2. (Offered as required.)

Psych. 104. Independent Study (1-3)

Readings on topics selected in consultation with a staff member. Research on assigned problems. Supervised field studies. **Prerequisites:** Psych. 1 and 2, and consent of head of department. May be repeated for credit. First and second semesters.

Psych. 105. Personality (3)

Theories and empirical data concerning the development, mechanisms and structure of personality and its deviations. **Prerequisite:** Psych. 1. First semester. Offered in 1964-65 and alternate years.

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 en-

vironment, 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 1964-65 and alternate years.

Psych. 308. 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. (Offered as required.)

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 2, and 20. 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, 2, and 20. 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 and 2. 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, 2, and 20. First semester. Offered in 1965-66 and alternate years.

Psych. 398. 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.

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 three areas: The behavioral option of the new 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; and lastly, in engineering

psychology students may develop an appreciation of engineering problems by taking courses in Electrical and Industrial Engineering. 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. 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.

Financial aid is regularly available in the form of teaching and research assistantships and graduate fellowships. All doctoral candidates are encouraged to serve at least two semesters as teaching assistants.

Psych. 418. Individual Testing (3)

A basic practicum course illustrating the contributions of psychometric and projective tests in the assessment of intelligence and personality. Offered as required in Psych. 450, 451, 452.

Psych. 424. Quantitative Methods (3)

Curve fitting and goodness of fit, linear and non-linear correlation and regression, trend analysis and analysis of covariance. Second semester. Offered in 1964-65 and alternate years.

Mr. Brody

Psych. 425. Design and Analysis of Experiments (3)

Analysis of variance applied to a variety of experimental designs. First semester.

Mr. Brody

Psych. 426. Research Techniques and Tactics (3)

Planning of experiments under both laboratory and industrial conditions. Appraisal of research ideas, methodology, and instrumentation. First semester.

Mr. Craig

Psych. 428. Thesis (3)

Original investigation for the master's thesis.

Psych. 429. Thesis (3)

Continuation of Psych. 428.

Psych. 432. Perception (3)

Evaluation of contemporary research and theories of human perception. Second semester. Offered in 1965-66 and alternate years. Mr. Craig

Psych. 433. Conditioning and Learning (3)

Coverage of a variety of empirically investigated topics in learning. First semester. Offered in 1965-66 and alternate years. Mr. Brody

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 1964-65 and alternate years. Mr. Millon

Psych. 435. Social Psychology (3)

Evaluation of contemporary research and theories of group behavior. First semester. Offered in 1964-65 and alternate years. Mr. Baker

Psych. 436. Physiological Psychology (3)

The study of the anatomical, physiological and biochemical bases of behavior. Second semester. Offered in 1964-65 and alternate years.

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 1964-65 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 1965-66 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. 452. Psychophysiology of Stress (3)

Both the behavioral impact of physiological stresses, as well as the physiological manifestations of psychological stresses will be considered. Second semester. Offered as required. Mr. Brozek

Psych. 454. Theories of Learning (3)

Critical survey of major theories of learning. Second semester. Offered in 1965-66 and alternate years. Mr. Brody

Psych. 455. Engineering Psychology (3)

Seminar on aspects of the application of experimental psychology to man-machine systems. First semester. Offered in 1965-66 and alternate years. Mr. Craig

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 in 1965-66 and alternate years. Mr. Baker

Psych. 460. Special Study (3)

Study of some special topic not covered in the regular course offerings.

Psych. 461. Non-thesis Research (3)

Original research not connected with master's or doctoral thesis.

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. Staff

RELIGION

Professor Eckardt
Associate Professor Fuesle

Religion 1. Basic Religion (3)

An introduction to the field of religion primarily through consideration of significant data selected from the Judeo-Christian tradition. First semester.

Religion 2. Basic Religion (3)

Elementary study emphasizing the questions religion seeks to answer and the place of religion in modern life. Exemplary problems: Can the existence of God be proved? Do religion and science conflict? Why do men suffer? Do miracles happen? How are the doctrines of the churches applied to such areas as sex and marriage, vocational decision, and socio-economic life? Second semester.

Religion 6. Old Testament (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 7. New Testament (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 13. Non-Christian Religions (3)

Study of selected faiths of India, the Orient, and the Near East. Similarities and differences between Western and Eastern religious traditions. Some attention to recent developments in the world religions. First semester.

Religion 14. The Religions of America (3)

Analysis of the traditions, beliefs, and practices of the major faiths in America today. Some attention to recent trends in the church and synagogue. Second semester.

Rel. 121. History of Christian Theology (3)

A study of the major phases in the development of Christian theology down

to the Reformation: the origins of certain basic Christian categories and beliefs and their subsequent systematic organization. Attention will be given to the relationship between origins and development, and to the role of various cultures in determining the forms of this development. First semester. Mr. McCue

Rel. 122. History of Christian Theology (3)

Continuation of Religion 121. Reformation and post-Reformation theology. A study and comparison of the major theses of the principal sixteenth-century reformers and of the Council of Trent, and a consideration of the subsequent history of Protestant and Roman Catholic theology. Second semester. Mr. McCue

Religion 201. Scientific Theory of Religion (3)

Consideration of the possibilities and limits of scientific study in the field of religion. The relation of religion to magic, science, and morality. Empirical analysis of the dimension of the "sacred" or "ultimate" in human life, primarily from a psychological point of view. Study and appraisal of such interpreters as Sigmund Freud, William James, and Paul Tillich. First semester.

Religion 202. Scientific Theory of Religion (3)

Scientific analysis of the religious dimension of man as an element of social life. Religion and the class structure, religion and social status, religion and political institutions, religion and socio-economic change. The functions of religion in different human societies and in American society. Among the interpreters considered are Karl Marx, Emile Durkheim, Max Weber, and Richard Niebuhr. Some attempt to formulate a general scientific theory of the nature of religion. Second semester.

RESERVE OFFICERS' TRAINING PROGRAM

EDUCATIONAL AND MILITARY OBJECTIVES: The Reserve Officers' Training Corps provides military training at civilian institutions for the purpose of qualifying selected students for appointment as commissioned officers in the services of the United States upon graduation. This objective is attained through courses and training methods which will be of value to the student in his professional or business career and, at the same time, prepare him to serve as an officer in the defense of his country.

COURSES: The R.O.T.C. General Military Science and Air Science curricula embrace subjects common to all branches of the Army and Air Force. Graduates of these courses may be offered commissions in any one of fifteen various branches of the Army or in the Air Force. This is of necessity dependent upon the needs of the Service and the individual student's training, background, and desires.

As an officer training course, R.O.T.C. is a four-year college program divided into a two-year Basic Course and a two-year Advanced Course. The courses carry college credit. Both courses are elective.

At the completion of any semester of the basic R.O.T.C. course, a student's continuance in the military program is optional to both the student and the R.O.T.C. department. Procedure for withdrawal from the basic R.O.T.C. course is the same as that used to withdraw from any other academic course.

A student who has withdrawn from the basic R.O.T.C. course may be readmitted at the beginning of a semester upon application by the student and acceptance by the military department concerned and with the concurrence of his curriculum advisor.

Students transferring from other institutions may enter the basic R.O.T.C. program at the appropriate level providing the institution from which transferred has a similar R.O.T.C. program for which the transferring student has received the necessary credits.

Students pursuing R.O.T.C. 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.

Qualified students may apply for and be accepted into the Advanced Program, with a commission as Second Lieutenant in the United States Army or Air Force Reserve as the objective. To be eligible for consideration and admission to the advanced program, a student must be a citizen of the United States between the ages of 14 and 25 for Air Force, and between the ages of 14 and 27 for Army, must be of good moral character, must have completed the Basic Course or received credit in lieu thereof, and must successfully complete the prescribed physical examination and officer qualification tests. The approval of the respective department head and the President of the University is also required for admission to the advanced program. All students enrolled in the advanced program are required to attend Summer Camp for a period of four weeks for the Air Force and six weeks for the Army, normally between the junior and senior years.

Students selected for admission to the advanced program are required to sign a written agreement to fulfill certain conditions prescribed by law and regulations. The student, by signing the contract, does not become a member of the Armed Forces of the United States.

Students in the Colleges of Arts and Science and of Business Administration may substitute advanced Military or Air Science credits for six hours of electives.

Students in the College of Engineering may substitute advanced Military or Air Science credits for six hours of General Study (elective) courses.

Uniforms, textbooks, and equipment are furnished by the government to basic students. Advanced students are furnished textbooks and equipment and are given a uniform and subsistence allowance. 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

Lieutenant Colonel Schumacher
Lt. Col. Beganie
Maj. Risch
Master Sergeant Podolsky
Sergeant First Class Webb
Staff Sergeants Greene, McTigue, Snyder
Specialist Five Burpee

The Army Reserve Officers' Training Corps was established at Lehigh University in September, 1919. The military courses are conducted under Department of the Army regulations as specified in their General Military Science Program.

The general objective of this course of instruction is to produce officers who by their education, training, and inherent qualities are suitable for continued development as officers in the United States Army. Instruction will cover military fundamentals common to all branches of the service. The aim is to provide a basic military education and to develop individual character and attributes essential to an officer.

Duration of the complete course of instruction comprises four years divided into Basic and Advanced.

BASIC COURSE. The basic course consists of the freshman and sophomore years.

During his sophomore year, the cadet is given an opportunity to apply for the advanced program.

The following requirements must be met for enrollment in the Basic Course:

1. Applicant must be a citizen of the United States.
2. Applicant must be between 14 and 23 years old.
3. Applicant must be a regularly enrolled student.
4. Applicant must be screened and found acceptable by the Department of Military Science.
5. Applicant must be examined and found physically qualified.
6. Applicants for enrollment who have a record of conviction by any civil court or by any type of military court martial, for other than a minor traffic violation, are not eligible for enrollment in the R.O.T.C. without specific approval by the Department of the Army. Request for such waiver must be made through the PMS.

ADVANCED COURSE. Students selected to pursue the advance course receive training in subjects which will prepare them for commissions in the officer corps and are given the fundamentals of leadership. The instruction is

supplemented by application of various functions and procedures involving student participation in the operation of the ROTC program and in allied extra curricular activities.

At the beginning of the second year of Advanced Military Science, outstanding students are designated as Distinguished Military Students. If, upon graduation, the required standards are maintained they are designated as a Distinguished Military Graduate. Distinguished Military Graduates may apply for and secure direct appointments in the Regular Army.

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.

*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.

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.*

*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.

DEPARTMENT OF AIR SCIENCE

Lieutenant Colonel Caskey

Major Watson, Atwood

Captain Sessa

Technical Sergeants Cockburn, Farr, Gavura

Staff Sergeant Hess

An Air Force unit of the Reserve Officers' Training Corps was first established at Lehigh University in October, 1946. The Air Science courses are conducted under Department of the Air Force directives and consist of four semesters of Basic AFROTC instruction and four semesters of Advanced AFROTC instruction.

Qualified sophomore Air Science students, regardless of academic field of study, may submit applications for admission into the Advanced AFROTC course. Successful applicants pursue a generalized AFROTC course of study with emphasis being placed upon leadership training in Air Science academic classes, leadership laboratories, and AFROTC extra-curricular activities. During the two years of the Advanced AFROTC program, the cadet serves as a cadet officer and progresses in rank commensurate with demonstrated leadership ability.

INSPECTION TRIPS. Inspection trips to Air Force bases are provided for both basic and advanced cadets. Normally a cadet will have one inspection trip during the first two years and another while in the Advanced Program.

EXTRA-CURRICULAR ACTIVITIES. AFROTC cadets normally extend their academic and leadership laboratory associations into extra curricular activities. AFROTC cadet organizations include the AFROTC Cadet Corps and the Arnold Air Society. Some of the sponsored activities include the Military Ball, the awards and decorations ceremony, and the commissioning ceremony.

The parents and friends of AFROTC cadets are cordially invited to attend these military activities as guests of the Air Science Department.

Basic Courses

A.S. 31. Freshman Air Science (0)

In lieu of military academic instruction, students will be permitted to take a required three-credit hour course from the curricula of the Colleges of Arts and Science, Business Administration, or Engineering. Courses will be selected from the areas of mathematics, physical or natural sciences, foreign languages, the humanities or social sciences, and must meet with the approval of the Professor of Air Science. At or prior to registration, the student's curriculum director will designate the course which the student will substitute for Air Science 31. Satisfactory completion of leadership laboratory is a mandatory requirement for basic AFROTC.

A.S. 32. Freshman Air Science (2)

Fundamentals of Aerospace Weapon Systems: An introductory survey of aerospace missiles and craft, and their propulsion and guidance systems; target intelligence and electronic warfare; nuclear, chemical, and biological warhead agents; defensive, strategic, and tactical operations; problems, mechanics, and military implications of space operations; and a survey of contemporary military thought.

A.S. 33. Sophomore Air Science (2)

Foundations of Aerospace Power: An introductory examination of the factors of aerospace power, major ideological conflicts, requirements for military forces in being, responsibilities of citizenship, development and traditions of the military profession, role and attributes of the professional officer in American democracy, organization of the armed forces as factors in the preservation of national security, and the United States Air Force as a major factor in the security of the free world.

A.S. 34. Sophomore Air Science (0)

In lieu of military academic instruction, students will be permitted to take a required three-credit hour course from the curricula of the Colleges of Arts and Science, Business Administration, or Engineering. Courses will be selected from the areas of mathematics, physical or natural sciences, foreign languages, the humanities or social sciences, and must meet with the approval of the Professor of Air Science. At or prior to registration, the student's curriculum director will designate the course which the student will substitute for Air Science 34. Satisfactory completion of leadership laboratory is a mandatory requirement for basic AFROTC.

Advanced Courses

Junior Air Science—Air Force Officer Development.

A year-long treatment of the knowledge and skills required of a junior officer in the Air Force with special emphasis on staff duties and leadership. Includes Air Force leadership doctrine, staff organization and functions, communicating, instructing, problem solving techniques, leadership principles and practices, and the military justice system.

A.S. 111. Junior Air Science (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. Junior Air Science (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.

Senior Air Science—Global Relations.

A study of global relations of special concern to the Air Force Officer with attention to such aspects as geography and international relations.

A.S. 113. Senior Air Science (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. Senior Air Science (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.

ROMANCE LANGUAGES

Professors Barthold, Van Eerde
Assistant Professors Farne, Valenzuela
Messrs. Concepcion, Guzman

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. (Not offered, 1964-65)

Fr. 24. Seventeenth Century French Literature (3)

Continuation of Fr. 23. Conducted in French. **Prerequisite:** Fr. 23. Second semester. (Not offered, 1964-65)

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.

Fr. 26. Eighteenth Century French Literature (3)

Continuation of Fr. 25. **Prerequisite:** Fr. 25.

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.

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. 221. Spanish Fiction of the Golden Ages (3)

The Spanish novel of the sixteenth and seventeenth centuries, with special attention to Cervantes' *Don Quixote*. Collateral reading and reports. First semester.

Span. 222. Spanish Drama of the Golden Ages (3)

Selected plays by Lope de Vega, Tirso de Molina, Ruiz de Alarcon, and Calderon. Collateral reading and reports. Second semester.

Span. 223. Proseminar (3)

A study of some author or group of authors or of a period. First semester.

Span. 224. Proseminar (3)

Continuation of Span. 223. Second semester.

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.

RUSSIAN

See German, page 226

SOCIAL RELATIONS

See Government, page 228

SPANISH

See Romance Languages, page 293

SPEECH

See English, page 206

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.

DEPARTMENT OF INTERCOLLEGIATE ATHLETICS

Director Leckonby

Assistant Director Short

Messrs. Packer, Cooley, Leeman, Christian, Bush, Jelic, Havach, Halfacre, LaPorta, Hamer, Shields

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, Halfacre, Leeman, Packer, Jelic, Bush
Messrs. LaPorta, Hamer, Shields

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.



*Williams Hall
houses the departments of Biology,
Geology, Metallurgical Engineering, and
the Marine Science Center.*

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 three weeks of instruction will receive a grade of "W." A student who withdraws from a course after the first three 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.

CURRICULUM TRANSFERS. The Dean of the College to which a student transfers, or a designated enrolling officer, will indicate to the Registrar, at

the time of transfer, the courses from the student's old curriculum which will be used to meet graduation requirements of the new curriculum. All grades, including failures, in the courses so used will be used in computing his cumulative scholastic average. The cumulative scholastic average for the new curriculum will not be computed until the student completes one semester or full summer session in the new curriculum. *A curriculum transfer does not remove a student from probation.*

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 in paragraph four above.

DROPPED FOR POOR SCHOLARSHIP. A student will be dropped for poor scholarship if for two consecutive terms (semester or full summer session) he fails to meet the standards set forth in paragraph four above.

HONORS

Honors are of four kinds: class honors, graduation honors, special graduation honors, and college honors. (For college honors, see page 68.)

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.

Special 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 special 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. Special 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 1962-63, over 550 students were assisted financially to the amount of \$600,000.

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 any of the scholarship or loan awards.

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 — April 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.

TUITION LOANS

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. 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 Fund Scholarship

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.

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. 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. In June '54, established this scholarship fund as a memorial to the class. 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.

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.

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 scholastic achievement, and leadership qualities, without restriction as to college or curriculum.

The Reese D. Isaacs Memorial Scholarships

Kenneth L. Isaacs, M.E. '25, established this fund as a memorial 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, usually to the amount of the tuition, for one or more students as the income may provide, 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 scholar-

ships 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 Engineer-

ing. 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 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. Murphey 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.

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 Rayless 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 available to undergraduates of any college or curriculum who qualify on the 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

Donald B. Stabler, C.E. '30, M.S. '32, established this fund in 1953. The fund is to be used to provide full tuition scholarships on the basis of character, intelligence, leadership qualities, and financial need. All factors being equal, preference is to be given first to candidates for the civil engineering curriculum; and secondly, to candidates for the other engineering curricula.

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.

The Treadwell Engineering Company Scholarship

The Treadwell Engineering Company of Easton, Pennsylvania, has established at Lehigh University the Treadwell Engineering Company 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 engineering 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

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 Foundation Scholarships

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.

Armstrong Cork Company Undergraduate Scholarship

The Armstrong Cork Company has awarded a two-year scholarship for a junior who desires to enter business or industry upon graduation. The scholarship covers the cost of tuition and a grant of \$60 for books. A cost-of-education grant of \$500 is made to the University. Nomination of the scholarship recipient is made by the Committee on Undergraduate Financial Aid, subject to the approval of the Armstrong Cork Company.

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.

California Oil Company Scholarship

The California 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 Scholarships

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 will range up to \$2,000 annually depending upon "demonstrated need." In addition the University will receive a grant-in-aid for each award.

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.

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.

Modern Transfer Company Scholarship

The Modern Transfer Company of Allentown, Pennsylvania, through its president, Samuel L. Lebowitz, E.M. '23, has established a \$1,000 a year scholarship at the University. The scholarship is awarded on the basis of high intelligence, financial need, and the qualities that give promise of leadership.

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.

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 \$300 for other college expenses. However, the University may award a lesser or a greater amount depending upon the financial need of the recipient. In addition, the University receives each year \$500 for "cost-of-education allowance" for each scholarship.

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.

Texaco Scholarship

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 Fund

The Union Bank and Trust Company of Bethlehem, Pennsylvania, has established three 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.

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 Scholarship

The Western Electric Fund has established at Lehigh University three annual scholarships, to a maximum of \$800 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 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.

The law specifies that first consideration must be given to those students who are preparing for careers in primary or secondary public school teaching, and to those students who are majoring in science, mathematics, engineering, or a foreign language.

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.

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 to found a fund, now amounting to \$300,000, the income of which is loaned to deserving students.

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 \$1500 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 Chem-

istry 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. Holders of the fellowships devote part time to graduate study, and part time to research work in the department to which they are assigned. Usually the research work can be used for the thesis or dissertation.

Annual stipends for most fellowships are \$1500 or more, depending upon the qualifications of the applicant. Graduate fellows pay the regular tuition fees. However, the Committee on Graduate Scholarships and Fellowships, 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. Half of the time of the holders of these fellowships must be devoted to research work on some problem in electrical, mechanical, or hydraulic engineering, proposed by the President of the Byllesby Engineering and Management Corporation and approved by the Lehigh Institute of Research; the other half is to be devoted to graduate study leading to the degree Master of Science. 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 half his time to research under the direction of the faculty and half to graduate study. While the fellowship 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. Half of the time of the holder of this fellowship must be devoted to research work in the department to which he is assigned; the other half is to be devoted to graduate study.

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 stipend has usually been \$750 per year.

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 \$1200 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 Allegheny-Ludlum Fellowship**
in Metallurgy.
- The American Chemical Society—Petroleum Research Fellowship**
in Chemical Engineering.
- The American Chemical Society—Petroleum Research Fellowship**
in Chemistry.
- The American Chemical Society—Petroleum Research Fellowship**
in Geology.
- The Armstrong Cork Company Fellowship**
in Physics.
- 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.
- The Esso Foundation Fellowship**
in Chemical Engineering.
- The F. E. F. Wheelabrator Corporation Fellowship**
in Metallurgy.
- The Howard Flint Fellowship**
in Chemistry (for research relating to printing ink).
- The General Telephone and Electric Company Fellowship**
in Metallurgy.

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 Mathematics, Chemical Engineering, and English.

The National Science Foundation Fellowship

A. Graduate Fellowships in Science, Mathematics, or Engineering.

B. Cooperative Graduate Fellowships in Science, Mathematics, or Engineering.

The Norwich Pharmaceutical Fellowship

in Chemistry.

The Ogden Corporation Fellowship

in Management Science

The Orthopedic Research Foundation Fellowship

in Chemistry.

The Sun Chemical Corporation Fellowship

in Chemistry.

The Union Bank and Trust Company Fellowship

in Business Administration.

The Union Carbide Corporation Fellowship

in Chemistry.

The United States Public Health Service (Water Pollution) Fellowship

in Biology.

The United States Rubber Company Fellowship

in Chemical Engineering.

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 disability, 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.

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 Choral Cup

The Choral Cup provided by Richard K. Burr, I.E. '53, John D. Kirkpatrick, Bus. Adm. '55, Donald E. Richert, Bus. Adm. '53, and Norman I. Stotz, Jr., Arts '52, is awarded to the outstanding senior participating in the vocal organizations of the Department of Music.

The Concert Cup

The Concert Cup provided by Richard K. Burr, I.E. '53, John D. Kirkpatrick, Bus. Adm. '55, Donald E. Rickert, Bus. Adm. '53, and Norman I. Stotz, Jr., Arts '52, is awarded to the outstanding senior 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.

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.

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.

Yeyo Fabianni Award

This award is made annually to the student who is adjudged to have produced the most effective modern painting.

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.

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 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.

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.

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.

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 scholastic record 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 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 sophomore 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 elec-

trical 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 freshman having the highest scholastic average.

Summer Sessions

The courses offered during the 1962 Summer Sessions were arranged as follows: (1) two undergraduate sessions of six weeks each from June 12 through July 20 and from July 23 through August 31; (2) the first graduate session of six weeks, June 17 through July 26; (3) the post session, July 29 through August 13; (4) the second six-week session, July 29 through August 27, designed primarily for graduate students; (5) the workshops, June 17 through July 26, consisting of programs in the fields of health education, and economic education, exclusively for teachers; (6) the special engineering courses and camps, including civil engineering, June 3 through June 22, and industrial engineering, June 10 through June 28 and August 12 through 30; (7) the reading and study development laboratory, July 15 through August 2 primarily for high school students, and August 5 through August 23 primarily for college entrants; and (8) The Reading Laboratory School, June 17 through July 26, a program for disabled readers of age 8 to 17.

The SUMMER SESSIONS ANNOUNCEMENT, containing a full description of courses to be offered in 1964 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. As time indicates certain needs not recognized at the moment, consideration will be given to the development of special courses for the General College Division group.

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 Educational Service, Department 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 courses offered in the afternoon, evening, and Saturday sessions, but is open alike to men and women students of twenty-one years of age and older.

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, history, government, and international relations. Still others result from cooperative arrangements with business and industry, and with service and welfare agencies.

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 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.

University Library

Two principles underlie the operation of the Lehigh University Library: the building of sound, balanced collections, and the provision of reference and circulation service to meet the needs of both faculty and students.

General and special collections now number some 420,000 volumes, with annual accessions of about 12,000 volumes. Over 3,500 current periodicals and serials are received, including seventeen 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, British Colonial history, and English and American literature. The Honeyman Collection of rare books in both literature and the history of science is available to the undergraduate.

The Library may be used either as a passive memory of recorded knowledge, or as an active agent in the process of formal education. In either case, a policy of open access to the general collection furnishes the Lehigh student with the maximum opportunity for exploiting the literature of his field. To this end also, instruction in the effective use of the Library is provided to all freshmen, and to upperclass students in a number of curricula, including engineering.

Library hours are as follows:

Monday — Friday	8 a.m. — 11 p.m.
Saturday	8 a.m. — 5 p.m.
Sunday	2 p.m. — 11 p.m.

Religious Observances

On each Sunday of the academic year, chapel services are held at 11 a.m. in Packer Memorial Church, with the Chaplain of the University in charge. Outstanding leaders of the Christian Church fill the pulpit approximately once a month. Music for these Sunday services is furnished by the Lehigh University Chapel Choir. In addition, Holy Communion services are held every Sunday at 9:30 A.M.

There are also a number of special religious observances, such as the Chapel Service and Convocation, which opens Freshman Orientation; and the annual Christmas Vesper Choral Program, on the Sunday before the 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 Director of Residence Halls and the Dean of Students.

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 director of the freshman engineering 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 343.)

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 343.)

Not all student problems are individual problems. Many are group problems, having to do with group living in the residence halls, with student ac-

tivities, 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.

Patients requiring more than a few days bed care are sent home or to a local hospital when indicated. Any expenses so incurred must be paid by the student.

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.

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 a 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 graded 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 Sabin 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.

Health and Accident Insurance

The University offers students a choice of two types of insurance policies against illness and/or injury. One policy covers both illness and accident, and the other accident only. The latter policy, of course, costs less. Both kinds are offered for a nominal fee, and on an entirely voluntary basis.

The Health Service highly recommends these insurance plans to both present and prospective students. Past experience has emphasized the importance of such protection, and we urge all students to participate in one or the other of these plans throughout their college careers. These policies cover 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 sickness or injury are usually required to carry both health and accident 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 professionally 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 assignments, 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, Department 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 three hours a week for six consecutive weeks. The instruction is adapted to the needs of the individual in well-equipped classrooms.

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 9, 1963, in Eugene Gifford Grace Hall. The sermon was delivered by The Reverend Elam Davies, M.A., D.D., Pastor Fourth Presbyterian Church, Chicago, Illinois.

University Day

University Day was observed Monday, June 10, 1963. The 95th Commencement Exercises were held in Eugene Gifford Grace Hall. The address to the graduating class was delivered by The Honorable William Warren Scranton, B.A., LL.B., LL.D., Governor of The Commonwealth of Pennsylvania.

Founder's Day

The 85th annual exercises in honor of the Hon. Asa Packer, founder of the University, were held Sunday afternoon, October 13, 1963, in Packer Memorial Church. The Commencement Address, "Ingredients: Study, Freedom and Excitement" was delivered by Nelson Jordan Leonard, B.S. in Chem.; B.Sc., Ph.D., Professor of Organic Chemistry, The University of Illinois.

Centennial Convocation

Under the general theme "The Exercise of Man's Incredible Powers," nineteen world leaders explored four major discussion areas during a three-day program October 24-26 which began the University's centennial observances.

Those participating in the program included John J. McCloy, Chairman of the Board, The Ford Foundation, and Partner, Milbank, Tweed, Hadley, and McCloy; Dr. Emilio G. Collado, Vice-President — Finance, Standard Oil Company, (New Jersey); General Maxwell D. Taylor, Chairman of the Joint Chiefs of Staff; The Right Honorable Lord Shawcross, P. C., Q.C., Director, Shell Transport and Trading Company, Ltd., Sir Hugh Taylor, President of the Woodrow Wilson National Fellowship Foundation, and Dean Emeritus of the Graduate School, Princeton University; Stewart S. Cort, President of the Bethlehem Steel Corporation; Dr. Clarence E. Larson, Vice President of the Nuclear Division, Union Carbide Corporation, and General Manager of Oak Ridge Operations; Joseph B. McFadden, Deputy Director of the Intergovernmental Committee for European Migration, and Professor and Head of the Division of Journalism, Lehigh University (on leave of absence, 1962-63); Dr. Kenneth G. McKay, Executive Vice President of Bell Telephone Laboratories; James C. Hagerty, Vice President in Charge of Corporate Relations, American Broadcasting — Paramount Theaters, Inc.; Seymour K. Freidin, Executive Editor — Foreign News of the New York Herald Tribune; The Honorable Hugh Scott, United States Senator from Pennsylvania; Dr. Edward Teller, Associate Director of the University of California Radiation Laboratory; Arthur H. Dean, Consultant to the Director of the United States Arms Control and Disarmament Agency; Roger M. Blough, Chairman of the Board and Chief Executive Officer of the United States Steel Corporation; Dr. William G. Pollard, Executive Director of the Oak Ridge Institute of Nuclear Studies; Frederick R. Kappel, Chairman of the Board of the American Telephone and Telegraph Company; Monroe J. Rathbone, Chairman of the Board, Standard Oil Company (New Jersey); and the Honorable Paul Martin, Secretary of State for External Affairs of the Dominion of Canada.

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 1963-64 are:

President, G. Douglas Reed '33, Baltimore, Md.

Senior Vice-President, Edward L. Forstall, '20 Swarthmore, Pa.

Junior Vice-President, Donald B. Stabler, '30, Harrisburg, Pa.

Treasurer, J. 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 20,000 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 thirty-five alumni clubs established in areas of alumni concentration. Important outposts of the University, these clubs hold meetings and carry on activities that support the activities of the University in its cultural, social, financial, and recreation phases.

The following are the alumni clubs:

New York Lehigh Club	Lehigh Club of York-Lancaster (Pa.)
Philadelphia Lehigh Club	Lehigh Club of Northern New Jersey (Newark)
Pittsburgh Lehigh Club	Lehigh Club of Northern California (San Francisco)
Chicago Lehigh Club	Lehigh Club of Southern California (Los Angeles)
Washington, D. C., Lehigh Club	Lehigh Club of Delaware (Wilmington)
Detroit Lehigh Club	Lehigh Club of Monmouth County, N. J.
Northeastern Pennsylvania Lehigh Club (Scranton and Wilkes-Barre)	South Jersey Lehigh Club (Camden)
Maryland Lehigh Club (Baltimore)	Bergen-Passaic Lehigh Club (N. J.)
Youngstown (Ohio) Lehigh Club	Central Ohio Lehigh Club
Lehigh Club of Northern New England (Boston)	Twin-City Lehigh Club (Minneapolis)
Lehigh Club of Central Pennsylvania (Harrisburg)	Lehigh Club of St. Louis (Mo.)
Lehigh Club of Northern New York (Schenectady)	Lehigh Club of Rochester (N. Y.)
Lehigh Club of Northern Ohio (Cleveland)	Lehigh Club of Atlanta (Ga.)
Lehigh Club of Fairfield County (Conn.)	Watchung Area Lehigh Club (Plainfield, N. J.)
Lehigh Club of Western New York (Buffalo)	Pacific Northwest Lehigh Club (Seattle, Wash.)
Lehigh Home Club (Bethlehem, Pa.)	Allentown (Pa.) Lehigh Club
Lehigh Club of Southeastern Pennsylvania (Reading)	Lehigh Club of Florida
Lehigh Club of Central Jersey (Trenton)	

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)
Eta Kappa Nu (electrical engineering)
Phi Alpha Theta (history)
Pi Mu Epsilon (mathematics)
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

In Engineering

American Chemical Society (chapter of student affiliates)
American Institute of Chemical Engineers (student chapter)
American Institute of Electrical Engineers and Institute of Radio Engineers
(combined, 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	Interfaith Council
Allentown Hospital	Interfraternity Council
Volunteers	Arcadia, the Student Council
Alpha Chi Epsilon (Episcopal pre- theological honorary society)	Band (including Brass Choir, Wood- wind Chamber Group, etc.)
Alpha Lambda Omega (Allentown group)	Baptist Student Group
Art Society	Camera Club
Bethlehem Tutorial Project	Canterbury Club
Bridge Club	Intervarsity Christian Fellowship
Chess Club	Lutheran Student Fellowship
Christian Council	Methodist Student Fellowship
Christian Science Organization	Model Railroad Club
Computer Society	Mustard and Cheese (dramatic club)
Cosmopolitan Club	Newman Club
Cut and Thrust Society (fencing)	Outing Club
Cyanide Club (junior honorary society)	Political Science Assembly
Ernest W. Brown Astronomical Society	Radio Society (W3AEQ)
German Club	Residence Halls Council
Glee Club	Sailing Club
Gryphon Society	Skiing Club
Hillel Society	Sports Car Club
Hockey Club	Town Council
	United Church of Christ Student Group
	Westminster Fellowship

The following Greek-letter national 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, Theta Xi.

Student Publications and Radio

The students of Lehigh University publish a semi-weekly newspaper, *The Lehigh University Brown and White*; a literary magazine, *Endor*; and a yearbook, *The Epitome*. An undergraduate magazine of general academic interest, *The Lehigh Review*, was established in 1962. The students' modern radio stations WLRN, 640 kc., and WLR, 690 kc., 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.

COOPERATIVE LECTURE SERIES. The Cooperative Lecture Series presents lectures throughout the academic year which are open without charge to the student body and the public. The Series is sponsored by the Cooperative Lecture Series Committee, often in cooperation with other campus organizations and various departments of the University. The Series was established in 1956.

CLEAVER CONCERTS. Musical programs called the Cleaver Concerts are presented each year to further the appreciation of music among the student body and the community. The programs are endowed through the gift of Mrs. Elizabeth K. Cleaver, and are named for her husband, the late Albert N. Cleaver, a former trustee of the University.

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 272.

GLEE CLUB. The University Glee Club performs at concerts and special occasions on the Lehigh campus and at other colleges and universities. The Club often collaborates with choruses of women's colleges in major works for mixed voices. Information on student participation in the Glee Club is given on page 272.

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.



The Lehigh University Band join with the Columbia University Band for a concert in Carnegie Hall.

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 order to cooperate more effectively with industry and government agencies.

The purposes of the Institute of Research include the training of men for research work, the publication of results of investigations, the conduct of general research, the conduct of cooperative research, and advisory service.

Detailed information concerning the organization and regulations of the Institute of Research will be provided by the Director upon request.

Lehigh University cooperates with industrial concerns, technical associations, and government agencies in carrying on basic research and applied research designed to develop new and to improve old products and methods of production. Cooperative research projects usually provide every year a number of research assistantships which are available to qualified graduate students. These assistantships provide stipends which vary from \$150 to \$350 per month, depending upon the qualifications of the appointee and the time assigned to the project. Appointments are for one year and may be renewed or extended. Part- or full-time employment on research projects is frequently available during the summer, and whenever possible it is desirable for entering students who hold research appointments 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 head of the department concerned.

Among the cooperative research programs in progress at present are those sponsored by the following agencies:

Aluminum Company of America
American Institute of Steel Construction
American Iron & Steel Institute
American Library Association
Bethlehem Steel Company
Bell Telephone Laboratories
The Boeing Company
Louis Calder Foundation
Column Research Council
Corn Industries Research Foundation

E. I. duPont de Nemours and Company
 Ellicott Machine Corporation
 Esso Education Foundation
 Folding Paper Box Association
 Fort Pitt Bridge Works
 Fuller Company
 Fund for the Advancement of Education (Ford Foundation)
 Guardian Electric Manufacturing Company
 Heat Exchange Institute
 Imperial Type Metal Company
 International Business Machines Corporation
 International Nickel Company
 S. C. Johnson and Son, Incorporated
 Kentile, Incorporated
 William S. Merrell Company
 Nashua Company
 National Bulk Carriers, Incorporated
 National Forge Company
 National Printing Ink Research Institute
 Paint Research Institute
 Pennsylvania Department of Highways
 Petroleum Research Fund of the American Chemical Society
 Pressure Vessel Research Council
 Reinforced Concrete Research Council
 Reynolds Metals Company
 Smith, Kline and French Foundation
 Sun Oil Company
 Technical Association of the Pulp and Paper Industry
 United States Government:
 Air Force—Office of Scientific Research and Development
 Air Force—Systems Command and Aeronautical Systems
 Division
 Army—Corps of Engineers
 Army—Research Office (Durham)
 Army—Electronic Materiel Agency
 Atomic Energy Commission
 Bureau of Public Roads
 Department of Health, Education, and Welfare
 Department of the Interior—Office of Saline Water
 Department of the Interior—National Park Service
 National Aeronautics and Space Administration
 National Institutes of Health
 National Science Foundation
 Navy—Bureau of Ships
 Navy—Office of Naval Research
 United States Steel Corporation
 Warner-Lambert Pharmaceutical Company
 Weidman & Lepel Laboratories
 Welding Research Council
 Western Electric Company

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 western slope of South Mountain and in Saucon Valley south of Bethlehem, bringing the total acreage 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, chemical engineering, and research in chemistry and chemical engineering.

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 Messenger 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 Education Building, headquarters of the Department of Education, is a rebuilt, temporary, one-story frame structure, 76 feet long and 30 feet wide. The building has a classroom with a capacity of approximately thirty, a seminar room, and six offices.

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 available 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 Air 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 Reading and Study Clinic occupies the basement.

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 departments of German and Classical Languages.

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, the Honeyman Collection, and the Art Gallery. 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 and the Vice-President and Provost may be 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 Air 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.

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 athletic 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 WLR.

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.

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, departmental libraries, and special collections of the departments of Biology, Geology, and Metallurgical Engineering.

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

Seven residence halls are located on the campus. These modern structures provide living accommodations for approximately 1,200 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.

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 is a temporary freshman residence hall which was formerly the Delta Tau Delta house. It is a three-story building with accommodations for sleeping and study, presently occupied by 26 students.

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, furnishes accommodations for 35 students.

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 1963

Students in the University

Undergraduate Students	2555
Graduate Students	1130
Total	3685

Students in Undergraduate Curricula

Curriculum	Seniors	Juniors	Sophomores	Freshmen	G.C.D.	Total
Arts and Science	186	165	140	191	....	682
Arts and Engineering	29	29	32	50	....	140
Business Administration	171	153	136	92	....	552
Chemical Engineering	34	23	38	....	....	95
Chemistry	10	9	16	....	....	35
Civil Engineering	22	22	35	....	....	79
Electrical Engineering	60	48	59	....	....	167
Engineering Mechanics	9	11	4	....	....	24
Engineering Physics	8	13	16	....	....	37
General Science & Mathematics	4	1	1	....	....	6
Industrial Engineering	36	49	43	....	....	128
Mechanical Engineering	44	31	43	1	....	119
Metallurgical Engineering	36	29	18	....	....	83
Mining Engineering	3	....	....	....	....	3
Unclassified Engineers .....	....	....	6	395	....	401
General College Division .....	....	....	....	....	4	4
Total	652	583	587	729	4	2555

Summer 1963**Students in the University**

Undergraduate Students	610
Graduate Students	566
Total	1176

Fall 1963**Students in the University**

Undergraduate Students	2696
Graduate Students	1223
Total	3919

Students in Undergraduate Curricula

Curriculum	Seniors	Juniors	Sophomores	Freshmen	G.C.D.	Total
Arts and Science	171	158	174	184	....	687
Arts and Engineering	31	31	40	78	....	180
Business Administration	141	146	102	85	....	474
Chemical Engineering	21	37	54	1	....	113
Chemistry	10	13	19	....	....	42
Civil Engineering	23	29	35	1	....	88
Electrical Engineering	53	54	84	5	....	196
Engineering Mechanics	13	6	13	1	....	33
Engineering Physics	15	13	25	....	....	53
General Science & Mathematics	3	1	1	....	....	5
Industrial Engineering	49	43	59	4	....	155
Mechanical Engineering	40	38	61	3	....	142
Metallurgical Engineering	37	15	13	1	....	66
Mining Engineering	1	....	....	....	....	1
Unclassified Engineers .....	....	....	7	447	....	454
General College Division .....	....	....	....	....	7	7
Total	608	584	687	810	7	2696

GEOGRAPHICAL DISTRIBUTION OF UNDERGRADUATE STUDENTS
Fall 1963

Alabama	1	Tennessee	1
Alaska	2	Texas	4
Arizona	1	Vermont	1
California	8	Virginia	30
Colorado	1	West Virginia	10
Connecticut	108	Wisconsin	6
Delaware	19	Argentina	1
District of Columbia	13	Austria	1
Florida	12	Brazil	2
Georgia	4	British Guiana	1
Hawaii	2	Burma	1
Illinois	19	Canal Zone	2
Indiana	2	Ecuador	2
Kansas	2	El Salvador	1
Kentucky	4	England	1
Louisiana	2	France	2
Maine	10	Germany	1
Maryland	95	Greece	1
Massachusetts	67	Guatemala	1
Michigan	6	India	1
Minnesota	3	Iran	2
Missouri	4	Italy	1
Nebraska	1	Mexico	1
New Hampshire	7	Nigeria	2
New Jersey	650	Panama	1
New Mexico	1	Peru	2
New York	444	Philippines	1
North Carolina	3	Puerto Rico	4
North Dakota	1	Sierre Leone	1
Ohio	55	South Africa	1
Oregon	1	Switzerland	2
Pennsylvania	1040	Thailand	1
Rhode Island	14	Venezuela	1
South Carolina	3		

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