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Graduate School Catalog
1975-1976

"This institution is an integrated institution of higher learning at all levels." — *Policy Statements of the Board of Regents of Texas Tech University.*

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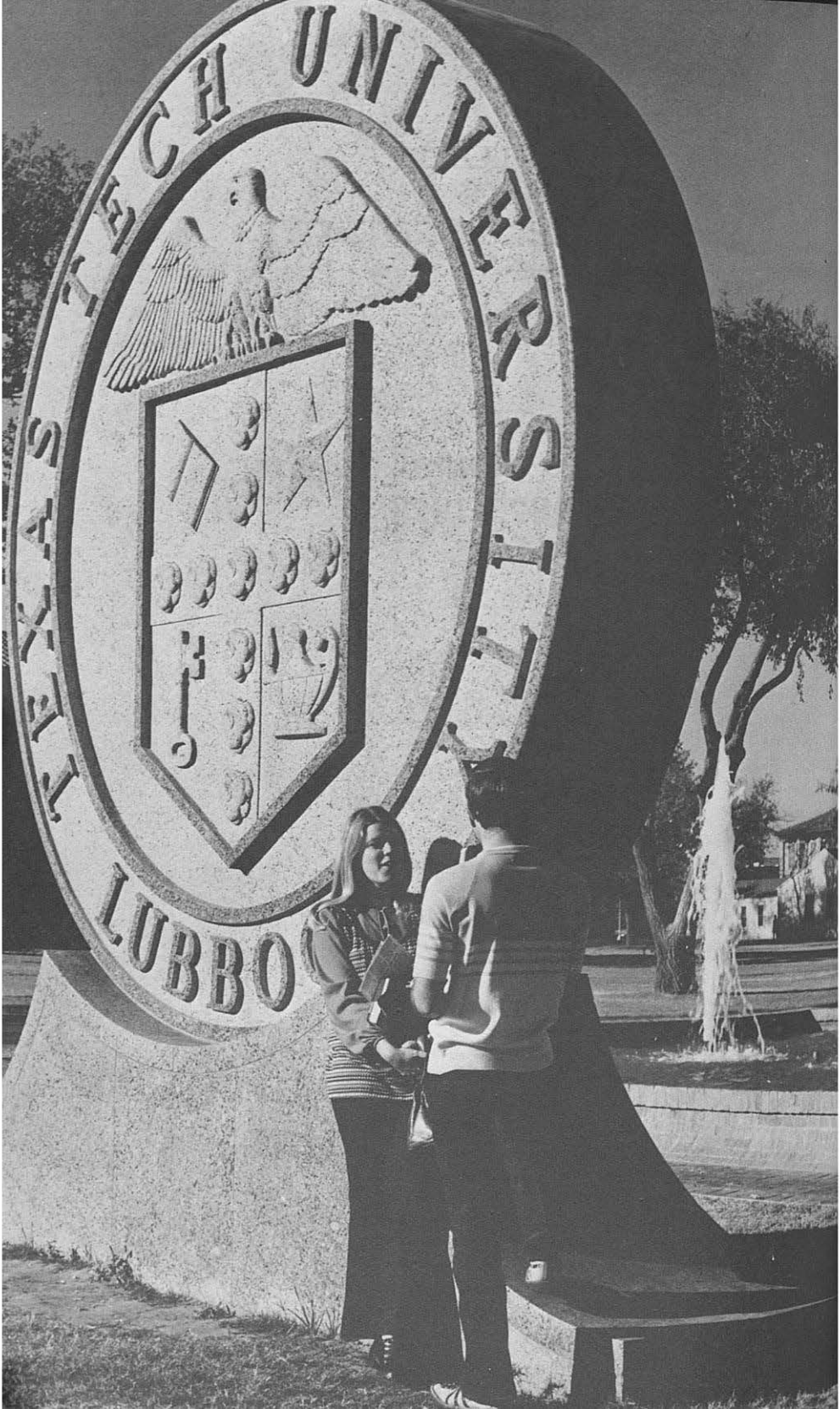
TECH UNIVERSITY
LUBBO

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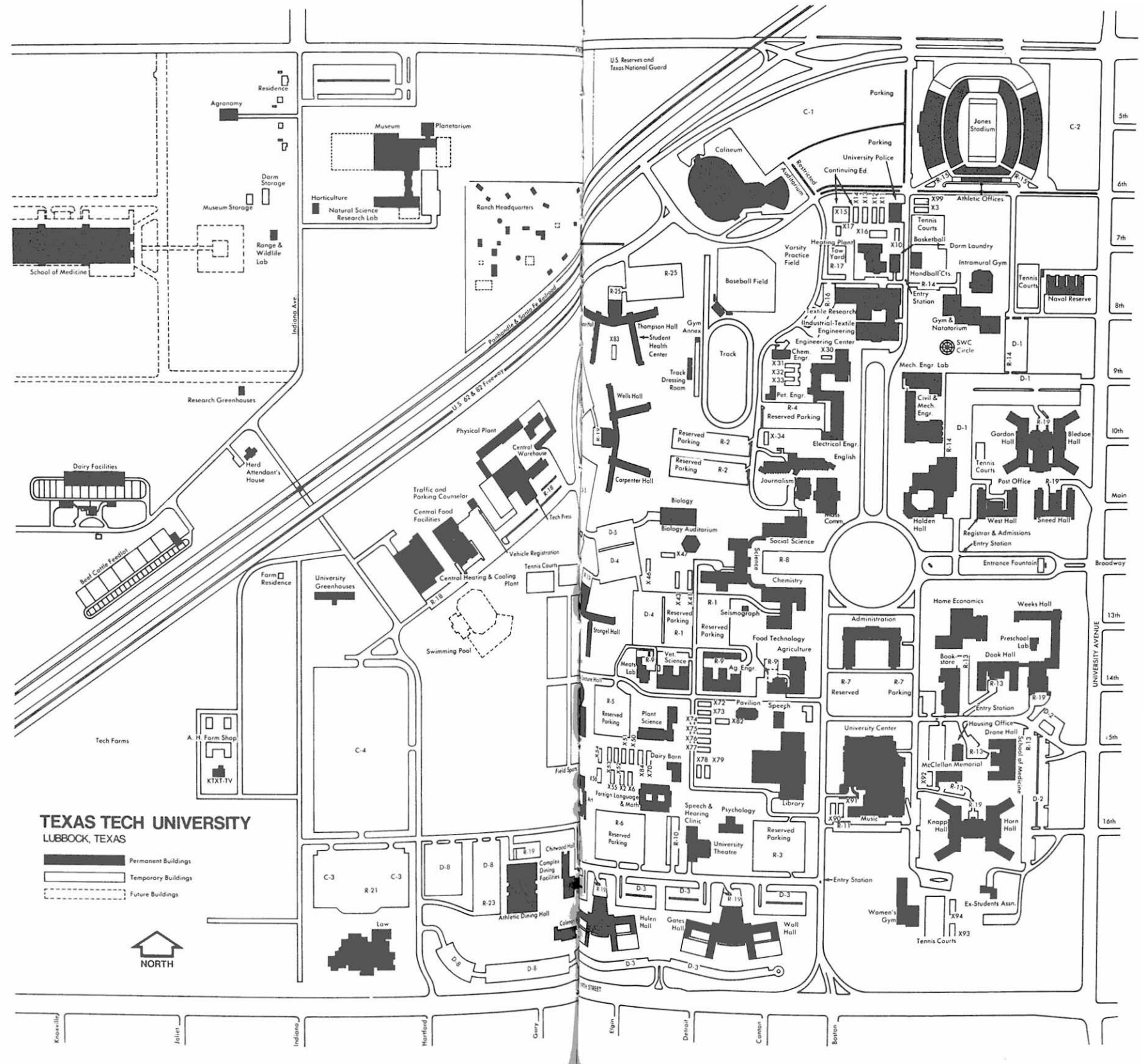
TEXAS TECH UNIVERSITY
LUBBOCK, TEXAS
Permanent Buildings
Temporary Buildings
Future Buildings
NORTH
Residence
Agronomy
Museum
Planetarium
Dorm Storage
Museum Storage
Horticulture
Natural Science Research Lab
Ranch Headquarters
Range & Wildlife Lab
School of Medicine
Indiana Ave.
Research Greenhouses
Pantonella & Santa Fe Railroad
U.S. 62 & 82 Freeway
Physical Plant
Central Warehouse
Dairy Facilities
Herd Attendant's House
Traffic and Parking Counselor
Central Food Facilities
Tech Press
Vehicle Registration
Beef Cattle Feedlot
Farm Residence
University Greenhouses
Central Heating & Cooling Plant
Tennis Courts
Swimming Pool
Tech Farms
A. H. Farm Shop
KTXT-TV
C-4
Law
Chitwood Hall
Complex Dining Facilities
Athletic Dining Hall
Hulen Hall
Gates Hall
Wall Hall
U.S. Reserves and Texas National Guard
Parking
C-1
Coliseum
Jones Stadium
C-2
Parking
University Police
Continuing Ed.
Restricted
Auditorium
Athletic Offices
Tennis Courts
Basketball
Dorm Laundry
Heating Plant
Tow Yard
Varsity Practice Field
Baseball Field
Intramural Gym
Handball Cts.
Entry Station
Naval Reserve
Thompson Hall
Student Health Center
Gym Annex
Track
Track Dressing Room
Textile Research
Industrial-Textile Engineering
Engineering Center
Gym & Natatorium
SWC Circle
Chem. Engr.
Pet. Engr.
Mech. Engr. Lab
Civil & Mech. Engr.
Wells Hall
Carpenter Hall
Reserved Parking
Electrical Engr.
English
Journalism
Mass Comm.
Gordon Hall
Bledsoe Hall
Post Office
Holden Hall
West Hall
Sneed Hall
Registrar & Admissions
Entry Station
Entrance Fountain
Broadway
Biology
Biology Auditorium
Social Science
Science
Chemistry
Seismograph
Food Technology
Agriculture
Stangel Hall
Meats Lab
Vet. Science
Ag. Engr.
Plant Science
Pavilion
Speech
Dairy Barn
Foreign Languages & Math
Speech & Hearing Clinic
Psychology
University Theatre
Library
Administration
Home Economics
Weeks Hall
Preschool Lab
Book-store
Dook Hall
University Center
Housing Office
Drane Hall
McClellan Memorial
School of Medicine
Music
Knapp Hall
Horn Hall
Women's Gym
Ex-Students Assn.
Tennis Courts
UNIVERSITY AVENUE
Main
Knoxville
Joliet
Indiana
Hartford
Gary
Elgin
Detroit
Canton
Boston
19th STREET

University Calendar 1975-1976

Fall 1975

August 26, Tuesday
Fall semester begins.
10 a.m., residence halls open for occupancy.

August 27, Wednesday
First meal, breakfast, served in residence halls.

August 27-30, Wednesday-Saturday noon
Registration for the fall semester.

September 1, Monday
Labor Day. University holiday.

September 2, Tuesday
7:30 a.m., classes begin.

September 30, Tuesday
Grade of W will be given for all courses dropped on or before this date.

November 7, Friday
Last day to drop a course.

November 26, Wednesday
12:30 p.m., classes dismissed for Thanksgiving holidays.

December 1, Monday
7:30 a.m., classes resume.

December 5, Friday
Last day for December degree candidates to complete correspondence courses, remove grades of I and PR, submit to the graduate Dean the final copy of theses and dissertations, pay binding fee, file statement of intention to graduate in the academic dean's office, and pay graduation fee in the Cashier's office.

December 15-19, Monday-Friday
Final examinations for the fall semester.

December 20, Saturday
10 a.m., residence halls close.
Fall semester ends.

December 22, Monday
Final grade reports due in the Registrar's office.

Spring 1976

January 13, Tuesday
Spring semester begins.
10 a.m., residence halls open for occupancy.

January 14, Wednesday
First meal, breakfast, served in residence halls.

January 14-17, Wednesday-Saturday noon
Registration for the spring semester.

January 19, Monday
7:30 a.m., classes begin.

February 16, Monday
Grade of W will be given for all courses dropped on or before this date.

March 1, Monday
Last day for May degree candidates to file statement of intention to graduate in the academic dean's office.

March 15, Monday
Last day for May degree candidates to order academic regalia and invitations at the Bookstore.

March 20, Saturday
12:30 p.m., classes dismissed for Spring Vacation.

March 29, Monday
7:30 a.m., classes resume.

April 2, Friday
Last day to drop a course.

April 22, Thursday
Last day for May degree candidates to complete correspondence courses, remove grades of I and PR, submit to the Graduate Dean the final copy of theses and dissertations, pay binding fee, and pay graduation fee in the Cashier's office.

May 5, Wednesday
Day of no classes.

May 6-12, Thursday-Wednesday
Final examinations for the spring semester.

May 13, Thursday
10 a.m., residence halls close. Degree candidates may occupy rooms until 10 a.m., Sunday, May 16.

May 14, Friday
12 noon, senior grade reports due in the Registrar's office.

May 15, Saturday
Commencement exercises.
Spring semester ends.

May 17, Monday
Final grade reports due in the Registrar's office.

Summer Session 1976

June 1, Tuesday
First summer term begins.

July 10, Saturday
First summer term ends.

July 12, Monday
Second summer term begins.

August 21, Saturday
Second summer term ends.

Directory

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Term Expires January 31, 1977

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CLINT FORMBY, *Hereford*
JOHN HINCHEY, M.D., *San Antonio*

Term Expires January 31, 1979

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B.S., North Carolina, 1937; M.S., Louisiana State, 1939; Ph.D., 1942.

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B.S. in Ed., Teacher's Coll. (Kansas City), 1937; M.Ed., Missouri, 1939; Ed.D., 1943.

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B.S., Houston, 1958; M.A., 1959; Ph.D., Oklahoma, 1963.

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B.A., Texas Western, 1948; M.A., Tulsa, 1951; Ph.D., Denver, 1960.

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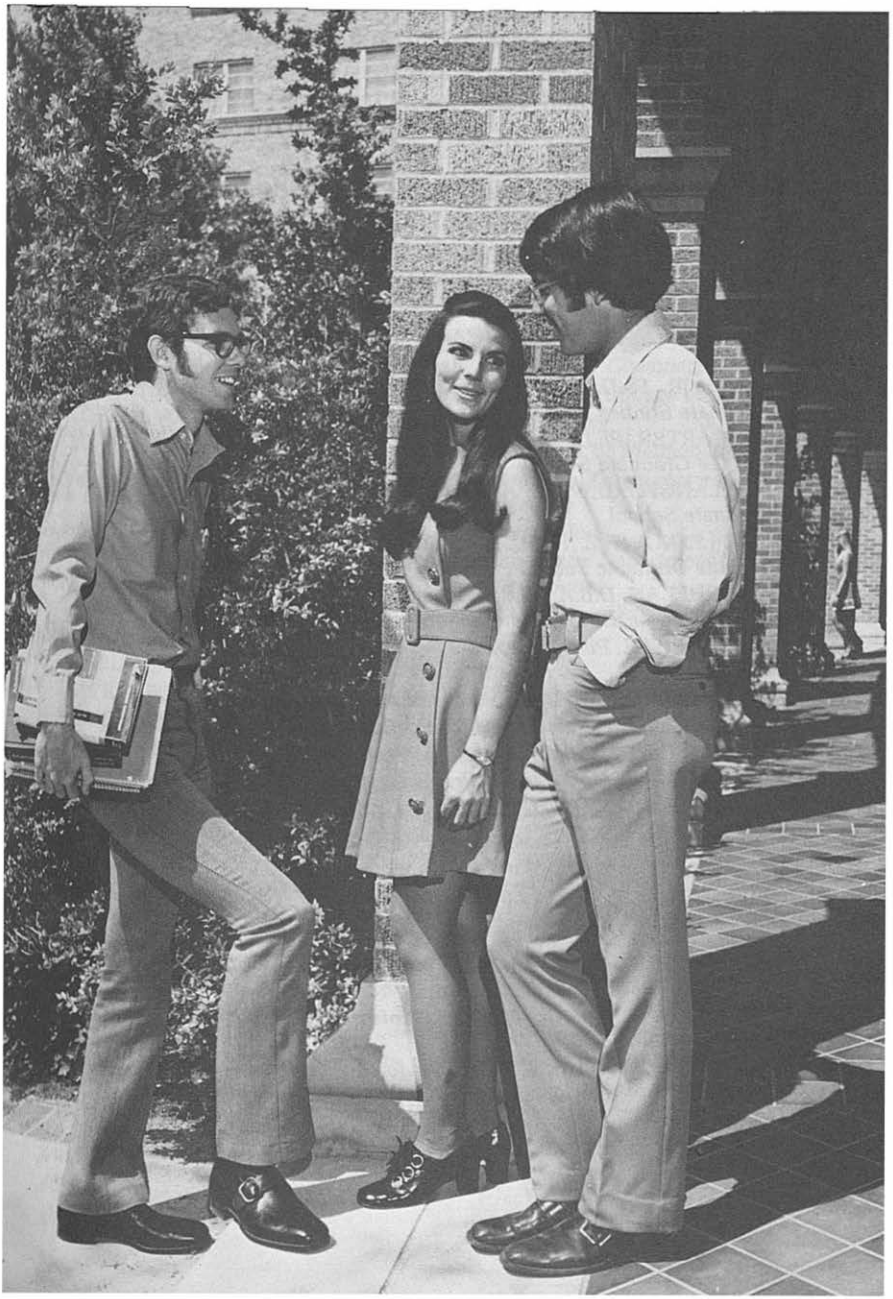

Graduate Council

The Graduate Council is composed of eleven members, nine of whom are elected by the graduate faculty and two of whom are appointed by the dean. The dean is *ex officio* chairman of the council; associate and assistant deans are *ex officio* and nonvoting members of the council as is the Vice President for Academic Affairs. Elective members serve for a period of three years and are not eligible for immediate reelection unless they have been chosen to fill an unexpired term. Appointive members serve for two years. By a system of rotation, some new members join the council each year, replacing those whose terms of office have expired. The dates after names listed below indicate the year of expiration of term of office.

The Graduate Council, assisted by the graduate faculty, is charged with the responsibility of formulating the policies of the Graduate School and the requirements for graduate degrees. These policies are administered by the dean.

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Graduate Faculty

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Members of the graduate faculty participate in all phases of the graduate program, assist in determining policy, and vote on candidates for graduate degrees. Membership is conceived of as a means of recognizing the members of the faculty for scholarly activities, creativity, direction of graduate research and study, and other contributions to the graduate programs of the University.

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OTTO MILLARD NELSON, *Ph.D., Associate Professor of History*

ROBERT LEE NEWELL, *M.S., Professor of Mechanical Engineering, Associate Dean of the College of Engineering, and Acting Chairman of the Department of Textile Engineering*

MERRILYN BETH NIEDERWERFER, *Ph.D., Assistant Professor of Home Economics Education*

DAVID K. NORTHINGTON, *Ph.D., Assistant Professor of Biological Sciences*

WILLIAM KIRK NORTON, JR., *Ph.D., Assistant Professor of Home and Family Life*

MARY SEYMOUR OWENS, *Ph.D., Professor of Health, Physical Education, and Recreation for Women and Associate Dean of the College of Arts and Sciences*

STEVE W. PANYAN, *Ph.D., Assistant Professor of Political Science*

RODERICK PARKINSON, *M.A., Associate Professor of Art*

GERALD D. PARR, *Ph.D., Assistant Professor of Education*

L. E. PARSONS, *B.S., Professor of Textile Engineering*

EARLENE L. PAYNTER, *Ph.D., Associate Professor of Speech and Theatre Arts*

WILLIAM LEON PEARCE, *Ph.D., Assistant Professor of Business Administration*

NEALE J. PEARSON, *Ph.D., Associate Professor of Political Science*

JOHN W. PELLEY, *Ph.D., Assistant Professor of Biochemistry*

FLOYD PERRY, JR., *Ed.D., Professor of Education, Associate Vice President for Academic Affairs, and Dean of Admissions*

ARLIN V. PETERSON, *Ed.D., Assistant Professor of Education*

RICHARD EMIL PETERSON, *Ph.D., Assistant Professor of Geosciences*

RUSSELL DEAN PETTIT, *Ph.D., Assistant Professor of Range and Wildlife Management*

FLORENCE L. PHILLIPS, *Ed.D., Professor of Psychology*

LEE J. PHILLIPS, *Ph.D., Assistant Professor of Industrial Engineering and Director of Continuing Engineering Education*

ROBERT HENRY PINDER, *Ph.D., Associate Professor of Home and Family Life*

GERALD N. PITTS, *Ph.D., Associate Professor of Computer Science*

JUANITA TITTLE POLLARD, *M.A., Professor of Art*

DAVID W. PORTER, *Ed.S., Associate Professor of Education*

CHARLES WILLIAM POST, *M.A., Associate Professor of Music*

J. C. PRABHAKER, *Ph.D., Associate Professor of Electrical Engineering*

RAY A. PURKERSON, *Ed.D., Assistant Professor of Education*

JOHN WILLIAM QUEEN, *M.F.A., Associate Professor of Art*

GUSTAVO M. QUESADA, *Ph.D., Associate Professor of Sociology and Health Communications*

DEE A. QUINTON, *Ph.D., Assistant Professor of Range and Wildlife Management*

LARRY RANDOLPH, *M.A., Associate Professor of Speech and Theatre Arts*

DONNA R. READ, *M.S., Associate Professor of Art*

CHARLES WESLEY REBSTOCK, *Ph.D., Associate Professor of Education*

MARYANNE REID, *Ed.D., Assistant Professor of Education*

ELBERT BRUNNER REYNOLDS, JR., *Ph.D., Associate Professor of Mechanical Engineering*

STEPHEN JAMES REYNOLDS, *M.A., Associate Professor of Art*

PATRICIA VICKERS RICH, *Ph.D., Assistant Professor of Geosciences*

CHARLES LATHAN RIGGS, *Ph.D., Professor of Mathematics*

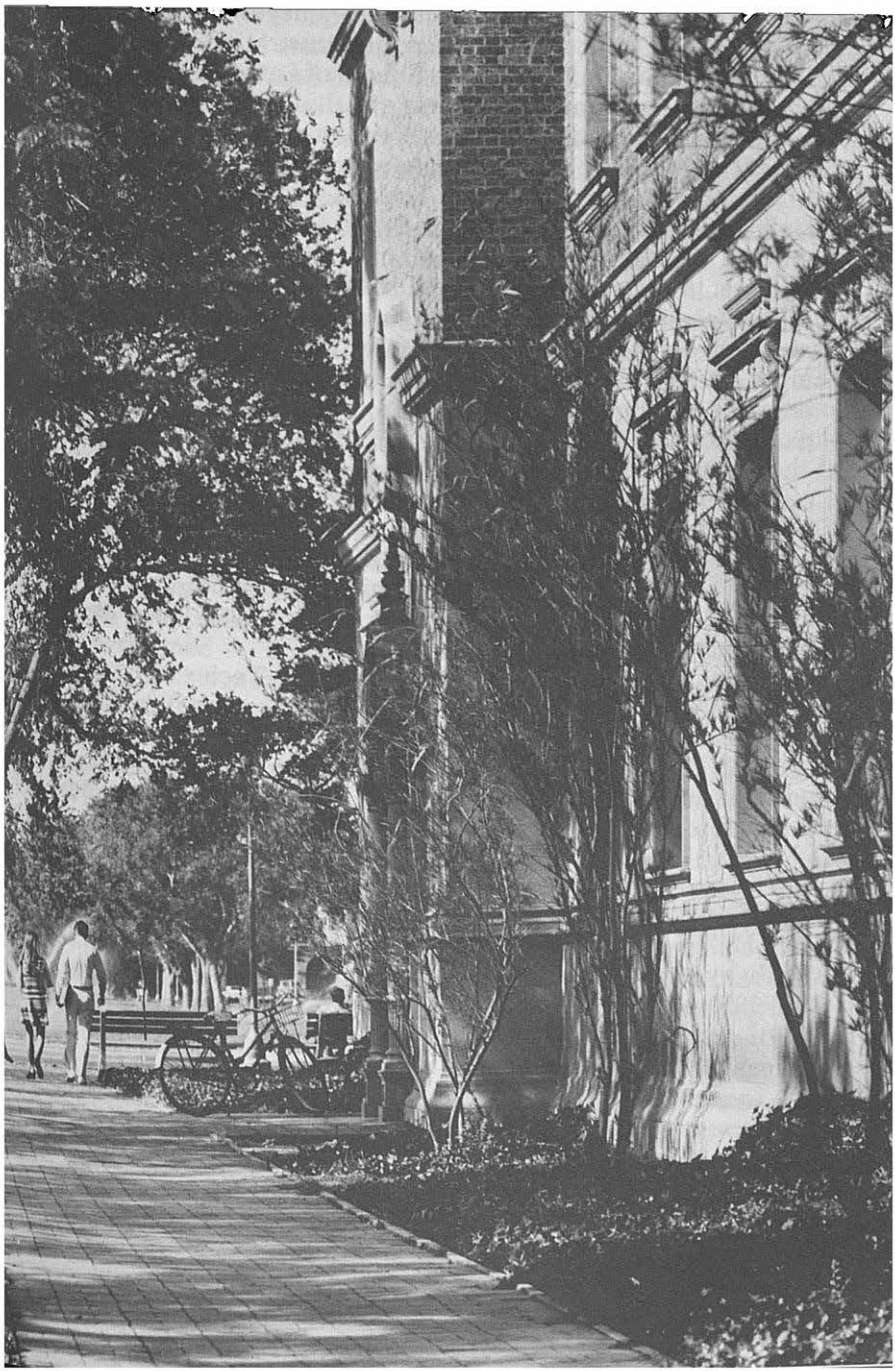
GEORGE STIEGLER ROBBERT, *Ph.D., Associate Professor of History*

LOUISE BUENGER ROBBERT, *Ph.D., Associate Professor of History*

ARTHUR THEOPHILE ROBERTS, *Ph.D., Professor of Business Administration*
WILLARD B. ROBINSON, *M.Arch., Associate Professor of Architecture and Curator of Historical Architecture*
DELILAH MANIRE ROCH, *Ph.D., Associate Professor of Clothing and Textiles*
RUTH M. ROGERS, *Ph.D., Associate Professor of Health, Physical Education, and Recreation for Women*
ROBERT ALAN ROOKER, *M.A., Associate Professor of Mass Communications*
BRENT S. ROPER, *Ph.D., Assistant Professor of Sociology*
S. BERNARD ROSENBLATT, *D.B.A., Professor of Mass Communications*
BILLY IRVAN ROSS, *Ph.D., Professor and Chairman of the Department of Mass Communications*
BLAIR A. ROWLEY, *Ph.D., Associate Professor and Chairman of the departments of Bioengineering, and Computer Medicine and Biomathematics*
DONALD W. RUDE, *Ph.D., Assistant Professor of English*
RONALD LEE RUSSELL, *Ph.D., Assistant Professor of Home and Family Life*
RICHARD EBERT SALZER, *Ph.D., Assistant Professor of Anthropology*
JOHN M. SANDERS, *J.D., Assistant Professor of Business Administration*
ALBERT JOSEPH SANGER, *M.S., Professor of Civil Engineering*
CHARLES WILLIAM SARGENT, *Ph.D., Professor of Health Communications*
CHARLES E. SASSE, *Ph.D., Assistant Professor of Animal Science*
RONALD EDWARD SCHULZ, *M.A., Professor of Speech and Theatre Arts*
HERMAN BRAZILL SEGREST, *Ed.D., Professor of Health, Physical Education, and Recreation for Men*
RALPH LOUIS SELLMEYER, *M.A., Professor of Mass Communications*
JOHN T. SENNETTI, *Ph.D., Assistant Professor of Business Administration and Statistics*
JACK SANDERS SEVALL, *Ph.D., Assistant Professor of Chemistry*
PATRICK W. SHAW, *Ph.D., Assistant Professor of English*
GERALD L. SHURBET, *Ph.D., Associate Professor of Mathematics*
BARBARA SIMMONS, *Ed.D., Assistant Professor of Education*
MILES E. SIMPSON, *Ph.D., Associate Professor of Sociology and Statistics*
VERA LOIE SIMPSON, *Ph.D., Associate Professor of Speech*
GERALD D. SKOOG, *Ed.D., Associate Professor of Education*
CHARLES A. SMITH, III, *Ph.D., Assistant Professor of Home and Family Life*
JIMMY HIRAM SMITH, *Ph.D., Associate Professor of Civil Engineering*
ROLAND E. SMITH, *Ph.D., Associate Professor of Political Science*
JEFFREY ROGER SMITTEN, *Ph.D., Assistant Professor of English*
WILLIS L. STARNES, *Ph.D., Assistant Professor of Biochemistry*
ROBERT G. STEADMAN, *Ph.D., Assistant Professor of Clothing and Textiles*
ELLA MAE STEELE, *Ed.D., Assistant Professor of Home and Family Life*
PATRICK R. STERRETT, *Ph.D., Assistant Professor of Anatomy*
ROBERT G. STEVENS, *Ph.D., Assistant Professor of Agronomy*
DOUGLAS MICHAEL STOCCO, *Ph.D., Assistant Professor of Biochemistry*
MICHAEL CARL STOUNE, *D.M.A., Associate Professor of Music*
LORUM H. STRATTON, *Ph.D., Associate Professor of Romance Languages*
MONTY J. STRAUSS, *Ph.D., Assistant Professor of Mathematics*
BETTY A. STREET, *M.S., Associate Professor of Art*
JAMES H. STRICKLAND, *Ph.D., Assistant Professor of Mechanical Engineering*
ERNEST WALTER SULLIVAN, II, *Ph.D., Assistant Professor of English*
ROBERT M. SWEAZY, *Ph.D., Associate Professor of Civil Engineering*
ALEXIS S. TAN, *Ph.D., Associate Professor of Mass Communications*

JERI TANNER, *Ph.D., Assistant Professor of English*
HASKELL GRANT TAYLOR, *M.A., Professor and Associate Dean for Administration, College of Business Administration*
THEODORE J. TAYLOR, *Ph.D., Assistant Professor of Economics*
OTIS WORTH TEMPLER, JR., *Ph.D., Associate Professor of Geography*
GEORGE TERESHKOVICH, *Ph.D., Associate Professor of Horticulture*
BETTY TEVIS, *Ph.D., Associate Professor of Health, Physical Education, and Recreation for Women*
ORLAN E. THOMAS, *D.M.A., Associate Professor of Music*
ARTHUR DUDLEY THOMPSON, *M.S., Professor of Architecture*
LEIF HARRY THOMPSON, *Ph.D., Assistant Professor of Animal Science*
PAUL EDWARD THOMPSON, *Ed.D., Associate Professor of Mathematics*
RICHARD EARL TOLLEY, *M.S., Professor of Music*
MYRON L. TRANG, *Ed.D., Assistant Professor of Education*
IDRIS RHEA TRAYLOR, JR., *Ph.D., Associate Professor of History*
THOMAS FREDERIC TROST, *Ph.D., Assistant Professor of Electrical Engineering*
ROGER MONROE TROUB, *Ph.D., Associate Professor of Economics*
YUNG-MEI TSAI, *Ph.D., Assistant Professor of Sociology*
BRIGGS L. TWYMAN, *Ph.D., Assistant Professor of History*
LOYD V. URBAN, *Ph.D., Assistant Professor of Civil Engineering*
WILLIAM G. VANDERBOK, *Ph.D., Assistant Professor of Political Science*
GENE S. VanHORN, *Ph.D., Assistant Professor of Biological Sciences*
WILLIAM PENNINGTON VANN, *Ph.D., Associate Professor of Civil Engineering*
MARY ANN VAUGHAN, *M.M., Associate Professor of Music*
RICHARD VENGROFF, *Ph.D., Assistant Professor of Political Science*
BEVERLY WOLFE VINSON, *Ph.D., Assistant Professor of Home and Family Life*
CHARLES ERNEST WADE, *Ph.D., Associate Professor of Business Administration*
JACK DOUGLAS WAGES, *Ph.D., Associate Professor of English*
FRED P. WAGNER, *Ph.D., Assistant Professor of Civil Engineering*
NORMA E. WALKER, *Ph.D., Professor and Chairman of the Department of Clothing and Textiles*
JOHN FRANK WALKUP, *Ph.D., Assistant Professor of Electrical Engineering*
ESTELLE HAYS WALLACE, *M.S., Professor of Home and Family Life*
DERALD DEE WALLING, *Ph.D., Associate Professor of Mathematics*
CHARLES RICHARD WARD, *Ph.D., Associate Professor of Entomology*
TERRY A. WATKINS, *Ph.D., Assistant Professor of Mathematics and Statistics*
JAMES TAGGART WATT, *Ph.D., Associate Professor of Business Administration*
ANTHONY BIDEN WAY, *Ph.D., Associate Professor of Anatomy*
RICHARD A. WEAVER, *Ph.D., Associate Professor of Speech and Theatre Arts*
JOEL C. WEINSHEIMER, *Ph.D., Assistant Professor of English*
JOHN THOMAS WHITE, *Ph.D., Associate Professor of Mathematics*
WILLIAM ELMER WHITTINGTON, *Ph.D., Professor of Business Administration*
JULIAN H. WILLIFORD, JR., *Ph.D., Assistant Professor of Food and Nutrition*
WELBORN KIEFER WILLINGHAM, *Ph.D., Associate Professor of Education*
MARGARET EILEEN WILSON, *Ph.D., Professor and Chairman of the Department of Health, Physical Education, and Recreation for Women*
WAYLAND H. WINSTEAD, *M.F.A., Assistant Professor of Speech and Theatre Arts*
ELEANOR WOODSON, *Ed.D., Associate Professor of Clothing and Textiles*
RUTH COWART WRIGHT, *Ph.D., Associate Professor of Political Science*
EHUD YAIRI, *Ph.D., Associate Professor of Speech*

JAMES T. YATES, *Ph.D., Associate Professor of Speech*
KENNETH B. YOUNG, *Ph.D., Assistant Professor of Agricultural Economics*
PAUL E. ZINTGRAFF, *Ed.D., Professor of Education*
WOLODYMYR TARAS ZYLA, *Ph.D., Professor of Slavic Languages and Literature*



General Information

Texas Tech University, which was founded in 1923 and enrolled its first students in the fall of 1925, is a state-supported, coeducational institution comprising the instructional colleges of Agricultural Sciences, Arts and Sciences, Business Administration, Education, Engineering, and Home Economics, the School of Law, the Graduate School, and a number of special departments and divisions. The 61st Legislature of the State of Texas authorized the creation of the Texas Tech University School of Medicine as a separate educational institution.

Lubbock, the home of Texas Tech, is a city of approximately 160,000 inhabitants. It is situated in the South Plains area of West Texas at an altitude of 3,250 feet. Dry, crisp air and sunny days throughout practically the entire year provide a healthful and invigorating climate.

The University campus, a contiguous tract of 1,839 acres, lies at the western edge of the business section of the city. University buildings number 209 and the plant value has been set at $140 million with an anticipated additional $17.5 million in construction to be added by the end of 1975 and $54.9 million by the end of 1976, including the first phase of the Texas Tech University School of Medicine.

The first president of Texas Tech was Paul Whitfield Horn (1925-1932). He was followed by Bradford Knapp (1932-1938), Clifford Bartlett Jones (1938-1944, President Emeritus, 1944-1972), William Marvin Whyburn (1944-1948), Dossie Marion Wiggins (1948-1952), Edward Newlon Jones (1952-1959), Robert Cabaniss Goodwin (1959-1966), and Grover Elmer Murray (1966-).

Graduate work has been offered at Texas Tech since 1927. In 1937 the graduate program became a separate unit under its own dean and council. Between 1928, when the first master's degree was awarded, and August 31, 1974 a total of 7,701 master's degrees had been conferred, and since 1952, when the doctorate was first awarded, 788 degrees have been conferred, of which 534 were Ph.D.'s, 183 were Ed.D's and 71 were D.B.A.'s.

Professors who have served as Graduate Dean are William Albert Jackson (1937-1938), Robert Cabaniss Goodwin (1938-1945), William Curry Holden (1945-1950), William Bryan Gates (1950-1963), Fred Durnford Rigby (1963-1968); Interim Graduate Deans Lawrence Lester Graves (1968-1970) and Thomas A. Langford (1970-1971); and current Graduate Dean J. Knox Jones, Jr. (1971-).

Special Facilities

Housing Accommodations. Prospective graduate students who are interested in living in a University residence hall should address an

inquiry to the Reservation Center, Box 4629, Texas Tech University, Lubbock, Texas 79409.

ICASALS. The International Center for Arid and Semi-Arid Land Studies (ICASALS) was established in 1966 when the Board of Regents adopted as the special mission of the University the study of arid and semi-arid lands, which comprise approximately half of the land surface of the earth. "Arid and semi-arid lands studies" is interpreted to mean not only the land itself and its plant and animal life, but man in all the varieties of his experiences in the dryer environments.

An integral part of the University, ICASALS has its foundations in the entire undergraduate and graduate academic structure. Guidance and coordination are provided by an Advisory Council composed of the University deans, the Vice President for Research and Graduate Studies, the Associate Vice President, and the Chairman of the Executive Committee of the Faculty Council. A Liasion Board consisting of representatives from each of the six colleges and two schools of the University, the Texas Tech University School of Medicine, the Texas Tech Library, and the Museum provides direct communication and coordination between ICASALS and the academic and functional units of the University.

ICASALS is the medium of stimulation, coordination, and implementation of symposia, public service programs, and information exchange pertaining to all aspects of arid lands and their inhabitants. It is directly concerned, also, with the application of data and techniques to human needs. It supports and facilitates the publication of results of arid and semi-arid land research. To the best of its abilities and resources it encourages and assists projects of all types, wherever a useful function may be performed — regionally, nationally, or internationally. ICASALS hopes by this means to render a significant contribution towards the social, technological, and economic advancement of arid and semi-arid regions.

Textile Research Center. The Textile Research Center has a continuing history of service in aiding the fiber and textile interests of Texas. The broadened scope of the Textile Research Center includes expanded activities in research on cotton, wool, and mohair, in addition to research on blends of natural and man-made fibers.

The objectives of the Center are to improve textile processing techniques and products utilizing the natural fibers, cotton, wool, and mohair, and blends of these fibers with other textile materials, including man-made fibers; to evaluate characteristics of fibers; to provide facilities and skilled personnel to help train students in textile science and engineering; and to assist the textile industry in solving problems from the processing of raw materials through the finishing of fabrics.

The facilities include a Physical Measurements Laboratory for determining the properties of fibers, yarns, and fabrics; a modern 1,000-spindle pilot plant for studying the relationships between fiber properties and variables in yarn manufacturing operations; a Structures

Laboratory incorporating knitting and weaving equipment for the creation of experimental fabrics; and a Chemical Processes Laboratory with laboratory-scale and production-scale equipment available for preparing, dyeing, and finishing fabrics.

Library. The University Library, the Law Library, the Medical Library, and the Southwest Collection are separate entities of the Library System of the University Complex coordinated by the Dean of Library Services.

The University Library serves the needs of both graduate and undergraduate students of Texas' third largest state-supported institution of higher learning. It contains some 1,490,194 bibliographic items, which include approximately 7,229 or more periodical subscriptions, and more than 317,589 units of microforms.

Thirty-four professional librarians, assisted by forty subprofessionals and over one hundred thirty-five students are on duty 103 hours per week to serve the library user. The following is the schedule of hours during the long term: 7:20 a.m. to 12 midnight, Monday through Friday; 8 a.m. to 5 p.m., Saturday; 2 p.m. to 12 midnight, Sunday. Holiday schedules vary and are posted well in advance. The summer schedule is subject to some variation with hours posted. Service is augmented by sixteen rapid-copy machines at the nominal price of five cents a page. The Library is a member of the Texas Information Exchange, which instantly links the Library with 30 other Texas libraries and some libraries outside the state by teletype.

Noteworthy is the fact that the University Library is one of two Regional Depositories for U.S. Government Documents in Texas. The *Checklist of United States Public Documents, 1789-1970,* contains bibliographic data on more than 2 million U.S. Government Publications. Part of this collection includes 1148 reels of microfilm of the papers of 12 of the U.S. Presidents. Also in book form are a series of papers now containing the first two volumes of the papers of Richard M. Nixon.

Museum. The Museum of Texas Tech University offers a total program of education, research, and public service in museum-related fields. The Museum contains important research collections in anthropology, art, biology, geosciences, and history. Graduate students and faculty members whose scholarly studies relate to the museum's collections may be assigned research space in the building. The Museum's library and public displays are open daily except Monday.

Graduate Studies. In 1972, under the auspices of the Director of Academic Publications, a continuing series entitled *Graduate Studies of Texas Tech University* was established. A refereed scholarly series, issued irregularly, the *Graduate Studies* is available to members of the Graduate Faculty of the University and, upon departmental recommendation, for outstanding dissertations and theses. By this means, the University provides for publication of outstanding results of research and

also for an exchange program through the library that enhances the collection of serial publications from other institutions.

Placement Service. Graduate students are urged to file their complete records (including photographs) with the Placement Service even though they may not contemplate immediate use of its facilities. Experience has shown that sooner or later almost every graduate with a master's or doctor's degree needs to have his record on file in the Placement office. To assemble such a record after a person has left the campus is difficult and sometimes impossible.

Southwest Collection. The Southwest Collection is both the University archives and a repository for historical information pertaining to the American Southwest.

Its quarters in the Social Science Building provide facilities for study and research, as well as space for receiving, sorting, and storing research materials such as personal papers, biographical data, noncurrent business records, maps, microfilms, tape recordings, periodicals, photographs, newspapers, and a library of Southwestern books and periodicals.

Manuscript holdings alone total over nine million leaves, and data pertaining to collections are published by the Library of Congress in the *National Union Catalog of Manuscript Collections.*

All materials may be used by both the University community and the general public for research or reference. Service is provided during the following hours: 8 a.m. to 5 p.m., Monday through Friday (open until 7 p.m., Tuesday); 8 a.m. to 12 noon, Saturday. Inquiries and donations are welcomed.

Student Health Service. The Texas Tech University School of Medicine operates the Student Health Service for all students in the Texas Tech University complex.

The Student Health Clinic is located in Thompson Hall. The clinic provides a walk-in type ambulatory service which supplies medical care of the scope which might be expected of a family physician's office. Treatment is confined to the clinic; physicians do not make dormitory or house calls. In-patient medical care is not provided by the Student Health Clinic. Where hospitalization is required, one of several excellent general hospitals in the community is utilized.

Additional details about the Student Health Service may be found in the *General Catalog* of Texas Tech University.

Fees and Deposits

The following information concerning fees and deposits applies only to semesters of long sessions; the *Summer School Bulletin* carries details about fees required in the summer terms.

Payment of Fees. Texas Tech University reserves the right to change fees in keeping with acts of the Texas State Legislature or the Board of Regents. All fees are payable in full within 10 days after the day of registration. Statements of tuition and other fees are mailed shortly (normally one day) after a student registers. The statement is mailed to the address indicated by the student on the Permit to Register. If the statement is not received within 5 days following registration, please contact the Office of Accounting and Finance. Duplicate statements are available; however, these cannot be mailed but may be picked up by the student. Payment may be made by checks printed with the magnetic ink characters or money orders payable to Texas Tech University. All checks and money orders are accepted subject to final payment. Cash will be accepted and receipts given for the payment of registration fees only by the University Cashier. Cash sent through the mail or transmitted in any other manner will be at the sender's risk. Failure to pay tuition and other registration fees will result in cancellation of a student's registration. A reinstatement fee of $5 will be charged to those students who subsequent to cancellation are permitted by the dean to reinstate such registration by payment of all appropriate tuition and registration fees.

Veterans who are residents of Texas may be eligible for exemptions under the Hazlewood Act. See the Coordinator of Veterans' Affairs in the Registrar's office.

Tuition Fees.

Tuition Fee for Resident Students: For legal resident students of the state of Texas, the tuition fee, each semester, is $4 per semester hour, but the total of such charge shall not be less than $50.

Tuition Fee for Nonresident Students: For nonresident students the tuition fee, each semester, is $40 per semester hour.

Tuition Fee for Foreign Students: For foreign students the tuition fee, each semester, is $14 per semester hour, but the total of such charge shall not be less than $200.

General Fees.

1. *General Property Deposit:* Each student enrolled in the University must make a general property deposit of $7. This deposit is subject to charges for property loss, damages, breakages, or violation of rules in the Library or laboratories.

A student is required to maintain a balance of $7 in his property deposit account. If the balance is below this amount he will be charged an additional fee sufficient to bring the account balance to $7. At his request this deposit, less charges, will be returned to the student upon termination of his tenure here as a student. Deposits will be held at least 60 days after the close of a semester, or after a student withdraws during a semester, so that all charges and fines may be accumulated from the various departments.

Under state law, deposits which remain without call for a refund for a period of four years from the date of last attendance will be forfeited and transferred to the Student Property Deposit Scholarship Account.

2. *Laboratory Fees:* A laboratory fee of $2 per semester is charged for all courses in which the combined lecture and laboratory credit is from 1 to 3 semester hours. For courses in which the semester credit is 4 semester hours or more the laboratory fee is $4 per semester.

3. *Student Services Fee:* Each student is required to pay a Student Services fee based on the number of semester credit hours for which he is enrolled. The required fee and the services to which the student is then entitled are as follows:

Credit Hours Enrolled	Required Fee	For Service Of
		*Group I**
1	$ 2.25	Campus Transportation System
2	4.50	KTXT-FM
		Student I.D. System
		University Daily
		Student Senate
		University Counseling Center
		*Group II***
3	6.75	(All of above)
4	9.00	University Health Center
5	11.25	
6	13.50	
7	15.75	
8	18.00	
		*Group III****
		(All of above)
9	20.25	Intramurals for Men
10	22.50	Intramurals for Women
11	24.75	Student Organizations
		Cultural Events
		University Theatre Productions
		Group IV
		(All of above)
		Texas Tech Band
		Texas Tech Chorus
12 or more	27.00	Texas Tech Symphony Orchestra
		Intercollegiate Athletics

*Students required to pay for Group I services may, at their option, elect to pay $18 for Group II services, $24.75 for Group III services, or $27 for Group IV services.

**Students required to pay for Group II services may, at their option, elect to pay $24.75 for Group III services, or $27 for Group IV services.

***Students required to pay for Group III services may, at their option, elect to pay $27 for Group IV services.

4. *University Center Fee:* This is a $5 fee authorized by state law to be paid each semester of the long session by every student enrolled for 3 semester hours or more.

5. *Student Use Fee:* This is a fee authorized by state law to be paid each semester by every student enrolled in the University. The charges per semester are as follows:

10 or more Semester Credit Hours	$50.00
9 Semester Credit Hours	49.50
8 Semester Credit Hours	44.00
7 Semester Credit Hours	38.50
6 Semester Credit Hours	33.00
5 Semester Credit Hours	27.50
4 Semester Credit Hours	22.00
3 Semester Credit Hours or less	16.50

6. *Fee for Change in Class Schedule:* Each time a student initiates a change in his previously approved class schedule he must pay a processing fee of $3 for each approved request. No charge will be made when the change is made for the convenience of the University. Any tuition and/or other fees chargeable as a result of class schedule changes will be made shortly after the 30th class day. Any tuition and/or other fees refundable as a result of class schedule changes will be made shortly after the 30th class day and in accordance with the following schedule:

1st class day through 12th class day	100 percent
13th class day through 14th class day	80 percent
15th class day through 20th class day	60 percent
21st class day through 25th class day	40 percent
26th class day through 30th class day	20 percent
After 30th class day	None

7. *Auditing Fee:* Students enrolled for 11 semester credit hours or less must pay a fee of $10 for the privilege of auditing a course.

Students enrolled for 12 semester credit hours or more who have obtained written permission from the dean may audit a course without paying an additional fee.

8. *Motor Vehicle Fees:* A fee is required for all motor vehicles to be parked on the campus at any time. A schedule of these fees, together with other vehicle information, is contained in the publication *Campus Traffic and Parking Regulations,* available at the Traffic and Parking Counselor's office or at the University Police Department.

9. *Identification Packet Replacement Fee:* Students who lose their ID Packets may have them replaced by applying at the Registrar's office. A fee of $5 will be charged any time during the semester for replacement of a lost ID Packet.

10. *Duplicate Certificate of Enrollment Fee:* A fee of 50 cents will be charged for each duplicate Certificate of Enrollment issued.

11. *Transcript Fee:* Copies of a student's transcript are available upon written request to the Registrar's office. A copy of the transcript includes only the academic record accumulated at Texas Tech University; copies of transcripts furnished from other institutions become the property of Texas Tech and will not be furnished by the University. The first copy of the transcript is free of charge; thereafter, the cost is $1 per copy, payable in advance. All transcripts must be requested by the student and must be made in writing. Adequate advance notice, normally one week, is required for transcript processing.

Special Fees.

1. *Fees for Private Music Instruction:* The University tuition fee does not cover the following costs for individual instruction offered by the Department of Music in voice and in wind and string instruments. When instruction is given in one of the following courses in applied music, the charges listed are made for each course, payable in full at the time of registration.

Applied Music 115, 116, 215, 216, 315, 316, 515 ..... $15
Applied Music 125, 126, 145, 146, 225, 226, 235, 236, 245, 246, 325, 326, 345, 346, 425, 426, 435, 436, 445, 446, 525, 535, 545 ..... $30

The following charges are made for practice room use and piano rentals; they are payable at the University Cashier's office:

One hour per day per semester $5.00
Each additional hour per day per semester $2.50
Musical instrument rental for class strings, woodwinds, brasses (each class) $2.50

2. *Fees for Use of Gymnasium Facilities:* Students not enrolled in a physical education laboratory course who wish to use the University gymnasium facilities will pay a fee of $1 per semester for use of lockers, if they are available. Towel service may be secured by payment of a $2 laundry fee plus a $1 deposit which will be refunded upon return of the towel.

3. *Graduation Fee:* Graduating students will be charged a graduation fee of $5 for each degree granted. The fee will be refunded, provided the student cancels his graduation intentions before the diploma has been printed and before other related steps are taken. If the student's intention to graduate is not cancelled in time, he will be charged $2 for reordering the diploma insert. If both the insert and the cover have to be reordered, the charge will be $5, as in the initial order.

4. *Fee for Binding Theses and Dissertations:* This fee is usually $3.10 per copy (plus state and city taxes) but is subject to change without notice. The fee for the microfilming of a doctoral dissertation is $25. Details are given in the section on Dissertation Fees.

Refund of Fees. Any student officially withdrawing during a semester, either at his request or at the request of the University because of failure to comply with a condition upon which his enrollment was

approved, will receive a refund on tuition fees, building use fees, applied music fees, and activity fees according to the following schedule:

1st class day through 14th class day	80 percent
15th class day through 20th class day	60 percent
21st class day through 25th class day	40 percent
26th class day through 30th class day	20 percent
After 30th class day	None
For courses of less than six weeks duration	None

Refunds of tuition and fees will be made according to the above schedule except (1) in no case will fees be refunded to a student suspended from the University by University authorities, and (2) full refund of tuition and fees will be made when the University is at fault. After a student has registered for a laboratory class and has once attended the class, no refund of the laboratory fee will be made unless the University is at fault. If the student is permitted to reenter school during the same semester in which he officially withdrew or was suspended, an additional reentrance fee of $5 will be charged.

Financial Assistance

University Assistantships (Available in nearly all departments)
- Teaching Assistantships
- Part-time Instructorships
- Research Assistantships

Federal Traineeships and Research Assistantships
- Research and Training Center (Research in Mental Retardation)
- Speech (Training in Speech-Hearing Problems)

Special Fellowships
- Available in a number of departments

University Counseling Center Positions
- Counseling Assistantships
- Reading Instructorships

Residence Hall Positions
- Head Residentships
- Resident Assistantships

Other Assistance
- Texas State Scholarships
- Federally insured and other loans

Inquiries concerning assistantships, traineeships, and fellowships should be addressed to the chairman of the department concerned. For information about residence hall positions, contact the University Housing Office. Information on other financial assistance is available from the Director, Division of Student Financial Aid.

Policies and Regulations

Graduate study is ideally characterized by intellectual curiosity and the desire to contribute to human knowledge. It is much more than a mere continuation of undergraduate work and should be contemplated only by those students who have demonstrated in their earlier studies exceptional intellectual ability and the capacity for independent thought and investigation.

For this reason, practically all graduate schools exercise some type of selectivity in their admission of students. Selective entrance requirements are partly for the maintenance of the high standards that must always characterize graduate study and partly for the benefit of students in helping them decide early whether they should undertake such work.

The Graduate School of Texas Tech University recognizes its obligation both to the standards mentioned above and to the citizens of Texas by a twofold classification of graduate students. In connection with the first obligation, the Graduate School requires evidence of an applicant's special ability for admission to its degree programs and reserves the right to decline to accept any applicant whose admission would not be to his best interest or that of the University. On the other hand, to fulfill its obligation to the citizens of Texas, the Graduate School makes its facilities available to a wide variety of students who are not eligible for advanced degrees or do not wish to become applicants for such degrees.

General

The Graduate School, like other colleges and schools of Texas Tech, reserves the right to institute, after due notice and during the course of a student's work toward a degree, any new ruling which may be necessary for the good of the University and therefore, ultimately, of recipients of its degrees. Normally a student may graduate under the provisions of the catalog in effect at the time he enrolls in the Graduate School.

Responsibility of Students. Each graduate student is expected to become thoroughly familiar with both departmental and Graduate School regulations and with the requirements for degrees. Failure to follow the regulations and requirements almost inevitably results in complications for which the Graduate School cannot assume responsibility.

To facilitate communications, graduate students should promptly notify the Graduate Office of their changes of address.

Graduate Advisers. The Dean of the Graduate School is the general adviser for all graduate students, but, insofar as the particular courses

are concerned, a student is counseled by the chairmen of his major and minor departments or by other professors designated for such counseling. Advisement in matters pertaining to teachers' certificates is the responsibility of the Director of Teacher Certification.

Enrollment by Faculty and Staff. Full-time members of the faculty and staff of Texas Tech University may enroll for courses by permission of the department chairman concerned. In registering for graduate work, they become subject to the usual regulations of the Graduate School. However, no member of the faculty who has held rank higher than instructor at Texas Tech normally is eligible to pursue a graduate degree program at this institution; exceptions require prior approval of the Graduate Dean.

Enrollment by Undergraduates. An undergraduate student who is within 12 hours of graduation and who has at least a B average in his major subject may enroll for courses carrying graduate credit, subject to the approval and certification of an acceptable grade-point average by the dean of his instructional college and the approval of the Dean of the Graduate School. This approval must be obtained on special forms at the time of registration. No course taken without this approval may be counted for graduate credit. Graduate work taken under this provision may not be used to meet undergraduate degree requirements.

An undergraduate who is permitted to enroll for graduate work as indicated above is required to take the Aptitude Test of the Graduate Record Examinations the first time it is administered after his enrollment for graduate work — if he has not taken it before.

The maximum amount of work that may be scheduled by an undergraduate taking courses for graduate credit is 16 hours in a semester or 6 hours in a summer term, including graduate and undergraduate work. Undergraduates permitted to enroll for graduate work are expected to receive their bachelor's degrees within a year of their first enrollment for graduate credit.

An undergraduate may not receive credit for more than 12 semester hours of graduate work completed prior to his admission to the Graduate School as an applicant for a graduate degree.

Extracurricular Activities. Graduate students may participate in extracurricular activities within University policies. They are encouraged to participate in honor societies for which they may be qualified. Graduate students who are satisfactorily pursuing full-time programs of graduate work are eligible to serve as officers in organizations of this type.

Work Load. A full graduate load normally varies from 9 to 16 hours in a semester or from 3 to 6 hours in a summer term. Students employed by the University in teaching or research capacities should adjust their enrollment to assure adequate time for fulfillment of their obligation to the University. Any questions concerning appropriate course loads should be referred to the Graduate Dean.

Full-time employees of the University usually are limited to 3 hours of graduate work in any semester or summer term; exceptions require appropriate supervisory approval and notification to the Graduate School.

Included in a graduate student's total load are extension courses and correspondence courses and also any courses that are being audited.

Students should be registered for the number of hours that reflects the extent of their involvement in the graduate program. This applies to research and thesis courses as well as formally structured classes. If a student is, for example, devoting full time to dissertation research, utilizing University facilities and faculty time, his schedule should reflect at least 12 hours of research or dissertation courses. A half-time teaching or research assistant should be enrolled for at least 6 hours even if working only on a thesis or dissertation in addition to his teaching duties.

Prerequisites for a Graduate Major. For a graduate major, an applicant must have completed, or must take, sufficient undergraduate work to insure adequate background for successful graduate work in the proposed field. With the approval of his department, the student may receive credit by examination for such leveling requirements. Any department may specify additional prerequisites if they are considered necessary and may require an applicant to pass an examination before his acceptance.

Residence. Study leading to a graduate degree involves sustained residence as well as the successful completion of course work. Residence is credited for work done on the campus of Texas Tech University and for certain types of courses (theses, field courses, practicums, internships, individual study, or any other such course) when offered at a place and under circumstances specifically established by the University in advance of the offering of the course.

Residence is not credited for work completed in the Division of Continuing Education.

The minimum residence requirements for graduate degrees will be found in the appropriate sections of this catalog.

Grades. The grades used in the Graduate School are the same as those used in undergraduate work (A, B, C, D, and F), but graduate credit is allowed only for courses completed with grades of A, B, and C, although grades of D and F are used in computing grade-point averages.

Upon departmental request and approval of the Graduate Dean, individually arranged courses, professional seminars, and certain other courses may (at departmental option) be graded P (pass) or F (fail).

No final grade assigned for a graduate-level course may be raised unless an error has been made. The substitution of another course for one completed with a low grade is not permitted.

Work completed at another graduate school with a grade less than B will not be accepted. In any case, grades on transferred work will not raise the grade average on courses completed in this Graduate School.

Symbols PR and I. The symbol PR (in progress) normally is assigned for every enrollment for a master's thesis (Course No. 631), or doctor's dissertation (Course No. 831) until the completed document has been approved by the student's committee and accepted by the Dean of the Graduate School. At that time the professor in charge will file change-of-grade forms replacing the symbol PR with letter grades.

PR may be given by a professor when a student's work in other research courses is not finished but is satisfactorily in progress at the end of a semester. This symbol must be replaced by a standard letter grade if credit is to be granted for the work.

The symbol I (incomplete) may be given by a professor when a student's work in a course has not been completed at the end of a semester and when the failure to complete the work has been due to causes beyond the student's control. It is not used as a substitute for F. When I stands for a year without action on the part of the student, it may become F.

Proficiency in English. A student found deficient in English may be required to complete satisfactorily certain specified courses in English usage (without graduate credit) before he is considered for admission to candidacy for a graduate degree.

Statement of Intention to Graduate. A student planning to graduate must file with the Graduate Office a "Statement of Intention to Graduate" approximately one month prior to the intended graduation date. (A list of deadlines will be sent to each student who indicates a current-semester graduation date on his registration form). No candidate's name will be placed on the "Tentative List of Graduates" for any graduation date unless this statement has been received at the Graduate Office by the specified deadline.

A candidate who fails to graduate at the expected time is required to file a new "Statement of Intention to Graduate" for any subsequent graduation.

Teacher Certification. Prospective students should understand that the material in this catalog applies only to requirements for graduate degrees and has no direct relation to certificates for public school teachers. The Graduate School gives no assurance that a program for a graduate degree and a program for a certificate will coincide. Students interested in certificates should confer with the Director of Teacher Certification at the outset of their work.

Admission to the Graduate School

Two types of admission are granted: 1) admission to a graduate degree program, and 2) admission as a special (nondegree) student. The requirements are explained in the following paragraphs.

Procedure for Admission to a Master's or Doctor's Degree Program. In order to be considered for admission to a graduate degree program at Texas Tech, an applicant must submit a formal application, transcripts of all previous college-level study, and scores on the Aptitude Test of the Graduate Record Examination (GRE). Applicants for programs in the College of Business Administration may submit scores on the Admission Test for Graduate Study in Business (ATGSB). At the time a formal application is made, the applicant should request that official transcripts be sent to the Director of Graduate Admissions from each college or university attended. In addition, the Educational Testing Service should be requested to send the official report of GRE or ATGSB scores to the Dean of the Graduate School.

The applicant should also contact the chairman of the department or program in which he or she hopes to study for information about any special admission requirements that unit may have, such as additional tests, applications, or letters of recommendation. The Dean of the Graduate School will not grant admission until all admissions materials have been received and the concerned academic department has recommended acceptance. The prospective student should apply in sufficient time (ordinarily at least three months prior to date of intended enrollment) to allow for the mailing of official transcripts and test scores and for the orderly evaluation of the documents. Some departments, operating on a limited quota of students each year, make final decisions as early as April 1.

Information about the GRE may be found below. Additional information about the GRE and the ATGSB may be obtained from Educational Testing Service, Princeton, New Jersey 08540.

An applicant who, because of current enrollment, cannot provide final transcripts at the time of his application should furnish transcripts of all completed study. He may then be considered for tentative admission upon the condition that final transcripts will be provided during the initial semester of enrollment at Texas Tech.

Applicants who, for reasons beyond their control, cannot provide all documents required for admission to a degree program by the time of planned initial enrollment may be considered for "special" admission (see below).

Procedure for Special (Nondegree) Admission. Any student who has earned a bachelor's degree at a recognized institution and who was in good standing at the school last attended may apply for admission as a "special student" in nondegree study. Educational Testing Service scores are not required for this type of admission. Transcripts of all

previous college study are required, except from an applicant who plans summer-only enrollment. However, the applicant who seeks to study for professional certification but not for degree credit must provide transcripts even if he expects to complete all certification work in summer-only study.

An applicant for admission to a degree program who has not been accepted may subsequently apply for "special student" admission. Also, as indicated above, a student who applies too late for full consideration for admission to a degree program before his planned initial enrollment may secure "special student" admission.

A student who is in special (nondegree) status has no assurance that work completed under this status will be applicable toward degree requirements should he subsequently gain admission to a degree program. In no case will more than 12 semester hours earned prior to admission to a degree program be counted toward degree requirements.

The Aptitude Test of the Graduate Record Examinations. The Aptitude Test is an objective type examination requiring approximately three hours and yielding two scores — Verbal (vocabulary and reading comprehension) and Quantitative (logical and mathematical reasoning).

All of the Graduate Record Examinations, of which the Aptitude Test is merely one, are prepared and scored by the Educational Testing Service, 20 Nassau Street, Princeton, New Jersey. (It has no connection with Princeton University.) A western office is maintained at 1947 Center Street, Berkeley, California 94704. Applicants from Texas should direct their correspondence to the Berkeley office.

The Graduate Record Examinations are administered in at least one center (usually several centers) in each of the 50 states and the District of Columbia, and in many foreign countries. In some of these centers, the tests are administered only once or twice a year; in many others, they are given six times a year, usually in January, February, April, June, October, and December.

Application blanks and details about the Aptitude Test and examination dates may be obtained from the Testing and Evaluation Division of Texas Tech University (which administers the tests in Lubbock), from similar agencies in other colleges and universities, or from the Educational Testing Service.

Each applicant is individually responsible for making arrangements to take the Aptitude Test and for having his scores sent to the Dean of the Graduate School, Texas Tech University, Lubbock, Texas 79409.

The completed application form and the examination fee (currently $10.50) must reach the proper office of the Educational Testing Service approximately a month in advance of the test date. Upon receipt of the application and the fee, the Educational Testing Service will mail the applicant a ticket of admission to the examination, specifying the room and the hour at which it will be held. In certain cases of financial hardship, the examination fee may be waived.

Continuation in the Graduate School. Every student enrolled in the Graduate School, whether he is working toward a degree or not, is required to maintain a high level of performance in his work and to comply fully with the policies of the institution. The Graduate School reserves the right to place on probation or to drop from its rolls any graduate student who does not maintain a satisfactory academic standing or who fails to conform to the regulations of the University or to the conventions of good citizenship.

Registration

Students who have been granted admission to the Graduate School are expected to register for course work whether or not they contemplate degree work. Failure to register ordinarily requires the student to reapply for admission.

The details of registration are under the jurisdiction of the Registrar, who furnishes to each enrollee complete instructions for all steps in the procedure. Students should follow carefully such instructions and those found below.

Departmental Approval of Courses. The student should have a schedule of courses approved by an official representative of the major department at the time of registration. It is the student's responsibility to see that course cards issued him correspond exactly to the courses listed on his schedule.

Enrollment of a graduate student in any course that carries graduate credit is automatically considered to be for graduate credit and affects relevant grade-point averages accordingly.

Registration in Session of Graduation. Even though there is only one commencement exercise each year, there are three official graduation dates: December, May, and August. Normally, every candidate for a graduate degree must be registered in the Graduate School in the session of his graduation. Failure to graduate at the expected time requires such additional registrations as may be necessary. As an exception to this rule, any student who fails to meet deadlines for a given graduation, but who completes all requirements for a degree prior to the following registration period, will not be required to register again.

Registration for Thesis or Dissertation Courses. Registration for a master's thesis (Course No. 631) is required at least twice; for a doctor's dissertation (Course No. 831), at least four times. Although concurrent multiple registration for each of these courses is common, only 6 hours of credit for 631 and 12 hours of credit for 831 will be reflected in final grades on the transcript. Students should be enrolled in thesis or dissertation courses every semester they are receiving direction or using University facilities on such projects. Normally a student should enroll for these courses under his committee chairman; however, in those instanc-

es where other professors on the committee are making substantial contribution to the student's research work, it is permissible for the student to enroll under those professors also.

Enrollment for thesis or dissertation courses is permitted only during a regular registration period. Students away from the campus may, however, register for such courses by mail, provided arrangements are made with the Registrar at least 30 days prior to the beginning of a registration period.

Registration When Using University Facilities. Students are required to register for appropriate courses in any term or semester in which they expect to receive assistance or use the facilities of the University.

Changes in Schedule and Withdrawal. A graduate student who wishes to drop a course or to withdraw from the Graduate School is required to make his request at the Graduate Office. A student who quits a course without official withdrawal will receive an F in that course.

After a schedule has been approved and the fees have been paid, each change will be subject to a charge of $3 unless it is made for the convenience of a department of the University.

Degree Programs

The Master's Degree

The requirements set forth in this section are in addition to those listed under the heading of "Policies and Regulations."

Prerequisites. Admission to a master's degree program is dependent upon the applicant's undergraduate record, his scores on the Aptitude Test of the Graduate Record Examinations, and the recommendation of his proposed major department.

A substantial body of undergraduate work in the major subject and considerable breadth of background are essential for graduate study. Therefore, students whose undergraduate programs are seriously deficient in breadth or depth may be required to complete additional preparatory work without degree credit.

Degrees Offered. In the "Program for the Master's Degree" and on the title approval page of a thesis, the exact and official designation of the degree must be used:

Master of Arts
Master of Art Education
Master of Business Administration
Master of Education
Master of Engineering
Master of Fine Arts
Master of Music
Master of Music Education
Master of Public Administration
Master of Science
Master of Science in Accounting
Master of Science in Agricultural Engineering
Master of Science in Chemical Engineering
Master of Science in Civil Engineering
Master of Science in Electrical Engineering
Master of Science in Home Economics
Master of Science in Industrial Engineering
Master of Science in Mechanical Engineering
Master of Science in Speech Pathology and Audiology

Major Subject. Every program for a master's degree not granted special exception must embody a major comprising at least 18 semester hours of graduate work (which may include a thesis) in a subject which has been approved for major work and for which the student has, or completes without degree credit, the necessary prerequisites for a graduate major as explained in an earlier section of this catalog.

Minor. Programs for a master's degree normally embody a minor representing approximately one-fifth to one-fourth of the total program.

Departments offering master's programs may, however, permit students to take all of their work for the degree within the department. A minor may be completed in a single department or in several departments, but the courses comprising the minor are subject to the following limitations: 1) they must carry graduate credit; 2) they must be acceptable to the student's major department; and 3) each course must be approved for the student by the department offering it. This approval is indicated in the degree plan by the signature of the department chairman (or graduate adviser) concerned. Its purpose is to make sure that a student does not enroll for a course for which he or she is not prepared.

Basic Plans for the Master's Degree. There are two basic plans for master's degree work: 1) a minimum of 24 hours of graduate course work plus 6 hours of the thesis course (631); 2) a minimum of 36 hours of graduate course work without a thesis. (Some degrees have a greater minimum hour requirement. An example is the Master of Fine Arts degree program, which requires 60 hours of graduate course work including a thesis or an exhibition.) The option to offer thesis or nonthesis programs is a departmental decision.

Filing the Official Degree Program. As soon as possible after admission to a degree program, but no later than during his first semester of work, the student should submit to the Dean of the Graduate School a "Program for the Master's Degree" as prepared by an official representative of the proposed major department and of other departments as indicated under "Minor" in the preceding section. Delay in submission of a degree program may result in postponement of admission to candidacy and graduation. The forms for the "Program" are available at the Graduate Office.

When the student receives an approved copy of his "Program" from the Graduate Office, he is expected to follow it as the basis of all subsequent enrollments. Substitution of courses can be made only on the written recommendation of the department or departments concerned and the approval of the Graduate Dean.

Approval of a "Program for the Master's Degree" does not, however, constitute admission to candidacy for a master's degree. It merely signifies that the proposed program will be acceptable if the student satisfies all of the regulations of the Graduate School and all of the requirements connected with his degree program.

Minimum Residence. The minimum residence for any master's degree is a full academic year or its equivalent of graduate work. Part-time enrollment is evaluated on a fractional basis.

Transferred and Extension Work. There is no automatic transfer of credit toward a master's degree, but, in general, work completed *in residence* at another accredited graduate school may, on the recommendation of the departments concerned, be accepted for as much as 6 semester hours toward a master's degree. Exceptions to this rule are granted in the case of the Master of Engineering degree and in certain

other instances upon agreement between the college or department concerned and the Graduate School. Work completed at another graduate school with a grade less than B will not be accepted.

A maximum of 6 semester hours of extension work completed through the Division of Continuing Education of Texas Tech may be credited on the course work for a master's degree (or a maximum of 9 hours on a 36-hour program) if the student had been officially admitted to the Graduate School prior to his enrollment for the extension work. Residence is not credited for extension work. Graduate credit is not granted for courses taken by extension at another university.

Not more than 9 semester hours (or 12 hours on a 36-hour program) of any combination of extension courses and courses completed elsewhere can be credited toward a master's degree.

Graduate credit is not granted for courses taken by correspondence.

Language Requirement. Although it is not a school-wide requirement, many departments require a reading knowledge of one or more foreign languages. (For information on this requirement, where it exists, see the appropriate departmental section in this catalog.) The essential purpose is to assure that the student gains access to scholarly literature of his field in more than one language. A foreign student may use his native language (if it is not English) to meet this requirement if this essential purpose is served thereby and his major department approves.

To qualify for Admission to Candidacy for a degree which requires knowledge of a foreign language, the applicant must demonstrate proficiency in one of the following ways (as specified by his department): 1) A student may fulfill the reading knowledge requirement by passing, with a B or better, the second course of the sophomore sequence of the required language. This grade must not be more than seven years old when a student's degree plan is submitted. 2) The student may enroll in one of the special 6-hour programs for graduate students offered by the departments of foreign languages. He must pass the second half of this program with a grade no lower than B. 3) The third plan for fulfilling the reading requirement is by examination. Under this plan the student passes one of the examinations furnished by the Educational Testing Service. Arrangements for taking these examinations in French, German, and Spanish can be made at the University Counseling Center which administers the tests for the Educational Testing Service. The examinations are given five times each year; the student should consult the Counseling Center for specific dates. The departments of Classical and Romance Languages and Germanic and Slavonic Languages will continue to administer the examinations in any acceptable foreign languages other than those listed above.

Tool-Subject Requirement. Some departments require a tool subject in lieu of, or in addition to, the language requirement. (For information on this requirement, where it exists, see appropriate departmental section of this catalog.) Where this provision is satisfied by formal

course(s), a grade of B or better is required, either in a single course or in the last of a sequence of such courses.

Grade Requirement for Graduation. For the master's degree, the minimum requirement for graduation is an average of B in the major subject, exclusive of credits for the master's thesis, and an overall average of B on all courses comprising the official program for the degree. Individual departments or colleges may have higher standards.

Admission to Candidacy. Every applicant for a master's degree is required to make formal application for admission to candidacy for the master's degree as soon as he has completed 9 to 12 semester hours of the work listed in his "Program for the Master's Degree," other than leveling courses. This application is submitted to the Dean of the Graduate School on a form obtainable at the Graduate Office.

The minimum interval between submission of the application for admission to candidacy and graduation is four months.

Admission to candidacy will be granted at such time as all of the following requirements have been met.

(1) Official admission to master's degree program has been received.

(2) At least 9 semester hours of the graduate work required for the master's degree have been completed.

(3) All required leveling work has been completed.

(4) An average grade of B or higher has been maintained in all graduate work.

(5) Proficiency in English and independent study has been acceptably demonstrated to the department.

(6) Proficiency in a foreign language or tool subject required for the particular degree has been acceptably demonstrated.

(7) The general field of the thesis has been stated and approved.

(8) Work to date is acceptable to the departments concerned, as attested by their approval of the application for admission to candidacy.

(9) The entire program conforms with the general requirements of the Graduate School and with the requirements of the particular degree.

Thesis. The master's thesis is expected to represent independent work by the student, conducted under the supervision of his committee, and to be written clearly and concisely in good English (or whatever other language may be appropriate). As soon as the student's area for thesis research has been determined, an advisory committee will be appointed by the Graduate Dean upon the recommendation of the major department. The committee must consist of at least two members of the Graduate Faculty. All members of the committee must approve and sign the thesis.

Available at the Texas Tech University Bookstore is a pamphlet entitled *Instructions for Preparing and Submitting Theses and Dissertations.* All manuscripts must conform to the published policies. An original and two copies of the thesis are required by the University.

Time Limit. With the exception of certain specially approved programs, work credited toward a master's degree must be completed within six years. Students whose graduate study here is interrupted by military service will be granted an extension of time for the period of their military duty, not exceeding five years.

Final Examination. Within the term or semester of intended graduation, and at a time specified by the major department, every candidate for a master's degree is required to pass a final comprehensive examination in the major field. The chairman of the advisory committee or the chairman of the major department should be consulted about the time and place of the examination.

A student who fails the final examination may repeat it once, but not until after an interval of four months or more.

At the discretion of the department concerned, a student who passes the examination but does not graduate within 12 months may be required to repeat the examination.

The Doctor's Degree

The requirements set forth in this section are in addition to those listed under "Policies and Regulations."

Admission to Doctoral Study. Admission to doctoral study is restricted to applicants whose backgrounds show definite promise of success on this, the highest level of academic endeavor. The formal requirements for admission to the doctoral program are a distinguished record in previous work (undergraduate and graduate) and a high score on the Aptitude Test of the Graduate Record Examinations. Each doctoral department has additional requirements which applicants must satisfy for admission. It is essential that the student communicate with departmental advisers on this matter.

Degrees Offered. Major work leading to the Doctor of Philosophy degree is offered in the following areas:

Agricultural Economics
Agronomy
Anatomy
Animal Science
Biology
Botany
Chemical Engineering
Chemistry
Civil Engineering
Economics
Electrical Engineering
Engineering (interdisciplinary)
English
Fine Arts

Geology
History
Home Economics
Industrial Engineering
Land Use Planning, Management and Design
Mathematics
Mechanical Engineering
Microbiology
Physics
Physiology
Political Science
Psychology
Range Science
Spanish
Zoology

The Doctor of Education degree is offered in several areas by the College of Education. The Doctor of Business Administration degree is offered with several areas of concentration.

Years of Study. A minimum of three years of graduate study beyond the bachelor's degree is required for the doctorate. Work completed for the master's degree may be considered as a part of this period if it forms a logical sequence in the entire program.

Work completed in the doctoral program of another recognized graduate school will be considered on the recommendation of the departments concerned, but no assurance can be given that such work will reduce the course or residence requirements in this Graduate School. In no case can transferred credit reduce the minimum residence (see below).

Doctoral study cannot be calculated solely in terms of credit hours, but the program for the doctorate normally requires the completion of 60 or more semester hours of work beyond the bachelor's degree, exclusive of credit for the dissertation.

Major and Minor. An applicant for the doctorate will devote most of his time to his major subject, but his program must include at least 15 semester hours beyond the bachelor's degree in a field(s) other than the general area of specialization. In the event that a student wishes to have an officially designated minor area, all 15 hours must be taken in that area.

In exceptional circumstances and with special approval, programs at variance with this description may be acceptable. Such programs must be clearly specified and approved by the major department and the Dean of the Graduate School.

In addition to any work completed elsewhere in a minor area, at least 6 semester hours must be completed here in that subject if it is to be considered an official minor.

Residence Requirement. Regardless of the amount of graduate work he may have completed elsewhere, every applicant for the doctorate is required to complete in residence in this Graduate School at least one year of graduate study beyond the master's degree or beyond the equivalent of this degree if he proceeds to doctoral work without taking a master's degree.

This residence is normally accomplished by the completion of a full schedule (at least 12 semester hours) of graduate work in each of the two

consecutive semesters of a long session. Students holding half-time graduate assistantships may satisfy this requirement by 9 hours of work in each of the long terms and 6 hours in the summer. Upon petition to the Graduate School, however, other patterns of residence may be approved if they include completion of at least 24 semester hours in a given 12-month period. The plan for completing this requirement should be submitted to the Graduate Dean prior to beginning residence. No part of this requirement can be satisfied by any type of off-campus enrollment.

Preliminary Examination. As early in his doctoral study as possible, the applicant will undergo a preliminary examination (oral or written or both), administered by the major and minor departments. This examination will serve as the basis of further counseling of the applicant. Its results will be reported to the Graduate Office on forms entitled "Doctoral Proposal and Report of Preliminary Examination" and obtainable in the Graduate Office.

Languages and Tool Subjects.

Doctor of Philosophy. Each department offering a doctoral program determines its language requirements, subject to the approval of the Graduate Council. Language requirements, if any, are described in the sections of this catalog devoted to instructional departments. In order to qualify for admission to candidacy in those programs which have a language requirement, applicants must demonstrate their competence in one of the following ways:

1) Students may fulfill the reading knowledge requirement by passing, with a B or better, the second course of the sophomore sequence of the required language. Those seeking to present a high level of competency will pass with a B or better the second course in the third year sequence of the language (except in the Department of English, which requires this level to be satisfied by making a B in a graduate course of an approved language). The second course of the sequence taken must be passed not more than seven years prior to the student's approval for doctoral work. 2) Students may satisfy the standard competency level by enrolling in one of the special 6-hour programs for graduate students offered by the departments of foreign languages. The second half of such a program must be passed with a grade no lower than B. 3) The third method of fulfilling the language proficiency requirement is by examination. The student will take one of the examinations furnished by the Educational Testing Service. Under this plan the student may demonstrate higher proficiency by surpassing an examination threshold score which is higher than that required for basic reading knowledge. Arrangements for taking these examinations in French, German, and Spanish can be made at the University Counseling Center. The examinations are given five times each year; the Counseling Center may be consulted for specific dates. The examination must have been taken not more than seven years prior to the student's approval for doctoral work.

The departments of Classical and Romance Languages and Germanic and Slavonic Languages will continue to administer the examinations in any acceptable foreign languages other than those listed above.

Some departments require a tool subject in lieu of, or in addition to, the language requirement. (For information on this requirement, where it exists, see appropriate departmental section of this catalog.) Where this provision is satisfied by formal course(s), a grade of B or better is required, either in a single course or in the last of a sequence of such courses.

Doctor of Education. In order to qualify for admission to candidacy, applicants for the Ed.D. degree are required to show competency in educational research methods and educational statistics, and also a foreign language if their research requires such competency. The examination in educational statistics is administered by a committee representing the College of Education.

Doctor of Business Administration. Early in his program, the D.B.A. student is required to demonstrate competency — by examination — in statistics, mathematics, computer use and basic management science. A core of tool requirements contains courses in advanced economics, statistics, and management science, which may be accomplished by either examination or a satisfactory grade in the appropriate courses.

Advisory Committee. As soon as an applicant has passed the preliminary examination administered by his major and minor departments, an advisory committee of at least three members will be appointed by the Graduate Dean on the recommendation of the departments concerned. This committee will hold meetings as often as necessary with the applicant and will direct his work at all stages.

Doctoral Proposal. The applicant and his major and minor departments will jointly complete and file at the Graduate Office the form, "Doctoral Proposal and Report of Preliminary Examination," on which will be indicated the results of the doctoral preliminary examination, a statement concerning the applicant's proficiency in English composition, and his plans for meeting requirements of residence, languages, and/or tool subjects and the course requirements in his major and minor subjects. The student's advisory committee also will be listed on this form. The form should be submitted as soon as possible after the results of the preliminary examination have been determined.

Qualifying Examination. The Qualifying Examination for Admission to Candidacy for the doctor's degree is one of of the major features of the doctoral program. This examination will be administered in both the major and minor areas of study. An applicant is eligible to stand for this examination only after he has satisfied the following requirements: 1) he must have been officially admitted to the doctoral program; 2) he must have passed the preliminary examination and have been provisionally accepted by his major and minor departments; 3) he must have received approval of his doctoral proposal from the Dean of the

Graduate School; 4) he must have completed most of the course work prescribed by his committee.

The Qualifying Examination normally is prepared and administered by the candidate's advisory committee and any other professors the committee or the Graduate Dean may consider necessary. In some instances the examination may be administered by the department or college concerned. The major portion of the examination is of an essay type, of at least six hours duration. It usually includes also an oral examination under the supervision of the committee and any other professors who may be invited to participate.

Procedure When the Examination is Satisfactory. If the Qualifying Examination is considered satisfactory and the requirements in languages (including English) and/or tool subjects have been met, the chairman of the advisory committee will send to the Graduate Dean, for consideration by the Graduate Council, a formal written recommendation that the applicant be admitted to candidacy for the doctor's degree. This recommendation should be forwarded as soon as possible after all the above requirements have been met.

Procedure When the Examination is Not Satisfactory. If the Qualifying Examination is not satisfactory, the chairman of the advisory committee will so notify the Graduate Dean, in writing. An applicant who does not pass the Qualifying Examination may be permitted to repeat it once, after a lapse of at least a semester or 15 weeks.

Admission to Candidacy. Authority for admitting an applicant to candidacy for a doctor's degree is vested in the Graduate Council. Upon receipt of a recommendation from the advisory committee, the Graduate Dean will submit it to the Graduate Council for action. The Council may approve the committee's recommendation, or it may, after consultation with the committee, suggest additional requirements which the applicant must satisfy.

By written communication, the Graduate Dean will transmit the results of the council's action to the applicant, to the chairman of his advisory committee, and to the chairman of the department concerned.

A student must be admitted to candidacy for the doctorate at least four months prior to the proposed graduation date.

Dissertation. A dissertation is required of every candidate for the doctorate.

The subject of the dissertation must be approved by the advisory committee and the Graduate Dean at least four months before the candidate's proposed date of graduation. The dissertation must demonstrate a mastery of the techniques of research, a thorough understanding of the subject matter and its background, and a high degree of skill in organizing and presenting the materials. The dissertation should embody a significant contribution of new information to a subject or a substantial reevaluation of existing knowledge, presented in a scholarly style. The work on the dissertation is constantly under the supervision

of the advisory committee and any other professors the committee or the Graduate Dean may consider necessary.

Available at the Texas Tech University Bookstore is a pamphlet entitled *Instructions for Preparing and Submitting Reports, Theses, and Dissertations.* All manuscripts must conform to the published policies.

An original and two copies of the dissertation are required by the University. They must be accompanied by two copies of an abstract, not more than 600 words in length.

Dissertation Fees. When a doctoral dissertation and its abstract have been approved by a student's advisory committee and accepted by the Dean of the Graduate School, the candidate will pay the University Cashier a "Microfilming and Shipping Charge" of $25 for the microfilming of the complete dissertation by University Microfilms, Inc. of Ann Arbor, Michigan, and the publication of the abstract in *Dissertation Abstracts.* (If the student elects the alternate plan of publishing only the abstract of his dissertation, the fee is $15.) Other services rendered by University Microfilms, Inc., are explained in the local pamphlet of instructions.

In addition to the fee indicated above, the doctoral candidate will pay to the Texas Tech Press the fee for binding the three official copies of the dissertation. Currently, this fee is $3.40 per copy (plus 5% city and state sales taxes), but like other fees, it is subject to change without notice as circumstances may require. If he wishes to do so, the student may have additional copies of his dissertation bound at the prevailing rate.

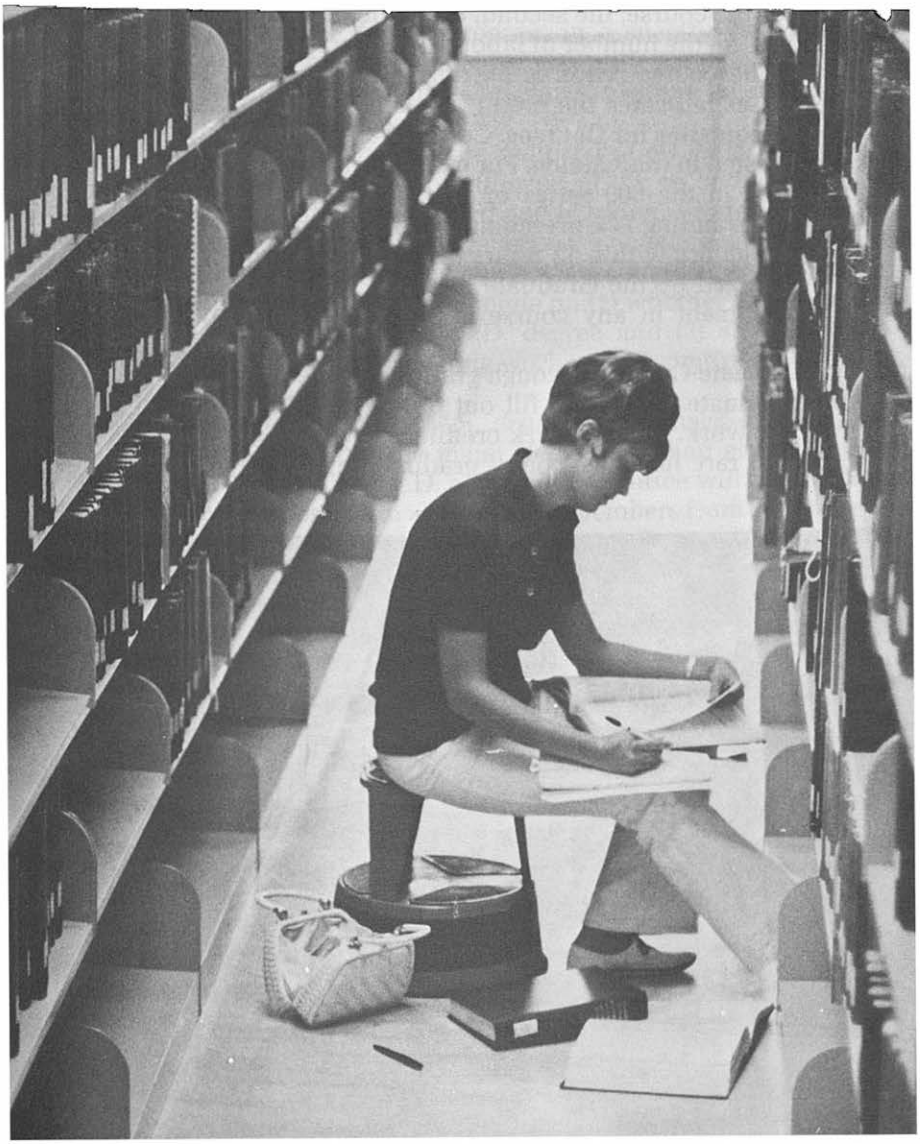
Grade Requirement. For the doctor's degree, the minimum requirement for graduation is an average of B in the major subject, exclusive of credits for the doctoral dissertation, and an average of B in all other courses taken for graduate credit outside the major. Individual departments and colleges may have higher standards than this minimum, school-wide requirement. No grade of less than B is acceptable for the dissertation.

Time Limit. All work for the doctorate must be completed within four years after the applicant has been admitted to candidacy.

Intervals Between Examinations. At least three months must intervene between the preliminary examination and the qualifying examination, and at least four months between the latter and the final examination.

Final Examination. A final public oral examination, usually over the general field of the dissertation, is required of every candidate for the doctorate. It may be scheduled at any suitable time after the dissertation (not necessarily the final version) has been approved by the advisory committee. The examination may not be administered until at least three weeks have elapsed following the candidate's submission to the Graduate Office of 70 copies of an announcement giving the time, place, and other information pertaining to the examination. (This announce-

ment should conform to a standard format available from the Graduate Office.) The examination is conducted by the advisory committee and the Graduate Dean or a professor designated to act in his place. If the advisory committee consists of fewer than five members, it should be enlarged for the purpose of the examination to a total of five or more members of the Graduate Faculty. All members of the committee participate fully in the examination and cast a vote. Professors other than members of the committee may participate in the examination, but have no vote in determining the outcome. At the conclusion of the examination, the chairman of the advisory committee will send a written notice to the Graduate Office, giving the result of the examination.



Explanation of Course Offerings

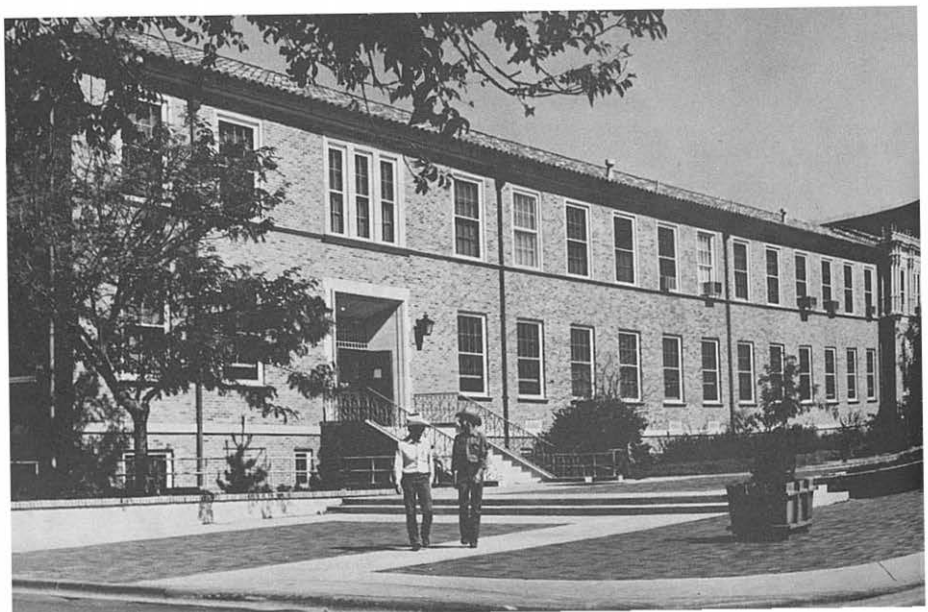
Not all of the courses listed in this catalog are offered every year. A class schedule, published just before the opening of each term or semester, indicates the courses to be available in that term or semester and the hours at which they will meet. The University reserves the right, however, to cancel any scheduled course, as well as to withdraw any program from the list of graduate offerings, if the best interests of the institution require such action.

Indication of Credit. The number of semester hours' credit for each course is shown immediately following its title, usually in this form: (3:2:3). The first digit in parentheses indicates the credit in semester hours for the course; the second, the number of lecture hours per week; and the third, the number of laboratory hours per week. If the third digit is zero, the course requires no laboratory work. A single number in parentheses indicates the credit in semester hours.

Prerequisites for Courses. Certain general prerequisites apply to all courses listed in this catalog. For example, all courses in this bulletin are numbered in the 500 series or above and are for graduate students. Graduate standing is a prerequisite for enrollment in such courses (except for seniors within 12 hours of graduation, whose enrollment may be authorized by the Graduate Dean).

Enrollment in any course must be approved by the department offering it.

Graduate Credit. Although graduate students occasionally enroll in undergraduate courses to fill out deficiencies in their preparation for graduate work. Course work credited toward a graduate degree must, except in rare instances, be of graduate level (500 or above).



College of Agricultural Sciences

Professor Anson Rabb Bertrand, Dean

Programs are available through the College of Agricultural Sciences leading to the Master of Science degree in thirteen major fields, and a Master of Education degree in Agricultural Education. Programs are also available leading to the Doctor of Philosophy degree in Agriculture with options in Agricultural Economics, Agronomy, Animal Science, and Range Science. An interdisciplinary program is offered leading to the Ph.D. degree in Land Use Planning, Management, and Design.

Minimum admission standards for the Ph.D. and M.S. programs will be those now used by the Graduate School; however, (1) admission to either the Ph.D. or M.S. degree program in a specific department requires formal approval by a departmental committee and (2) a specific department may require higher admission standards than the minimum requirements of the Graduate School.

A preliminary examination will be required of all Ph.D. students. The examination will be given before the end of the second long-term semester in which the student is enrolled and working toward the Ph.D. degree in the College of Agricultural Sciences. The student's progress will be evaluated at this point by the student's graduate advisory committee. Recommendations will then be made on (1) whether the student should continue work toward the Ph.D. degree and (2) any courses which the student should take as leveling work to overcome deficiencies revealed by the examination.

Advisory committees for the M.S. degree will consist of at least three members, with two from the major department and at least one from another department. The Ph.D. advisory committee will consist of a minimum of five members, with at least three members from the major department and two from outside the department. Responsibilities of the advisory committee are stated elsewhere in this catalog.

The requirements for minors will be the same as those previously specified in this graduate catalog for both the M.S. and Ph.D. programs.

No specific language or tool requirements exist for the Ph.D. programs in the College of Agricultural Sciences. However, such requirements may be incorporated in individual programs as appropriate.

Department of Agricultural Economics

Professor James E. Osborn, Chairman.

Horn Professor Williams; Professors Bennett and Fowler; Associate Professors Bell, Graves, Kennedy, Lee, Owens, and Roy; Assistant Professors Freeman and Young.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND OPTION FOR THE DOCTOR'S DEGREE

Students seeking a master's degree in the Department of Agricultural Economics should consult the chairman of the department about their programs before enrolling for any course. Before being recommended for admission to a master's or doctor's degree program with a major in Agricultural Economics, the student may be required to take (without graduate credit) such undergraduate leveling courses as may be specified by the department.

The department offers both the thesis and nonthesis options for the master's degree.

Courses in Agricultural Economics. (AECO)

511. **Seminar (1:1:0).** Current agricultural economic problems.

520. **Research Methodology in Economics (2:2:0).** Prerequisite: Graduate standing. Advanced training in research methods and procedures including role and uses of theory, problem selection, development and testing of hypotheses.

530. **Special Study in Agricultural Economics (3).** Prerequisite: Graduate standing and consent of instructor. Individual and group study in advanced topics in agricultural economics not treated in other graduate courses. May be repeated for credit.

531. **Advanced Production Economics (3:3:0).** Prerequisite: AECO 336 or equivalent and graduate standing. Criteria of resource efficiency; interindustry relationships; uncertainty and expectations; location and timing of production and technological changes.

532. **Agriculture and Public Policy (3:3:0).** Prerequisite: AECO 435 or equivalent. Analysis and evaluation of policies and programs affecting agriculture. Includes price and income policies, regulatory and service programs, marketing agreements and orders, antitrust and foreign trade policies.

533. **Seminar in Agricultural Marketing (3:3:0).** Prerequisite: AECO 337 or equivalent. Market structure analysis and public policy, interregional competition and regional economic development, economics of grading and marketing research.

534. **Research in Agricultural Economics (3).** A selected research problem in agricultural economics. May be repeated for credit upon approval.

535. **Contemporary Agricultural Economics (3:3:0).** Prerequisite: Graduate standing. Survey of the nature and development of basic economic principles and analytical economic research methods with applications to agriculture. For nonmajors only.

536. **Agricultural Distribution Economics (3:3:0).** Prerequisite: AECO 4315 or equivalent. Economic principles and quantitative analytical procedures applied to the marketing and distribution of agricultural products with emphasis on fundamental demand relationships emphasizing storage and inventory control; transportation and intermarket distribution; grades and quality control; product differentiation and price discrimination; location of processing facilities; and marketing programs.

537. **Advanced Statistical Methods in Economic Research (3:3:0).** Prerequisite: AECO 341, graduate standing, and consent. Advanced statistical methods of analyzing economic data based on probability theory with

emphasis on choice of statistical procedures, efficient use of computer programs, tests of significance, and interpretation of the results.

538. **Advanced Agricultural Resource Economics (3:3:0).** Prerequisite: AECO 4313, graduate standing, or consent. Economic theory and empirical investigation of resource utilization in agriculture with special emphasis on arid and semiarid land areas.

539. **Rural Economic Development (3:3:0).** Prerequisite: Graduate standing, AECO 436, 4313, or consent. The application of economic theory, alternative growth models, requirements for growth, and quantitative techniques to problems concerning rural economic development and growth with emphasis on agriculture.

5311. **Econometric Methods (3:3:0).** Prerequisite: AECO 432 and 4312 or equivalent and graduate standing. Formulation, statistical fitting, and use of single and multi-equation models for the analysis of economic data. Statistic properties of various estimators, historical developments, and efficient use of computer programs.

5312. **Operations Research in Agricultural Economics (3:3:0).** Prerequisite: AECO 432 and 4312 or equivalent and consent. Development, use, and evaluation of linear and nonlinear models including farm and enterprise profit maximization models, transportation and spatial equilibrium models, inventory and business accounting models, Markov Chain analysis, simulation models, input-output models, systems analysis and other operations research models applicable to agriculture.

5313. **Application of Computer Programming Techniques in Agricultural Economics (3:3:0).** Prerequisite: I E 321, AECO 341, or consent. Applications in agriculture and related business enterprises of programming techniques for digital computers with emphasis on selection of variables and programs, preparation of data, understanding and using programs, interpretations of results, and the writing of special programs.

5314. **Farm and Ranch Business Analysis and Management (3:3:0).** Prerequisite: AECO 334 or consent. This course is designed for vocational agriculture teachers, county agents, employees in agribusiness firms, and students outside the Department of Agricultural Economics working toward the M.S. degree. Major emphasis on farm planning and analysis, enterprise budgeting, cost, returns, resource requirements and acquisition, and financial growth and management.

631. **Master's Thesis (3).** Enrollment required at least twice.

731. **Research (3).**

831. **Doctor's Dissertation (3).** Enrollment required at least four times.

Department of Agricultural Education

Professor T. L. Leach, Chairman.
Professor Eggenberger.

MAJORS AND MINORS FOR THE MASTER'S DEGREE

Students seeking a master's degree in the Department of Agricultural Education should consult with Professor Eggenberger before enrolling in any courses. A student may earn either a Master of Science or a Master of Education degree.

All students are required to submit a satisfactory paper on a subject concerning agriculture or agricultural education in order to pass the English proficiency requirement of the department.

Courses in Agricultural Education. (AGED)

531. **Investigation in the Field of Agricultural Education (3).** Investigation of a problem in the field of agricultural education or extension education of special interest to the student; presentation of a paper. May be repeated for credit.

532. **Research Methods and Analysis in Vocational Education (3:3:0).** Adoption of research techniques to studies in agricultural education. The selection of a research topic and determining the correct research design and treatment of the data.

533. **Methods of College Agricultural Teaching (3:2:3).** Provides an opportunity for the observation, discussion, and exploration of various agricultural teaching methods. Also the essential conditions for effective learning and an appreciation of the problems of the student will be taught.

535. **Problems (3).** Problems in the field of agricultural education and extension education of special interest to the individual student. May be repeated for credit.

536. **Advanced Methods of Teaching Agricultural Mechanics (3:3:0).** Organization, management, and equipping the vocational agriculture shop; preparation and use of job sheets; demonstration of the use of correct shop teaching techniques; development of an agricultural mechanics course of study.

537. **History and Principles of Vocational Education (3:3:0).** Development of vocational education programs with emphasis on national and state legislation which has induced trends in the development of the current programs.

538. **Program Development in Agricultural and Extension Education (3:3:0).** Organization of educational programs on a local, county, state, and national basis. Study of cooperative extension in agriculture; development, objectives, organization, program building, and methods of teaching.

5310. **Advanced Methods in High School Vocational Agriculture (3:3:0).** Study and investigation of recent advances and concepts in specialized areas, and current problems in vocational agriculture.

5311. **Advanced Methods in Adult Agriculture Education (3:3:0).** Methods of determining needs, evaluating programs, and methods of teaching educational programs for adults involved in agriculture. Detailed study of Young Farmer Programs.

5312. **Advanced Methods in Future Farmer Work (3:3:0).** Building programs of work for Future Farmer chapters, preparing leadership materials, and a study of proficiency awards, advanced degrees, and scholarships available in Future Farmer work.

5313. **Organization and Administration of Vocational Education (3:3:0).** Preparation of vocational administrators in the areas of program standards for vocational education, finances, state plan, planning housing, recruitment and selection of personnel, and role of community advisory committees as applied to vocational education.

630. **Master's Report (3).**

631. **Master's Thesis (3).** Enrollment required at least twice.

Department of Agricultural Engineering

Professor J. Wayland Bennett, Acting Chairman.
Professors Grub and Ulich; Associate Professors Carpenter, Dvoracek, and Foerster.

MAJORS AND MINORS FOR THE MASTER'S DEGREE

Prior to enrolling in a graduate program in Agricultural Engineering, students should consult the department chairman or the department graduate committee chairman concerning requirements and programs of study.

Before being recommended for admission to a master's degree program with a major in this department, the student may be required to take a preliminary examination to determine proficiency in background for graduate work or may be required to take (without graduate credit) such undergraduate leveling courses as may be designated by the department graduate committee.

Within the basic degree requirements of the Graduate School, as given in this catalog, department major graduate students must enroll in a graduate seminar during each regular long-term semester enrollment. In addition, a designated minor and/or a tool-subject of no less than 6 credit hours is a department requirement. Students with minors in this department will follow the requirements of their major departments.

Courses in Agricultural Engineering. (AG E)

511. **Seminar (1:1:0).** Classical development of the agricultural engineering profession and significant research. Oral presentations and organized discussion. May be repeated for credit.

530. **Agricultural Engineering Research (3).** Advanced selected research problems in agricultural engineering. May be repeated for credit.

532. **Anstrumentation and Research Methods (3:3:0).** Principles, use, and limatation of instruments in measurement of physical quantities. Also research design, model study, analysis, and similitude.

533. **Advanced Theory of Farm Machinery Design (3:2:2).** Machine functional requirements, analysis of forces, loads, stress, materials, design, performance of series, testing of proto models, and manufacture.

534. **Theory of Agricultural Structures Design (3:3:0).** Theoretical approach to an analysis of structures applicable to agricultural enterprises. Materials and structural design for housing plants, animals, and produce.

535. **Design Theory of Earth Structures (3:3:0).** Design principles of earthen embankments: engineering soil classification, earth pressures, seepage, consolidation, settlement, slope stability, and landslides.

536. **Advanced Farm Electrification and Processing Systems (3:3:0).** Theory of electronic and mechanical controls for automated materials handling and processing systems related to agricultural plants and enterprises.

537. Advanced Theory of Water Utilization (3:3:0). Advanced study of surface and underground water resources and means of utilization for agricultural, domestic, and industrial purposes.

539. Bioengineering — Environmental Control (3:3:0). Bioengineering aspects of environmental research facilities. Analysis of plant and animal growth chambers, including restrained and unrestrained measurement of physiological functions.

5312. Similitude and Dimensional Analysis (3:2:3). Prerequisite: Basic mathematics and/or consent of instructor. Principles of dimensional analysis and their application to design of models. Design, testing, and interpretation of true, distorted, linear, and nonlinear models, analogies. Applications.

5314. Operations Research in Water Resources (3:3:0). Applications of linear and dynamic programming techniques to water resources problems; water resource systems analysis; water resources development; and operations research techniques.

5315. Soil Dynamics in Tillage and Traction (3:3:0). Prerequisite: Approval of instructor. Dynamic strength of soils including stress-strain relationships in the analysis of tractors and tillage devices. Experimental methods and techniques for determination of soil-machines relationships for agricultural and industrial application.

5316. Physical Systems in Hydrology (3:3:0). Prerequisite: Graduate standing. Major physical processes relating to hydrologic systems of the earth; linear and nonlinear analysis of hydrologic systems; model building; time series analysis, calibration and validation of hydrologic models.

631. Master's Thesis (3). Enrollment required at least twice.

Courses in Mechanized Agriculture. (MCAG)

531. Investigations in Advanced Agricultural Mechanics (3). Individual study or investigation of an advanced phase of agricultural mechanics. Emphasis on advanced mechanization technology. May be repeated for credit.

540. Technical Training Program Development (4). Prerequisite: Graduate student classification and approval of instructor. Individual study of technical mechanization training programs requiring a library search, on-the-job training, and term report. Prepares student for teaching in special industry and public educational programs.

5310. Advanced Applications of Field Machinery (3:3:0). Prerequisite: Graduate standing. Study of advanced field machinery capabilities, versatility, operation, and maintenance. Includes analyses of field job requirements, selection of equipment, operational procedures, supervision, and management.

5311. Electronic Controls in Agricultural Processing and Production Systems (3:3:0). Prerequisite: Graduate standing. Theory of electricity and electronic equipment for advanced agricultural enterprise applications. Includes automatic controls of mechanical devices for heating, cooling, lighting, timing, sensing, computation, and power applications.

5313. Physical Properties and Processing of Agricultural Products (3:2:3). Prerequisite: Graduate standing. Physical and biological properties of agricultural products. Advanced design theory of processing equipment, material flow, packaging, and alternative systems design.

Department of Agronomy

Horn Professor Harold E. Dregne, Chairman.
Professors Allen, Ayers, Bennett, Bertrand, Downes, and Harvey; Associate Professors Jaynes, Krieg, and Meyer; Assistant Professor Stevens.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND OPTION FOR THE DOCTOR'S DEGREE

Students seeking a master's or doctor's degree in the Department of Agronomy should consult the chairman of the department about their programs before enrolling for any courses. Major programs are available in crop science and soil science.

Before being recommended for admission to a master's degree program with a major in this department, the student may be requested to take a preliminary examination to determine proficiency in background for graduate work or may be required to take (without graduate credit) such undergraduate leveling courses as may be designated by the department.

If the preliminary examination for admission to doctoral studies reveals serious weaknesses in the student's subject matter background, the student may be required to take remedial courses designated by the graduate faculty of the department. The student's advisory committee will make recommendations concerning language requirements and basic work in other sciences.

Courses in Agronomy. (AGRO)

511. **Seminar (1:1:0).** Prerequisite: Approval of the instructor. Current literature in the field. May be repeated for credit on approval of major professor.

512. **Problems in Field Crops (1).** Prerequisite: Graduate standing and consent of instructor. Selected problems based on the student's needs and interest, not included in other courses. May be repeated for credit with approval of department.

513. **Problems in Soils (1).** Prerequisite: Graduate standing and consent of instructor. Selected problems based on the student's needs and interests, not included in other courses. May be repeated for credit with approval of department.

520. **Instrumental Analysis for Plants and Soils (2:1:3).** Prerequisite: Graduate standing and consent of instructor. A comprehensive review of the types and uses of analytical instruments available and used in making plant, soil, and water analyses. Theory and application of each instrument are emphasized.

530. **Pasture Management (3:3:0).** Prerequisite: Graduate standing and consent of instructor. The theoretical basis and fundamental principles of cultivated pasture management, interrelationship of grazing animals, soils, and pasture development and management. Influence of climate, evaluation of forages. International pasture problems.

531. Soil Fertility and Fertilizers (3:3:0). Prerequisite: AGRO 241 or 343; not open to students having had AGRO 4311 or the equivalent. Evaluation and application of theory to soil fertility and fertilizers; a study of growth curves and predicting crop response and nutrient need.

533. Pedology (3:3:0). Prerequisite: Approval of instructor. Processes of rock weathering with associated soil formation. Genesis of clay minerals. Soil forming factors and their interrelationships.

534. Research (3). Prerequisite: Approval of major professor. A specific problem in line with the major interest of the student. May be repeated for credit upon approval of major professor.

535. Inorganic Plant Metabolism (3:3:0). Prerequisite: BOT 331 or AGRO 4316 or consent of instructor. Relationships of the soil, water, plant systems to inorganic nutrition are discussed. Theories of ion uptake as related to membrane chemistry and tissue anatomy. Accumulation and function of inorganic elements in plant tissues. Influences of inorganic elements on soil environment and plant development. Emphasis on analytical aspects of plant nutrition.

536. Soil and Plant Relationships (3:3:0). Prerequisite: Approval of instructor. Selected topics in soil-plant relationships. Cause and effect, management, and control of factors influencing plant growth in the soil.

537. Methods in Plant Breeding (3:3:0). Prerequisite: Approval of instructor. Methods applicable to improving self- and cross-pollinated plants. Inbreeding, selection, hybridization, heterosis, quantitative inheritance, induced mutation, and ploidy.

538. Laboratory Methods in Plant Breeding (3:0:9). Prerequisite: AGRO 431 and graduate standing in agriculture or biology. Field study of plant breeding programs and techniques.

539. Soils and Crops in Arid Lands (3:3:0). Characteristics of soils and crops in arid lands of the world. Relation to environmental factors. Potential for utilization.

5310. Soil Physics (3:2:3). Prerequisite: Consent of instructor. Physical characteristics of soils and porous media and principles underlying flow and distribution of water, air, and heat in soils.

5311. Organic Plant Metabolism (3:3:0). Prerequisite: BOT 331 or AGRO 4316; recommended: CHEM 325 and 326 or consent of instructor. Considerations to cellular organization and its relation to cellular metabolism. Bioenergetics and biochemistry of the organic constituents of living systems including their synthesis and metabolism is considered. Emphasis also placed on use of analytical measurements of organic metabolism.

5312. Environmental Crop Physiology (3:3:0). Prerequisite: BOT 331 and consent of instructor. The plant-environment interaction in relation to growth and production of crop communities. Radiant energy, carbon dioxide, water, and temperature relationships in crop stands.

5313. Soil Mineralogy (3:3:0). Prerequisite: AGRO 436 or GEOL 241. The mineralogical makeup of sand, silt, and clay. The relation of physical and chemical soil properties to mineralogy.

5314. Advanced Soil Classification (3:2:3). Prerequisite: AGRO 241 or approval of instructor for nonagriculture majors. A study of the taxonomic System of Soil Classification as used in the United States.

5315. Herbicidal Action in Plants (3:2:3). Prerequisite: AGRO 4313 or consent of instructor. Mode of action and factors affecting herbicidal movement and reactions in plants.

612. **Selected Topics in Crop Science (1).** Prerequisite: Graduate standing and approval of instructor. Advanced topics selected by departmental recommendation. May be repeated in different areas.

613. **Selected Topics in Soil Science (1).** Prerequisite: Graduate standing and approval of instructor. Advanced topics selected by departmental recommendation. May be repeated in different areas.

631. **Master's Thesis (3).** Enrollment required at least twice.

632. **Advanced Genetics (3:2:3).** Prerequisite: AGRO 341 or consent of instructor. Basic principles of plant inbreeding, hybridization, selection, and progeny testing.

634. **Advanced Soil Chemistry (3:2:3).** Prerequisite: AGRO 436 or consent of instructor. Adsorption reactions, ion activities, solubility characteristics, equilibrium reactions.

635. **Advanced Soil Physics (3:2:3).** Prerequisite: AGRO 5310 or consent of instructor. The physical constitution and properties of soils.

638. **Metabolism of Crop Plants (3:2:3).** Prerequisite: AGRO 5311 or consent of instructor. Energy, adsorption, solution, and chemical reactions in plants.

831. **Doctor's Dissertation (3).** Enrollment required at least four times.

Courses in Production Horticulture. (PRDH)

511. **Seminar (1:1:0).** Prerequisite: Approval of instructor. Current literature in the field. May be repeated for credit.

512. **Problems in Fruits and Vegetables (1).**

531. **Fruit and Vegetable Research (3).** Prerequisite: Consent of major professor. An outline of a specific problem of specialized study not included in regular course work. May be repeated for credit with approval of major professor.

532. **Fruit and Vegetable Crop Behavior (3:3:0).** Prerequisite: BOT 331. Crop responses and their modification. Recently developed techniques used to regulate physiological processes in growth and maturation of fruit and vegetable crops.

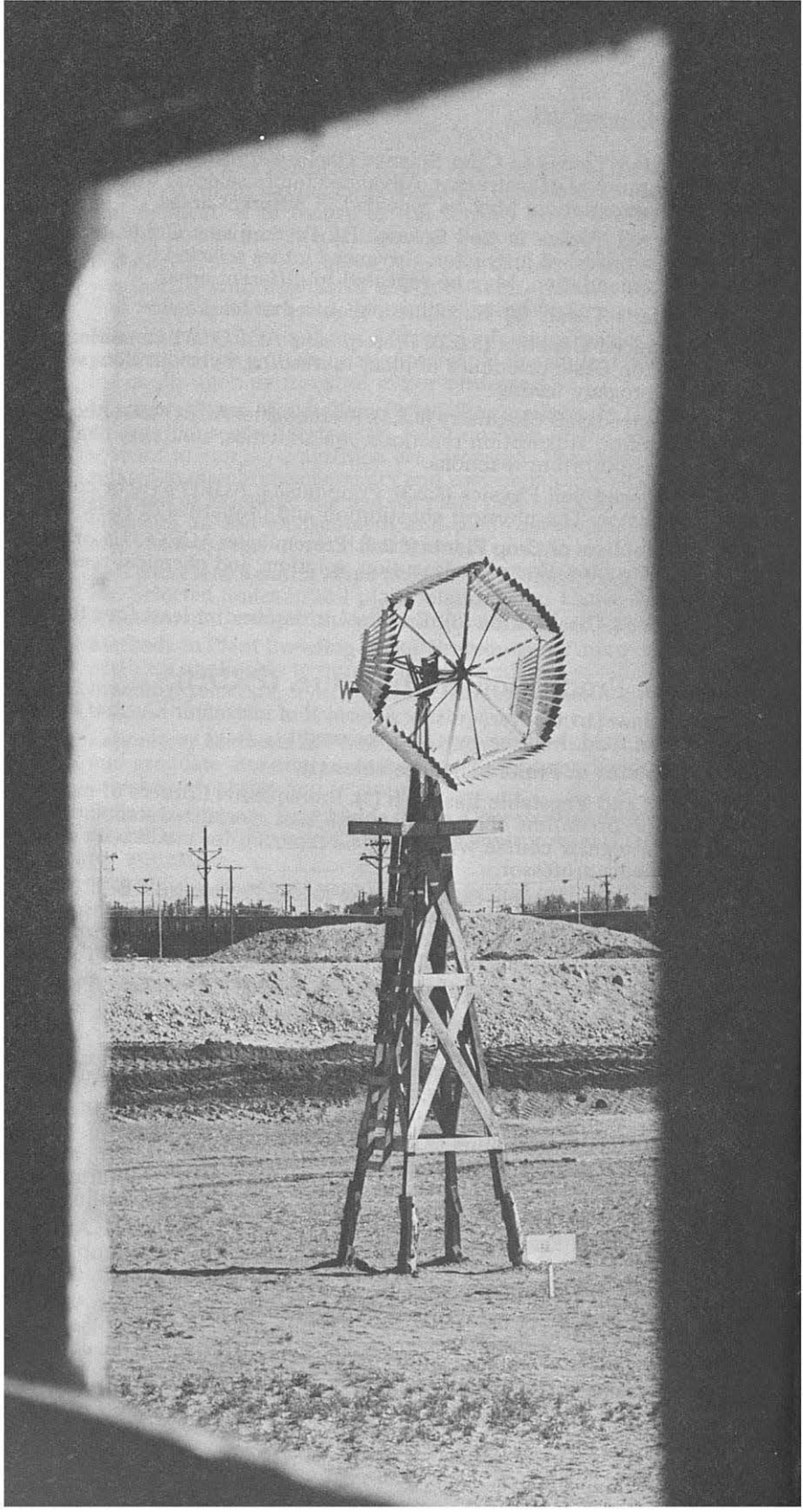
534. **Selected Topics in Fruit Production (3:3:0).** Prerequisite: PRDH 431. Recent developments in production requirements, trends in mechanization of production and harvest.

535. **Selected Topics in Vegetable Production (3:3:0).** Prerequisite: PRDH 435. Recent developments in production requirements, trends in mechanization of production and harvest.

536. **Post Harvest Handling of Fruit and Vegetable Crops (3:3:0).** Prerequisite: BOT 331, AGRO 4316, or approval of instructor. Control of physiological changes and associated economic values of crops after harvest by refrigeration, controlled atmosphere, and proper handling.

537. **Breeding of Fruit and Vegetable Crops (3:3:0).** Prerequisite: AGRO 341. Application of genetic principles to fruit and vegetable crop improvement. Techniques employed in breeding programs. Required projects.

538. **Horticultural Research Methodology (3:2:3).** Prerequisite: ANSC 536, AECO 341, or approval of instructor. Definition of problem and research objectives, design of experiment, data collection, analysis, interpretation, and economic evaluation. Use of canned computer programs and supplemental statistical analyses.



Department of Animal Science

Professor A. Max Lennon, Chairman.
Professors Albin, Baumgardner, Curl, Durham, Hudson, Ramsey, Sherrod, and Tribble; Associate Professor O'Brien; Assistant Professors Gaskins, Sasse, and Thompson.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND OPTION FOR THE DOCTOR'S DEGREE

Students seeking a master's or doctor's degree in the Department of Animal Science should consult the chairman of the department about their programs before enrolling for any courses. Admission to the Graduate School requires departmental recommendation as well as the approval of the Graduate Dean.

Master's Degree Programs

Applicants for the master's degree may pursue one of three courses of study: (1) animal breeding (physiology, genetics), (2) animal nutrition, or (3) meat science. Before being recommended for admission to a master's degree program with a major in this department, the student may be requested to take a preliminary examination to determine proficiency in background for graduate work or may be required to complete (without graduate credit) such undergraduate leveling courses as may be designated by his advisory committee.

Doctor's Degree Program

The candidate for the Doctor of Philosophy degree in Agriculture with an option in Animal Science may emphasize one of several areas of interest. Among the areas of major study are animal genetics, animal nutrition, reproductive and general physiology, and meat science.

If the preliminary examination for doctoral studies reveals serious weaknesses in the student's subject matter background, the student may be required to take remedial courses designated by the graduate faculty of the department.

Courses in Animal Science. (ANSC)

511. **Seminar (1:1:0).** Analysis of current and significant past research. Oral presentations and discussions; enrollment required in each semester of student's residence.

521. **Animal Protein Nutrition (2:2:0).** Prerequisite: CHEM 5330, 5331. An in-depth study of nitrogen metabolism in animals, evaluation of protein feedstuffs, and protein requirements for production.

522. **Animal Mineral and Vitamin Nutrition (2:2:0).** Prerequisite: Permission of instructor; CHEM 5330 and 5331. An in-depth study of vitamin and mineral chemistry, metabolism, interrelationships, and requirements for production.

523. **Animal Energy Utilization (2:2:0).** Prerequisite: CHEM 5330, 5331; permission of instructor. An in-depth study of energy utilization in animals, evaluation of sources, and requirements for production.

524. **Ruminant Nutrition (2:2:0).** Prerequisite: CHEM 5330, 5331; permission of instructor. A study of the digestive physiology of ruminants. Emphasis to be placed on rumen fermentation and its relationship to practical nutrition. Individual topics and current research information.

531. **Developmental Growth and Fattening (3:3:0).** A study of differentiation, development, growth, and fattening of domestic animals as influenced by hereditary and environmental interactions, and the interrelationships of growth and fattening with the physical and chemical composition of the body.

532. **Environmental Physiology of Domestic Animals (3:3:0).** The study of animal-environment relationships with particular emphasis upon animal acclimitization to environmental conditions encountered in arid and semiarid land areas.

533. **Techniques in Animal Research (3).** Techniques currently employed in animal research. Inservice training in the use and application of these techniques.

534. **Research in Animal Science (3).** Inservice research work in breeding, nutrition, or meats. Problems are done on a semi-independent basis. Design and carrying out of actual experiments, including publication of results. May be repeated for credit.

535. **Endocrinology (3:3:0).** A study of the endocrine glands and their secretions. The role of hormones in livestock production, including their influence upon metabolism dietary requirements, growth, reproduction, lactation, and fattening.

536. **Biometry (3:2:2).** Introduction to biological statistics sampling techniques; normal distribution; confidence intervals; testing hypotheses; nonparametric methods; linear regression and correlation; one way analysis of variance; mean separation procedures.

537. **Advanced Animal Breeding (3:3:0).** Population parameters. Heritability and heterosis. Genetic-environmental interactions. Methods for deriving population statistics. Genetic bases for performance testing programs.

539. **Physiology of Reproduction (3:2:2).** Anatomy of reproductive systems; physiological regulations of reproductive processes; estrous cycle; gonadal functions; semen evaluation; fertilization; embryology; pregnancy; parturition; lactation; factors affecting reproductive efficiency; research techniques.

541. **The Science of Meat and Meat Products (4:3:3).** The application of various scientific disciplines in the study of meat and meat products. Histological, chemical, and biological properties of meat. Palatability characteristics, nutritive value, and quality factors. Preservation and packaging. Methods of analysis.

542. **Computer Processing of Biological Data (4:3:1).** Prerequisite: Permission of instructor. The application of electronic computers to the processing of biological data including basic computing concepts, use of library programs, and programming of related problems. Problems in the students' own areas will be solved.

543. **Advanced Analysis of Biological Data (4:3:1).** Prerequisite: Permission of instructor. Analysis of biological data resulting from unbalanced experiments. Least squares, analysis of variance, multiple regression.

544. **Principles of Animal Pathology (4:3:3).** Prerequisite: ANSC 447 or its equivalent; permission of instructor. A course designed to present the

principles of animal pathology and provide essential background information for the interpretation of animal diseases that the student may encounter.

545. **Pathology of Organ Systems (4:3:3).** Prerequisite: ANSC 544. A course designed to apply the principles learned in ANSC 544 to the organ systems. Various disease processes, including neoplasia, as they relate to organ systems are studied.

5312. **Advanced Studies in Specialized Areas of Animal Science (3:3:0).** Study and investigation of recent advances and concepts in specialized areas, research techniques, and current problems. May be repeated for credit. Advanced graduate standing only.

5313. **Advanced Beef Production (3:3:0).** Advanced study of beef production and management. Emphasis to be placed on the application of current research for improving the efficiency of beef production.

5314. **Advanced Swine Production (3:3:0).** Advanced study of swine production and management. Application of research in swine genetics, nutrition, physiology, environment, and disease production. Current status of swine research.

5321. **Advanced Meat Science (3:3:0).** Advanced study of meat components, their development, and effect on meat characteristics and processing properties. Emphasis on current scientific literature.

631. **Master's Thesis (3).** Enrollment required at least twice.

731. **Research (3).** Investigation in areas of current interest. May be repeated for credit.

831. **Doctor's Dissertation (3).** Enrollment required at least four times.

Entomology

Professors Ashdown and Huddleston; Associate Professor Ward; Assistant Professor Foster.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND MINORS FOR THE DOCTOR'S DEGREE

The Entomology Section offers programs of study leading to the Master of Science degree under the aegis of the arthropod biology program (see Interdisciplinary Programs section of this catalog). Specialization is available in agricultural, environmental, medical and veterinary, urban and industrial, and systematic aspects of entomology. Minors for the master's and doctor's degrees from other departments are encouraged.

Although the basic degree requirements of the Graduate School are followed, students should consult the Entomology chairman concerning adequacy of undergraduate preparation and the program for graduate work before enrolling for any courses.

Stipends are awarded to qualified applicants. Nonresident tuition is waived with the award. Students having this support have special responsibilities in research projects.

Courses in Entomology. (ENTO)

511. **Seminar (1:1:0).** A central theme will be chosen for each semester; relevant topics will be assigned for each week. A selected student will be charged with the major responsibility of preparing for and leading each week's discussion. May be repeated for credit.

531. **Entomology Research (3).** Prerequisite: Consent of major professor. An outline of a specific problem of specialized study not included in regular course work. May be repeated for credit with approval of major professor.

532. **Literature and History of Entomology (3:3:0).** Prerequisite: A basic entomology course or permission of instructor. The background and development of entomology as a science is traced through its historical literature. Concepts of insect life and taxonomy from the ancients down to modern genetic concepts are developed.

533. **Advanced Insect Taxonomy (3:1:6).** Prerequisite: Basic entomology and ENTO 334 and 335 or permission of the instructor. Description, keys, and literature for determining insects to genus and species. A specialized group will be assigned for detailed study.

534. **Advanced Economic Entomology (3:3:0).** Prerequisite: ENTO 231, 321, or graduate standing. Factors influencing insect control, with special emphasis on the principles of insect control, resistance, and new control measures, as they relate to specific insect problems.

535. **Systematic Entomology (3:3:0).** History and principles of insect classification: taxonomic procedures and rules of nomenclature.

536. **Advanced Insect Morphology (3:2:3).** Prerequisite: A basic entomology course or permission of the instructor. The structure and function of insect organ systems.

537. **Pesticides (3:3:0).** Prerequisite: An introductory course in entomology. Advanced study of the registration, development, and legal use of pesticides.

631. **Master's Thesis (3).** Enrollment required at least twice.

Department of Food Technology

Professor M. L. Peeples, Chairman.
Associate Professor Miller; Assistant Professor Maxson.

MAJORS AND MINORS FOR THE MASTER'S DEGREE

The department emphasizes the technological aspects of food handling including the application and coordination of the physical and biological sciences, economics, and engineering to the development, processing, packaging, quality control, and distribution of foods. Research programs are in food microbiology and fermentation, food chemistry, food engineering, and commodity products.

The increasing consumer demands for greater varieties of highly nutritious and convenience foods of uniformly high quality create many and varied career opportunities in the food and allied industries, including management, research and development, process supervision, quality control, procurement, distribution, sales, and merchandising.

Before enrolling in any courses, students seeking the master's degree in Food Technology should consult the chairman of the department concerning adequacy of undergraduate preparation and the program for graduate work.

Courses in Food Technology. (FD T)

530. **Research in Food Industry (3).** Scientific research problems of industrial nature. May be repeated for credit.

532. **Selected Topics in Food Technology (3:3:0).** May be repeated for credit.

533. **Research in Food Technology (3).** Scientific research in problems of technological nature. May be repeated for credit.

534. **Additives for Food Processing (3:3:0).** Information on the properties and uses of direct food additives as preservatives, antioxidants, sequestrants, surfactants, stabilizers, flavorings, color, and other.

535. **Processing Characteristics of Major Food Constituents (3:3:0).** Isolation and characteristics of plant and single cell protein, refining and modification of fats and oils, processing of carbohydrate materials, and control of water quantity and state in foods.

536. **Advanced Food Processing Techniques (3:1:4).** This course allows for practice in the processing and formulating of food products at the pilot plant level. May be repeated for credit at discretion of advisor.

537. **Advanced Food Analysis Techniques (3:1:4).** May be repeated at discretion of advisor.

631. **Master's Thesis (3).** Enrollment required at least twice.

Department of Park Administration, Landscape Architecture, and Horticulture

Associate Professor George Tereshkovich, Acting Chairman.
Professor Kitchen; Associate Professors Mertes and Zukauckas; Assistant Professor Fish.

MAJORS AND MINORS FOR THE MASTER'S DEGREE

The program in Park Administration is one of the earliest established in the field. Undergraduate programs in park administration and horticulture have received national acclaim. Landscape architecture receives special emphasis along with environmental and outdoor recreation study programs.

The department offers a flexible interdisciplinary program leading to the Master of Science degree. Individual needs and career objectives are fully considered, and the department welcomes students with bachelor's degrees in a wide variety of fields. Primary emphasis is focused on environmental management, leisure science, park and open space planning, and regional resource analysis and development.

An interdisciplinary program at the doctoral level, entitled Land Use Planning, Management, and Design, is offered through the Graduate School. See Interdisciplinary Programs section of this catalog for description.

Multidisciplinary environmental and outdoor recreation research within the department has support from the university and from federal, state and local agencies. Participating units include the National Park Service, U.S. Army Corps of Engineers, Texas Parks and Wildlife Department, and Division of Planning Coordination, Office of the Governor, and southwestern cities and counties.

A Graduate Record Examination score of at least 1,000 and other requirements established by the Texas Tech University Graduate School must be met. General character references and past experience in park administration or allied fields are also considered.

Stipends are awarded to qualified applicants. Nonresident tuition is waived with the award. Students having this support have special responsibilities in research projects.

Courses in Park Administration. (P A)

531. Park Administration Research (3). Prerequisite: Consent of major professor. An outline of a specific problem of specialized study not included in regular course work. May be repeated for credit with approval of major professor.

532. Research Methods in Park Administration (3:3:0).

534. State, Regional, County, and Metropolitan Park Systems of the Country (3:3:0). A review of the more important park systems of the country. Organization, administration, operation.

535. National Park System and Other Federal Agencies Administering Federal Lands (3:3:0). Prerequisite: Consent of instructor. A review of federal programs which created outstanding examples of recreational facilities.

536. Interpretation Techniques (3:3:0). Prerequisite: Consent of instructor. Methods of interpretation of historical, ethnic, and cultural aspects of a region.

538. Contemporary Problems in Management of Renewable Natural Resources (3:3:0). Prerequisite: Permission of instructor. Interdisciplinary graduate course dealing with current issues in natural resources management.

540. Advanced Park Administration (4:3:2). Essential to the development of advanced park administration concepts is the ability to ferret out fundamental facts, analyze this data, and make critical accurate judgements for sound decisions and subsequent action. The aims and topics included within the syllabus outline are geared to achieve these ends.

541. Advanced Park Planning and Design (4:1:8). The advanced student, through analysis and interpretation, develops comprehensive long-range plans for area, regional, state, and national park systems. Recreational needs, tourism, conservation, recreational economics, policies, and legislation are incorporated into this research and planning.

542. Advanced Park Planning and Design (4:1:8). Prerequisite: P A 541. A continuation of P A 541, in which the advanced student, through analysis and interpretation, develops comprehensive long-range plans for area, regional, state, and national park systems.

5333. Outdoor Recreation Systems Planning (3:3:0). Prerequisite: Approval of instructor. Location theory applied to the allocation of natural resources for outdoor recreation development. Topical areas include bas-

ic central place theory, site analysis, supply, need, geographic factors affecting demand, time and distance factors affecting location of park and recreation areas, alternative methods of estimating future use, economic valuation of recreation developments, economic impact on local areas, cost and investment considerations, pricing and paying for outdoor recreation areas and facilities, and major political-economic policy issues in outdoor recreation.

5334. **Recreational Programming and Analysis (3:3:0).** Prerequisite: College algebra, one year of economics, and approval of instructor. Application of principles of management, public administration, and systems analysis to the administration of natural resources for recreation and other uses. Emphasis will be on the application of resource managing agencies at various levels. Additional techniques include planning, programming, and budgeting and critical path project planning. Course will utilize the team approach with speakers or lecturers from management and economics.

5335. **Principles of Tourism (3:3:0).** Prerequisite: Approval of department. Survey course dealing with the history, philosophy, taxonomy, and general state of the art of tourism. Focus will be international, national, regional, state, and local. Course will take a systems approach with emphasis on the various linkages within the recreation tourism complex. Private, quasipublic, and public development will be considered.

5336. **Regional Resource Analysis (3:3:0).** Prerequisite: Approval of department. Techniques for evaluation of the economic, social, political, and resource base of a community with emphasis on the planning and development of park and open space areas. Methods of community analysis include economic base study, land use study, power structure study, communications, and leadership identification.

5337. **Field Studies in Regional Resource Analysis (3:3:0).** Prerequisite: P A 5336. Participation by the class in the development of a community analysis, physical and policy planning, and implementation framework. Work involves several meetings in the community, with private and public leaders such as government, business, industry, commerce, education, religion, and other civic groups. Students will have the opportunity for interaction with key decision makers and community leaders. Emphasis will be on planning parks, recreation facilities, and open space.

5339. **Plants in an Urban Society (3:3:0).** A study of representative groups of selected trees, shrubs, and nonwoody materials, with specific reference to their importance in urban environments. Emphasis on relationships, distribution, usage, and effects of the changes in environment on plants, man, and other components of the ecosystem. Course will focus on use of indigenous materials of the southwest.

631. **Master's Thesis (3).** Enrollment required at least twice.

Courses in Horticulture. (HORT)

511. **Horticulture Seminar (1:1:0).** Review and discussion of current literature in the field. May be repeated for credit.

531. **Horticulture Research (3).** Prerequisite: Consent of major professor. An outline of a specific problem of specialized study not included in regular course work. May be repeated for credit with approval of major professor.

532. **Ornamental Plant Behavior (3:3:0).** A recent approach to the modifications in crop responses and recently developed techniques used to

regulate physiological responses of growth and production of horticultural crops.

533. Horticultural Plant Evaluation Techniques (3:3:0). The fundamental methods, means, data taking, and analysis to permit a clearer understanding and more thorough analytical techniques.

631. Master's Thesis (3). Enrollment required at least twice.

Department of Range and Wildlife Management

Professor Donald F. Burzlaff, Chairman.
Professors Dahl and Wright; Associate Professors Ueckert and Sosebee; Assistant Professors Garcia, Quinton, and Pettit.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND OPTION FOR THE DOCTOR'S DEGREE

Students seeking a Master's or Ph.D. degree in the Department of Range and Wildlife Management should consult the chairman of the department about their programs before enrolling for any courses. Areas of emphasis are available in either range science or wildlife management.

Both thesis and nonthesis programs are available at the master's degree level. The former requires a minimum of 24 credit hours of graduate course work plus 6 credit hours of thesis. The nonthesis program requires a minimum of 36 credit hours of graduate course work of which 9 must be closely related and of a supporting nature in a specific discipline.

Before being recommended for admission to a master's degree program with a major in this department, the student may be requested to take a preliminary examination to determine proficiency in background for graduate work and may be required to take (without graduate credit) such undergraduate leveling courses as may be designated by the department.

If the preliminary examination for admission to doctoral studies reveals serious weaknesses in the student's subject matter background, the student may be required to take remedial courses as designated by the graduate faculty of the department. The student's advisory committee will make recommendations concerning language requirements and supporting work in other sciences.

There is no general foreign language requirement for the Ph.D. degree, but such a requirement may be incorporated in individual programs if appropriate. All doctoral candidates must complete two semesters of calculus and a course in experimental designs.

Courses in Range and Wildlife Management. (R&WM)

510. Seminar (1). Prerequisite: Departmental approval. An organized discussion of current problems in range and wildlife management. May be repeated.

530. Fire Behavior and Ecology (3:2:3). Application of weather and fire behavior principles to prescribed burning; planning and conducting prescribed fires; the role of fire in succession and management of plants and animals in all major vegetation types of U.S.

531. Synecology (3:3:0). Prerequisite: R&WM 436 or equivalent. An advanced study of the range eco-system, causes and patterns of community development; coactions of plants and animals; and dynamics of succession and community change. Field trips required.

533. The Physiological Basis for Grazing Management (3:2:3). A study of the physiological processes, morphological development, nutritional qualities, and palatability of range plants and their effect on animal production.

535. Problems in Research (3). Prerequisite: Approval of instructor. Individual study and research in range and wildlife-related problems. May be repeated for credit.

536. Ecology of Arid Lands (3:3:0). Prerequisite: Approval of instructor. A study of the unique ecological features of arid lands, including plant and animal adaptations.

537. Range Research Methods (3:2:3). Prerequisite: ANSC 536, AGRO 532 or approval of instructor. Methods and techniques of measuring range vegetation. Methods of analysis and presenting data. Application of experimental designs to range problems.

538. Contemporary Resource Use (3:3:0). Prerequisite: Approval of instructor. Review and assessment of current natural resource problems. Emphasis is placed on ecological relevance, research, and application of management.

539. Experimental Design and Analysis (3:2:2). Prerequisite: ANSC 536 or equivalent. Definition, description, and evaluation of the principal experimental designs and methods of analysis.

540. Advanced Range Management Planning (4:3:3). Prerequisite: R&WM 337 and 436 or equivalent. Advanced course in range inventory, analysis, and management planning.

541. Wildlife Epizootiology and Pathobiology (4:3:2). Prerequisite: Graduate standing in wildlife management or biology. An upper-level course dealing with the diseases and disease agents of lower vertebrates, particularly those wildlife species of economic significance. Emphasis will be placed on the diagnosis and management of infectious and noncommunicable diseases.

5310. Advanced Studies in Wildlife Habitat (3:3:0). Prerequisite: Approval of instructor. An ecological approach to game management stressing the relationships between animals and their habitat. Field trips required.

5311. Waterfowl Ecology (3:2:3). Prerequisite: R&WM 433 or approval of instructor. An ecological examination of waterfowl behavior, breeding biology, and habitat requirements. Field trips required.

5313. Advanced Upland Game Ecology and Management (3:2:3). Prerequisite: Approval of instructor. An advanced study of the ecology and management of upland game resources. Field trips are required.

5314. **Plant Ecophysiology (3:3:0).** Prerequisite: R&WM 436, BIOL 333, and BOT 331 or approval of the instructor. Advanced study of the influences of the environmental complex on the processes, structure, and physiological functioning of an individual plant or species.

5316. **Advanced Range Ecology (3:2:3).** Prerequisite: Approval of instructor. An advanced study of plant-soil-animal interactions on rangelands. A thorough analysis of plant communities and factors causing their change as well as the qualitative and quantitative characteristics are studied. Field trips required.

5318. **Wildlife Conservation and Management (3:3:0).** An examination of conservation principles and management practices enhancing wildlife populations. A terminal course not open to range and wildlife majors.

5319. **Ecology of Renewable Natural Resources (3:3:0).** Prerequisite: Approval of instructor. An introduction to the ecology of the renewable (biological) natural resources such as vegetation wildlife, soil, and water. Normally a terminal course and not open to range or wildlife management majors.

5320. **Advanced Big Game Ecology and Management (3:3:0).** Prerequisite: Approval of instructor. An advanced study of the ecology and management of big game resources. Field trips required.

5321. **Wildlife Ethology (3:3:0).** Prerequisite: 6 hours of wildlife or advanced biology or approval of instructor. Introduction to the behavioral aspects of wildlife ecology and management.

631. **Master's Thesis (3).** Enrollment required at least twice.

731. **Research (3).** Prerequisite: Admission to doctoral study and consent of the instructor.

831. **Doctor's Dissertation (3).** Enrollment required at least four times.

College of Arts and Sciences

Professor Lawrence L. Graves, Dean

Department of Anthropology

Professor William J. Mayer-Oakes, Chairman.
Professor Montgomery; Associate Professors Campbell, Hickerson, Keslin, King, Lamb, and Way.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND MINORS FOR THE DOCTOR'S DEGREE

The graduate faculty of the Department of Anthropology offers a program of study leading to the Master of Arts degree in general anthropology.

The graduate program in anthropology is designed to provide the student with broad preparation in all four subfields of anthropology. To this end the curriculum is composed of required courses in each subfield with a small number of elective courses and a thesis providing the opportunity for concentration. A thesis and the ten courses listed below with an asterisk are required of each student. Additional courses will be required, the exact number depending upon the individual student's background and interest. A normal program will require two years to complete, with the intervening summer session often utilized for field work leading to a thesis.

Normal preparation for entrance to the M.A. program is successful completion of the undergraduate major in anthropology (or its equivalent) at Texas Tech University. Competence in an appropriate foreign language will be required of certain graduate students, depending upon the specific program.

The degree program is designed to provide training and knowledge beyond the undergraduate major for students wishing to (a) prepare for entry into a Ph.D. program, (b) prepare for college, junior college or high school teaching, or (c) prepare for a nonteaching career at the M.A. level.

Courses in Anthropology. (ANTH)

*5300. **History of Anthropological Theory (3:3:0).** The main currents of anthropological development (e.g., dialectical materialism, historical particularism, French structuralism) and a study of the men and women who directed them (e.g., Spencer, Tylor, Boas, Freud, Steward, Levi-Strauss).

*5301. **Teaching, Learning, and Research Resources in Anthropology (3:3:0).** A seminar designed to familiarize students with the entire range of anthropological resources and to give them direction in teaching methods. A variety of ways to present anthropology and to integrate its basic concepts and data will be discussed.

5302. Individual Research (3). Tutorial, reading, and/or field guidance for the student on a topic of his own choosing in consultation with an appropriate graduate faculty member.

5303. The Anthropoligical Study of Technology (3:3:0). The development of the major facets of preindustrial technology together with modern methods of analysis for such materials as lithics, wood, bone, metals, ceramics, and textiles and the kinds of cultural information that can be gained from them.

***5311. Physical Anthropology I (3:2:2).** A comprehensive overview of primate phylogenetic development with special emphasis on the morphological, physiological, and genetic aspects of man.

***5312. Physical Anthropology II (3:2:2).** A comprehensive overview of human population variation as a consequence of population interaction in differing ecosystems. A study in human biology, ecology, and demography.

5313. Physical Anthropology III (3:3:0). A comparative approach to the behavioral patterns of humans, other primates, and nonprimates.

***5321. Cultural Anthropology I (3:3:0).** A study of cultural elements and of models of culture. Ethnology, culture and personality, folklore, art, and religion are among the topics to be presented.

***5322. Cultural Anthropology II (3:3:0).** Models in social anthropology, social structure, and social organization.

5323. Cultural Anthropology III (3:3:0). Designed to give emphasis to selected elements of cultural anthropology this course supplements ANTH 5321 and 5322. Topics vary according to student needs and interest (e.g., cognitive anthropology, urban anthropology, political anthropology).

***5331. Ethnography I (3:2:2).** Oriented around concepts of field methodology, with specific topics varying from semester to semester according to student-selected specific geographic areas.

5332. Ethnography II (3:3:0). Intensive study of specific cultural strategies of adaptation to the natural and social environment.

5335. Origins of Social Customs and Institutions (3:3:0). A study of a selection of the world's cultures and institutions, with emphasis on problems of contemporary American culture. Designed especially for public school teachers.

***5341. Anthropological Archeology I (3:2:2).** An intensive survey of the development and present status of method and theory in archeology.

***5342. Anthropological Archeology II (3:2:2).** An intensive overview of the current status of knowledge of the past gained by archeological means.

5343. Anthropological Archeology III (3:3:0). An intensive examination of either a currently important methodological topic in archeology or the archeological knowledge extant from a site or geographic unit.

***5351. Anthropological Linguistics I (3:2:2).** An intensive and critical survey of major contemporary models for the syntactic and semantic description of natural languages.

5352. Anthropological Linguistics II (3:2:2). Survey of the nature of the interrelationships between language and other cultural phenomena.

***631. Master's Thesis (3).** Prerequisite: Completion of all required M.A. courses. Enrollment required at least twice.

Department of Art

Professor B. C. Lockhart, Chairman.
Horn Professor Kincaid; Professors Durland, Hanna, Hastie, Howze, Pollard, and Stephen; Associate Professors Alesch, Bagley, Everton, Gibbons, Jensen, Kreneck, Milosevich, Morrow, Parkinson, Queen, Read, Reynolds, and Street; Assistant Professors McDonnell and Moon.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND OPTION FOR THE DOCTOR'S DEGREE

The Department of Art supervises a program leading to the Master of Art Education degree (M.A.E.) with a major in Art Education. This program is comprised of 36 semester hours of graduate work including 12 semester hours of Art Education core courses, 9-12 semester hours of related art courses, 6-9 semester hours as a minor (taken outside the Department of Art), and 6 semester hours of thesis or professional report. A preview committee composed of three graduate faculty members of the Department of Art will evaluate applicants who have met the entrance requirements of the Graduate School of Texas Tech University. The applicant for the Master of Art Education degree must have art certification or its equivalent and must submit a portfolio and/or slides of his art production. On the basis of these requirements, recommendations will be made concerning the acceptance of students to the Master of Art Education degree program. The preview committee will determine and prescribe any leveling work to be completed before or after acceptance.

The Department of Art supervises various programs leading to the Master of Fine Arts degree (M.F.A.) with a major in Art. A two-year program comprised of 60 semester hours of graduate work is available with a major area of concentration in two-dimensional or three-dimensional studio. A one-year program comprised of 36 semester hours is available for students with a major area of concentration in Interior Design. Entrance into these programs presumes a Bachelor of Fine Arts degree with at least 70 semester hours of art or its equivalent. A graduate preview committee, composed of three graduate faculty members in the Department of Art, will examine a portfolio of the student's art work and hold a personal interview, if feasible, with each student. On the basis of these examinations, recommendations will be made concerning acceptance to the M.F.A. program. The faculty committee will determine and prescribe any leveling work to be completed before or after acceptance.

The Department of Art participates in the program leading to the Doctor of Philosophy degree in Fine Arts. (See "Interdepartmental Programs" section for general degree requirements and description of this doctoral program.) A major in art can be selected in this interdisciplinary program and the Department of Art supervises this particular major. The major in art is designed to prepare broadly trained persons for

leadership roles in art. Emphasis can be directed toward administration, management, education, or professional production. The latter category is not to be interpreted as developing one's own, personal, artistic production. The essential ingredient of the major emphasis must be concerned with developing and promoting various educational programs in the fine arts that will ultimately involve greater segments of the populace in this nation.

For acceptance into the doctoral program, the applicant must have completed a master's degree, or its equivalent, with emphasis in some area of the arts. Every effort will be made to select candidates who possess strong leadership qualities. The applicant is expected to possess a high level of competency in an area of artistic production. Also, applicants must have demonstrated excellence in teaching and/or communicative skills related to their professional experiences. The professional maturity of the applicant will be of primary importance. Acceptance into the program will be determined to a great extent by an evaluation of the applicant's long-range professional goals and any evidence of achievement the applicant has made toward accomplishing these goals.

Entrance into this program will require that the applicant be interviewed by a graduate preview committee composed of graduate art faculty. Applicants approved by the preview committee will be recommended by the Department of Art to the Fine Arts Doctoral Committee for acceptance into the program. Final acceptance is contingent upon satisfaction of Graduate School requirements.

Courses in Art. (ART)

511. **Advanced Art Unit (1).** Prerequisite: Departmental approval. Individual investigation in art. May be repeated for credit.

518. **Art Seminar (1:1:0).** Prerequisite: Departmental approval. An investigation of current trends in art based on a survey of the literature. May be repeated for credit.

530. **Readings in Art Education (3:3:0).** A survey of pertinent literature in the field of and relative to art education.

531. **Special Problems in Art (3).** Prerequisite: Departmental approval. Advanced, independent work in an art area in which a student has had previous training. May be repeated for credit.

532. **Research Methods in the Visual Arts (3:3:0).** Prerequisite: Departmental approval. A survey of research methods applicable to the visual arts.

533. **Environmental Studies Related to Interior Design (3:3:0).** Prerequisite: Consent of instructor. Behaviorial oriented studies serving the sociophysical requirements of the client, ranging from natural environmental disasters to man's individual sensory responses to manipulated elements of interior design. May be repeated for credit.

534. **Advanced Studio: Two-dimensional (3).** Prerequisite: Departmental approval. The development and execution of advanced two-dimensional studio problems. May be repeated for credit.

535. Advanced Studio: Three-dimensional (3). Prerequisite: Departmental approval. The development and execution of advanced three-dimensional studio problems. May be repeated for credit.

537. Art for Exceptional Children (3:1:4). Prerequisite: Departmental approval. Review of the characteristics of typical children; application of this knowledge in unfolding the creative potentialities of each child through the use of art experience.

538. Art for the Culturally and Economically Disadvantaged (3:3:0). A review of the literature including descriptive and other recent research into the problems of the culturally deprived student.

539. Methods and Materials Laboratory in Art (3:0:9). A course wherein graduate students develop theory and applications of classroom practices with art processes and techniques encountered at their own level. May be repeated for credit.

5310. Aesthetic Theory as Applied to Art (3:3:0). A course designed to enable students to understand how various conceptions of art have implications for the teaching of art.

5311. Experimental Methods in Teaching Art (3:2:3). A combination of theory and practicum to develop an awareness of and practice in innovative procedures relative to art teaching. May be repeated for credit.

5312. The Interrelationship of the Arts (3:3:0). A study of the visual and performing arts and the implications for fine arts curriculum.

5313. Curriculum Development in Art Education (3:3:0). Prerequisite: ART 530 and 532. Fundamental bases for curriculum development in art education.

5314. Supervision and Administration in Art Education (3:3:0). Prerequisite: ART 5313. School organization, personnel, curriculum, responsibilities of modern administration, and supervision.

5315. Historical Survey of the Teaching of Art (3:3:0). Survey of the historic growth of art education in Europe and America.

5316. History and Theory of Interior Design (3:3:0). Prerequisite: Consent of instructor. Emphasis on current trends such as computer-sided design and programming from the industrial revolution to today. May be repeated for credit.

5317. Research into the Effects of the Interior Design Environment on the User (3:3:0). Prerequisite: Consent of instructor. Suggested areas of study include color, texture, and illumination. May be repeated for credit.

5318. Advanced Problems in Interior Design (3:0:9). Prerequisite: Consent of instructor. Investigation and execution of special problems in the field of interior design. May be repeated for credit.

5319. Production Procedures for Interior Designers (3:1:4). Prerequisite: Consent of instructor. Studies of materials and procedures used in producing furnishings, including analysis of the relationship between design and quality in materials and construction used in the design product. May be repeated for credit.

5320. Structure in Interior Design (3:1:4). Prerequisite: Consent of instructor. Relationships between systems, methods, techniques, materials, costs of new construction and remodeling. May be repeated for credit.

5321. Home Furnishings Industry (3:3:0). Prerequisite: Consent of instructor. Patterns of production and distribution in the home furnishings industry, the market area, and in merchandising techniques. May be repeated for credit.

5322. **Interior Design Seminar (3:1:4).** Prerequisite: Approval by the student's advisory committee. Individual readings in current problems relating to interior design, and applying this information to setting up the thesis problem. May be repeated for credit.

5323. **Special Unit Course in Interior Design (3:0:9).** Prerequisite: Consent of instructor. Intensive course consisting of various units of work with specialists in charge of each phase. May be repeated for credit.

5330. **Graduate Seminar in Art History (3:3:0).** Prerequisite: Departmental approval. A conceptual/comparative approach to select topics in art history as seen in the visual arts and reflected in contemporary writings. May be repeated for credit.

5331. **Graduate Problems in Art History (3:3:0).** Prerequisite: Departmental approval. A conceptual/comparative examination of certain art historical problems which emphasizes the interrelationship of the arts. May be repeated for credit.

5332. **Art for the Preprimary Child (3:1:4).** Study of the function of art in early childhood education involving both theory and practice with art learning activities appropriate for preprimary children.

5333. **Advanced Photography (3:0:9).** Prerequisite: Departmental approval. Experimental investigation into still and motion picture photography as creative media in visual communication. May be repeated for credit.

5334. **Advanced Design (3:0:9).** Prerequisite: Departmental approval. Investigation into the visual design components of form and content as related to contemporary graphic communication. May be repeated for credit.

5335. **Theory and Practice of Art for Elementary Teachers (3:1:4).** Prerequisite: Departmental approval. Art activities and experiences for the child.

5336. **Graduate Sculpture (3:0:9).** Prerequisite: Departmental approval. The development and execution of advanced problems in sculpture. May be repeated for credit.

5337. **Graduate Painting (3:0:9).** Prerequisite: Departmental approval. The development and execution of advanced problems in painting. May be repeated for credit.

5338. **Graduate Textile Design (3:0:9).** Prerequisite: Departmental approval. The development and execution of advanced problems in textiles. May be repeated for credit.

5339. **Graduate Pottery (3:0:9).** Prerequisite: Departmental approval. The development and execution of advanced problems in pottery.

5340. **Graduate Jewelry (3:0:9).** Prerequisite: Departmental approval. The development and execution of advanced problems in jewelry. May be repeated for credit.

5341. **Graduate Printmaking (3:0:9).** Prerequisite: Departmental approval. The development and execution of advanced problems in printmaking. May be repeated for credit.

5342. **Art of the Renaissance (3:3:0).** Developments in European architecture, painting, and sculpture studied in the cultural, philosophical, scientific and technological, and aesthetic contexts of the 15th and 16th centuries, including a consideration of the discursive and performing arts as they relate to problems in the visual arts.

5343. **Art of Classical Antiquity (3:3:0).** A study of the architecture, painting, and sculpture of the Greek and Roman civilizations, including a consideration of major aspects of the interrelated discursive and performing

arts, and including a study of general cultural, philosophical, and aesthetic problems.

5344. Survey of Two-Dimensional Studio Art (3:0:9). Prerequisite: Departmental approval. A course wherein graduate students pursue a particular area of two-dimensional studio art at their own level. May be repeated for credit.

5345. Survey of Three-Dimensional Studio Art (3:0:9). Prerequisite: Departmental approval. A course wherein graduate students pursue a particular area of three-dimensional art at their own level. May be repeated for credit.

630. Master's Report (3).

631. Master's Thesis (3). Enrollment required at least twice.

731. Research (3). May be repeated for credit.

831. Doctor's Dissertation (3). Enrollment required at least four times.

Department of Biological Sciences

Professor Raymond C. Jackson, Chairman.
Horn Professor Strandtmann; Professors Baker, Berlin, Camp, Jones, Mecham, Mitchell, Packard, Proctor, and Rose; Associate Professors Allen, Atchley, Baugh, Burns, Carter, Coulter, Elliot, Felkner, George, Goodin, Kuhnley, Morey, Rylander, and Thayer; Assistant Professors Genoways and Northington.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

The graduate faculty of the Department of Biological Sciences offers studies in biology, botany, microbiology, and zoology. Graduate programs in microbiology are offered under the auspices of the graduate faculty in microbiology. A description of programs in microbiology may be found in the Interdisciplinary Programs section of this catalog.

Before being recommended for admission to a master's degree program, the student may be required to take an examination which includes the subject matter usually required of undergraduates.

If the preliminary examination for admission to doctoral studies reveals serious weaknesses in the student's subject-matter background, the student may be required to take remedial courses designated by the graduate faculty of the department. The basic degree requirements of the Graduate School determine the policy of the department.

The Department of Biological Sciences has no general requirement of a foreign language for the Ph.D. degree. However, it may be necessary for a student to demonstrate a proficiency in a foreign language(s) in certain programs, if such is necessary for research purposes.

The student's advisory committee will make recommendations concerning language options and basic work in other sciences.

Courses in Biology. (BIOL)

511. Seminar (1:1:0). Required of all graduate students majoring in biology. May be repeated for credit.

512. **Advanced Experimental Heredity (1:0:3).** Prerequisite: BIOL 141, 142; BIOL 331 or its equivalent. Experimental inquiry of heredity mechanisms; emphasis on Drosophila genetics.

513. **Special Problems in Biometry (1).** Prerequisite: BIOL 552 or equivalent; consent of instructor. Advanced topics in biometry. May be repeated for credit.

520. **Advanced Experimental Laboratory in Developmental Biology (2:0:6).** Prerequisite: Consent of instructor. A developmental biology laboratory in experimental techniques designed for the graduate student.

521. **Biological Electron Microscopy (2:2:0).** Prerequisite: Consent of instructor. Description of techniques used in preparing biological samples for electron microscopy and introduction to the theory and principles of electron microscopes.

522. **Instructional Methods in Biology (2:1:3).** Prerequisite: Acceptance in a graduate degree program in the Department of Biological Sciences. Survey of tools, methods, and professional practices used in biology instruction at the college level. Formal lecture and discussion will be coordinated with supervised teaching with an emphasis on teaching experience in a laboratory in the student's area of specialization.

530. **Advanced Developmental Biology (3:3:0).** Prerequisite: BIOL 342 or consent of instructor. Studies in animal and plant development, stressing the principles of molecular, cellular, and organismic development.

532. **Population Genetics (3:2:3).** Prerequisite: BIOL 331 or the equivalent. Genetics of natural populations, basic dynamics, and evolutionary mechanisms responsible for origin of species.

533. **Selected Topics in Radiation Biology (3:2:3).** Prerequisite: Consent of instructor. Principles of radiation biology applied to biological problems.

534. **Application of Radioactive Tracers in Biology (3:2:3).** Prerequisite: BIOL 433 or BIOL 533.

535. **Biological Fine Structure (3:3:0).** Prerequisite: CHEM 342 or CHEM 436 recommended. Modern concepts of the structure and function of cell organelles and various cellular phenomena will be approached at the molecular level.

536. **Techniques in Biological Electron Microscopy (3:0:9).** Prerequisite: Consent of instructor; BIOL 342 recommended; prerequisite or parallel: BIOL 521. Preparation of biological samples for electron microscopy and operation of the electron microscope.

537. **Special Problems in Genetics (3).** Prerequisite: BIOL 331 or consent of instructor. Readings and experiments with plants, animals, and microorganisms. May be repeated for credit.

538. **Advanced Population Biology (3:2:3).** Prerequisite: BIOL 331, 333, or equivalent. Introduction to population biology with emphasis on theory and experimental applications.

539. **Ecology of Inland Waters (3:2:3).** Prerequisite: Consent of instructor. A brief introduction to the major groups of aquatic vascular plants, algae, and invertebrates occurring in the western portion of North America as well as the underlying limnological principles affecting their distribution.

542. **Advanced Cell Biology (4:3:3).** Prerequisite: 8 hours of biology, 8 hours of chemistry, plus at least one semester of organic chemistry; or consent of instructor. Structure and function of cells with introduction to modern techniques for cell study. Course is offered to graduate students with no formal training in cell biology.

551. Cytogenetics (5:3:6). Prerequisite: BIOL 331 or AGRO 341. A study of genetic mechanisms of plants and animals and their correlated cytological interpretations.

552. Biometry (5:4:3). Prerequisite: College Algebra. The application of statistical methods to data from various fields of biological research. Special emphasis is placed on practical computation procedures.

5313. Biochemical Genetics (3:3:0). Prerequisite: BIOL 331, 342, and organic chemistry; biochemistry recommended. A comprehensive basis of heredity as interpreted through molecular and biochemical studies.

731. Research (3). Prerequisite: Admission to doctoral study and consent of instructor. May be repeated for credit. Research in areas of current interest.

831. Doctor's Dissertation (3). Enrollment required at least four times.

Courses in Botany. (BOT)

531. Problems in Botany (3). May be repeated for full credit in another field or with new materials in the same field. Offered at intervals.

532. Vector Relationships in Plant Diseases for Advanced Students (3:2:3). Prerequisite: BOT 332; ENTO 334, or equivalent with consent of instructor. Insect, mite, and nematode transmission of plant pathogens with emphasis on pathogen-vector relationships.

534. Advanced Plant Anatomy (3:0:9). Advanced anatomy of vascular plants. Offered at intervals.

535. Field Botany (3:3:0). Readings, reports, and field work on assigned problems. Cost of field trips held to a minimum. May be repeated for credit with new materials. Offered at intervals.

536. Taxonomy of Lower Green Plants (3:2:3). Prerequisite: BIOL 141, 142; BOT 333, 334; or consent of instructor. Classification of the lower plants exclusive of the fungi. Lecture, laboratory, and field study.

537. Morphology of the Vascular Plants (3:2:3). Prerequisite: BIOL 141, 142; BOT 333, 334; or consent of instructor. The form and reproduction of plant groups. Field trips required.

538. Advanced Taxonomy of the Vascular Plants (3:2:3). Prerequisite: BOT 334; consent of instructor. A critical study of classification and nomenclature as applied to vascular plants.

539. Plant Speciation (3:3:0). Prerequisite: BIOL 331 or AGRO 341. Genetic and environmental factors operating in plant evolution and species formation. A critical examination of natural and experimental populations.

5311. Morphogenesis and Plant Growth Regulators (3:2:3). Prerequisite: BOT 331 and organic chemistry. A course in biochemistry is highly recommended. Study of environmental and chemical control of plant morphogenesis, growth and development. Photoperiodism, thermal regulation, naturally occurring hormones, and synthetic growth regulators.

5331. Plant Growth and Development (3:2:3). Prerequisite: A course in organic chemistry. A course in plant physiology presented at an advanced level for graduate students with a background in organic chemistry and biology but with no previous training in plant physiology.

5332. Plant Pathology for Advanced Students (3:2:3). Prerequisite: MBIO 340 or equivalent; ENTO 231 or equivalent; 12 semester hours in plant sciences, or consent of instructor. Principles underlying the cause,

identification, and control of plant diseases. A course for graduate students who have had no previous courses in plant pathology.

5333. **Plant-Water Relationships (3:3:0).** Prerequisite: BOT 331 or consent of instructor. Advanced studies on the properties of water and solutions, cell water relations, soil water, soil-root interfaces, water and salt absorption, translocation and transpiration. Emphasis on the understanding of water deficits developed under arid conditions.

5335. **Advanced Structure and Physiology of Woody Plants (3:0:9).** Prerequisite: BIOL 141, 142; or BOT 333; or BOT 339. The anatomy, growth, and physiology of woody plants are considered with emphasis on adaptations to the arid and semi-arid environment; a course for graduate students who have not received credit for BOT 335 or equivalent.

5336. **Readings in Plant Geography (3:3:0).** Prerequisite: Consent of instructor. Selected readings in the geographic distribution of plants and its underlying principles. This course is offered for graduate students who have had no previous courses in plant geography.

5338. **Morphology of Fungi for Advanced Students (3:2:3).** Morphology as a basis for classification of the fungi. A course for graduate students who have not received credit for BOT 438 or its equivalent.

5339. **Experimental Plant Anatomy (3:2:3).** Prerequisite: BOT 339; or BOT 534; or consent of instructor. The anatomy of plants is considered in relation to experiments on the developmental biology of cells, tissues, and organs.

5341. **Plant Chemosystematics (3:2:3).** Prerequisite: Consent of instructor. A survey of approaches to systematic problems stressing biochemical methods with most emphasis on laboratory techniques for analysis of flavonoid compounds.

630. **Master's Report (3).**

631. **Master's Thesis (3).** Enrollment required at least twice.

731. **Research (3).** Prerequisite: Admission to doctoral study and consent of instructor. May be repeated for credit. Research in areas of current interest.

831. **Doctor's Dissertation (3).** Enrollment required at least four times.

Courses in Microbiology. (MBIO)

521. **Instrumental Methods of Microbiology (2:0:6).** Prerequisite: Consent of instructor. Application of instrumental methods to the analysis of physiological phenomena at the cell and cell-free level.

531. **Research in Microbiology (3).** Prerequisite: MBIO 341, 440, and consent of instructor. Research problems in selected areas in microbiology. May be repeated for credit.

532. **Selected Topics in Microbiology (3:3:0).** Prerequisite: MBIO 341, 440, and consent of instructor. Study of advanced concepts of microbiology. May be repeated for credit.

533. **General Virology (3:2:3).** Prerequisite: Consent of instructor. An introduction to the biology of animal, bacterial, and plant viruses.

534. **Microbial Genetics (3:2:3).** Prerequisite: Consent of instructor. Current biochemical, physiological, and physio-chemical ideas and techniques of molecular genetics applied to microorganisms.

536. **Immunochemistry (3:2:3).** Prerequisite: Consent of instructor.

537. **Microbial Metabolism (3:3:0).** Prerequisite: MBIO 433. CHEM 342 or CHEM 5330, and consent of instructor. The study of microbial intermediary metabolism.

5323. Laboratory Microbial Physiology (3:0:9). Prerequisite: MBIO 433 or 5333 and consent of instructor. Research techniques for the study of microbial physiology.

5330. Advanced General Microbiology (3:2:3). Prerequisite: 12 semester hours in the departments of Biological Sciences or Chemistry and MBIO 341; prerequisite or parallel: 6 semester hours in chemistry and consent of instructor. Detailed studies on growth and development of microbial anatomy, viral assembly, growth, genetic variation, and taxonomy. For advanced study by graduate students with majors other than microbiology.

5332. Immunobiology (3:2:3). Prerequisite: MBIO 440 and consent of instructor. Mechanisms and detection of acquired immunity.

5333. Advanced Bacterial Physiology (3:3:0). Prerequisite: 6 semester hours of microbiology; 12 semester hours of chemistry, including biochemistry or concurrent registration; consent of instructor. Advanced study of bacterial physiology includes sections on thermodynamics, physiology of bacterial growth and reproduction, aerobic and anaerobic carbohydrate metabolism.

631. Master's Thesis (3). Enrollment required at least twice.

731. Research (3). Prerequisite: Admission to doctoral study and consent of instructor. May be repeated for credit. Research in areas of current interest.

831. Doctor's Dissertation (3). Enrollment required at least four times.

Courses in Zoology. (ZOOL)

5118. Laboratory in Comparative Endocrinology (1:0:3). Prerequisite or parallel: ZOOL 5318 or a basic course in endocrinology. Application of basic small surgery techniques to the study of hormone interaction.

521. Selected Topics in Invertebrate Physiology (2:2:0). Prerequisite: BIOL 342 or ZOOL 439; CHEM 335 or 342; consent of instructor. Advanced concepts in invertebrate physiology. May be repeated for credit.

522. Selected Topics in Mammology (2:2:0).

531. Problems in Zoology (3). May be repeated for full credit in another field or with new materials in the same field.

532. Principles and Methods of Systematic Zoology (3:2:3). Prerequisite: Consent of instructor. Procedures useful in taxonomic and ecological studies of natural populations.

533. Herpetology (3:2:3). Prerequisite: Consent of instructor. The course will be concerned with the biology of amphibians and reptiles. Stress will be placed on classification, evolution, ecology, and anatomy of the various groups.

534. Advanced Invertebrate Zoology (3:2:3). Prerequisite: Consent of instructor. Emphasis upon selected major groups, particularly terrestrial forms. Written reports on special projects required.

535. Field Zoology (3:3:0). Readings, reports, and field work on assigned problems. May be repeated for full credit with new materials. An acceptable written report of the semester's work required.

536. Mammology for Advanced Students (3:2:3). Prerequisite: ZOOL 436. Studies of recent advances in mammalogy.

537. Physiological Ecology of the Vertebrates (3:3:0). Prerequisite: Consent of instructor. A study of the physiological adaptations of organisms, particularly vertebrates, to their environments.

538. **The Arachnids (3:2:3).** Prerequisite: Consent of instructor. Emphasis on systematics, morphology, distribution, ecology, and behavior. Field trips required.

539. **Biology of Helminth Parasitism (3:2:3).**

560. **Tropical Parasitology (6:4:6).**

5311. **Biology of the Acarina (3:2:3).** Prerequisite: Consent of instructor. Morphology, ecology, cytology, and behavior of mites.

5313. **Advanced Ornithology (3:2:3).** Prerequisite: Consent of instructor. Selected topics including avian systematics, migration, physiology, ecology, and comparative behavior.

5314. **Zoogeography (3:3:0).** Prerequisite: ZOOL 533 and 536 recommended or consent of instructor. Study of the geographical distribution of vertebrate animals with special reference to North America. Faunal regions, barriers, dispersal, and the relationship of distribution to the origin of species and intraspecific groups.

5317. **Experimental Embryology (3:2:3).** Prerequisite: BIOL 332; consent of instructor. A survey of experimental work concerning mechanisms of development.

5318. **Comparative Endocrinology (3:3:0).** Prerequisite: ZOOL 244, 331, BIOL 342, and consent of instructor. Hormones as chemical coordinators of bodily functions.

5319. **Ichthyology (3:2:3).** Prerequisite: Consent of instructor. The classification, evolution, distribution, and ecology of fish.

5320. **Comparative Neuroanatomy (3:2:3).** Prerequisite: ZOOL 244 or consent of instructor. Topics in functional and comparative vertebrate anatomy, with special emphasis on the evolution of the central nervous system.

5337. **Vertebrate Zoology for Advanced Students (3:2:3).** Prerequisite: BIOL 142; ZOOL 244 or a course in chordate anatomy. Modern concepts of field and laboratory vertebrate biology. Field work required. Open to graduate students who have not taken ZOOL 437 or equivalent.

5339. **Comparative Physiology for Advanced Students (3:2:3).** Prerequisite: 8 semester hours of chemistry; ZOOL 244, 336; CHEM 335, 336, recommended. Comparative study of the functions of organ systems and how these systems interact. Open to graduate students who have had no training in comparative physiology.

630. **Master's Report (3).**

631. **Master's Thesis (3).** Enrollment required at least twice.

731. **Research (3).** Prerequisite: Admission to doctoral study and consent of instructor. May be repeated for credit. Research in areas of current interest.

831. **Doctor's Dissertation (3).** Enrollment required at least four times.

Department of Chemistry

Horn Professor Henry J. Shine, Chairman; Associate Professor Robert G. Rekers, Assistant Chairman.

Welch Professor Shoppee; Professors Dennis, Lee, Redington, and Song; Associate Professors Adamcik, Anderson, Bartsch, Draper, Marx, and Wilde; Assistant Professors Blackmer, Holwerda, Mills, Mitchell, O'Brien, and Sevall.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

The department offers study in five areas of specialization. These areas are analytical chemistry, biochemistry, inorganic chemistry, organic chemistry, and physical chemistry. Specialization in biochemistry also is offered under the auspices of the interdisciplinary program in biochemistry described in the Interdisciplinary Programs section of this catalog.

Each student majoring in this department for an advanced degree must take four written preliminary diagnostic examinations to ascertain his comprehension of chemistry. The examinations are based on the undergraduate curriculum. Each student is expected to take examinations in organic and physical chemistry plus two selected from the areas of analytical, inorganic, and biochemistry. Those students who desire to specialize in biochemistry will take examinations in physical, organic, biochemistry, and either analytical or inorganic chemistry. These examinations are given during the first week of each semester, according to schedules posted on the departmental bulletin board. Students will have an opportunity to register for such remedial courses as the examinations may show to be necessary.

Each graduate student in this department is expected to do some teaching before receiving an advanced degree. The minimal requirements are one laboratory for a master's and two for a doctor's degree.

A satisfactory proficiency in one approved language is required of each candidate for a graduate degree. Approved languages are French, German, and Russian.

Credit for the research presented in the doctoral dissertation in this department shall constitute not less than one-sixth nor more than one-third of the total work presented for the degree.

A minor of 18 semester hours of work may be taken within the department.

A cumulative examination system is used as the written part of the qualifying examination, with cumulatives offered eight times each school year. Passing a graduated number each year over a three-year period is required, together with a successful oral defense of an original research proposal, to satisfy the qualifying examination requirement.

Courses in Chemistry. (CHEM)

511, 512. Seminar (1:1:0 each). Prerequisite: Graduate standing in chemistry. Required of all entering graduate students majoring in chemistry.

531, 532. Research (3 each). May be repeated for additional credit.

5121. Laboratory Methods in Modern Organic Chemistry I (1:0:3). Prerequisite: Parallel registration in, or previous credit for, CHEM 5323. Synthetic and analytical techniques of organic chemistry. Not open to majors in chemistry.

5122. **Laboratory Methods in Modern Organic Chemistry II (1:0:3).** Prerequisite: CHEM 5121, 5323; parallel registration in, or previous credit for, CHEM 5324. A continuation of synthetic and analytical techniques of organic chemistry. Not open to majors in chemistry.

5221. **Laboratory Techniques in Modern Organic Chemistry I (2:0:6).** Prerequisite: Parallel registration in, or previous credit for, CHEM 5323 required. Synthetic and analytical techniques of organic chemistry. Not open to majors in chemistry.

5222. **Laboratory Techniques in Modern Organic Chemistry II (2:0:6).** Prerequisite: CHEM 5321, 5323; parallel registration in, or previous credit for, CHEM 5324 required. A continuation of synthetic and analytical techniques of organic chemistry. Not open to majors in chemistry.

5301. **Advanced Inorganic Chemistry I (3:3:0).** Prerequisite: CHEM 445. Principles of coordination chemistry. Structure, bonding, properties, and reactions of complex compounds.

5302. **Advanced Inorganic Chemistry II (3:3:0).** Prerequisite: CHEM 5301. Reaction mechanisms of inorganic compounds.

5303. **Modern Inorganic Chemistry (3:3:0).** Prerequisite: CHEM 347, 348 or 5340, 5341. Advanced survey of modern topics in inorganic chemistry, including atomic and molecular structures, chemical bonding, coordination chemistry, non-aqueous solvents, descriptive chemistry of the elements. May not be taken for credit by chemistry majors.

5304. **Topics in Inorganic Chemistry (3:3:0).** Prerequisite: Consent of instructor. Special areas of inorganic chemistry not commonly included in other courses. May be repeated for additional credit.

5312. **Modern Techniques of Chemical Analysis (3:2:3).** Prerequisite: CHEM 251. Measurement of physical properties related to chemical structure and reaction with emphasis on the newer, rapidly developing techniques. Not open to majors in chemistry for credit.

5314. **Advanced Analytical Chemistry (3).** Prerequisite: CHEM 251, 347, 348. General principles and special methods of analytical chemistry.

5315. **Spectrographic Analysis I. Emission Spectra (3:2:3).** Prerequisite: Consent of instructor. PHYS 331 is recommended. Qualitative and quantitative analysis using emission spectra.

5316. **Spectrographic Analysis II. Absorption Spectra (3:2:3).** Identification of compounds and analysis of mixtures by means of their absorption spectra.

5317. **Selected Topics in Analytical Chemistry (3:3:0).** Prerequisite: Consent of instructor. May be repeated for additional credit.

5321. **Advanced Organic Chemistry I (3:3:0).** Prerequisite: CHEM 335, 336, 325 or 315, 326 or 316. Principles and reactions of organic chemistry, with emphasis on the most recent developments from the current literature.

5322. **Advanced Organic Chemistry II (3:3:0).** Prerequisite: CHEM 5321. Continuation of CHEM 5321.

5323. **Modern Principles of Organic Chemistry I (3:3:0).** A survey of modern organic chemistry with emphasis on reactions and contemporary theory. Primarily intended for graduate minors in chemistry; may not be included in the degree program of a graduate student majoring in chemistry.

5324. **Modern Principles of Organic Chemistry II (3:3:0).** Prerequisite: CHEM 5323. A continuation of CHEM 5323. Primarily intended for graduate minors in chemistry; may not be included in the degree program of a

graduate student majoring in chemistry. Will serve as the prerequisite for other graduate courses in organic chemistry.

5325. Topics in Organic Chemistry (3:3:0). Prerequisite: CHEM 5321. May be repeated for additional credit.

5327. Physical Organic Chemistry I (3:3:0). Prerequisite: CHEM 5321. Properties and reactions of organic compounds and the mechanisms of organic reactions considered from the standpoint of the principles of physical chemistry.

5330. Biochemistry I (3:2:3). Prerequisite: CHEM 341 or 325, 326, 335, 336 or the equivalent. Properties of biological compounds. Chemical processes in living systems. For advanced study by graduate students with majors outside the department.

5331. Biochemistry II (3:2:3). Prerequisite: CHEM 5330. Properties of biological compounds. Chemical processes in living systems. For advanced study by graduate students with majors outside the department.

5332. Advanced Biochemistry (3:3:0). Prerequisite: CHEM 436 and 437 or CHEM 433. Modern concepts of molecular structure and function in living systems.

5333. Proteins (3:3:0). Prerequisite: CHEM 436 and 437 or CHEM 433 or BCH 5721 or equivalent. Chemical and physical properties of proteins. Primary and conformational structure determination.

5334. Topics in Biological Chemistry (3:3:0). May be repeated for additional credit.

5335. Physical Biochemistry (3:3:0). Prerequisite: CHEM 347, 348, 433, or the equivalents. Classical and statistical thermodynamics of biological systems, biological information theory, structures of biopolymers, chemical kinetics of enzyme reactions, and relaxation kinetics for fast reactions.

5336. Biochemical Mechanisms (3:3:0). Prerequisite: CHEM 433 or consent of instructor. Mechanisms of biochemical reactions, particularly electron transfer processes. Quantum mechanical description of biological energy conversion.

5337. Enzymes (3:3:0). Prerequisite: CHEM 436 and 437 or CHEM 433 and 434. Structure, mode of action, and kinetics of enzymes.

5338. Biochemical Methods (3:1:6). Prerequisite: CHEM 436 and 437 or CHEM 433 and 434. Techniques used in biochemical research. Includes purification of an enzyme and use of radioactive isotopes.

5339. Nucleic Acids (3:3:0). Prerequisite: CHEM 436 and 437 or CHEM 433 or equivalent. Modern concepts of structure and function of nucleic acids. Protein biosynthesis.

5340. Physical Chemistry Principles I (3:3:0). Prerequisite: CHEM 137, 138, PHYS 143, 241, MATH 151, 152 or their equivalents. A foundation course, for the graduate student minoring in physical chemistry, covering a wide range of principles. Prerequisite for other courses in physical and inorganic chemistry. May not be included in degree programs of students majoring in chemistry.

5341. Physical Chemistry Principles II (3:3:0). Prerequisite: CHEM 5340. A foundation course, for the graduate student minoring in physical chemistry, covering a wide range of principles. Prerequisite for other graduate courses in physical and inorganic chemistry. May not be included in degree programs of students majoring in chemistry.

5342. Advanced Physical Chemistry (3:3:0). Prerequisite: CHEM 347, 348. Modern physical chemistry, primarily from the molecular approach, with numerical problems.

5343. Quantum Chemistry (3:3:0). Prerequisite: CHEM 5342. The application of non-relativistic wave mechanics to problem of chemical structure and reactivity.

5344. Kinetics of Chemical Reactions (3:3:0). Prerequisite: CHEM 347, 348. Kinetics and mechanisms of chemical reactions in homogenous and heterogeneous systems.

5346. Statistical Mechanics for Chemists (3:3:0). Prerequisite: CHEM 5342. Statistical mechanics in chemistry applied to both closed and open systems, including thermodynamics, lattices, surfaces, and non-equilibrium conditions.

5347. Chemical Thermodynamics (3:3:0). Prerequisite: CHEM 347, 348. Equilibrium thermodynamics in chemical systems influenced by various physical variables, with an introduction to irreversible thermodynamics.

5348. Topics in Physical Chemistry (3:3:0). Prerequisite: CHEM 347, 348. May be repeated for additional credit.

631. Master's Thesis (3). Enrollment required at least twice.

831. Doctor's Dissertation (3). Enrollment required at least four times.

Department of Classical and Romance Languages

Professor Norwood H. Andrews, Jr., Chairman.
Horn Professor Bumpass; Professors Christiansen, Cismaru, Finco, García-Girón, Maxwell, Oberhelman, and Patterson; Associate Professors Bubresko, George, Morris, and Stratton; Assistant Professor Hopkins.

This department supervises Master of Arts programs in Classical Humanities, French, and Spanish, and a Doctor of Philosophy program in Spanish. Graduate minors are also available in Greek, Italian, Latin, and Portuguese.

The departments of Classical and Romance Languages, English, and Germanic and Slavonic Languages offer interdepartmental programs in linguistics and comparative literature at the master's and doctor's levels. See section entitled Interdepartmental Programs in this bulletin.

In order to qualify for admission to candidacy, applicants for the Ph.D. degree in Spanish are required to demonstrate a reading knowledge of French and another language outside the major field and approved by the advisory committee as appropriate to their individual research. Candidates for the M.A. degree in this department must demonstrate a reading knowledge of a second foreign language.

With departmental approval, courses may be repeated for credit as topics vary. Graduate standing is a prerequisite for all courses.

Courses in Classical Humanities. (CLHM)

MAJORS FOR THE MASTER'S DEGREE

530. Research in Classical Humanities (3).

531. The Literature of Greece to 401 B.C. (3:3:0). A graduate course involving the reading of significant portions of archaic and classical Greek literature for the purpose of studying the characteristically Greek attitudes toward life and literature.

532. The Literature of Greece after 401 B.C. (3:3:0). A literary study of the principal writers in Greek between the end of the Athenian empire and the end of the second century A.D.

533. Studies in Greek Philosophy (3:3:0). Studies in the Pre-Socratics, Plato, Aristotle, and Hellenistic philosophy. (PHIL 532)

536, 537. Comparative Ancient and Modern Institutions and Customs I and II (3:3:0 each). A study of the social, political, economic, and private aspects of ancient life, especially as they have comparative value to modern times.

5310. Methods of Literary Criticism (3:3:0). Theories and practices of literary criticism and analysis. (C LT 5310, FREN 5310, SPAN 5310)

5311. The Transmission of Ancient Literature (3:3:0). A basic study of the transmission of classical literature from the original composition to the modern received text, including paleography, textual criticism, book production prior to the era of movable print, and a brief survey of the contributions of prominent textual scholars.

5312. Teaching Classical Humanities (3:3:0). Designed to give the student the skills and techniques needed to teach classical humanities in high school and junior college.

5350. The Classical Tradition in French Letters (3:3:0). Designed to acquaint students with the influence of ancient Rome and Greece on French letters. Readings and lectures in English. (C LT 5350, FREN 5350)

5351. The Classical Tradition in Hispanic Letters (3:3:0). Designed to acquaint students with the influence of ancient Greece and Rome on Hispanic letters. Readings and lectures in English. (C LT 5351, SPAN 5351)

631. Master's Thesis (3). Enrollment required at least twice.

Courses in French. (FREN)

MAJORS AND MINORS FOR THE MASTER'S DEGREE
AND MINORS FOR THE DOCTOR'S DEGREE

531, 532. Research in French (3 each).

533. Studies in Medieval Language and Literature (3:3:0). Reading, linguistic analysis, and philological interpretation of selected Old French texts.

534. The Romantic Movement in France (3:3:0). A detailed study of French romanticism in all genres; its origins, its creations, and its influences.

536. Old French (3:3:0). A study of the phonology, morphology, and syntax of medieval French. Reading and linguistic analysis of representative texts.

5310. Methods of Literary Criticism (3:3:0). Theories and practices of analysis and criticism. (CL T 5310, CLHM 5310, SPAN 5310)

5312, 5313. Studies in French Language and Literature I and II (3:3:0 each). The content of these courses, through concentration on a literary genre, school, or linguistic topic, will vary to meet the needs of the particular group of students.

5317. Seminar in Seventeenth Century Literature (3:3:0). Readings, analysis, and interpretation of selected works of Corneille, Racine, Boileau, Molière, and others.

5318. Seminar in Eighteenth Century Literature (3:3:0). Readings, analysis, and interpretation of selected works of Bayle, Montesquieu, Voltaire, Marivaux, Chénier, and others.

5319. Seminar in Nineteenth Century Literature (3:3:0). A research course in which students investigate in depth individual topics organized around a central theme.

5320. Seminar in Twentieth Century Literature (3:3:0). A research course in which students investigate in depth individual topics organized around a central theme.

5341, 5342. Intensive French for Graduate Research I and II (3:3:0 each). French readings with related grammar to acquaint graduates with French as a research skill; equivalent to two years of normal course work.

5350. The Classical Tradition in French Letters (3:3:0). Designed to acquaint students with the influence of ancient Rome and Greece on French letters. Lectures *only* in English; readings in French. (C LT 5350, CLHM 5350)

630. Master's Report (3).

631. Master's Thesis (3). Enrollment required at least twice.

Courses in Greek. (GRK)

MINORS FOR THE MASTER'S DEGREE

531, 532. Research in Greek (3 each).

533. Survey of Greek Prose (3:3:0). The development of Greek prose from its origins to the second century A.D.; special emphasis on Herodotus, Thucydides, Plato, Polybius, and Plutarch.

534. Survey of Greek Poetry (3:3:0). The development of Greek poetry from Homer to the Hellenistic era. Emphasis on Homer, Hesiod, Archilochus, Sappho, Pindar, Apollonius Rhodius, Callimachus, and Theocritus.

535. Survey of Greek Drama (3:3:0). A survey of Greek tragedy and comedy from its origins to the Hellenistic period.

5341, 5342. Intensive Greek for Graduate Research I and II (3:3:0 each). Greek readings with related grammar to acquaint graduates with Greek as a research skill; equivalent to two years of normal course work.

Courses in Italian. (ITAL)

MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

531, 532. Research in Italian (3 each).

533. Survey of Italian Prose (3:3:0). The origin of Italian language in the twelfth century to date. Attention will be given to Boccaccio's *Decameron*, and the "Dolce Stil Novo" of Dante and the Trecentisti; Manzoni's *I Promessi Sposi;* Verga's *I Malavoglia.*

534. Survey of Italian Poetry (3:3:0). The evolution of Italian poetry from the "Dolce Stil Novo" to date. Emphasis will be given to Dante, Petrarca, Ariosto, Leopardi and Ungaretti.

535. Survey of Italian Drama (3:3:0). The origin of Italian drama from Iacopone's *Il Pianto della Madonna* (13th century), to date. Emphasis will be given to Poliziano, Tasso, Goldoni, D'Annunzio, and Pirandello.

536. Seminar in Italian Literature (3:3:0). Contents of this course will vary to meet the needs of students.

5341, 5342. Intensive Italian for Graduate Research I and II (3:3:0 each). Italian readings with related grammar to acquaint graduates with Italian as a research skill; equivalent to two years of normal course work.

Courses in Latin. (LAT)

MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

531, 532. Research in Latin (3 each).

533. Seminar in Latin Literature (3:3:0). Content will vary to meet the needs of the students.

534. Survey of Latin Poetry (3:3:0). A survey of Latin poetry from the earliest Saturnian verse to Claudian.

535. Survey of Latin Drama (3:3:0). Latin drama from its beginnings to the time of Seneca.

536. Survey of Latin Prose (3:3:0). Latin prose literature from its origins to the time of Apuleius.

5341, 5342. Intensive Latin for Graduate Research I and II (3:3:0 each). Latin readings with related grammar to acquaint graduates with Latin as a research skill; equivalent to two years of normal course work.

Courses in Linguistics. (LING)

530. Romance Linguistics (3:3:0). Prerequisite: Consent of department chairman. Origin and history of the Romance languages; emphasis on the main traits of phonology, morphology, and syntax.

5311. Linguistic Techniques in Teaching Romance Languages (3:3:0). Prerequisite: Consent of department chairman. Study of language teaching materials. Linguistic analysis and preparation of drills based on current texts.

5335. Methods of Teaching Spanish and English to Bilingual Children (3:3:0). As a part of the composite minor or for credit in education, there is no prerequisite; a student who wishes to apply this course toward a major or minor in Spanish must have completed SPAN 331 and 332 or the equivalent. Applied linguistics as it relates to second language teaching techniques for the elementary school level.

Courses in Portuguese. (PORT)

MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

531, 532. Research in Portuguese (3 each).

533. Survey of Portuguese Literature (3:3:0). The evolution of Portuguese literature from its origins to date; special emphasis on the *cantigas*, Gil Vicente, Camões, Garrett, Eça de Queiroz, and Fernando Pessoa.

534. **Seminar in Portuguese Literature (3:3:0).** Content will vary to meet the needs of students.

535. **Survey of Brazilian Poetry and Drama (3:3:0).** The evolution of Brazilian poetry and drama from the Arcadian poets of the eighteenth century through Romanticism, Symbolism, Parnassianism, Modernism, and the post-Modernist Movement.

536. **Survey of Brazilian Prose (3:3:0).** The Brazilian novel and short story from their beginnings to date with special emphasis on the early Romantics, Machado de Assis, Aluízio Azevedo, Lins do Rego, Jorge Amado, and writers of the post-Modernist Movement.

537. **Seminar in Brazilian Literature (3:3:0).** Content will vary to meet the needs of students.

5341, 5342. **Intensive Portuguese for Graduate Research I, II (3:3:0 each).** Portuguese readings with related grammar to acquaint graduates with Portuguese as a research skill; equivalent to two years of normal course work.

5373. **A survey of Hispanic Lands and Peoples from Regional Literature (3:3:0).** (SPAN 5373, GEOG 5373)

Courses in Spanish. (SPAN)

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

531, 532. **Research in Spanish (3 each).**

533. **History of the Spanish Language (3:3:0).** Prerequisite: One year of Latin or equivalent. The development of the Spanish language from its earliest forms to the present.

534. **Old Spanish (3:3:0).** The reading and linguistic analysis of early texts.

535. **Metrics (3:3:0).** The structure and development of Spanish prosody.

536. **Stylistics (3:3:0).** Study and practice in the elements of prose style and form.

537. **Bibliography and Methods of Research (3:3:0).** Systematic study of bibliographical materials, methods, and problems in the field of Hispanic research.

538, 539. **Summer Language Institute (3:3:0 each).** Advanced study of the area, civilization, language, and culture. Offered in Mexico in the summer.

5310. **Methods of Literary Criticism (3:3:0).** Theories and practices of literary analysis and criticism. (CL T 5310, CLHM 5310, FREN 5310)

5312, 5313. **Studies in Spanish and Spanish American Literature (3:3:0 each).** The nature and content of these courses will vary to meet the needs of students.

5314. **Medieval Literature (3:3:0).** Spanish literature from its earliest monuments to the end of the Middle Ages.

5315. **Renaissance Literature (3:3:0).** A survey of Spanish Renaissance literature.

5316. **Cervantes (3:3:0).** A detailed study of the major and minor works.

5317. **Seminar in Golden Age Literature (3:3:0).** Content will vary to meet the needs of students.

5318. **Eighteenth Century Literature (3:3:0).** A history of Spanish literature in the eighteenth century.

5319. **Studies in Modern and Contemporary Spanish Literature (3:3:0).** Representative literature of Spain in the modern and contemporary periods.

5320. Seminar in Modern Spanish Literature (3:3:0). Content will vary to meet the needs of students.

5321. Studies in the Latin American Novel (3:3:0). The rise and development of the novel in Latin America during the nineteenth and twentieth centuries.

5322. Seminar in Latin American Literature (3:3:0). Content will vary to meet the needs of students.

5323. Modernism (3:3:0). A detailed study of Spanish American Modernism.

5341, 5342. Intensive Spanish for Graduate Research I and II (3:3:0 each). Spanish readings with related grammar to acquaint graduates with Spanish as a research skill; equivalent to two years of normal course work.

5343, 5344. Intensive Oral Spanish for Graduates (3:3:0 each). Individually structured class coordinating books, tapes, video, etc., with individual instruction to provide near native fluency in speech and pronunciation for bilingual education personnel or similar professional people.

5351. The Classical Tradition in Hispanic Letters (3:3:0). Designed to acquaint students with the influence of ancient Greece and Rome on Hispanic letters. (C LT 5351, CLHM 5351)

5360. Studies in Chicano Life and Literature (3:3:0). Designed to familiarize the student with the history, the culture, and the literature of the Mexican-American people.

5371. Architecture of the Pre-Columbian and Post-Columbian (16th through 18th centuries) Periods in Middle and South America (3:3:0).

5373. A Survey of Hispanic Lands and Peoples from Regional Literature (3:3:0). (PORT 5373, GEOG 5373)

630. Master's Report (3).

631. Master's Thesis (3). Enrollment required at least twice.

731, 732. Research (3 each).

831. Doctor's Dissertation (3). Enrollment required at least four times.

Computer Science

Associate Professor Barry L. Bateman, Chairman.
Professors Archer, Barton, Griffith, and Rigby; Associate Professors Burford, Dock, Smith, and Vines.

(For a description of the options and minors for the master's and doctor's degrees, see the section entitled "Interdisciplinary Programs" in this catalog.)

Courses in Computer Science. (C S)

511. Seminar (1:1:0). Prerequisite: Permission of instructor. Discussion will concern present research conducted in computer science. Other special topics will also be considered.

531. Special Problems in Computer Science (3:3:0). Individual studies in advanced computer science and technology.

532. Computer Network Analysis (3:3:0). Prerequisite: Permission of instructor. Study of machines whose behavior may be programmed. Included are logical network theory, switching theory, sequential machines, turing machines, and computability and recursive functions.

533. **Theory of Finite Automata (3:3:0).** Prerequisite: C S 532 or equivalent. A study of finite automata. Topics covered include sequential machines, transition tables and diagrams, neural network models, memory in finite state machines, and probabilistic machines.

534. **Theory of Computability and Unsolvability (3:3:0).** Prerequisite: C S 533. A study of computable functions, operations on computable functions, recursive functions, turing machines, unsolvable decision problems, and applications and further development of the general theory.

535. **Algebraic Linguistics Applied to Computer Languages (3:3:0).** Prerequisite: C S 534. Analytic models in algebraic linguistics with special emphasis on computer languages. Special attention given to axiomatic-deductive structure of analytic models. Topics considered include languages and partitions, union and intersection of two partitions, adequate languages, simple strings and trees, and string operations.

536. **Real Time and Time Sharing Systems (3:3:0).** Prerequisite: Permission of instructor. Study of the functional needs in real time and time sharing systems. Basic techniques, and display concepts, random-access files, computer networks, simultaneous operations, multiprogramming, and multiprocessing.

537. **Information Storage and Retrieval (3:3:0).** Prerequisite: Permission of instructor. Structure of semiformal languages and models for the representation of structured information. The analysis of information content by statistical, syntactic, and logical methods. Search and matching techniques. Automatic retrieval systems, matching and question-answering systems. Evaluation of retrieval effectiveness.

538. **Computer Facility Operations (3:3:0).** Prerequisite: Permission of instructor. A comprehensive study of the problems associated with the organization of a data processing facility. Particular emphasis is placed on organization and policies; planning and scheduling; operating controls; equipment installation, layout and maintenance; budgeting and costing practices; performance analysis; and managing operations personnel.

539. **Systems Organization and Evaluation (3:3:0).** Prerequisite: C S 538. Overall organization of components into a system, interface between components. Relationship between computer organization and software systems. Word-oriented versus character-oriented machines. Simplex and multi-processor machines. Special purpose computers. Evaluation software systems and subsystems, hardware and peripheral systems, and their requirements for service support through selected case studies which are taken from a cross-section of computer installations in education, business, and industry.

5314. **Design of Computer Languages (3:3:0).** Prerequisite: Permission of instructor. Study of formal language systems and their interrelationships. Includes descriptive and command languages, object languages and their syntax languages, behavioral and structural languages, and mixed languages. Machine-oriented and problem-oriented languages; algebraic and business-oriented languages; information processing and string transforming languages are considered.

5315. **Heuristic Programming and Artificial Intelligence (3:3:0).** Prerequisite: Permission of instructor. Intelligence as applied to machines and to the programming which can be developed to control machines. Cybernetics, learning behavior, learning of machines, self-adaptive systems, pattern recognition, problem systems, error-detecting and correcting codes, theory of games and maze learning.

5319. Information Theory and Coding (3:3:0). Prerequisite: Permission of instructor. Information encoding and decoding, entropy of information, language and meaning, randomness and creativity, signals and noise, efficient codes, search techniques, classification of information.

Department of Economics

Professor Robert L. Rouse, Chairman.
Professors Clover, Gilliam, Hill, Krause, Stem, and Wittman; Associate Professors Bonnington, Jonish, Troub, and Uselton; Assistant Professors Butler, Greenhut, and Taylor.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

Students seeking the master's or doctor's degree in Economics should consult with the Graduate Adviser in the Department of Economics or the chairman of the department.

The Master of Arts program requires a thesis and 24 semester hours beyond the bachelor's degree including a minor of 6 or 9 semester hours in an appropriate field. A student has the option of choosing a nonthesis 36-semester hour program including a 6 or 9 semester-hour minor.

The candidate for the doctor's degree may select specialized fields from within the areas of international and development economics; monetary and fiscal economics; agricultural economics; economic history, methodology, and history of economic thought; labor and manpower economics; and general economics.

The doctoral student in economics must demonstrate a mathematical proficiency in calculus and analytical geometry and one additional tool requirement from the following three options: foreign language, advanced mathematics, or computer-related skills.

Courses in Economics. (ECO)

531. Economic Research (3:3:0). Prerequisite: ECO 232. Directed student research in selected areas, with written reports under the supervision of a qualified instructor.

532. Current Problems in Public Finance (3:3:0). Prerequisite: Consent of instructor. Research in and analysis of developments in state and local governmental finance, intergovernmental federal, state, and local relationships, and major current issues in fiscal policy.

533. Economics of Education (3:3:0). Prerequisite: Consent of instructor. An analysis of the economic dimensions of education. Will cover such topics as the efficiency of educational provision, education as an investment in human capital, and the problems and issues of financing education.

535. Seminar in Economic Policy (3:3:0). Prerequisite: ECO 430. An analysis of major economic goals and policies of government and industry.

536. **Advanced International Economics (3:3:0).** Prerequisite: ECO 338 or consent of instructor. An analysis of basic principles, problems and policies in international economics. Special attention is given to theories and alternative policies for economic development.

537. **Seminar in Public Finance (3:3:0).** Prerequisite: Consent of instructor. Analysis of economic effects of taxation, governmental expenditures, debt management, and budgetary planning and administration.

538. **The Nature, Method, and Scope of Economics (3:3:0).** An analysis of the subject matter of economics and the different approaches in acquiring knowledge in the field. Attention is paid to the relationship between the positive and normative aspects of economics.

539. **Classical Economic Thought (3:3:0).** Prerequisite: ECO 430. A critical analysis of the contributions of the Mercantilists, Monetary Economists, physiocrats, and other pre-classical writers of economic thought. An intensive investigation of the body of classical and neoclassical thought as developed by Smith, Malthus, Ricardo, Day, Mill, Marshall and others.

5311. **Philosophy and Historiography of Economic History (3:3:0).** An analytical study of the philosophy and historiography of economic history, with emphasis on the interpretation of economic history and the use of the historical method of analyzing economic forces and influences.

5312. **Seminar in Economic History (3:3:0).** An analysis of selected topics from the economic history of the Western World. Each student is required to plan and to execute a research project related to the topic of the seminar.

5313. **Survey of Theories of Economic Growth and Development (3:3:0).** Prerequisite: ECO 3311 or 3314 or equivalent. A survey of the theories of growth and development.

5314. **Seminar in Economic Growth and Development (3:3:0).** Prerequisite: ECO 5313. Intensive research into and analysis of selected economic growth and development topics. May be repeated for credit as topics vary.

5315. **Seminar in Ecological Economics (3:3:0).** Prerequisite: Graduate standing in economics. Topics in the economics of man's use and control of his environment.

5317. **Labor Markets: Theory and Public Policy (3:3:0).** Prerequisite: ECO 5351 or consent of instructor. An analysis of labor market theory, human capital, labor market institutions, and public policy toward the labor market.

5321. **Seminar in Mathematical Economics (3:3:0).** Prerequisite: ECO 3313 or equivalent, or consent of instructor. A study of modern mathematical techniques used in the development and verification of economic theory.

5331. **Individual Study in Economics (3:3:0).** Prerequisite: Permission of instructor. Directed reading and research concerning a specific problem or subject field in economics.

5341. **Price and Income Theory (3:3:0).** Prerequisite: ECO 5531 or 232. Designed for graduate students who need intensive study of intermediate economic price and income theory.

5342. **Managerial Economics (3:3:0).** Prerequisite: ECO 5341 or equivalent. An advanced course in the application of economic theory and analysis to the problems of the firm. Emphasis on mathematical tools of analysis.

5351. Advanced Micro-Economic Analysis (3:3:0). Prerequisite: ECO 3314 or 5341. Economic factors involved in the theory of the firm and determination of price. Special emphasis on the cases of monopoly, monopolistic competition, and oligopoly.

5352. Advanced Macro-Economic Analysis (3:3:0). Prerequisite: ECO 3311 or 5341. A theoretical and empirical approach to aggregate demand and supply analysis. Emphasis on macro-economic models.

5353. Seminar in the Teaching of Economics (3:3:0). Designed for graduate teaching assistants but open to other students interested in teaching economics, stressing the theories of the learning process, the characteristics of the successful educator, and the specific techniques involved in facilitating learning.

5360. Seminar in Advanced Economic Analysis (3:3:0). Prerequisite: ECO 5351 and consent of instructor. Selected topics in microeconomic theory, e.g., production theory, welfare theory, choice theory.

5361. Seminar in Manpower Problems and Research (3:3:0). A seminar on national and regional manpower problems and programs. Some emphasis on research giving the student the opportunity to formulate policy statements in response to particular problems.

5362. Empirical Studies in Macroeconomics, a Seminar (3:3:0). Prerequisite: ECO 5352 and consent of instructor. Selected topics in macroeconomic theory and policy with special emphasis on empirical studies.

5371. Theory of Monetary Economics (3:3:0). Prerequisite: Permission of instructor. The theory of money, interest, prices, and output presented in a general equilibrium framework; course deals specifically with such topics as cost of capital portfolio balances, wealth effects, and decision-making under conditions of uncertainty.

5372. Seminar in Monetary Economics (3:3:0). Prerequisite: ECO 5371 and permission of instructor. Examples of topics to be covered: studies in the quantity theory of money; a monetary history of the United States; current issues in international monetary economics. May be repeated for credit as topics vary.

5531. The Economic Environment (5:5:0). A rigorous study of microeconomic and macroeconomic theory with applications to the major problems of the economy.

630. Master's Report (3).

631. Master's Thesis (3). Enrollment required at least twice.

731. Research (3).

831. Doctor's Dissertation (3). Enrollment required at least four times.

Department of English

Professor Marion C. Michael, Chairman.
Horn Professor Walker; Professors Berry, Culp, K. Davis, Gillis, McCullen, Jr., Mogan, and Nall; Associate Professors Crider, D. Davis, Eddleman, Higdon, Langford, McDonald, Terrell, and Wages; Assistant Professors Aycock, V. Davis, Foster, Gilbert, Johnson, Kloessel, Rude, Shaw, Smitten, Sullivan, Tanner, and Weinsheimer.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

Before beginning a graduate program in English, students must consult the Chairman of Graduate Studies concerning departmental admission procedures and degree requirements. Admission to the Graduate School requires departmental recommendation as well as approval by the Graduate Dean.

The master's degree program offers advanced study in literature and language. It is intended to be not merely a continuation of undergraduate work but a distinctly different educational experience requiring study in greater depth and the development of critical thinking.

Applicants for the M.A. degree may complete 24 hours of graduate courses and a thesis or 36 hours of course work. Recommended areas of specialization are English literature before 1700, English literature after 1700, American literature, comparative literature, or linguistics. Supporting work is available in bibliography, folklore, literary criticism, and teaching college English. Reading knowledge of one foreign language is required.

The doctoral program requires both greater breadth of study than the M.A. program and greater concentration in an area selected for specialization. To fulfill these requirements the student must demonstrate a reasonably comprehensive knowledge of literature and the ability to engage in original research.

Doctoral students may specialize in an area of English literature, American literature, two closely related areas of English and American literature, or comparative literature. They may minor outside the department or within the department in one of the above areas or in linguistics. Course work for the Ph.D. generally amounts to 60-63 hours beyond the B.A. degree. In addition the student must pass a comprehensive examination, prepare a dissertation, and acquire college teaching experience. Reading knowledge of two foreign languages is required or high competence in one language to be demonstrated by passing with a B or better a graduate course taught in that language.

The departments of Classical and Romance Languages, English, and Germanic and Slavonic Languages offer interdepartmental graduate programs in linguistics and comparative literature. See section entitled Interdepartmental Programs in this bulletin.

Graduate courses designated "studies" may be repeated for credit with the permission of the department as topics vary. Topics of studies courses are announced in advance.

Courses in English. (ENG)

530. **Studies in Medieval Literature (3:3:0).** Intensive study of the works of Chaucer, other major writings in Middle English, and their background.

531. Studies in Comparative Literature (3:3:0). A seminar in themes, motifs, types, genres, etc. in selected works of world literature in translation.

532. Teaching of College English (3:3:0). Theory and practice of teaching freshman composition. Required for new teaching assistants.

533. Studies in Renaissance Literature (3:3:0). English poetry and prose of the sixteenth century.

534. Old English (3:3:0). The grammar and vocabulary of Old English. Readings in poetry and prose.

535. Studies in Early Victorian Literature (3:3:0). Readings, analysis, and research in the English writers of the mid-nineteenth century. The emphasis varies from semester to semester among the poetry, novel, and other prose of the period.

536. Beowulf (3:3:0). Prerequisite: ENG 534 or consent of instructor. Intensive study of the poem, its sources, analogues, and criticism, with references to other heroic literature.

538. Studies in Early English Romantics (3:3:0). Development of romanticism in the late eighteenth and early nineteenth centuries with emphasis on Wordsworth and Coleridge. Thematic interpretation, techniques, and criticism.

539. Studies in the Neo-Classical Age (3:3:0). Topics in Dryden, Pope, Swift, and their contemporaries.

5311. Studies in Seventeenth Century Literature (3:3:0). Concentrated studies in English literature, 1600-1660, treating, in various semesters, drama, poetry, prose, and significant authors, e.g., Donne, Milton.

5312. Studies in Drama (3:3:0). Concentrated studies in English, American, or world drama.

5313. Studies in Modern European Literature (3:3:0). A seminar in themes, motifs, types, genres, etc. in selected works of continental literature in translation, from about 1500 to the present.

5314. Studies in Literary Criticism (3:3:0). Problems in literary theory and analysis.

5315. Studies in Folklore (3:3:0). Prerequisite: Strong background in literature or permission of instructor. Primarily the influence of folklore on literature.

5318. Studies in Eighteenth Century American Literature (3:3:0). Representative readings in the Colonial, Revolutionary, and Early National periods.

5319. Studies in Shakespeare (3:3:0). Emphasis on the comedies, tragedies, histories or a combination of these.

5322. Studies in Modern British Literature (3:3:0). Intensive study of major twentieth century authors within a selected genre.

5323. Studies in Nineteenth Century American Literature (3:3:0). Topics in major figures and movements in nineteenth century American literature.

5324. Studies in Twentieth Century American Literature (3:3:0). Topics in major figures and movements in twentieth century American literature.

5325. American Novel to 1900 (3:3:0). Development of the American novel through the nineteenth century with emphasis on representative works.

5326. American Novel since 1900 (3:3:0). Advanced survey of the American novel from 1920 to the present; in alternate semesters, concentration on the novels of William Faulkner or other major authors or movements.

5327. Studies in the English Novel (3:3:0). Topics in major figures and movements in the English novel.

5329. **Studies in Modern Poetry (3:3:0).** Readings and research in representative modern poets. May be taught with English, American, or world literature emphasis.

5330. **Studies in Creative Writing (3:3:0).** Prerequisite: Consent of creative writing staff based on submission of a body of creative work. Theory and practice of creative writing in various genres.

5334. **History of the English Language (3:3:0).** Prerequisite: Knowledge of phonetic transcription or permission of the Chairman of the Interdepartmental Program in Linguistics. Development of English from its earliest origins to the present, with emphasis on its phonological, morphological, and syntactic change.

5335. **Principles of Language (3:3:0).** General introduction to the theory and techniques of modern linguistics.

5337. **Studies in Linguistics (3:3:0).** Special topics.

5338. **Linguistic Analysis I: Syntax (3:3:0).** Prerequisite: One course in linguistics or permission of instructor. Modern theory and practice in the description of semantic, syntactic, and morphemic structures of natural languages.

5339. **Linguistic Analysis II: Phonology (3:3:0).** Prerequisite: One course in linguistics or permission of instructor. Phonetic theory and practice in the morphophonemic descriptions of natural languages.

5341. **Studies in Bibliography (3:3:0).** Introduction to analytical and enumerative bibliography with emphasis on research methods for graduate studies in literature and language. Recommended for master's candidates; required for doctoral candidates.

5351. **Studies in Later Victorian Literature (3:3:0).** Readings, analysis, and research in English writers of the later nineteenth century. Emphasis varies from semester to semester among the poetry, drama, novel, and other prose of the period.

5381. **Studies in Later English Romantics (3:3:0).** The achievement of romanticism in the first quarter of the nineteenth century with emphasis on Byron, Shelley, and Keats. Thematic interpretations, techniques, and criticism.

5391. **Studies in the Age of Johnson (3:3:0).** Topics in principal authors and literary trends in the latter half of the eighteenth century.

630. **Master's Report (3).**

631. **Master's Thesis (3).** Enrollment required at least twice.

731, 732. **Research (3 each).**

831. **Doctor's Dissertation (3).** Enrollment required at least four times.

Department of Geography

Professor William B. Conroy, Chairman.
Associate Professors Davidson, Elbow, and Templer.

MINORS FOR THE MASTER'S DEGREE

Courses in Geography. (GEOG)

531. **Seminar in Geographic Thought and Methodology (3:3:0).** A review and analysis of the development of geographic thought and methodology.

532. Seminar in Regional Geography (3:3:0). Consideration of the objectives and methods of regional analysis and the application of research techniques to the physical and cultural geography of selected regions. May be repeated for credit with change of subject matter.

533. Seminar in Historical and Cultural Geography (3:3:0). Consideration of selected topics in historical and cultural geography. May be repeated for credit with change of subject matter.

534. Seminar in Urban Aspects of Regional Analysis (3:3:0). Study of selected urban problems and patterns as related to regional analysis.

535. Seminar in the Conservation of Natural Resources (3:3:0). Study of selected natural resources and the problems associated with their conservation and management. May be repeated for credit with change of subject matter.

536. Seminar in Geography of Arid Lands (3:3:0). Systematic and regional review and analysis of the physical nature and problems of human utilization of the arid and semi-arid lands of the earth.

537. Seminar in Arid Lands Problems (3:3:0). Study of selected problems of human utilization of the arid and semi-arid lands of the earth.

538. Seminar in Spatial Analysis in Economic Geography (3:3:0). Selected problems in the spatial organization of human behavior, especially problems associated with location analysis of economic activity.

539. Seminar in Regional Analysis (3:3:0). Consideration of the objectives and methods of regional analysis and the application of research techniques to the spatial analysis of selected regions.

5310. Readings in Geography (3). Conference course. May be repeated for credit.

5335. The Role of Geography in the Social Studies (3:3:0). A study of the perspective of modern geography and of its role in the social studies curricula of elementary and secondary schools. Designed especially for public school teachers.

5373. A Survey of Hispanic Lands and Peoples From Regional Literature (3:3:0). (PORT 5373, SPAN 5373)

Department of Geosciences

Associate Professor D. R. Haragan, Chairman.
University Professor Childs; Professors Arper, Black, Brand, Conselman, Harris, Jacka, Mattox, Murray, and Shurbet; Associate Professors Cebull, Güven, and Reeves; Assistant Professor Behnken.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

The Department of Geosciences offers graduate study programs leading to the M.S. degree in a wide variety of specialties in geology and geophysics. Emphasis at the Ph.D. level is in four general areas. These are

(1) Structural geology, tectonics, geophysics;
(2) Sedimentology, sedimentary petrology, sedimentary geochemistry;

(3) Vertebrate and invertebrate paleontology; and

(4) Diverse disciplines whose central focus is water resources.

Details concerning the specific makeup of these informal groupings are available from the department.

General degree requirements are those of the Graduate School (see this catalog). Admitted students are strongly encouraged to associate themselves with a faculty member or members by the end of their first semester in residence. This instructor(s) will serve as the student's principal adviser and will be responsible for the student's degree program.

The department encourages students whose bachelor's degrees are in other sciences to enter the Geosciences graduate program. Required leveling work, if any, will be determined on an individual basis, primarily by the staff member(s) in the student's field of interest. Graduate minors (required only for the Ph.D. candidate) may be taken either inside or outside the Department of Geosciences.

Requirements for the master's degree beyond those stipulated by the Graduate School, if any, are determined in each case by the student's thesis director (or committee). There is no foreign language requirement for the master's degree.

Requirements for the doctor's degree beyond those stipulated by the Graduate School, if any, are determined in each case by the student's dissertation director (or committee). Proficiency in two foreign languages, or high proficiency in one foreign language, is mandatory. This requirement may be fulfilled either by course work or by examination (see earlier section of this catalog). In the former case, a tool subject (for example, computer science) may be substituted for one language. For the foreign language requirement, only German, French, or Russian will be accepted without special justification and prior written departmental permission. Acceptable tool subjects are determined by the student's dissertation director (or committee).

Courses in Atmospheric Science. (ATMO)

530. **Advanced Problems in Atmospheric Science (3).** Prerequisite: Consent of instructor. Solution of special problems relating to atmospheric science.

5311. **Biometeorology (3:3:0).** Prerequisite: Consent of instructor. A physical description of atmospheric processes, their interaction with and influence on the biosphere.

5312. **Applied Meteorology (3:3:0).** The application of meteorological and climatological data, principles, and analyses to specific problems or operational procedures.

5313. **Advanced Dynamic Meteorology (3:3:0).**

5314. **Physical and Dynamical Climatology (3:3:0).** A study of the physical principles controlling climate with special emphasis on the global energy and water balance regimes of the Earth and its atmosphere.

5315. **Atmospheric Convection (3:3:0).**

5316. **Dynamics of Severe Storms (3:3:0).**

5317. **Atmospheric Vortices (3:3:0).**
5318. **Hydrometeorology (3:3:0).**
5319. **Cloud and Precipitation Physics (3:3:0).**
5320. **Mesometeorology (3:3:0).**
5321. **Survey of Weather Modification (3:3:0).**

Courses in Geochemistry. (G CH)

533. **Selected Topics in Geochemistry (3:3:0).** Prerequisite: Consent of instructor. Topics in geochemistry related to current research projects of graduate students and staff will be discussed. Content of the course will be correspondingly different each time offered.
534. **Advanced Problems in Geochemistry (3).** Prerequisite: Consent of instructor. Modern analytical methods for rocks, minerals, and natural fluids will be discussed. Atomic absorption and flame emission spectroscopy, X-ray fluorescence spectroscopy, and colorimetric methods of silicate analysis is covered.
536. **Sedimentary Geochemistry (3:2:2).** Formation of sedimentary minerals along with the basic physio-chemical and crystal chemical principles relevant to sedimentary minerals will be discussed. Chemical weathering of clay minerals, diagenesis of carbonates, and formation of evaporites are principal topics.
537. **X-Ray Powder Diffraction Methods (3:2:3).** Fundamental and practical aspects of X-ray diffraction on polycrystalline substances like minerals, rocks, and other solids.
538. **Advanced Methods in X-Ray Crystallography (3:2:3).** X-ray diffraction analysis of the atomic structure of solids with theory and practice in techniques of single crystal X-ray methods.
539. **Clay Mineralogy (3:2:3).** Atomic structures of clay minerals in relation to physical, engineering, and colloid chemical properties of these materials. Clay-organic complexes will be discussed along with instrumental methods of clay analysis such as X-ray diffraction, atomic absorption spectrascopy, and ion exchange methods.

Courses in Geology. (GEOL)

511. **Seminar (1:1:0).**
532. **Advanced Historical Geology (3:3:0).** Prerequisite: Stratigraphy and sedimentation, or permission. The following aspects of the geologic record are investigated: (1) reconstructing ancient depositional environments, paleogeography, and structural, eustatic, and climatic history by integrating data from modern depositional provinces, such as sedimentary structures, lithofacies, texture, mineralogy, paleontology, and soils; (2) fundamental aspects of historical geology — subdivision of the record, correlation and recognition of unconformities — are re-examined within light of modern concepts. Field trips required. Practical and economic applications considered.
533. **Petrology of Igneous Rocks (3:3:0).** Prerequisite: GEOL 4321 or equivalent. Crystallization and differentiation of igneous minerals. Origin and evolution of magmas and their relationship to orogeny and metamorphism. Study of rock suites using petrographic microscope.
535, 536. **Advanced Work in Specific Fields (3 each).**
539. **Vertebrate Paleontology (3:2:3).** Topic will be alternated so course is repeatable for credit. One topic will deal with the fossil record of lower vertebrates (fish, amphibians, and reptiles), while the second will con-

sider the fossil record of birds and mammals. Emphasis will be placed on morphological adaptations through time in each section.

543. Carbonate Petrology and Petrography (4:2:6). Prerequisite: Optical mineralogy, sedimentation and stratigraphy, or permission. The following aspects of carbonate rocks are investigated mainly from analysis of thin sections and hand specimens: (1) classification; (2) characteristics of modern and ancient carbonate and evaporite facies models — mineralogy, texture, structures, lithofacies, and biofacies; (3) diagenesis — mineralogic stabilization, dolomitization, cementation, lithification. Field trips required. Practical and economic applications considered.

544. Sedimentary Petrology and Petrography (4:2:6). Prerequisite: Optical mineralogy, sedimentation and stratigraphy, or permission. The following aspects of sedimentary rocks (emphasis on clastics) are investigated mainly from analysis of thin sections and hand specimens: (1) mineralogy, texture, and classification; (2) characteristics of source areas and depositional provinces — parent materials, structure and topography, climate, depositional environments; (3) diagenesis — weathering, soil formation, cementation and lithification. Field trips required. Practical and economic applications considered.

563. Advanced Field Geology (6).

5216. Remote Sensing Instrumentation (2:1:2).

5311. Micropaleontology (3:2:3). Prerequisite: Invertebrate zoology or invertebrate paleontology. Lectures and labs are designed to acquaint the student with basic lab techniques, morphology, and classification within the major microfossil groups, and to demonstrate the usefulness and importance of microfossils as biostratigraphic and paleoecologic tools.

5312. Economic Geology (3:2:3). Prerequisite: Consent of instructor. Formation and controls of ore deposits. Determination of origin, sequence, and temperatures through polished-sections and ore microscopy. Field trips to appropriate ore deposits are scheduled and required.

5313. Application of Geology in Engineering Projects (3:2:3). Evaluation of geologic factors in prediction and prevention of material failures in engineering projects. Study of documented case histories of tunnel, dam, highway, foundation, and landslide problems during and after construction.

5314. Paleozoic, Mesozoic, Cenozoic Stratigraphy (3:3:0). Analyses of significant stratigraphic units with emphasis on correlation, environments of deposition, and paleogeographic relationship. Concentration of effort is directed to southwestern United States.

5315. Metamorphic Microtextures (3:1:6). Prerequisite: GEOL 332 or equivalent; some facility with petrographic microscope; consent of instructor. Laboratory and lectures are designed to prepare students for structural work in crystalline (mainly metamorphic) terrains. Review of important metamorphic minerals and of zones, facies, and facies series; relationship of metamorphism and deformation; metamorphic textures and their use in structural interpretation.

5316. Remote Sensing Techniques (3:2:3). Development and applicability of various remote sensing methods, use of instrumentation for quantitative comparisons and measurements, electronic enhancement methods, practical field problems using Gemini, Apollo, RB-57 and ERTS photography. Course in air photo interpretation (GEOL 331) useful prerequisite but not exclusively necessary.

5317. Selected Topics in Structural Geology (3:3:0). Prerequisite: Consent of instructor. Topics in structural geology and geotectonics vary from year to year, depending on the special interests and needs of students and

on important developments in the field. Usually a seminar. May be repeated for credit.

5320. **Stratigraphic Paleontology (3:1:6).** Study of selected faunas of the invertebrate phyla with emphasis on the use of fossils for correlation and paleoecological interpretations. Several field trips to localities of particular paleontologic interest are included.

5324. **Advanced Sedimentation (3:2:3).** Advanced principles of sedimentary petrography and petrology.

5327. **Problems in Paleontology (3:2:3).**

5328. **Geotectonics (3:2:3).** Prerequisite: GEOL 332 or equivalent; consent of instructor. Fundamental problems associated with large-scale structural features and regional events. Subjects include neotectonics; the ocean basins and continental cratons; theory and development of geosynclines; problems related to large-scale faulting; tectogenesis, morphogenesis, epeirogenesis, and orogenesis and their relationship to plutonism; current state of geotectonic theory, including aspects of plate tectonics.

5329. **Description and Analysis of Mesoscopic Structures (3:2:3).** Detailed structural analysis of features whose scales range mainly from hand-specimen to outcrop size including a description of the techniques basic to the study of complexly deformed terrains.

5330. **Paleolimnology (3:2:3).**

631. **Master's Thesis (3).** Enrollment required at least twice.

731, 732. **Research (3 each).** Required of all doctoral candidates.

733. **Advanced Problems in Geology (3).**

831. **Doctor's Dissertation (3).** Enrollment required at least four times.

Courses in Geophysics. (G PH)

531. **Wave Propagation in Layered Media (3:3:0).** The theory of elastic wave propagation in layered media is developed. The results are applied to experimental data of wave propagation in the solid earth, the ocean, and the atmosphere.

532. **Introduction to the Theory of Elastic Waves (3:3:0).** Generalized equations for stress-strain relationships in an elastic body are derived. From them, the equations of motion for elastic waves propagating in a solid are derived. Propagation of each wave type is related to the problem of determining the internal structure of the earth.

533. **Selected Topics in Geophysics (3:3:0).** Topics to be discussed will be selected by the instructor. The selection will be based upon requirements and interests, but will usually reflect the current geophysical literature.

534. **Advanced Problems in Geophysics (3:1:6).** Individual research into topics and problems of particular interest to the student. May be repeated for credit.

Department of Germanic and Slavonic Languages

Horn Professor Carl Hammer, Jr., Chairman.
Professors Alexander (Associate Chairman) and Zyla; Associate Professors Bacon and Hull.

The department offers majors and minors in German for the master's degree, and minors in German for the doctor's degree. Minors for the master's degree are offered also in Russian.

The master's program in German requires 30 hours of graduate courses including a thesis, or 36 hours without a thesis. Unless the student has at least 12 hours of undergraduate work at the senior-year level, he must expect to do appropriate leveling work.

The master's minor in German or Russian requires at least 6 hours of graduate work. As a prerequisite, the student must have completed at least 331, 332 sequence (or its equivalent) of undergraduate work. The doctoral minor requires at least 18 hours of graduate work, with the same prerequisite as for the master's minor.

The department participates in the interdepartmental programs in Comparative Literature and Linguistics. For further information on these programs see the later section of this catalog entitled "Interdepartmental Programs."

Courses in German. (GERM)

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND MINORS FOR THE DOCTOR'S DEGREE

531, 532. Research in German (3 each). Prequisite: B.A. or equivalent in German or 12 hours of advanced work in German. May be repeated for credit.

533, 534. Intensive German for Graduate Research I, II (3:3:0 each).

5312, 5313. Studies in German Language and Literature I, II (3:3:0 each). Prerequisite: Consent of department chairman. The content of this course will vary to meet the needs of the particular group of students, with concentration on a literary genre or movement, or on a linguistic topic.

5316. Middle High German (3:3:0). A study of the language and literature of Germany from about 1100 to 1500.

5317. The German Novelle (3:3:0). A detailed study of the German Novelle from its origins to the early 1900's, with special emphasis on its development in the nineteenth century. Conducted entirely in German.

5318. Old Icelandic (3:3:0). A study of the language and literature of medieval Iceland. A survey of the written remains of Continental Scandinavia will be made.

5321, 5322. Seminar in Modern German Literature I, II (3:3:0 each). Study of various genres of twentieth-century German literature, with special emphasis on its philosophical and psychological impact on the present. Conducted entirely in German. May be repeated for credit.

631. Master's Thesis (3). Enrollment required at least twice.

Courses in Russian. (RUSN)

MINORS FOR THE MASTER'S DEGREE

531, 532. Research in Russian (3 each). Intensive study of an author or his major works, or of a literary period or movement. Research paper required. May be repeated for credit.

Department of Health, Physical Education, and Recreation for Men

Professor John W. Cobb, Chairman.
Professors Kireilis and Segrest; Associate Professors Buchanan, Burkhardt, and Mason; Assistant Professors Bobo and Kozar.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND MINORS FOR THE DOCTOR'S DEGREE

Graduate study is offered through the Department of Health, Physical Education, and Recreation for Men leading to a Master of Education degree in Physical Education. The Master's program consists of 30 hours of graduate work, including a thesis, or 36 hours without thesis. The graduate faculty will determine and prescribe any leveling work to be completed before or after admission. There is no foreign language requirement.

All students seeking admission to the graduate program should consult with the chairman of the department or the graduate adviser before enrolling in any course.

Courses in Physical Education. (P E)

(All courses are open to both men and women.)

531. **Administration of Physical Education (3:3:0).** Principles, problems, relationships, and procedures in the supervision of elementary and high school physical education programs.

532. **Supervision of Physical Education (3:3:0).** Principles, problems, relationships, and procedures in the supervision of elementary and high school physical education programs.

533. **Facilities for Physical Education (3:3:0).** Principles, terminology, and standards for planning, constructing, using and maintaining facilities.

534. **Administration of the School Health Program (3:3:0).** For teachers, coaches, and school administrators who desire an understanding of a well-balanced health program.

535. **Techniques of Research in Health, Physical Education, and Recreation (3:3:0).** Research methods, research design, treatment, and interpretation of data.

536. **Problems in Health, Physical Education, and Recreation (3).** Individual study of problems relating to health, physical education, and recreation. May be repeated three times for credit.

537. **Seminar in Health, Physical Education, and Recreation (3:3:0).** Specific research topics will be studied in the areas of activity analysis, physiology of exercise, and psychology of sports. May be repeated once for credit.

538. **Physiology of Exercise (3:3:0).** Effect of muscular activity on body processes.

539. **Advanced Measurement in Physical Education (3:3:0).** Constructing, evaluating, and standardizing motor performance tests.

5302. **Motor Activity for the Atypical (3:3:0).** A survey of selected human disabilities. Implications for motor activities for the disabled.

5304. Physiological Kinesiology (3:3:0). The study of the functional bases of human movement with particular emphasis on the muscular system.

5305. Psychological Kinesiology (3:3:0). The study of the principles and concepts of human behavior related to and affected by human movement with special emphasis on motor skill learning.

5306. Mechanical Analysis of Motor Performance (3:3:0). A study of the laws and principles governing human motion. Emphasis on analysis of sports movement with application to the teaching and learning of motor skills.

5322. Organization and Administration of Interscholastic and Intercollegiate Athletic Programs (3:3:0). Methods in organizing and administering the interscholastic and intercollegiate athletic programs. Study of: staff, program, budget, health and safety, facilities, publicity, history, duties of an athletic director, and national, state, and local controls.

5324. Organization and Administration of Intramural Sports (3:3:0). Administrative procedures connected with organization, records, equipment, program, and staff duties; intramural sports, officiating; ethics, rules, mechanics, and practice.

630. Master's Report (3).

631. Master's Thesis (3). Enrollment required at least twice.

Department of Health, Physical Education, and Recreation for Women

Professor Margaret E. Wilson, Chairman.
Professors Dabney, Horton, Hoyle, and Owens; Associate Professors Rogers and Tevis; Assistant Professor Moore.

MAJORS AND MINORS FOR THE MASTER'S DEGREE

The department offers a program of graduate study leading to the Master of Education degree. This program consists of a minimum of 30 hours of graduate work including a thesis or 36 hours without thesis. The department will determine and prescribe any necessary leveling work. There is no foreign language requirement.

Students seeking the master's degree in physical education should consult with the chairman of the department or the Chairman of the Graduate Area in Physical Education about their program before enrolling in any courses.

Courses in Physical Education. (P E)

(All courses are open to both men and women.)

531. Administration of Physical Education (3:3:0). Principles, problems, and procedures for administering physical education programs; for school administrators, athletic directors, physical education directors, and city recreation directors.

532. Supervision of Physical Education (3:3:0). Principles, problems, relationships, and procedures in the supervision of elementary and high school physical education programs.

533. **Facilities for Physical Education (3:3:0).** Principles, terminology, and standards for planning, construction, use, and maintenance of facilities.

534. **Administration of the School Health Program (3:3:0).** For teachers, coaches and school administrators who desire an understanding of a well-balanced health program.

535. **Techniques of Research in Health, Physical Education, and Recreation (3:3:0).** Research methods, research design, treatment and interpretation of data.

536. **Problems in Health, Physical Education, and Recreation (3:3:0).** Individual study of problems relating to health, physical education, and recreation. May be taken three times for credit.

537. **Seminar in Health, Physical Education, and Recreation (3:3:0).** Specific research topics will be studied in the areas of activity analysis, physiology of exercise, and psychology of sports. May be repeated once for credit.

538. **Physiology of Exercise (3:3:0).** Effect of muscular activity on body processes.

539. **Advanced Measurement in Physical Education (3:3:0).** Constructing, evaluating, and standardizing motor performance tests.

5302. **Motor Activity for the Atypical (3:3:0).** A survey of selected human disabilities. Implications for motor activities for the disabled.

5304. **Physiological Kinesiology (3:3:0).** The study of the functional bases of human movement with particular emphasis on the muscular system.

5305. **Psychological Kinesiology (3:3:0).** The study of the principles and concepts of human behavior related to and affected by human movement with special emphasis on motor skill learning.

5306. **Mechanical Analysis of Motor Performance (3:3:0).** A study of the laws and principles governing human motion. Emphasis on analysis of sports movement with applications to the teaching and learning of motor skills.

5324. **Organization and Administration of Intramural Sports (3:3:0).** Administrative procedures connected with organization, records, equipment, program, and staff duties; intramural sports, officiating; ethics, rules, mechanics, and practice.

631. **Master's Thesis (3).** Enrollment required at least twice.

Department of History

Professor David M. Vigness, Chairman.
Horn Professor Wallace; Professors Blaisdell, Connor, Graves, and Manning; Associate Professors Barr, Blakeley, Chong, Collins, Flynn, Johnson, Kuethe, Nelson, Newcomb, Reese, G. Robbert, L. Robbert, and Traylor; Assistant Professors Harper, Hayes, Jebsen, King, and Twyman.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

The department recommends that students applying for admission to its graduate programs submit scores on the Advanced Test (history) of the Graduate Record Examination. Information on departmental admission standards, prerequisites, and other matters dealing with gradu-

ate study in history may be acquired by writing the graduate adviser or the chairman of the department.

A student in the standard master's degree program must complete 30 hours of graduate courses including HIST 534, one seminar in the 600-course series, and 6 hours in thesis work. His course work is planned in consultation with the graduate adviser or his thesis director soon after his admission. The department requires a reading knowledge of one foreign language.

To provide a program of study for persons whose interests may not be oriented toward formal research, the department offers a non-thesis master's program designed to contribute significantly to their intellectual development. The program is not recommended for students contemplating doctoral work. To complete the program, a student must offer a minimum of 30 semester hours in history and 6 in a minor. Of the history hours, at least 6 must be from among HIST 534, 535, and 536 and at least 6 must be from among seminars at the 600 level with a grade of B or higher under two or more instructors. No more than 18 semester hours may be offered in any one of the four areas of American, European, Latin American, and Asian history.

The department offers doctoral work in four areas of historical study: American, European, Latin American, and Asian. For purposes of doctoral study, these areas are subdivided into fields as follows:

American: Early American; Nineteenth Century; Recent; Social, Cultural, and Urban; Diplomatic; South and Negro; West and Southwest; Economic and Labor.

European: Classical; Medieval; Early Modern European to 1789; Modern European; Great Britain; Modern Britain and the Empire-Commonwealth.

Latin American: Colonial; National.

Asian: East Asia.

A doctoral student must choose five fields of study for his program, at least two of which must be outside the major area of study. Dissertations may be written in American, Mexican, or Modern Western European history. Ordinarily all programs should include at least one field in European history and one field in American history. All doctoral programs must include HIST 534, 535, and two seminars in the 600-course series, or their equivalents.

The minor should be one which will support the student's program, and, therefore, it is chosen ordinarily from areas of the social sciences or humanities, though in special cases minors in basic sciences or professional areas are acceptable. Individualized interdisciplinary minors focusing on the student's research or career interests may be accepted. The minor program is planned with the graduate adviser and approved by the advisory committee or the graduate studies committee if the advisory committee has not yet been formed. No more than 6 hours of history may be applied to an interdisciplinary minor program.

In the preliminary examination, the student is tested orally in five fields of historical study plus the minor field. The purpose of the examination is to determine if the student should be encouraged to continue his study toward the doctorate, and, if so, to guide him with specific recommendations on steps he should take before the qualifying examination. In this latter examination, the student is expected to show command of five fields of history and the minor area of concentration.

The language requirement for the Ph.D. degree is a reading knowledge of two of the following: German, French, or Spanish. In the case of students in American history or Mexican history, one of the choices may be another language or a relevant research tool (such as computer science or statistics) with the approval of the student's advisory committee and the Graduate Studies Committee.

Courses in History. (HIST)

511. **Teaching of History in College (1:1:0).** An observation-and-advice course rather than a seminar. Concerned with supervision of teaching assistants: classroom visitation, judgment on performances, and advice and assistance to individual instructors.

531. **Readings and Research (3).** Independent study course designed for masters' or general students. Subject varies with student's particular interest and desires. Instructor's consent needed.

534. **Historical Methods and Historiography (3:3:0).** Research methods; bibliography, government documents, newspapers, dissertations, archives and manuscripts, oral history, quantitative history, historical archeology; literary organization and style; footnote and bibliographic forms.

535. **Historians and Historical Literature (3:3:0).** A survey of major historians and historical works from Herodotus to the present, emphasizing the development of history as an intellectual orientation and as an academic discipline.

536. **The Literature of American History (3:3:0).** An extensive survey of significant historical writing on major issues of the American past. Focus on major monographic studies and multi-volumed interpretations, integrating a broad spectrum of writing on American history.

539. **Administration of Archival and Manuscript Collections (3:3:0).** An intensive study of archival principles and techniques emphasizing current trends and challenges, with an opportunity for professional management and/or research facility enhancement through in-service training.

5311. **Studies in Southern History (3:3:0).** An analysis of the major issues and controversies of the South with emphasis on the period from the American Revolution to the present.

5312. **Studies in Recent United States History (3:3:0).** Selected periods in twentieth century American history — the Progressive Era and the 1920's, the New Deal and World War II, and the postwar years.

5313. **Studies in United States Social and Cultural History (3:3:0).** Includes discussions of education, religion, and reform in successive periods, the impact on society of industrialization, war, and depression, and the arts in society.

5314. **Studies in the Frontier and Western American History (3:3:0).** An examination of selected areas with emphasis on exploration, settlement,

Anglo-American expansion, foreign and Indian conflicts, life-ways, and resulting changes in American institutions.

5315. **Studies in United States History (3:3:0).** Selected topics in United States history, with emphasis on those areas not covered by more narrow studies courses.

5316. **Studies in Modern European History (3:3:0).** Material varied periodically, so that one time the subject matter concerns the 1815-1870 years, another time the period from 1870 to World War I. Emphasis on a long term paper and practice in research in printed primary sources.

5317. **Studies in Medieval History (3:3:0).** Study of selected topics in the intellectual history of the early and high middle ages. Individual reports discussed in a seminar situation.

5318. **Studies in the Renaissance and Reformation History (3:3:0).** Study of selected topics in the intellectual or religious history of the Renaissance or the Reformation. Individual reports discussed in a seminar situation.

5319. **Studies in Asian History (3:3:0).** Designed primarily to deal with the processes of East Asia's intellectual, political, social, and economic modernization with special emphasis on East Asian responses to meet the challenges from the West during the nineteenth and twentieth centuries.

5321. **Studies in British History (3:3:0).** An organized studies course covering selected topics in British history. Topics vary according to the instructor's interests and the students' needs.

5322. **Studies in United States Diplomatic History (3:3:0).** Americam diplomacy and foreign policy with emphasis on either pre-1900 or post-1900 periods. Stress on the literature of United States diplomatic history.

5323. **Studies in American Constitutional History (3:3:0).** Constitutional development of the United States, 1787-1972; special emphasis on influence of Supreme Court on U.S. history.

5324. **Studies in English Colonial American History (3:3:0).** Topics vary from semester to semester, including seventeenth century Massachusetts, the coming of the American Revolution, and the new nation after 1776.

5325. **Studies in American Economic History (3:3:0).** Historical analysis and interpretation of growth and change in the United States economy, with emphasis on ideas and institutions in business and agriculture.

5327. **Studies in Texas History (3:3:0).** Topics vary with interests and needs of each class; emphasis on Spanish heritage, Texas Revolution, Republic, political, economic, and social developments, ethnic groups.

5328. **Studies in Colonial Latin American History (3:3:0).** Explores the principal historical literature and interpretations for Colonial Spanish America from the conquest to independence.

5329. **Studies in Ancient History (3:3:0).** Study of selected topics in the political or intellectual history of Greece and Rome based upon a study of the sources, in translation if advisable.

5330. **Studies in American Urban History (3:3:0).** Selected topics in the dynamics of urbanization and in the effects of cities on American History from the colonial period to the present.

5331. **Studies in British Empire History (3:3:0).** An organized studies course covering selected topics in the history of the British Empire. Topics vary according to the instructor's interests and the students' needs.

5332. **Studies in National Latin American History (3:3:0).** Examines the history of the area since independence with emphasis on modernization. Includes consideration of Latin America as a civilization while revealing unique characteristics of the individual countries.

5333. **Studies in Mexican History (3:3:0).** Designed to explore through lectures and reading programs specific topics selected for interests and needs of the students. Oral reports and written examinations.

5334. **Studies in American Labor History (3:3:0).** Study of the role of the wage-earner and organized labor in United States history with emphasis on bibliography and the problems of interpretation.

5336. **Studies in Nineteenth Century United States History (3:3:0).** Selected topics in the history of the United States, 1789-1890 with emphasis on bibliography and problems of interpretation. Extensive readings of monographs and journals.

5340. **Studies of Black People in the United States (3:3:0).** An analysis of the major issues and controversies in Afro-American history from an introduction of African background to the present.

5341. **Studies in Tudor-Stuart England (3:3:0).** An organized studies course covering selected topics in Tudor-Stuart England. Topics vary according to the instructor's interests and the students' needs.

5342. **Studies in French Revolutionary and Napoleonic Years (3:3:0).** Emphasis on study of the vitally important French Revolutionary-Napoleonic years from the discussion and research standpoint, with reports presented and a term paper prepared.

5343. **Studies in East European and Russian History (3:3:0).** Study of selected topics through lectures by the instructor, preparation and presentation of research papers, class examination of source materials, and study of the historiography.

5344. **Studies in Modern European Social Movements (3:3:0).** Focus on Socialist, Communist, Anarchist, Syndicalist, and other "leftist" movements in nineteenth and twentieth century Europe. Emphasis is theoretical and political.

631. **Master's Thesis (3).** Enrollment required at least twice.

633. **Seminar in Southwestern History (3:3:0).** Political, economic, and social development of the American Southwest with special emphasis on the U.S.-Mexican War, Santa Fe trade, and U.S.-Mexican border.

634. **Seminar in American History (3:3:0).** A research course featuring formal papers on selected topics. Topics chosen in consultation with the instructor.

635. **Seminar in European History (3:3:0).** Research seminar, with stress on methodology, types of research materials available in our library in European history, delivery of reports, and submission of an extensive term paper.

636. **Seminar in Latin American History (3:3:0).** A research course featuring formal papers on selected topics. Topics usually arranged in consultation between student and instructor.

637. **Seminar in British History (3:3:0).** A research oriented course covering selected topics in British history.

731, 732. **Research (3 each).** Independent study course designed for post-masters' students. Subject varies with students' particular interest and needs. Instructor's consent needed.

831. **Doctor's Dissertation (3).** Enrollment required at least four times.

Department of Mass Communications

Professor Billy I. Ross, Chairman.
Professors Brenner, Rosenblatt, Sargent, and Sellmeyer; Associate Professors Hsia, Quesada, Rooker, and Tan; Assistant Professors Dean, Gould, and Harp.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND MINORS FOR THE DOCTOR'S DEGREE

Students seeking the Master of Arts degree in Mass Communications should consult with the chairman of the department or the graduate adviser about the program before enrolling in any courses. The master's program consists of 30 hours of graduate work, including a thesis, or 36 hours without a thesis. Within the program a student may declare an area of concentration in one of the following fields: advertising, health communications, journalism, telecommunications, or mass communications. Students without an undergraduate major in one of these fields may be required to take up to 6 hours of graduate leveling work. Such courses do not count towards fulfillment of the core requirement.

Mass Communications majors must fulfill a tool requirement in statistics or a foreign language. Such courses must be in addition to the 30 hours (or 36 in the nonthesis option) required in the regular program. Students should consult with the graduate adviser regarding means of fulfilling this requirement.

Courses in Mass Communications. (MCOM)

511. Studies and Problems in Mass Communications (1). Individual research and studies into the problems of mass communications. May be repeated up to 8 hours.

532. Seminar in Public Opinion and Propaganda (3:3:0). Study of the developing literature in this field of specialization. Bases of public opinion and propaganda. Opinion-making processes of governments, political parties, pressure groups.

533. Seminar in Legal Problems of Mass Communications (3:1:5). Reading and research in law of libel, privileged areas, privacy, and other legal problems facing the mass media.

534. Methods of Research (3:3:0). The tools and methods of research; qualitative and quantitative measures; testing of data for reliability and validity; interpretation of research findings.

535. Administration of Communication Media (3:3:0). Problems of executive planning and management of newspapers, magazines, and broadcast media.

5311. Studies in International Communications (3:3:0). A critical examination of the structure, control, and performance of the media systems of nations and regions.

5312. Seminar in Mass Communications Theory (3:3:0). Study of major communication theories and theorists; analysis or research findings in communication of ideas and information through mass media; information

perception and attention; mass media audiences; mass communication and attitude change.

5313. **Seminar in Mass Communication History (3:3:0).** A study of the various mass communications histories that have been written; extended readings in biographies of outstanding figures and histories of media institutions.

5314. **Readings and Research (3).** Directed reading and research with particular reference to trends, interpretations, and developments in various media.

5330. **Problems in Mass Communications (3:3:0).** A study of each of the mass media — characteristics, functions, structure, and support as well as exploration of the various theories and models of communication. (No degree credit when taken for leveling purposes.)

5335. **Seminar in Public Relations (3:3:0).** Analysis in depth of the social and environmental changes affecting the role of public relations activities in our present system.

630. **Master's Report (3).**

631. **Master's Thesis (3).** Enrollment required at least twice.

Courses in Journalism. (JOUR)

530. **Seminar in Education for Journalism (3:3:0).** History of education for journalism with emphasis on current philosophies. Journalism and the liberal arts; areas of specialization; critical evaluation of curriculum.

531. **Seminar in Modern Editing (3:3:0).** Critical and analytical approach to the problems of editing.

536. **Problems in Investigative Reporting (3:0:9).** A seminar in public affairs reporting at the local, state, and regional levels. In-depth study of social, political, and economic questions; preparation of articles in these areas.

537. **Seminar in the Press and Society (3:3:0).** Examination of the news media in terms of social significance and effects upon people and institutions. Evaluation of press performance.

5315. **School Publications (3:3:0).** Study of the methods and procedures of producing school publications. Problems related to staff organization, personnel instruction, editorial supervision, advertising revenue, business management, promotion, and production. Role of school publications and the school administration.

5316. **Individual Study in Journalism (3).** Individual research and studies of the problems in Journalism.

5331. **Journalism Problems — Advanced (3:3:0).** An advanced study of the basics of writing and editing news stories and headlines, layout of newspaper pages, basic photography, public opinion and propaganda, consumer magazines. (No degree credit when taken for leveling purposes.)

Courses in Advertising. (ADV)

5331. **Advertising Problems — Advanced (3:3:0).** Exploration of current theory and the analysis of application. Emphasis on new trends and developments in advertising theory. (No degree credit when taken for leveling purposes.)

5332. **Studies of Problems of Advertising/Public Relations (3).** Directed individual study of contemporary, advanced advertising or public relations problems varying with the interest and need of the student.

5334. Advertising in a Contemporary Society (3:3:0). A broad perspective and penetrating study of advertising — functions, role, challenges, and opportunities for business and society.

5336. Advertising and the Consumer (3:3:0). Survey and analysis of current behavioral science findings as related to advertising.

5337. Seminar in Advertising and Mass Communication Media (3:3:0). The study and analysis of mass communication media in relation to its role as a carrier of advertising. Emphasis on the latest techniques in media research and media planning by computer.

Courses in Telecommunications. (TELE)

531. Studies and Problems in Telecommunications (3). Individual research and studies of the problems in telecommunications. May be repeated for credit.

532. Educational Television (3:3:0). The history, social impact, and effect that educational broadcasting has had upon the American way of life. Evaluation of instructional and public television programs.

533. Contemporary Issues in Telecommunications (3:3:0). A definitive study of the current issues and problems which affect telecommunications with special investigations into related influences from government, mass media, education, and society.

5331. Telecommunications Problems — Advanced (3:3:0). A comprehensive exploration of current theory and application; emphasizing new trends and developments of telecommunications theory. (No degree credit when taken for leveling purposes.)

Courses in Photography. (PHOT)

531. Photography and Film Problems (3). An individual advanced study and analysis of photography and/or film. Emphasis will be on new theories and techniques and their application.

Courses in Health Communications. (HCOM)

For a listing of courses in health communications, see the Department of Health Communications in the School of Medicine section later in this catalog.

Department of Mathematics

Associate Professor J. Dalton Tarwater, Chairman.
Professors Amir-Moez, Boullion, Chanda, Conover, Ford, Komkov, Lewis, Nelson, Rigby, and Riggs; Associate Professors Anderson, Baldwin, Bennett, Hildebrand, Hunt, Kellogg, McLaughlin, Miller, Mitra, Moreland, Newman, Saeks, Shurbet, Thompson, Walling, and White; Assistant Professors Conatser, Davenport, Duran, Hamilton, Meyer, Strauss, and Watkins.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

The Department of Mathematics offers graduate work leading to the M.A., M.S., and Ph.D. degrees. Students seeking an advanced degree in mathematics should consult with the Director of Graduate Studies in

Mathematics before enrolling in any courses. The Department of Mathematics offers a number of graduate courses which are suitable for students who wish to complete a minor in mathematics.

The Department of Mathematics does not have a foreign language requirement for the master's degree. Two foreign languages (French, German, or Russian) are required for the Ph.D. degree. With departmental approval, proficiency in computer programming may be substituted for one of the required foreign languages.

The M.A. degree consists of 36 hours of graduate work including 3 hours of credit for a departmental report. The student must complete three sequences chosen from algebra, analysis, geometry, probability, and statistics, number theory and applied mathematics. This option is offered primarily for those students who wish to teach mathematics at the precollege level.

The M.S. degree consists of 36 hours of graduate work including 3 hours of credit for a departmental report, or 30 hours of graduate work, including 6 hours of credit for the master's thesis. The student must complete two of the core sequences listed in the Ph.D. program for the 36-hour option and one of the core sequences for the 30-hour option.

Each doctoral student will undergo a preliminary examination as early as possible in his graduate training. The student will choose three of the following six core areas for the purpose of preliminary examinations: algebra, applied mathematics, complex analysis, probability and statistics, real analysis, and topology. These examinations will be administered annually in May and the results evaluated by the Graduate Programs and Policies Committee of the Mathematics Department. Each doctoral student must also pass a qualifying examination in his specialty area.

Courses in Mathematics. (MATH)

511, 512. **Seminar (1:1:0 each).** Prerequisite: Graduate standing in mathematics. May be repeated for credit.

531. **Advanced Problems (3).** Prerequisite: Graduate standing in mathematics. May be repeated for credit.

532, 533. **Intermediate Analysis I, II (3:3:0 each).** Introduction to mathematical analysis; includes integration theory; theory of limits; infinite processes.

534, 535. **Theory of Numbers I, II (3:3:0 each).** Prerequisite: MATH 437. Diophantine equations; binary quadratic forms; algebraic numbers theory of number-theoretic functions; partitions; the prime number theorem.

536, 537. **Modern Algebra I, II (3:3:0 each).** Prerequisite: MATH 4321 or consent of instructor. Groups; rings; fields; linear algebra; Galois theory.

538. **Foundations of Mathematics (3:3:0).** Prerequisite: Graduate standing in mathematics. Selected topics in algebra; the number system; the axiomatic approach to mathematics.

539. Dimension Theory (3:3:0). Prerequisite: MATH 5317 or consent of instructor. Dimension; dimension of Euclidean spaces; covering and imbedding theorems; mappings in spheres; dimension and measure.

5312, 5313. Functions of a Complex Variable I, II (3:3:0 each). Prerequisite: MATH 434 or 4319. The extended complex plane; elementary transformations; power series; complex integration; Taylor and Laurent expansions; meromorphic and entire functions; the calculus of residues.

5314, 5315. Functions of a Real Variable I, II (3:3:0 each). Prerequisite: MATH 533 or equivalent. The real number system, set and measure theory; properties of Riemann and Lebesgue integrals.

5316, 5317. Topology I, II (3:3:0 each). Prerequisite: MATH 4316. Point set theory; introduction to combinatorial topology.

5318. Operational Calculus (3:3:0). Prerequisite: MATH 434. The convolution of continuous functions; extension to operators and the operational calculus, the Laplace transform and the convolution transform.

5319. Fourier Analysis (3:3:0). Prerequisite: MATH 5315. Orthogonal series; convergence and summability of Fourier series; Fourier transforms.

5320. Introduction to Non-Standard Analysis (3:3:0)

5321, 5322. Methods of Applied Mathematics I, II (3:3:0 each). Prerequisite: MATH 4319 or its equivalent. Theory of congruence. Special functions; fourier series, Laplace transforms; boundary value problems; topics in functional analysis.

5323, 5324. Theory of Ordinary Differential Equations I, II (3:3:0 each). Prerequisite: MATH 432, 435, or consent of instructor.

5325, 5326. Partial Differential Equations I, II (3:3:0 each). Prerequisite: MATH 432, 435, or consent of instructor.

5329, 5330. Numerical Analysis I, II (3:3:0 each). Prerequisite: MATH 4311. Stability and error analysis; numerical solution of ordinary and partial differential equations; integral equations.

5331, 5332. Advanced Topics in Analysis I, II (3:3:0 each). Prerequisite: Consent of instructor. May be repeated for credit.

5333, 5334. Functional Analysis I, II (3:3:0 each). Prerequisite: MATH 5314. Normed linear spaces and their abstract completions. Closed graph theorem. Theorem of uniform boundedness. Hahn-Banach theorems. Weak topologies; adjoints; resolvents; convex sets and related topics.

5335, 5336. Advanced Mathematics for Teachers I, II (3:3:0 each). Prerequisite: Consent of instructor. Selected topics in mathematics. May be repeated for credit.

5337, 5338. Topics in Numerical Analysis I, II (3:3:0 each). Prerequisite: MATH 5330, 4325. Current advanced topics in numerical analysis; research work using computers. May be repeated for credit.

5339. Advanced Linear Algebra (3:3:0). Prerequisite: MATH 4321. Abstract vector spaces; multilinear forms; linear transformations; tensor products of transformations; proper values; canonical forms; unitary spaces; matrix inequalities; singular values of transformations; topics in linear algebra.

5341, 5342. Advanced Topics in Algebra I, II (3:3:0 each). Prerequisite: Consent of instructor. May be repeated for credit.

5343, 5344. Advanced Topics in Applied Mathematics I, II (3:3:0 each). Prerequisite: Consent of instructor. May be repeated for credit.

5345, 5346. Algebraic Topology I, II (3:3:0 each). Prerequisite: MATH 537 and 5317 or consent of instructor. Categories, functors; homotopy; fundamental group; covering spaces; homology; the Eilenberg-Steenrod ax-

ioms; cohomology; products; higher homotopy groups; obstruction theory; related topics.

5347, 5348. Riemann Surface Theory I, II (3:3:0 each). Prerequisite: MATH 5313 or consent of instructor. Manifolds; Riemann surface of an analytic function; covering manifolds; combinatorial topology; differential and integrals on Riemann surfaces; uniformization.

5349. Nonparametric Statistical Inference (3:3:0). Prerequisite: MATH 4315. Statistical inference; asymptotic distribution theory; tests on permutation of observation; rank order statistics; nonparametric tolerance limits; theory of runs.

5351. Advanced Topics in Geometry (3:3:0). Prerequisite: Consent of instructor. May be repeated for credit.

5352. Differentiable Manifolds (3:3:0). Prerequisite: MATH 4316 or consent of instructor. Differentiable mappings; manifolds; differential forms and the Grassmann algebra.

5353, 5354. Theory of Generalized Functions I, II (3:3:0 each). Prerequisite: MATH 5312 and 5314 or consent of instructor. Schwartz distribution and their properties; analytic representations; Fourier transforms of distributions; linear topological spaces; distributions and kernels.

5355, 5356. Theory of Groups I, II (3:3:0 each). Prerequisite: MATH 536 or consent of instructor. Composition series; Abelian and solvable groups; direct and sub-direct products; nilpotent groups; permutation groups; and selected topics.

5357, 5358. Theory of Rings I, II (3:3:0 each). Prerequisite: MATH 536 or consent of instructor. Modules; chain conditions; radicals; semi-simplicity; commutative rings; algebras; tensor products; and selected topics.

5361, 5362. Advanced Topics in Topology I, II (3:3:0 each). Prerequisite: MATH 5317 and consent of instructor. May be repeated for credit.

5363. Decision Theory (3:3:0). Prerequisite: MATH 4314, 4315, 5372 or consent of instructor. Game theory, statistical decision; bayesian statistics.

5367. Advanced Statistical Methods (3:3:0). Prerequisite: MATH 4314, 4315, 5371 or consent of instructor. Factor analysis; modeling; special topics in designs; sensitivity analysis; nonlinear estimation.

5369. Advanced Stochastic Processes (3:3:0). Prerequisite: MATH 4314, 4315 or consent of instructor. Linear estimators; filters; spectral analysis; linear systems; recursive filters; stationary and nonstationary processes.

5371. Design of Experiments (3:3:0). Prerequisite: MATH 4315. Principles of design and analysis of experiments; Latin squares; split plots; incomplete block designs; efficiency.

5372. Theory of Linear Statistical Models (3:3:0). Prerequisite: MATH 4315. Multivariate normal; convariance matrix and operations; distribution of quadratic forms; general linear hypothesis of full and non-full rank; specific linear models.

5373. Stochastic Processes (3:3:0). Prerequisite: MATH 4313. Study of processes which develop in time according to probabilistic laws; Brownian motional life and death processes; stochastic models; Markov processes; Ergodic theorems.

5374, 5375. Advanced Mathematical Statistics I, II (3:3:0 each). Prerequisite: MATH 4315. Topics selected from analysis of variance and design of experiments; multivariate analysis; sampling from finite populations; nonparametric methods; sequential analysis.

5376, 5377. Advanced Probability I, II (3:3:0 each). Prerequisite: MATH 4313, 5314, and 5315. Measure and integration, axiomatic foundations of

probability theory; random variables; distributions and their characteristic functions; stable and infinity divisible laws; limit theorems for sums of independent random variables; conditioning; Martingales.

5378. Statistical Multivariate Analysis (3:3:0). Prerequisite: MATH 4315, 4324 or consent of instructor. Multivariate normal distribution; estimation of the mean vector and covariance matrix; distribution of sample correlation coefficients; the generalized T^2statistic; classification; distribution of the sample covariance matrix.

5379. Statistical Sampling Theory (3:3:0). Prerequisite: MATH 4315. Theory of simple random sampling; stratified random sampling; cluster sampling; ratio estimates; regression estimates; other sampling methods.

5380. Intermediate Probability Theory (3:3:0). Prerequisite: MATH 4314, 4315 or consent of instructor. Random walks; Markov chains; recurrent events; elementary queueing theory; lattice random variables.

5383, 5384. Intermediate Mathematical Statistics (3:3:0 each).

630. Master's Report (3).

631. Master's Thesis (3). Enrollment required twice.

731. Research (3).

831. Doctor's Dissertation (3). Enrollment required at least four times.

Department of Music

Professor Harold Luce, Chairman.
Professors Barber, Deahl, Ellsworth, Hemmle, Kenney, Killion, Marple, Maynard, McCarty, Redcay, Tolley, and van Appledorn; Associate Professors Britten, Cutter, Gillas, Post, Stoune, Thomas, and Vaughan; Assistant Professor McGowan.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND OPTION FOR THE DOCTOR'S DEGREE

The Department of Music offers a major area of emphasis for the Doctor of Philosophy degree in Fine Arts. It offers the Master of Music degree with a major in Performance, in Music History and Literature, or in Music Theory; and the Master of Music Education degree. The M.M. degree consists of 30 hours of graduate work including a thesis for the Music History and Literature or Music Theory majors. The Master of Music Education degree may be attained with a 30-hour program including a thesis or a 36-hour program without a thesis.

For the Performance major, two public performances are required: one solo recital, and a second performance, the content of which will be determined and approved by the appropriate applied divisional faculty. Both performances must be judged satisfactory by the student's applied music faculty committee. A student whose recital is judged unsatisfactory will be permitted to present another recital program no earlier than four months from the date of the previous recital. The student is responsible for submitting two tape recordings of each required performance to the office of the Graduate Dean.

There may or may not be a foreign language requirement for the doctoral program in Fine Arts, depending upon the dissertation option

and the major. There is no foreign language requirement for the Master of Music degrees or for the Master of Music Education degree; however, vocal performance majors must demonstrate singing proficiency in French, German, and Italian.

All applicants for admission to graduate programs in music are required to submit scores for both the Aptitude Test and the Advanced Test in Music of the Graduate Record Examination. In addition all applicants will take the Music Department Placement Examinations in Music History and Music Theory. Performance majors will take an Applied Music Placement Test and Music Education majors will take a Placement Test in Music Education. All Placement Examinations will be given during the registration period of each semester. Deficiencies may be removed by appropriate leveling work. The prospective graduate student should also consult the section of this catalog entitled "Admission to the Graduate School."

The doctoral program in Fine Arts has an interdisciplinary core composed of Fine Arts requirements and electives to provide professional development outside the major department. (See section entitled "Interdepartmental Programs" for further description of this program.) The program includes a major area of emphasis (art, music, or theatre arts) including an area core and an individualized curriculum. A dissertation requirement, which will allow several avenues for scholarly research, must be satisfied. The Ph.D. in Fine Arts requires the completion of a minimum of 54 semester hours of work beyond the master's degree, and admission to the program requires that the applicant has completed a master's degree, or its equivalent, with emphasis in some area of the arts. In addition to the admission requirements established by the Graduate School of Texas Tech University, each department in this program exercises other requirements relative to the nature of the individual major programs.

Courses in Music. (MUS)

5310. **Music in Contemporary Society (3).**

731. **Research (3).**

831. **Doctor's Dissertation (3).**

Courses in Applied Music. (M AP)

515, 525, 535, 545. **Instrument or Voice (1:0:½; 2:0:1; 3:0:1; 4:0:1).**

530. **Pedagogy of Applied Music (3:3:0).** Advanced study in the pedagogy of applied instrumental or vocal masterworks from easy-moderate to difficult. Emphasis in the pedagogy of interpretation, technic, and memorization.

533. **Applied Music Literature (3:3:0).** Prerequisite: The undergraduate music literature courses required on the B.M. or B.M.E. degree. Advanced study of literature for the various applied music areas. Individual research projects and class performance.

631. Graduate Recital (3:0:1). Enrollment required at least twice.

Courses in Music Composition. (M CP)

532, 533. Advanced Music Composition (3:3:0 each). For students following a music composition option. Semesters I and II. Free composition in the larger forms with emphasis on works for orchestra. May be an individual study course.

Courses in Music Education. (M ED)

513, 523, 535. Workshop of Contemporary Trends in Elementary Music Education (1:0:2; 2:0:4; 3:0:6). For graduates in elementary education and for specialists in music at the elementary level. Music activities for elementary school students stressing techniques and materials developed at recent national seminars.

530, 531. Seminar in Music Education (3:3:0 each). Evaluation of Philosophy, curricula, principles, practices, and materials. Special studies allow concentration in the field of the student's major activity.

532. Choral Music Workshop (3:3:0). Prerequisite: Departmental approval. Emphasis upon the organization and development of choral organizations in the public schools, including tone production, rhythmic precision, balance, blend, diction. Individual and group project required.

533. Instrumental Music Workshop (3:3:0). Departmental approval. Emphasis upon the organization and development of instrumental groups in the public shools, and upon development of performance excellence by these groups.

534. Marching Band Direction (3:3:0). Planning, charting, scoring, and rehearsing for marching band shows, contests, and festivals. Study of marching band styles.

537. Instrumental Repertoire (3:3:0). Literature for small and large instrumental ensembles.

538, 539. Instrumental Conducting Techniques and Analysis (3:0:3 each). Structural analysis and study of conducting problems in major instrumental works. Individual instruction courses. Participation in a major instrumental ensemble required.

5231, 5232, 5233, 5234, 5235. Teaching Applied Music in the Public Schools I, II, III, IV, V (2:2:0 each). Techniques, materials, and procedures for class and individual instruction of applied areas in the public schools. I. Woodwinds; II. Brass; III. Percussion; IV. Strings; V. Voice. May be repeated once in a new section.

5311, 5312. Advanced Choral Methods and Techniques (3:0:3 each). An individual study course in advanced choral methods, including a detailed study of the techniques used in achieving a satisfactory performance of choral literature from the Renaissance to the Romantic and Romantic to Contemporary periods. Participation in a major choral organization required.

5314. Special Problems in Music Education (3:3:0). Prerequisite: Consent of advisor. Investigation and execution of special problems in the field of Music Education. May be repeated with a new problem.

5315. Choral Repertoire (3:3:0). Analysis of choral works of all periods for both small and large ensembles.

5329. **Administration and Supervision of Music Education (3:3:0).** Administrative functions, responsibilities, and techniques from elementary school through high school.

5330. **New Approaches to Music in Junior and Senior High Schools (3:3:0).** New materials and teaching methods for upper grades.

5331. **Music in Early Childhood and Kindergarten (3:3:0).** A study of music and related materials that can strengthen the instructional aims for significant learnings by children two through five years old.

5335. **Music for Children (3:3:0).** Prerequisite: 6 semester hours in music education or two years' teaching experience in elementary grades. A creative approach to child development through various music activities in grades 1-6.

5340. **Philosophy and Problems of Teaching Music in Junior and Senior Colleges (3:3:0).** An introduction to teaching in colleges for the new or inexperienced teacher.

5341. **Class Piano Techniques (3:3:0).** Methods and procedures of teaching class piano.

631. **Master's Thesis (3).** Enrollment required at least twice.

Courses in Music Ensemble. (M EN)

510. **Graduate Ensemble (1:0:5).** Instruction and demonstration of ensemble technic in performance situations. Preparation of and participation in performed material is required.
Sec. 1. Chorus
Sec. 2. Orchestra
Sec. 3. Band
Sec. 4. Music Theater
Sec. 5. Chamber Music
Sec. 6. Instrumental Ensemble
Sec. 7. Music Theater Activities
Military Band. Part of Basic ROTC. For particulars, inquire of the officer in command.

Courses in Music Literature. (M LT)

515, 525. **Collegium Musicum (1:1:2) (2:1:4).** The study and performance of music before 1750. May be repeated for credit.

531. **The Great Historical Periods of Music (3:3:0).** Critical examination of the essential compositional features of music and their change from the Middle Ages to the twentieth century.

537. **Seminar in the History of Opera (3:3:0).** Studies in the development of opera during the 17th, 18th, 19th, and 20th centuries.

5311. **Symphonic Literature (3:3:0).** Studies in the development of orchestral music from the Baroque Era to the present.

5312. **Chamber Music Literature (3:3:0).** Studies in the development of chamber music from the Baroque Era to the present.

5313. **Great Composer Seminar (3:3:0).** Critical examination of the works of a single composer, e.g. Bach, Haydn, Mozart, Beethoven, Wagner, Verdi, Brahms, or Stravinsky. A different composer will be studied each time course is offered. May be repeated for credit.

5331, 5332, 5333, 5334, 5335, 5336. Seminar in the History and Literature of Music; Middle Ages (5331), Renaissance (5332), Baroque (5333), Classic Period (5334), Romantic Period (5335), Twentieth Century (5336) (3:3:0 each).

Courses in Music Theory. (M TH)

521, 522. Styles (2:2:0 each). A study of the development of harmonic, melodic, rhythmic, and tonal practices from Richard Wagner to the present.

524. Eighteenth Century Counterpoint and Fugue (2:2:0). A study of counterpoint and fugue in the music of Bach and Handel and their contemporaries. Original writing in the style.

525. Modal Counterpoint (2:2:0). Vocal counterpoint of the sixteenth century; Mass, Motet, Madrigal; solo vocal writing in the modes; synthesis in two to six voice texture; group sight reading of the literature. Elective on all graduate music programs.

528, 529. Advanced Orchestration (2:2:0 each). Free work in the large instrumental, choral, and Musico-dramatic forms as well as electronic techniques and tape recorder music. May be an individual instruction course.

530. Structural Functions of Western Music (3:3:0). A study of tone, texture, and form in the music of the Western hemisphere.

531. Seminar in Music Theory (3:3:0). Prerequisite: Graduate classification. History of musical practice; survey of theoretical texts, treatises, and materials from pre-Baroque to the present.

533. Acoustics (3:3:0). A study of the sciences of musical sound.

534. Pedagogy of Theory (3:3:0). A resume of the materials, organization, techniques, and problems of college freshman and sophomore theory courses.

535, 536. Contemporary Techniques (3:3:0 each). For composition majors. Semesters I and II. Intensive analysis and synthesis of contemporary European and American music with emphasis on melody, harmony, rhythm, texture, form, and media. May be an individual study course.

537, 538. Composition (3:3:0 each). Prerequisite: M TH 433 or equivalent. Advanced work in free composition for chamber groups, orchestra, band, chorus, or the electronic media. May be repeated for credit. An individual instruction course.

631. Master's Thesis. (3). Enrollment required at least twice.

Department of Philosophy

Professor Charles Sidney Hardwick, Chairman.
Professor Little; Assistant Professors Cortes and Ketner.

MINORS FOR THE MASTER'S DEGREE
AND THE DOCTOR'S DEGREE

Courses in Philosophy. (PHIL)

531. Studies in Philosophical Classics (3). Prerequisite: Consent of instructor. Special studies in philosophical classics. Independent work under a staff member with prior permission. May be repeated.

532. **Studies in Greek Philosophy (3:3:0).** Studies in the Pre-Socratics, Plato, Aristotle, and Hellenistic philosophy. May be repeated.

533. **Studies in Medieval Philosophy (3:3:0).** Studies in Jewish, Christian, and Islamic thought in the Middle Ages. May be repeated.

534. **Studies in American Philosophy (3:3:0).** Studies in major American philosophers and philosophical movements from colonial times to the present. May be repeated.

536. **Continental Rationalism (3:3:0).** The influence of the deductive model on thinkers at the beginning of the postmedieval period, especially on Descartes, Spinoza, and Leibniz. May be repeated.

537. **British Empiricism (3:3:0).** Discussion and analysis of the turn toward sense experience at the beginning of the modern period. Locke, Berkeley, and Hume examined in detail. May be repeated.

539. **Seminar in Logic (3:3:0).** Prerequisite: PHIL 3319 or consent of instructor. The study of logical systems; the study of problems in the philosophy of logic. May be repeated.

5310. **Aesthetics (3:3:0).** Some central problems in the philosophy of art: the nature of a work of art, modern and traditional definitions of art, aesthetic experience, and aesthetic judgment.

5311. **Existentialism (3:3:0).** Major themes of the existential movements in the nineteenth and twentieth centuries. Studies in the works of Kierkegaard, Nietzsche, Heidegger, Jaspers, Sartre, and Camus.

5312. **Analytic Philosophy (3:3:0).** Detailed analysis of some of the major works of Carnap, Russell, Moore, Wittgenstein, and Austin.

5313. **Social Philosophy (3:3:0).** Selected topics in the theory and methodology of the social sciences.

5314. **Philosophy of Science (3:3:0).** Methodological and conceptual issues in the physical and social sciences. Emphasis upon a scientific investigation as a way of knowing.

5335. **Basic Issues in Contemporary Philosophy (3:3:0).** Prerequisite: Consent of instructor. Certain topics around which philosophical controversies emerge: rational and empirical knowledge; science and value; etc. Designed for graduate education students, but open to others.

Department of Physics

Professor B. J. Marshall, Chairman.
Professors Das Gupta, Kim, Lodhi, Mires, Quade, and Thomas; Associate Professors Gott, Howe, Mann, and Sandlin; Assistant Professor Hatfield.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

The master's degree requires a minimum of 24 hours of graduate course work plus 6 hours of thesis. The candidate must take the Advanced Test in Physics of the Graduate Record Examination and score in the upper 40 percentile ranks. The candidate must show a proficiency in one foreign language, usually French, German, or Russian. All candidates present a thesis on some research problem and undergo a final oral examination on the thesis problem.

The doctoral program requires a high score on the Aptitude Test of the G.R.E. and a score in the upper 40 percentile ranks on the G.R.E.

Advanced Test in Physics. The candidate must also show reading proficiency in one foreign language, usually French, German or Russian. This requirement is usually satisfied at the master's level. Doctoral study cannot be calculated solely in terms of credit hours, but the program normally requires 60 semester hours beyond the bachelor's degree plus 12 hours of dissertation for a research problem. These 60 hours include one year courses in quantum mechanics, electromagnetism, theoretical physics and advanced dynamics and statistical mechanics. These courses represent 26 of the 42 hours taken in the Physics Department and are the core of the program. The other 18 hours are taken in the minor field with the department allowing 6 hours to be taken in physics outside of the major field of interest. For example, a candidate doing work in solid state may take nuclear physics as part of his minor work. At the end of the second year, the candidate is required to pass written and oral examinations over the core curriculum. Finally, a dissertation on an original research project and an oral defense of the dissertation are required.

Courses in Physics. (PHYS)

511, 512. Seminar (1:1:0 each). Required of all graduate students.

513. Techniques of Experimental Physics (1:0:3). Prerequisite: Graduate standing in physics. The use and development of experimental apparatus, design of experiments, treatment of data.

530. Advanced Topics (3:3:0). Prerequisite: Approval of department chairman. Advanced topics selected by departmental recommendation. May be repeated in different areas.

531. Advanced Topics in Quantum Mechanics I (3:3:0). The bases of quantum mechanics, the hydrogen atom, matrix representations, and approximation methods.

532. Advanced Topics in Quantum Mechanics II (3:3:0). Angular momentum, electromagnetic interactions, identical particles, and scattering theory.

533. Advanced Topics in Solid State Physics (3:3:0). Specific heats, ferroelectronics, conductivity, and band theory of solids.

535. Introduction to Statistical Physics (3:3:0). Prerequisite: PHYS 432, 437, and 438; enrollment in PHYS 438 may be parallel. Elements of probability theory and statistics; conceptual foundation of kinetic theory. Gibb's statistical mechanics, the method of Darwin and Fowler, derivation of the laws of macroscopic thermodynamics from statistical considerations; other selected applications in both classical and quantum physics.

536. Advanced Dynamics (3:3:0). Prerequisite: PHYS 541 or consent of instructor.

537, 538. Theoretical Physics (3:3:0 each). Introduction to contemporary methods of mathematical physics. Classical vectorial and analystical mechanics, special theory of relativity, and elementary quantum mechanics. Theoretical foundations of current departmental research fields are developed.

631. Master's Thesis (3). Enrollment required at least twice.

633, 634. **Quantum Mechanics (3:3:0 each).** Prerequisite: PHYS 437, 438, and 541, 542. Review of formal theory of quantum mechanics; quantum theory of angular momentum; relativistic wave equations, formal theory of scattering, including S-Matrix theory; quantum theory of fields, including quantum electrodynamics theory of weak interactions, theory of strong interactions, and disperation relations.

635, 636. **Electromagnetic Theory (3:3:0 each).** Prerequisite: MATH 434, 435, PHYS 335, 336. Advanced treatment of Maxwell's theory, including electrostatics, magnetostatics, theory of radiation, and application of the theory to select contemporary problems.

637, 638. **Structure of Matter (3:3:0 each).** Prerequisite: Departmental approval. Contemporary concepts of the structure of material and the empirical evidence supporting these concepts. Atomic structure, molecular structure, nuclear structure, sub-nuclear particles; the gaseous, liquid, and solid states; transitions between states. A mature mathematical treatment.

639. **Advanced Statistical Physics (3:3:0).** Prerequisite: PHYS 535. Advanced application of statistical methods to problems of transport phenomena, non-equilibrium thermodynamics, imperfect gases, phase transitions, and quantum fluids.

733, 734. **Advanced Solid State Physics (3:3:0 each).** Prerequisite: Departmental approval. A professional level course covering both experimental and theoretical aspects of solid state physics.

735, 736. **Atomic and Molecular Spectra (3:3:0 each).** Prerequisite: Departmental approval. A professional level course covering both experimental and theoretical aspects of atomic and molecular structure.

737, 738. **Advanced Topics in Theoretical Physics (3:3:0 each).** Prerequisite: Departmental approval. Current topics in theoretical physics, which may include application of group theory, quantum mechanics of many-body systems, theory of elementary particles, general relativity, and theory of plasmas.

739. **Individual Study (3).** Prerequisite: Departmental approval. Theoretical or experimental study in problems of current interest. May be repeated for credit.

7311, 7312. **Advanced Nuclear Physics (3:3:0 each).** Prerequisite: PHYS 437, 438. A professional level course covering both experimental and theoretical aspects of nuclear physics.

831. **Doctor's Dissertation (3).** Enrollment required at least four times.

Department of Political Science

Professor Jack W. Hopkins, Chairman.
University Professor Kennedy; Professors Havens, Jones, Oden, Tamkoc, and Tucker; Associate Professors Baird, Burnett, Clotfelter, Hannon, Kyre, Mayer, Pearson, Smith, and Wright; Assistant Professors Cochran, Karnig, Panyan, Sigelman, Vengroff, and Vanderbok.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

Graduate study is offered in the following seven general fields; American government and politics, political theory, methodology, public administration, international relations, comparative government,

and public law. A special graduate program is offered in public administration, leading to the Master of Public Administration (M.P.A.) degree.

To be admitted to the graduate program, the student must submit three letters of recommendation, preferably from former teachers, to the chairman of the department, and must have a total GRE score of at least 1000 and an overall average of B.

Master's degree work may follow two options: 24 hours of course work plus a thesis, or 36 hours of course work without a thesis. There are no language or research tool requirements for the master's degree. The M.P.A. program requires 36 hours of course work and an internship assignment.

The doctoral degree requires a minimum of 60 semester hours of graduate work beyond the bachelor's degree, exclusive of credit for the dissertation. The language requirement for the Ph.D. degree may be satisfied in one of the following options: (1) a reading knowledge of two foreign languages; (2) a high proficiency in one foreign language; (3) a reading knowledge of one foreign language and passing of two approved courses in a tool subject with a grade of B or above; or (4) a high proficiency in methodology, demonstrated by passing of four approved courses (at least one of which will be outside the Department of Political Science) in a tool subject with a grade of B or above, or by examination. Courses used to satisfy the language or tool subject requirements may not be used also to satisfy departmental field requirements.

For the qualifying examination, the student will select three fields of study, one of which may be outside the department.

A brochure providing additional information regarding requirements and procedures may be obtained from the department.

Courses in Political Science. (POLS)

531. **Readings and Research — Individual Study (3).** May be repeated for credit.

5322. **The American Political Environment (3:3:0).** Advanced study in subjects relevant to an understanding of how the political process is affected by the environment of politics.

5323. **American Political Parties, Interest Groups, and Politics (3:3:0).** Advanced study of the political process, oriented to recent research in the area of political parties, elections, and the recruitment of political leadership.

5324. **The Executive (3:3:0).** Study of the executive branch of government in the United States, with particular emphasis on the presidency.

5325. **The Legislature (3:3:0).** Legislative bodies, legislative behavior, and the legislative process, with particular emphasis on the United States Congress.

5326. **State Government and Politics (3:3:0).** Study of the American states on a comparative basis, with emphasis on recent empirical research.

5327. **Selected Topics in American Government and Politics (3:3:0).** Problems in American government and politics. Varying topics from semester to semester.

5329. **Urban Government and Politics (3:3:0).** The structure and function of urban political systems; the distribution of political, economic, and social power; correlates of urban public policy; intergovernmental relations; and minority group politics.

5330. **Ancient and Medieval Political Theory (3:3:0).** Political ideas of the great thinkers in the Western world from the time of the Golden Age of Greece until the rise of modern political thought in the 16th century.

5335. **Modern Political Theory (3:3:0).** Major politicial thinkers beginning with the 16th century and ending with Fascism.

5336. **Contemporary Political Theory (3:3:0).** An examination and criticism of the main concepts, movements, and thinkers in political theory in the contemporary world.

5337. **American Political Theory (3:3:0).** Selected topics for intensive research and study.

5338. **Selected Topics in Political Theory (3:3:0).** Examination of varying ideas and concepts, such as liberty, authority, justice, equality, and nationalism.

5340. **Seminar in Public Administration (3:3:0).** Critical survey of the development of the field of public administration.

5342. **Fiscal Administration and Policy (3:3:0).** Political aspects of fiscal accountability and responsibility and governmental fiscal policy formulation, adoption, and execution.

5343. **Public Personnel Administration (3:3:0).** Description and analysis of the personnel function in public agencies.

5344. **Public Budgeting (3:3:0).** Political aspects of the budgetary process as the central mechanism for public resource allocation and executive planning.

5345. **Comparative and Developmental Administration (3:3:0).** Focuses on comparative and developmental issues of public administration by examining the administrative systems of historical, contemporary underdeveloped, modern totalitarian, and modern democratic systems.

5346. **Program Evaluation and Quantitative Analysis (3:3:0).** Quantitative approaches toward an understanding of public administration and behavior and statistical tools for analysis of administrative problems and programs.

5347. **Internship in Public Administration (3:3:0).** An integral feature of the Master of Public Administration degree program, the internship provides for an assignment in a government office for periods ranging from three to six months.

5348. **Selected Topics in Public Administration (3:3:0).** Special studies on varying subjects in public administration. Topics will vary from semester to semester.

5350. **The Judicial Process (3:3:0).** The judicial process from the political science perspective, treating various theoretical approaches and the general topics of recruitment, court systems, access to the judicial arena, and the impact of judicial policy-making.

5352. **The Supreme Court in American Life (3:3:0).** A study of American constitutional law with emphasis on the Supreme Court, its organization, personnel, great decisions, and its role in U.S. policy.

5353. **Law and Social Change (3:3:0).** Analysis of law as a political phenomenon in terms of its relationship to change in the social-political system.

5354. **Courts and Urban Politics (3:3:0).** Analysis of factors influencing the administration of justice within the urban context.

5355. Special Topics in Judicial Politics (3:3:0). Special studies in varying subjects on judicial politics. Topics will vary from semester to semester.

5356. Judicial Behavior (3:3:0). Political analysis of actors in the judicial decision-making arena.

5360. International Relations (3:3:0). An introductory exploration of the substantive and methodological scope of topics researchable using macro-level analytic frameworks, emphasizing systems theory.

5362. International Politics (3:3:0). Study of international politics in the twentieth century and domestic and international variables that influence the behavior of decision-makers.

5363. International Organization (3:3:0). The role of global, regional, and functional international agencies in the relations of men and nations and in the solution of social, economic, and political problems.

5365. Special Topics in International Relations (3:3:0). Intensive research in topics varying from semester to semester.

5366. International Security and Peace Studies (3:3:0). Varying applications of analytic models to political conflict questions with reference to the emerging literature in peace research.

5370. Comparative Politics (3:3:0). Critical survey of the major theories and literature in comparative politics, the logic of cross-national and cross-cultural inquiry, and the major concepts and approaches.

5372. Latin American Political Systems (3:3:0). Analysis of political cultures and systems of Latin America, with special attention to nationalism, revolutionary movements, indigenous political theories, and political socialization and participation.

5373. Comparative Politics: Asia (3:3:0). Intensive study of selected sociopolitical characteristics and problems of contemporary Asia.

5374. African Political Systems (3:3:0). Examination of the political systems of sub-Saharan Africa, with particular reference to current theories of modernization.

5376. Selected Topics in Comparative Government (3:3:0). Studies in comparative politics, with topics varying from semester to semester.

5377. Parliamentary Democracies (3:3:0). Examination of the socio-political systems of Britain, the older Commonwealth, and the parliamentary democracies of Western Europe.

5378. Politics of the Developing Areas (3:3:0). Substantive and theoretical-methodological issues in the study of the development process, emphasizing the political aspects of development.

5380. Political Inquiry (3:3:0). Principles and issues of modern political analysis, approaches, types and problems of inference, and a survey of important literature with respect to its contribution to political explanation.

5381. Research Design (3:3:0). Design and execution of political research. Application of statistical techniques and procedures to political phenomena.

5382. Data Analysis (3:3:0). Linear and multivariate methods relevant to the analysis of political processes and problems. Hypothesis testing, simple linear correlation and regression, multiple and partial correlation, analysis of variance, causal modeling, factor analysis, and analysis of covariance.

5383. **Selected Topics in Methodology (3:3:0).** Different emphases, such as survey research, attitude measurement, advanced quantitative techniques, and game theory, and varying topics from semester to semester.

631. **Master's Thesis (3).** Enrollment required at least twice.

731. **Research (3).**

831. **Doctor's Dissertation (3).** Enrollment required at least four times.

Department of Psychology

Professor Robert Wayne Bell, Chairman.
Professors Anderson, Andreychuk, George, Halcomb, Kuntz, Locke, Mahone, Phillips, and Ray; Associate Professors Bodden, Cannon, Carlson, Chatfield, D. Cogan, R. Cogan, Gillis, Landers, Lawlis, and McGlynn; Assistant Professors Elias, Greene, James, and Marshall.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

Prior to consideration for admission to a graduate program in psychology, applicants must consult the chairman of the department. Admission to the Graduate School requires the recommendation of the department as well as the approval of the Graduate Dean. Students who are not officially approved for a degree program may not enroll in any practicum-type courses. Students may not take practicum-type courses toward a minor in psychology without approval of the instructor.

Applicants for the master's degree may pursue one of three courses of study: (1) general experimental psychology, (2) counseling psychology, or (3) clinical psychology.

The master's degree program in couseling or clinical psychology requires a one-semester internship at an approved facility.

Conducted jointly with the College of Education is a program leading to certification as a counselor in the public schools. Students interested in this program are invited to write to the College of Education.

A doctoral program is offered which may emphasize one of several areas of interest. Among the several options are general experimental, learning, physiological and comparative, industrial, counseling, and clinical psychology. Doctoral students who emphasize counseling or clinical psychology in their programs will be expected to complete a year of internship in an approved facility.

Courses in Psychology. (PSY)

510. **Colloquium in Engineering Psychology (1:1:0).**

532. **Problems in Psychology (3).** Prerequisite: 12 advanced hours of psychology and prior permission of instructor. Independent work under individual guidance of a staff member.

534. **Practicum in Psychological Testing (3:3:0).** Prerequisite: Permission of instructor. Instruction and practice in giving intelligence, aptitude, interest, and/or personality tests. Emphasis on individual tests.

537. Vocational-Educational Counseling I: Theory and Research (3:3:0). A review of major theories of vocational choice; critique of research related to vocational counseling. A review of theory in research in educational counseling as related to post high school students. The use of occupational information in counseling; use of the dictionary of occupational titles in counseling.

538. Vocational-Educational Counseling II: Assessment and Intervention (3:3:0). Utilization of vocational and educational tests in career counseling. Use of personality testing in counseling. Emphasis on counseling strategy, report writing, and practice in vocational-educational counseling. Emphasis on youth and adults.

5311, 5312. Projective Techniques I, II (3:3:0 each). Prerequisite: PSY 534 and permission of instructor. Psychological principles and theories of perception, motivation and related topics as applied to projective methods. Study and administration of specific projective tests.

5315. Practicum in Personality Assessment (3:3:0). Prerequisite: Permission of instructor. Instruction and supervised practice in scoring, interpreting, and reporting results from personality, motivation, attitude, and diagnostic instruments of the paper and pencil type.

5316. Introduction to Adjustment Counseling and Psychotherapy (3:3:0). Prerequisite: PSY 435 or 436. Consideration of theories of adjustment counseling. Attitudes and orientation of the counselor in the counseling relationship, oral discussion, recordings, and role playing.

5318. Practicum in Techniques of Counseling (3:2:3). Prerequisite: Prior permission of instructor. Supervised experience in interviewing. Adjustment counseling, vocational counseling and/or psychological evaluation. Student works with a limited number of clients through the psychology clinic.

5319. Behavioral Aspects of Mental Retardation (3:3:0). Prerequisite: ED 5320 or permission of instructor. Behavioral science approaches to the problems of mental retardation — an advanced survey.

5320. Seminar in Mental Retardation (3:3:0). Prerequisite: ED 5320 or permission of instructor. Applied research tactics in selected areas of mental retardation. In-depth discussion of procedures, controls, and interpretation. Students will design and conduct research under instructor supervision as well as disseminate experimental findings via formal publication outlets or scientific meetings. Topics varied. May be repeated for credit.

5321. Practicum in Mental Retardation (3:1:3). Prerequisite: PSY 5320 or permission of instructor. Supervision in diagnostics, training, management, and treatment practices with cases selected from mentally retarded children and adults. Emphasis may vary and course may be repeated for credit.

5322. Family Counseling (3:3:0). Prerequisite: PSY 5316 and permission of instructor. A study of approaches to couseling of families with parent, child problems. Theory and practice.

5323. Group Counseling and Psychotherapy (3:3:0). Prerequisite: Prior permission of instructor. Designed to provide theories of approaches to group work and a personal experience with group processes. Various points of view will be studied.

5324. Seminar in Personality Theory (3:3:0). Prerequisite: PSY 436. A critical review of current theories of personality.

5325. **Case Studies in Vocational Rehabilitation (3:3:0).** Prerequisite: Prior permission of instructor. Critical analysis of actual cases derived from the files of the State Office of Rehabilitation and the State Commision for the Blind.

5326. **Medical Aspects of Rehabilitation (3:3:0).** Prerequisite: Prior permission of instructor. A joint medical-psychological seminar considering medical aspects and psychological components of disabling diseases and the interaction of these two factors as the individual reacts to the residual handicap. Rehabilitation emphasis.

5327. **The Psychology of Disability (3:3:0).** Prerequisite: Prior permission of instructor. A medical psychological approach to rehabilitation of the disabled. Special emphasis upon attitudes toward disability, social and psychological implication of mental and physical disabilities as related to the client's self concept, and attitudes of the community toward the client.

5328. **Seminar in Social Psychology (3:3:0).** Prerequisite: PSY 434. Contemporary attitude theory and research; systematic theory in social psychology; social structure and personality; the psychology of social movements and current research trends.

5329. **Seminar in the Psychological Analysis of Social Systems (3:3:0).** Prerequisite: Permission of instructor. Analysis of social systems, from small groups to large organizations and communities. Communication flow in organizations, structure-function relationships, social units as systems; measurement operations. May be repeated once for credit.

5330. **Attitude Organization and Change (3:3:0).** Prerequisite: PSY 434. Advanced study of the formation, organization, and change of social and interpersonal attitudes. The role of belief and values. Emphasis on current research and theory.

5331. **Small Group Behavior (3:3:0).** Prerequisite: PSY 434. Advanced study of the nature and origin of small groups and interaction processes. Emphasis on data obtained from empirical studies rather than theoretical or logical analysis.

5332. **Advanced Seminar in Community Psychology (3:3:0).**

5333. **Seminar in Behavior Modification (3:3:0).** Prerequisite: PSY 4317 or permission of instructor. A critical analysis of emerging patterns of management, training, and therapy that derive from contemporary learning theory. Some practice in applying such procedures will be included.

5334. **Advanced Counseling Psychology (3:3:0).** Prerequisite: PSY 539 and 5318. Consideration of theories of vocational development and theories of counseling. Discussion of professional issues and problems related to the area of counseling psychology.

5335. **Seminar in Developmental Psychology (3:3:0).** Intensive study of contemporary research and issues in developmental psychology.

5336. **Advanced Child Psychology (3:3:0).** A survey of theoretical foundations of modern child psychology; psychoanalytic theories, social learning theories, cognitive-developmental theories, and comparative ecological theories, research strategies and appropriate models in developmental.

5337. **Play Therapy (3:3:0).** Prerequisite: Prior permission of instructor. Study of theory and application of play techniques in diagnostic and therapeutic work with children; the child's symbolic communications through languages, art, and play materials. Review of research.

5338. Seminar in Psychopathology (3:3:0). Prerequisite: PSY 435 or equivalent. Advanced study in the area of abnormal or deviant forms of behavior, including both functional and organic conditions.

5339. Seminar in Psychotherapy Research and Theory (3:3:0).

5340. Seminar in Behavioral Counseling (3:3:0). A consideration of the systematic differential application of techniques derived from psychological research to the problems of behavior change in the counseling relationship.

5341. Comprehensive Habilitation of the Developmentally Disabled (3:3:0).

5343. Seminar in Psychometrics (3:3:0). Prerequisite: PSY 5314, 5347, 5348 or consent of instructor. Analyze methodological and theoretical problems in measurement and test construction.

5344. Introduction to Mathematical Models in Psychology (3:3:0). Prerequisite: Permission of instructor. An introduction to the application of mathematical models in the areas of verbal learning, signal detection, choice theory stimulus sampling etc. Each of the models will be examined in terms of of their fit to current data.

5345. Research Seminar in Clinical and Counseling Psychology (3:3:0). Prerequisite: PSY 5347 and 5348. Survey of methods and approaches to research in these areas.

5346. Seminar in Human Factors (3:3:0). Prerequisite: PSY 5347, 5348, 5351, or permission of instructor. Intensive analysis of concepts associated with human factors research and theory. Original research problems will be developed by the student.

5347. Advanced Correlational Methods and Factor Analysis (3:3:0). Prerequisite: Permission of instructor. Comprehensive survey of multi-variance analysis including multiple correlation and factor analysis and other correlational techniques. Review of analysis of co-variance.

5348. Advanced Statistical Methods and Experimental Design (3:3:0). Prerequisite: Permission of instructor. Logical principles governing sound experimentation: Conventional designs utilizing analysis of variance. Introduction to complex analysis of variance designs, trend tests, and analysis of co-variance.

5349. Seminar in the Teaching of Psychology (3:3:0). Prerequisite: Consent of instructor. Study of methods applied to teaching at the college level. Preparation of course materials, presentation, audio-visual aids, etc. May not be used as part of degree program.

5350. Systems of Psychology (3:3:0). The nature of psychological systematics and theory construction, including cultural and other factors influencing system building. Consideration of major systems from the Hellenic period to the present.

5351. Advanced Experimental Psychology (3:3:0). Prerequisite: PSY 437, 5347 and 5348. Advanced research techniques; each class member required to design, execute, and write up one or more original experiments. Study of methodological problems in research.

5352. Seminar in Learning Theory (3:3:0). Prerequisite: PSY 4317. Current systems and theories of learning.

5353. Seminar in Physiological Psychology (3:3:0). Prerequisite: PSY 4327 or equivalent. Open to graduate students in the biological sciences with credit in PSY 230 or equivalent. Current trends in psycho-physiological research.

5354. Seminar in Perception (3:3:0). Prerequisite: PSY 4323 or prior permission of instructor. Major problems areas in psychology of perception, such as the study of the psycho-physiology of sensory processes; per-

ception theory; implication theory; implications for usage in social and clinical psychology.

5355. **Seminar in Comparative Psychology (3:3:0).** Prerequisite: Prior permission of instructor. Study of the use of subhuman organisms in psychological research. Emphasis on modifiability or behavior as a function of phylogenetic level, social structure of animal groups, instincts, imprinting, and learning.

5356. **Seminar in Motivation (3:3:0).** Prerequisite: PSY 4322 or prior permission of instructor. Study of psychological, social and physiological factors in motivation. Human and animal.

5357. **Seminar in Mathematical Models of Learning (3:3:0).** Prerequisite: PSY 5344 and 5352. An examination of current stochastic and simulation models of classical avoidance conditioning, paired-associate learning, probability learning, concept identification, etc., in light of current experimental evidence.

5359. **Advanced General Psychology (3:3:0).** Prerequisite: Prior permission of instructor. Advanced study in general psychology. Review of relevant literature.

5360. **Seminar in Verbal Behavior (3:3:0).** Prerequisite: Consent of instructor. Study of the problems of the acquisition of language, symbolic communication, information processing, and the learning of verbal material. Psycholinguistics, Information Theory, and Meaningfulness.

5361. **Advanced Practicum in Counseling and Clinical Psychology (3:1:3).** Prerequisite: PSY 5318 and prior permission of instructor. Supervised practice in psychodiagnostics and psychotherapy with selected cases. Emphasis on a wide variety of experience. May be repeated.

5362. **Master's Internship in Counseling and Clinical Psychology (3).** Prerequisite: By arrangement with department chairman. Full-time supervised internship in an appropriate facility.

5363. **Doctoral Internship in Counseling and Clinical Psychology (3).** Prerequisite: By arrangement with department chairman. Full-time supervised internship in an appropriate facility. Enrollment required four times to complete one calendar year.

5370. **Engineering Psychology (3:3:0).** Prerequisite: Consent of instructor. Introduction to human factors and their function in man-machine systems. Emphasis is on the perceptual and work capacities of man in relation to various task situations.

5371. **Seminar in Psychopharmacology (3:3:0).** Prerequisite: PSY 5353 or consent of instructor. Open to graduate student in biological sciences. Examination of research on behavioral effects of psychoactive drugs and the usefulness of these drugs in experimentation and therapy.

5372. **Human Performance (3:3:0).** Human motor, perceptual, and verbal skills from the point of view of methods of analysis, measurement, and theory. Supervised research is part of the course requirement.

5373. **Advanced Seminar in the Physiological Basis of Learning and Memory (3:3:0).** Prerequisite: PSY 5352 and 5353. PSY 5358 is recommended. An intensive review and interpretation of the recent advances in the study of the physiological substrates of learning and memory. Topics may vary. May be repeated for credit.

5374. **Advanced Seminar in Animal Learning (3:3:0).** Prerequisite: PSY 5352. In depth coverage of current data area in Learning. Student review and integration under direction of instructor. Topics varied. May be repeated for credit.

5375. **Advanced Seminar in Operant Conditioning (3:3:0).** Operant behavior techniques as applied to different areas of research. In depth discussion

of procedures, controls, and interpretation. Students will design and conduct research under the close supervision of the instructor. Topics may vary.

5376. Advanced Seminar in Perception (3:3:0).

5377. Advanced Seminar in Human Learning (3:3:0). Prerequisite: PSY 5352. An examination of human conditioning, verbal learning, memory, conceptual behavior, cognition, etc. Emphasis will be on both theory and current data.

631. Master's Thesis (3). Enrollment required at least twice.

731, 732. Research (3 each).

831. Doctor's Dissertation (3). Enrollment required at least four times.

Department of Sociology

Professor H. Paul Chalfant, Chairman.
Professors Cartwright, Minnis, and Rodnick; Associate Professors Chandler, Davies, Dunn, Quesada, and Simpson; Assistant Professors Davis, Havens, Heller, and Roper.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND MINORS FOR THE DOCTOR'S DEGREE

The department offers a research and teaching master's degree in general sociology intended to provide the student with a well-rounded coverage of the discipline when combined with an undergraduate major. Students with less than an adequate background will be expected to make up any deficiencies. Although the degree may be received on the basis of a minimum of 30 hours of graduate work, the graduate faculty reserves the right to request additional work when this will provide the student with a stronger program that is needed. A copy of the departmental degree requirements may be obtained from the chairman upon request.

Each student will establish proficiency in a foreign language by one of the methods acceptable to the Graduate School. In unusual cases 6 hours of graduate credit in a tool-subject approved in advance by the department may be substituted. Burden of proof shall be on the student to show that such substitution will be more valuable to his degree program and/or career plans than a standard foreign language.

Courses in Sociology. (SOC)

531. Graduate Studies in Sociology (3). Prerequisite: Consent of department chairman. Individual study. May be repeated for credit.

532. Seminar in the Person and Society (3:3:0). Prerequisite: 12 hours of sociology or consent of instructor. Theories of social psychology in sociology. Examination of symbolic interactionist theory, the process of socialization, and selected problems related to the effects of the social structure on a given person during various periods of his life span.

533. **Seminar in Contemporary Sociological Theory (3:3:0).** Prerequisite: 9 hours of advanced credit in sociology, including SCO 436, or consent of instructor.

534. **Seminar in Sociological Research Methods (3:3:0).** Prerequisite: 9 hours of advanced credit in sociology including SOC 439, or consent of instructor.

535. **Seminar in Deviant Behavior (3:3:0).** Prerequisite: SOC 230, 233, and 6 hours of advanced sociology, or consent of instructor.

536. **Seminar in Sociological Uses of Historical Data (3:3:0).** Prerequisite: 6 hours of sociology and 6 hours of history, or consent of instructor. Archival research, analysis and use of documents, records and other historical materials as they may be interpreted sociologically.

537. **Seminar in Demography (3:3:0).** Prerequisite: 12 hours of sociology or consent of instructor. Theory and skills of population analysis including use of census data in sociological and social science research.

538. **Seminar in the Origins of Social Theory (3:3:0).** Prerequisite: 12 hours advanced credit in sociology, or consent of instructor. Study of the development of sociological theory both in the United States and in Europe, varying from term to term with emphasis on Germany and Eastern Europe, France and England, the United States, or outstanding individual theorists in any of these countries. May be repeated for credit as topic veries.

539. **Seminar in Techniques of Social Measurement (3:3:0).** Prerequisite: 12 hours of advanced work in sociology, including SOC 439 or equivalent. Detailed study of various techniques in sociology; precision in measurement of social variables; scale preparation and analysis. May be repeated for credit as topic varies.

5311. **Seminar in Criminology (3:3:0).** Prerequisite: 12 hours of advanced sociology or consent of instructor. Critical review of current theory and research in criminology; investigation of selected aspects of criminal behavior. May be repeated for credit as topic varies.

5312. **Seminar in Urban Problems (3:3:0).** Prerequisite: 12 hours of advanced sociology or consent of instructor. Extensive analysis of the process of urbanization, including health, housing, major social institutions, and welfare with emphasis upon causation and critiques of proposed solutions. May be repeated for credit as topic varies.

5313. **Seminar in Minority Relations (3:3:0).** Prerequisite: 12 hours of advanced sociology or consent of instructor. Covers both American and cross-cultural study of inter-ethnic and inter-faith relations, with special attention to conflict, accommodation, acculturation, and assimilation. May be repeated for credit as topic varies.

5314. **Seminar in Comparative Sociology (3:3:0).** Prerequisite: 12 hours of advanced sociology or consent of instructor. The comparative method had a place in sociology from its beginning. Contemporary social problems in industrial nations of the world as well as the so-called "underdeveloped" areas are covered. The primary focus of the seminar is upon transitional industrial and urban patterns. May be repeated for credit as topic varies.

5315. **Seminar in Social Change (3:3:0).** Prerequisite: 12 hours of advanced sociology or consent of instructor. Linear and cyclical theories; analysis of the idea of progress, stage theories, dialectical materialism, and the lag hypothesis. May be repeated for credit as topic varies.

5316. **Seminar in Social Gerontology (3:3:0).** Prerequisite: Permission of instructor. Theory and research on aging, covering demographic, sociocultural, economic, individual, and societal factors. Aging is examined

as a developmental process and current population trends are noted. Interdisciplinary aspects are stressed. May be repeated for credit as topic varies.

5318. Seminar in Sociological Studies of Culture (3:3:0). Prerequisite: Permission of instructor. A preliminary study of theories of origins of institutions will be followed by a detailed study of several selected and widely differing cultures with an emphasis on Mexican mestizo and American middle class cultures. May be repeated for credit as the topic varies.

5331. Field Research (3). Individual research project off campus, covering entire term or longer. Research plans must be approved in advance by the staff. May be repeated for credit with permission.

5332. The Research Organization (3:3:0). Participation in campus-based organized research project. Required at least once of research assistants; open to other students.

5333. The Teaching of Sociology (3:3:0). Concentration upon college teaching of basic sociology. May be required of teaching assistants at the option of the department, but open to other students as well.

5335. Society and Its Institutions (3:3:0). Prerequisite: Two or more years of teaching experience in the public shcools, and consent of instructor. Study of society as a network of institutions, stressing the interdependence of institutions, with special reference to problems created in the contemporary American society by changes in some of the basic institutions.

5336. Seminar in Family Change (3:3:0). An analysis of how the family institution has changed, given the influence of other institutions and society in general. The family is treated as both a dependent and independent variable.

5349. The Family in Cross-Cultural Perspective (3:3:0). The family institution will be viewed from a cross-cultural perspective utilizing the American family as a comparison unit. A world-wide orientation will be utilized.

5381. Seminar in Medical Sociology (3:3:0). A survey of the state of the art at the individual, professional, and institutional levels of analysis. Emphasis should be placed into correlational thinking rather than into memorization. May be repeated for credit as topic varies.

631. Master's Thesis (3). Enrollment required at least twice.

Department of Speech and Theatre Arts

Professor William K. Ickes, Chairman.
Professors Ashby and Schulz; Associate Professors Cheatham, Deethardt, Jordan, Paynter, Randolph, Simpson, Weaver, Yairi, and Yates; Assistant Professors Erickson, McLaughlin, and Winstead.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND OPTION FOR THE DOCTOR'S DEGREE

The department offers two master's degrees: the Master of Arts and the Master of Science in Speech Pathology and Audiology. The department also participates in the interdisciplinary Doctor of Philosophy program in Fine Arts. The salient features of the three programs are as follows.

The Master of Arts degree requires a minimum of 30 semester hours beyond the baccalaureate. The student may select a major in either

Theatre Arts or Speech Communication. A minor may be completed in another area of the same department. Proficiency in a foreign language is required for students majoring in theatre arts. This proficiency may be demonstrated by any of the methods acceptable to the Graduate School; or, in lieu of a foreign language and with the consent of the student's adviser, 6 hours of graduate or 12 hours of undergraduate tool courses may be substituted for this requirement. There are no language or tool requirements for the speech communication major.

The Master of Science degree in Speech Pathology and Audiology requires a minimum of 33 semester hours beyond the baccalaureate. However, by the time of graduation, students in this program are expected to have completed the requirements for certification in the American Speech and Hearing Association. Therefore, transfer students or students with no undergraduate background in speech pathology or audiology may find it necessary to take course work totaling up to 60 semester hours to complete undergraduate leveling certification and/or degree requirements. The student has the option of demonstrating language proficiency, completing 6 semester hours of statistics, or completing 6 semester hours of other "tool" courses recommended by the department. Any of these requirements may be satisfied at the undergraduate level. A student may choose either a thesis or a nonthesis option; the nonthesis option requires a minimum of 36 semester hours.

The department participates in the interdisciplinary program leading to the Ph.D. degree in Fine Arts. (See section entitled "Interdepartmental Programs" for general degree requirements and description of this doctoral program.) A major in Theatre Arts may be selected and complemented by courses in the other participating departments. An applicant for admission to the program must have completed the master's degree or its equivalent, with emphasis in some area of the arts. The doctoral program itself requires a minimum of 54 semester hours of graduate work beyond the master's culminating in a dissertation requirement which allows for several avenues of scholarly research.

Courses in Speech Communication. (SCOM)

511. **Studies and Problems in Speech Communcation (1).** May be repeated for credit.

521. **Studies and Problems in Speech Communication (2).** May be repeated for credit.

531. **Studies and Problems in Speech Communication (3).** May be repeated for credit.

532. **Research Methods in Speech Communication (3:3:0).** An examination and application of research methods as they apply to oral interpretation, public address, speech and hearing pathology, and therapy and theatre.

533. **Quantitative Research Methods in Speech Communication (3:3:0).** Participants will integrate principles of the philosophy of science and quantiative research methods into a study of contemporary speech

communication research, emphasizing research designs, quantitative treatments, and analysis.

534. Quantitative Research Methods in Speech Communication II (3:3:0). A survey of techniques for the measurement of source, message, and receiver variables in speech communication, with emphasis on validation studies.

5311. Cross Cultural Communication (3:3:0). An examination of the role of communication in different cultures with particular emphasis on cross-cultural communication problems.

5312. Oral Communications in Group Processes (3:3:0). A study in depth of the theories, experiments, and research dealing with the oral communication in group processes.

5313. Psychology of Speech (3:3:0). An exploration of intrapersonal and interpersonal bases of human speech behavior.

5314. Speech Behavior in Organizational Hierarchies (3:3:0). A study of human communication in complex organizations with an emphasis on vertical and horizontal internal information flow, interview theory, and external communications.

5331. Classical Rhetoric and Public Address (3:3:0). A historical and critical study of Greek and Roman rhetoric and public address in relation to theories and methods of public speaking.

5332. Medieval, Renaissance, and 18th Century Rhetoric and Oratory (3:3:0). A study of medieval, renaissance, and 18th century rhetoric and oratory. Offered biannually.

5333. Contemporary Rhetorical Theory and Practice (3:3:0). A study of modern rhetorical theories, their comparison with classical concepts, and the impact of twentieth century research.

5334. Crisis Communication: The Role of Communication in Social Movements (3:3:0). An examination of the role of communication in the major social movements in the United States.

5341. History of Oral Interpretation (3:3:0). A seminar course in the development of oral interpretation from ancient Greece to modern times.

5342. Theories of Oral Interpretation (3:3:0). A seminar course in the development of modern theories and approaches to oral interpretation.

5351. Teaching Speech Communication in Colleges and Universities (3:3:0). The philosophy and programs unique to the teaching of speech fundamentals and advanced courses in institutions of higher learning will be studied, with special emphasis on the basic course.

5352. Studies in the History of Speech Education (3:3:0). A study of the sources that have contributed to the development of speech pedagogy in the modern classroom; theories, practices, events, and personalities.

5353. Communication Education in the Elementary School (3:3:0). A study of the basic characteristics of speech skills and abilities necessary for effective speech, and the use of speech in classroom activities.

631. Master's Thesis (3). Enrollment required at least twice.

Courses in Speech Pathology and Audiology. (SPPA)

531. Studies and Problems in Speech Pathology and Audiology (3). May be repeated for credit.

533. Seminar in Speech Pathology: Stuttering (3:3:0). Limited to speech correction and audiology majors who have completed SPPA 4311 or its equivalent, or who have obtained consent of instructor. A study of stuttering beyond the scope of introductory presentation. Stuttering

theory, research, and therapy studied from the view of learning theorists, phychoanalysts, and other disciplines which profess to treat stuttering.

534. **Seminar in Speech Pathology: Articulation and Voice Disorders (3:3:0).** Prerequisite: An undergraduate major in speech pathology is required or the consent of instructor. A study at the advanced level of articulation, voice disorders, and alaryngeal speech. The course considers etiology, diagnosis, and therapy.

535. **Seminar in Audiology: Psychophysics of Audition (3:3:0).** Prerequisite: An undergraduate major in audiology or speech pathology is required or the consent of instructor. This course considers the basic correlates of the auditory stimulus, the mechanical properties of the ear, and the psychophysiology of hearing and deafness.

536. **Seminar in Audiology: Aural Rehabilitation (3:3:0).** Open to speech pathology and audiology majors, or other students who have completed SPPA 432 and 433 or equivalent. A study of the language, social, and educational problems of the more severely hard-of-hearing or deaf individual and the current methods of dealing with these problems.

537. **Seminar in Audiology: Clinical Audiology (3:3:0).** Limited to students who have taken SPPA 432 and 433, and 439 or equivalent or consent of instructor. This course deals with advanced audiometric problems primarily from a clinical point of view, but also includes an introduction to experimental audiology.

538. **Seminar in Speech Pathology: Language Problems in Children (3:3:0).** Prerequisite: An undergraduate major in speech pathology is required or consent of instructor. This course considers the nature of language disorders in children, the etiological factors responsible for language disorders in children, and the therapeutic processes involved in the treatment of language disorders in children.

539. **Seminar in Speech Pathology: Language Problems in Adults (3:3:0).** Prerequisite: SPPA 340 is required or consent of instructor. This course considers the nature of language disorders in adults, the etiological factors responsible for language disorders in adults, and the therapeutic processes involved in the treatment of language disorders in adults.

5126. **Graduate Clinical Practice: Speech (1:0:3).**

5127. **Graduate Clinical Practice: Audiology (1:0:9).**

5226. **Graduate Clinical Practice: Speech (2:0:6).**

5227. **Graduate Clinical Practice: Audiology (2:0:6).**

5311. **Instrumentation in Speech and Hearing Science (3:3:0).** Acquaints the student with instrumentations used in speech and hearing science and research; its construction and use. An introduction into basic electronics will be a part of this course.

5312. **Speech Disorders Associated with Cleft Palate (3:3:0).** Review of embryology and etiology of cleft palate. Research pertaining to the communication disorders frequently associated with cleft palate. Emphasis is placed on diagnostic and therapeutic methods employed in the treatment of cleft palate. Participation in cleft palate clinic.

5313. **Speech and Language Disorders Associated with Cerebral Palsy (3:3:0).** A study of the history and causes of cerebral palsy and the therapeutic procedures used to reduce the handicapping effects of cerebral palsy.

5314. **The Modification of Speech and Language Disorders (3:3:0).** Prerequisite: PSY 240 or equivalent or consent of instructor. Applies the principles of behavior modification (both operant procedures and/or

desensitization process) to the acquisition and/or correction of speech and language disorders.

5315. Neuropathologies of Speech and Language (3:3:0). Prerequisite: SPPA 340. Research and theory concerning the nature, etiologies, and principles of treatment of neuropathologies of speech and language including dysarthria, aphasia, and cerebral palsy.

5316. Industrial Audiology (3:3:0). Prerequisite: SPPA 432, 433 or equivalent or consent of instructor. This course deals with industrial and environmental noise pollution and its effects on man and his hearing. Sources of noise are identified and noise control and abatement procedures are discussed. An introduction to complex noise spectra is included.

5317. Independent Research in Speech Pathology (3). May be repeated for credit.

5318. Independent Research in Audiology (3). May be repeated for credit.

631. Master's Thesis (3). Enrollment required at least twice.

Courses in Theatre Arts. (TH A)

531. Studies and Problems in Theatre Arts (3). May be repeated for credit.

532. Studies in Modern Theatre (3:3:0). The principal developments in European and American theatre theories and practices from 1870 to the present.

533. Studies in the Production of Pre-Modern Drama (3:3:0). A study of the problems of producing classical, Elizabethan, French neo-classic, Restoration, and eighteenth century drama for present-day audiences.

534. Theory and Practice of Scene Design (3:2:3). Advanced work in the total process of designing for the stage. Includes work on models, sketches, painting, elevations, and working drawings.

535. Theatre Costume Design (3:2:3). Study of factors influencing theatre costume design with student projects in designing costumes for representative plays.

536. Theory and Practice of Stage Lighting (3:2:3). Advanced work in lighting design through student projects. Study of the factors governing lighting design with an emphasis on the use of light as a means of artistic expression.

537, 538. Advanced Practicum in Repertory Theatre I, II (3:0:9 each). Prerequisite: An undergraduate major in theatre arts, or consent of instructor. Practical work in supervision of the organization, mounting, and presentation of plays in a repertory situation. May be repeated for credit.

539. Seminar in Theatre History (3:3:0). Prerequisite: An undergraduate major in theatre arts or consent of instructor. Consideration of the theatre of a specific historical epoch, or the comparative study of the theatre of several periods. May be repeated for credit.

5310. Introduction to Theatre for Graduates (3:3:0). A general survey of modern dramatic theories and practices for graduate students with no previous training in theatre arts.

5311. Advanced Directing (3:2:3). Study of procedures and techniques of directing, culminating in the direction of a laboratory production.

5312. Theatre Management (3:2:3). Study of university, community, and professional theatre management with special attention to policy making, audience building, play selection, staff organization, budget preparation, and relationships with governmental and private agencies and foundations.

5313. **Dramatic Criticism (3:3:0).** Principles of dramatic criticism from Aristotle to the present day.

5314. **Advanced Studies in Children's Theatre (3:2:3).** Study of advanced problems in producing plays for child audiences.

5315. **Administration in the Contemporary Theatre (3:3:0).** Prerequisite: B A 5370. An approach to the administrative functions as they relate to the modern theatre organization.

5316. **Promotion in Theatre Arts (3:3:0).** Prerequisite: B A 5350. An approach to the field of promotion with emphasis on application to theatre arts.

5317. **Funding of Theatre Arts (3:3:0).** Prerequisite: B A 5500. A seminar in locating and arranging funding for theatre organizations.

5320. **Theatre Planning (3:3:0).** A study of the planning and design of theatre facilities.

5321. **History of Design Presentation (3:3:0).** Theories of historical and modern techniques and styles in rendering and design presentation for scenery and costumes.

5322. **Designing for Opera, Ballet, Modern Dance, and Symphonic Drama (3:3:0).** A survey of philosophical and practical approaches. Study of historical development of each form with their design problems.

5323. **Problems in Lighting, Costuming, and Scenery (3:3:0).** Development of complete scenery, costume, and lighting designs for selected plays and theatre buildings from research to presentation.

5324. **The Teaching of Acting (3:3:0).** Study of modern theories and practices of acting. Design of the acting course.

5325. **Period Styles in Acting (3:3:0).** Analysis of the stylistic characteristics of representative plays from the major periods in theatre history as these characteristics relate particularly to the theatres of the period and to the art of acting. The expression of these characteristics through acting in selected scenes.

5326. **Seminar in Directing Methods (3:3:0).** A study of the methods of selected modern directors.

5327. **Special Problems in Directing (3:3:0).** Study in the unique problems in staging special forms such as musical comedy and revue, opera, outdoor drama, pageants, light and sound shows, etc. Student preparation of selected projects.

5328. **The American Theatre (3:3:0).** Chronological coverage of American Theatre History from its beginning through the 1960's.

5329. **The Playwright in the English Renaissance (3:3:0).** This course deals with the social and theatrical conditions which gave rise to the outpouring of drama which occurred during the English Renaissance. Playscripts will be studied and analyzed to provide an understanding of the theatre of the time.

5330. **Comedy and Tragedy (3:3:0).** An historical and philosophical approach to the development of the forms of drama.

5331. **Studies in Contemporary Theatre (3:3:0).** A seminar in contemporary theatre theories and practices.

631. **Master's Thesis (3).** Enrollment required at least twice.

831. **Doctor's Dissertation (3).** Enrollment required at least four times.

Interdepartmental Programs

Comparative Literature.

W. T. Zyla, Chairman of the Interdepartmental Committee on Comparative Literature; Norwood H. Andrews, Jr., Director, Comparative Literature Studies.

Courses taught by faculty of participating departments.

OPTIONS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

The departments of English, Classical and Romance Languages, and Germanic and Slavonic Languages offer programs in comparative literature at the master's and doctor's levels.

At the master's level the program is administered by the interdepartmental committee, which is composed of faculty members from the departments involved in the program. The degrees offered are the Master of Arts with a major in English and a program in comparative literature; and the Master of Arts with a major in French, German, or Spanish with a program in comparative literature. Credit is offered on a reciprocal basis for courses taken in these departments.

The doctor's degree is offered by the Department of English with a major in English and a field of specialization in comparative literature and by the Department of Classical and Romance Languages with a major in Spanish and a field of specialization in comparative literature.

Candidates for admission to the graduate programs in comparative literature should have completed one year of university-level study (or equivalent) in a classical language and/or two years of university-level study in a modern foreign language in addition to having met the general requirements of the Graduate School. Inquiries about the master's and doctor's programs in comparative literature should be addressed to the Chairman of the Department of Classical and Romance Languages.

At the master's level, candidates complete 24 hours of course work in the participating departments, the greater part of which, including the thesis, will be in the field of comparative literature. A 6-hour minor is also required.

At the doctor's level, the program includes approximately two years of course work beyond the master's degree. This program is supervised by a doctoral advisory committee appointed for the purpose. For individual course descriptions, see cross-referenced listings under participating departments.

Courses in Comparative Literature. (C LT)

Students with adviser's permission may take 531, 532, 630, 631, and other courses in Classical Humanities, English, French, German, Greek, Italian, Latin, Portuguese, Russian, and Spanish to be applied toward the comparative literature programs.

530. **Studies in Medieval Literature (3:3:0).** (ENG 530)
534. **Old English (3:3:0).** (ENG 534)
536. **Beowulf (3:3:0).** (ENG 536)
5310. **Methods of Literary Criticism (3:3:0).** (CLHM 5310, FREN 5310, SPAN 5310)
5312. **Studies in Drama (3:3:0).** (ENG 5312)
5313. **Studies in Modern European Literature (3:3:0).** (ENG 5313)
5314, 5315. **Studies in French Language and Literature I, II (3:3:0 each).** (FREN 5312, 5313)
5316, 5317. **Studies in German Language and Literature I, II (3:3:0 each).** (GERM 5312, 5313)
5318, 5319. **Studies in Spanish and Spanish American Literature (3:3:0 each).** (SPAN 5312, 5313)
5325. **The German Novelle (3:3:0).** (GERM 5317)
5326, 5327. **Seminar in Modern German Literature I, II (3:3:0 each).** (GERM 5321, 5322)
5333. **Studies in Literary Criticism (3:3:0).** (ENG 5314)
5341. **Studies in Bibliography (3:3:0).** (ENG 5341)
5350. **The Classical Tradition in French Letters (3:3:0).** (CLHM 5350, FREN 5350)
5351. **The Classical Tradition in Hispanic Letters (3:3:0).** (CLHM 5351, SPAN 5351)
731, 732. **Research (3 each).** (ENG 731, 732, SPAN 731, 732)
831. **Doctor's Dissertation (3).** (ENG 831, SPAN 831) Enrollment required at least four times.

Fine Arts.

MAJORS FOR THE DOCTOR'S DEGREE

A doctoral program in Fine Arts is supervised through the collective efforts of the departments of Art and Music, and the Theatre Arts area of the Department of Speech and Theatre Arts. The overall purpose of the program is to develop leadership among persons in the Fine Arts. Because of this basic intention, the program is characterized by an interdisciplinary approach to the arts in order that candidates may become aware of the total scope and educational interrelatedness of the Fine Arts.

The program requires a minimum of 54 semester hours of graduate work beyond the master's degree. An "interdisciplinary core" (12 semester hours minimum) includes courses in art, music, theatre arts, philosophy, and museum operation/orientation. In addition to this a "collateral" (6 semester hours minimum) selected from outside the major department is required.

Majors for the program are offered in three areas: art, music, and theatre arts. The major (24 semester hours minimum) is characterized by a basic core and an individualized curriculum. The individualized curriculum allows the candidate to pursue a professional goal relative

to his own interests and/or competencies. Generally, the emphasis within each major can be developed in one of four general directions: (1) Arts Administration, (2) Arts Education, (3) Arts Management, or (4) Arts Professional Production. The departmental representative of the major selected should be consulted for details.

The dissertation requirement (12 semester hours) can be satisfied by one of three options: (1) an internship, (2) a professional problem, or (3) a formal dissertation. Regardless of the dissertation option taken, it will culminate in an independent study characterized by a stated problem, a hypothesis, and a planned structure of execution, and will be prepared for Graduate School acceptance.

In addition to Graduate School requirements, acceptance into the program is contingent upon the prospective candidate's being recommended by the Fine Arts Doctoral Committee that is representative of art, music, and theatre arts faculty. The department in which the applicant intends to major will be responsible for recommending the applicant for acceptance into the program. All applicants for the program must have completed a master's degree or its equivalent with emphasis in some area of the arts.

For listings of courses, see appropriate departmental sections.

Latin American Area Studies.

Harley D. Oberhelman, Chairman of the Latin American Area Studies Committee.
Courses taught by faculty of participating departments.

MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

A doctoral minor in Latin American Area Studies is administered by the Latin American Area Studies Committee. The minor consists of 18 hours of graduate level Latin American content courses taken in the participating departments and approved by the student's doctoral committee. No courses from the student's major field may be included in the minor. At least three different fields must be represented in the minor, and the maximum number of hours permitted in any one field is 9. Doctoral minors in the program must demonstrate a speaking knowledge of either Spanish or Portuguese and a reading knowledge of the other.

A minor at the master's level shall consist of a minimum of 9 hours in at least two fields outside the major.

Courses marked with an asterisk will be considered acceptable as part of the minor when the topic studied deals with Latin America. For current course descriptions see individual departmental listings.

Courses in Anthropology. (ANTH)
5321. Cultural Anthropology I (3:3:0).
5322. Cultural Anthropology II (3:3:0).

Courses in Economics. (ECO)
*531. Economic Research (3:3:0).
*536. Advanced International Economics (3:3:0).
*5313. Survey of Theories of Economic Growth and Development (3:3:0).
*5314. Seminar in Economic Growth and Development (3:3:0).

Courses in Geography. (GEOG)
*532. Seminar in Regional Geography (3:3:0).
*533. Seminar in Historical and Cultural Geography (3:3:0).
*5310. Readings in Geography (3:3:0).
5373. A Survey of Hispanic Lands and Peoples from Regional Literature (3:3:0).

Courses in History. (HIST)
*531. Readings and Research (3:3:0).
5328. Studies in Colonial Latin American History (3:3:0).
5332. Studies in National Latin American History (3:3:0).
5333. Studies in Mexican History (3:3:0).
636. Seminar in Latin American History (3:3:0).
*731. Research (3).

Courses in Political Science. (POLS)
*531. Readings and Research — Individual Study (3:3:0).
*5360. International Relations (3:3:0).
*5370. Comparative Politics (3:3:0).
*5372. Latin American Political Systems (3:3:0).
*5378. Politics of the Developing Areas (3:3:0).
*731. Research (3).

Courses in Portuguese. (PORT)
*531, 532. Research in Portuguese (3 each).
535. Survey of Brazilian Poetry and Drama (3:3:0).
536. Survey of Brazilian Prose (3:3:0).
537. Seminar in Brazilian Literature (3:3:0).
5373. A Survey of Hispanic Lands and Peoples From Regional Literature (3:3:0).

Courses in Sociology. (SOC)
*531. Graduate Studies in Sociology (3).
*5318. Seminar in Sociological Studies of Culture (3:3:0).

Courses in Spanish. (SPAN)
*531, 532. Research in Spanish (3 each).
538, 539. Summer Language Institute (3:3:0 each). Offered in Mexico.

***5312, 5313. Studies in Spanish and Spanish American Literature (3:3:0 each).**
5321. Studies in the Latin American Novel (3:3:0).
5322. Seminar in Latin American Literature (3:3:0).
5323. Modernism (3:3:0).
5360. Studies in Chicano Life and Literature (3:3:0).
5371. Architecture of the Pre-Columbian and Post-Columbian (16th through 18th centuries) Periods in Middle and South America (3:3:0).
5373. A Survey of Hispanic Lands and Peoples from Regional Literature (3:3:0).
***731, 732. Research (3 each).**

Linguistics.

Nancy Hickerson, Chairman of the Interdepartmental Committee on Linguistics. Courses taught by faculty of participating departments.

OPTIONS FOR THE MASTER'S DEGREE

The departments of Classical and Romance Languages, English, and Germanic and Slavonic Languages offer a program in linguistics at the master's level. Credit for course work is offered on a reciprocal basis, each department offering major credit for courses listed in the program which are taught by staff members in the other departments. Credit for the master's thesis (6 hours) is also offered on a reciprocal basis, each department allowing its majors to select a thesis director from another department if feasible. The degree offered is the Master of Arts. In the departments of Classical and Romance Languages or Germanic and Slavonic Languages the majors would be in French, German, or Spanish with a field of specialization in linguistics. In the Department of English the major would be in English with a field of specialization in linguistics.

The program consists of 24 hours of course work plus a thesis or 36 hours of course work without a thesis, to be approved by the Chairman of the Interdepartmental Committee on Linguistics. Candidates will be urged to take courses from each of the participating departments.

Courses in Linguistics. (LING)

530. Romance Linguistics (3:3:0).
531, 533. Research in French (3 each). (FREN 531, 532)
534. Old English (3:3:0). (ENG 534)
535. Research in Portuguese (3). (PORT 531)
536. Beowulf (3:3:0). (ENG 536)
537. Research in Spanish (3). (SPAN 531)
538, 539. Research in German. (3 each). (GERM 531, 532)
5310. Research in Portuguese (3). (PORT 532)
5311. Linguistic Techniques in Teaching Romance Languages (3:3:0).
5335. Methods of Teaching Spanish and English to Bilingual Children (3:3:0).
5340. Studies in Medieval Language and Literature (3:3:0). (FREN 533)

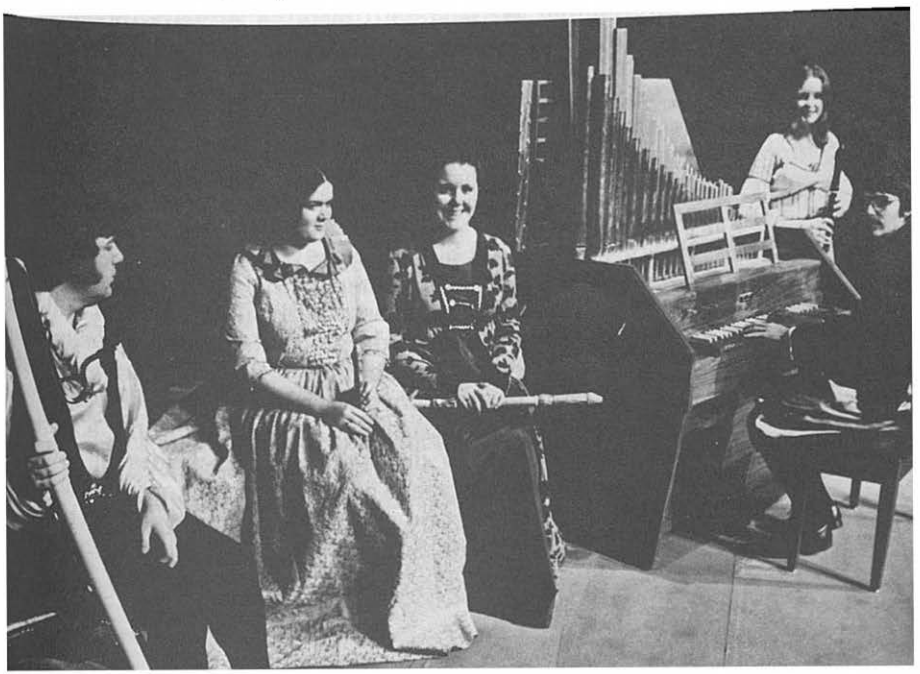
5341. Research in Spanish (3). (SPAN 532)
5342, 5343. Studies in French Language and Literature I, II (3:3:0 each). (FREN 5312, 5313)
5344. Principles of Language (3:3:0). (ENG 5335)
5345. Studies in Linguistics (3:3:0). (ENG 5337)
5346. Linguistic Analysis I: Syntax (3:3:0). (ENG 5338)
5347. Linguistic Analysis II: Phonology (3:3:0). (ENG 5339)
5348, 5349. Research (3 each). (ENG 731, 732)
5350. Middle High German (3:3:0). (GERM 5316)
5351. Old Icelandic (3:3:0). (GERM 5318)
5352, 5353. Studies in German Language and Literature I, II (3:3:0 each). (GERM 5312, 5313)
5354, 5355. Research in Russian (3 each). (RUSN 531, 532)
5356, 5357. Research in Latin (3 each). (LAT 531, 532)
5358, 5359. Research in Greek (3 each). (GRK 531, 532)

The following may also be taken as part of the program in linguistics:

Courses in Spanish. (SPAN)
533. History of the Spanish Language (3:3:0).
534. Old Spanish (3:3:0).

Courses in Anthropology. (ANTH)
5302. Individual Research (3).
5351. Anthropological Linguistics I (3:2:2).
5352. Anthropological Linguistics II (3:2:2).

Courses in French. (FREN)
536. Old French (3:3:0)



College of Business Administration

Professor Jack D. Steele, Dean

Professors Amason, Balsley, Barton, Bowlin, Cain, Chisholm, Dale, Dukes, Imke, V. Luchsinger, Roberts, Rouse, Ryan, Stem, Taylor, Whitehead, Whittington, and Williams; Associate Professors Caldwell, Dock, Ezell, Guy, L. Luchsinger, Phelan, Ponthieu, Wade, and Watt; Assistant Professors Barnum, Clay, Cornette, Dowell, Flowers, Gleason, Grube, Holder, Hoover, Justis, Lilly, Mann, Pearce, Petty, Sanders, and Sennetti.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

Master of Business Administration. The college's M.B.A. program is designed to provide a broad background for multiple careers in business, government, and related activities with particular emphasis on developing managerial perspective, analytical tools, and skills. The program is sufficiently flexible to permit more depth in at least one academic area. Generally, the student may expect to complete the program in from one to two years depending on his prior academic training and business experience.

Master of Science in Accounting. This program is especially suited to the practicing accountant and the recent undergraduate in liberal accounting programs. The student may follow a program of 36 hours of course work or 24 hours of course work and a thesis.

Master of Science in Business Administration. The M.S. degree in Business Administration is designed to produce a specialist in one of the functions of business: accounting, finance, management, marketing, management information systems and business statistics, quantitative sciences, and operations research. The student following the nonthesis option will take from 18 to 21 semester hours of course work in his specialty area, 6 semester hours of tool and quantitative courses, and 9 to 12 semester hours of electives. Normally the student may expect to complete the program in from one to two years depending on his prior preparation.

Doctor of Jurisprudence — Master of Business Administration. The college, in association with the School of Law, offers a program which enables the student to earn both the Doctor of Jurisprudence and Master of Business Administration degrees in roughly four years of full-time academic work. A student with an undergraduate business background may complete both degrees with 102 hours of law and business courses, a net saving of 24 credit hours from the total hours necessary if the degree programs were pursued separately. A student without a business background may complete both degrees with 129 hours of law and business courses. The first two years of study are taken mostly in the School of Law. Application must be made to and approved by both the School of Law and the Graduate School.

Doctor of Business Administration. The Doctor of Business Administration degree is offered with first-field and second-field concentrations in accounting, finance, management, marketing, and information systems and quantitative sciences. The program has three emphases for the student: to provide a broad, integrated knowledge of business, to develop specialized knowledge in at least three fields of concentration, and to develop research skills. Examinations must be passed to show competency in the following subjects as soon after commencement of the program as possible: basic mathematics and calculus, elementary statistics, and use of the computer. Early in his program the student must satisfy tool requirements — either through examination or course work with a minimum grade of B — in advanced statistics, operation research models, and advanced micro- and macro-economics. There is no requirement for a foreign language. The student who is successful continuously at each step in progress should complete degree requirements in about two years of full-time study beyond the master's degree.

The College of Business Administration requires that its master's program students maintain at least a 3.08 cumulative grade-point average. Doctoral students must maintain a 3.20 cumulative average. The grade-point average is computed on all courses completed until the student has completed 12 credit hours of degree program work, at which time the average is computed only on degree program courses. Students falling below these averages will be subject to probationary action.

(All courses in the College of Business Administration have been renumbered. The former course numbers are indicated in parentheses following the course descriptions.)

Courses in Business Administration. (B A)

ACCOUNTING

5300. Controllership (3:3:0). Examination of the role of the controller in the firm. (ACCT 531)

5301. Managerial Accounting I (3:3:0). Prerequisite: B A 2301 or 5500. Limited to nonaccounting majors. Uses of accounting in business, including the interpretation of financial statements and accounting reports. (ACCT 5341)

5302. Current Accounting Theory (3:3:0). Examination of current accounting literature, such as accounting bulletins of the American Institute of Certified Public Accountants, S.E.C. accounting releases, etc. (ACCT 533)

5303. Seminar in Accounting (3:3:0). Comprehensive study of some area of accounting, such as internal auditiong, accounting for the federal government, auditiong of specific enterprises, accounting for fiduciaries and estates, advanced cost problems, and advanced machine accounting. (ACCT 535)

5304. Concepts of Cost/Managerial Accounting (3:3:0). Principles and techniques of cost accounting for product costing, planning, control, and decision making.

5305. Fundamentals of Income Taxation (3:3:0). A detailed study of selected provisions of the Internal Revenue Code, combined with elementary tax planning in business and individual transactions. Course may not be included as part of graduate degree requirements for accounting majors.

5306. Advanced Corporation Accounting (3:3:0). Prerequisite: 12 hours of advanced accounting or consent of instructor. Problems and theory: corporate equities, capital adjustments, reorganizations, dissolutions, business combinations, financial reporting. (ACCT 538)

5307. Seminar in Federal Taxes (3:3:0). Investigation into organization and operation of the Internal Revenue Service. Tax research and planning in areas of federal income, gift, and estate taxation. (ACCT 539)

5308. Federal Income Tax Law for Partnerships (3:3:0). Includes study of withdrawals by partners, sale of partnership interests, adjustments to basis upon withdrawal of partner, transfers of unrealized receivables and appreciated inventories. (ACCT 5321)

5309. Federal Income Taxation of Corporations and Shareholders (3:3:0). Study of corporate tax problem areas, including liquidations, formation and reorganization, collapsibility, dividends, and "Subchapter S" treatments. (ACCT 5322)

5310. Advanced Accounting Problems I (3:3:0). A study of advanced accounting problems varying with the needs of the particular students. Individual instruction. (ACCT 5311)

5311. Advanced Accounting Problems II (3:3:0). A study of advanced accounting problems varying with the needs of the particular students. Individual instruction. (ACCT 5312)

5312. Internship (3:3:0). The student is placed in an internship in accounting and upon completion submits a report of his internship. (ACCT 532)

5313. Contemporary Issues of Cost/Managerial Accounting (3:3:0). A graduate seminar which introduces the student to contemporary issues such as human asset accounting, social accounting, international management accounting issues, and behavioral science and accounting.

5314. Advanced Concepts of Cost/Managerial Accounting (3:3:0). A study of advanced cost managerial accounting concepts with a quantitative emphasis. Credit will not be granted for students who have had the equivalent of B A 4309.

5315. Estate, Trust, and Gift Taxation (3:3:0). Intensive study of federal taxation of the estate and trust entities and the transfer of property rights through gifts. (ACCT 5315)

5316. Oil and Gas Taxation (3:3:0). Analysis of oil and gas transactions under provisions of federal income tax laws. Studies of current practices in planning petroleum transactions. (ACCT 5316)

5317. Contemporary Approaches to the Development of Accounting Theory (3:3:0). Recent contributions in the development of accounting theory and hypotheses including scientific methods, measurement theory, communication theory, operationalism, and other disciplines. (ACCT 5317)

5318. Income Tax Research and Planning (3:3:0). Fundamental procedures in research of income tax subject areas, such as depreciation, inventories, etc. Principles involved in necessary planning of actions for a desired tax result. (ACCT 5318)

5319. **Seminar in Auditing (3:3:0).** Auditing philosophy. A critical examination of contemporary societal and professional auditing issues. A study of auditing research, including the behavioral aspects of audits. (ACCT 5319)

5500. **Principles of Accounting (5:5:0).** Survey of accounting procedures, accumulation of information regarding the accounting entity, and interpretation for control purposes and managerial decisions (ACCT 5531)

5501. **Financial Accounting Concepts and Practice (5:5:0).** Study of financial accounting concepts, uses, applications. Emphasis on measuring and reporting financial position, changes in financial position, and results of operations of economic entities for external purposes. May not be included as part of graduate degree requirements for accounting majors.

6310. **Advanced Accounting Theory and Practice (3:3:0).** Development of accounting theory and practice. Objectives and limitiations of accounting and survey of accounting areas as they relate to the business environment. (ACCT 5351)

7332. **Research in Accounting (3).** (ACCT 731)

MANAGEMENT

5180. **Individual Problems (1:1:0).** Study of problems in administration and human resources for the individual student. (MGT 511)

5370. **Organization and Human Behavior (3:3:0).** Prerequisite: Consent of instructor. An introduction to the decision-making process and the principles of organization and administration as basic social techniques. (MGT 5331)

5371. **Management Decision Making (3:3:0).** Prerequisite: Consent of instructor. Limited to other than management majors. A basic management theory course intended to provide students with an orientation to the decision-making function of the manager or administrator. (MGT 5341)

5372. **Production/Operations Management (3:3:0).** Fundamentals of the production/operations function from a problems and quantitative models approach. (MGT 5342)

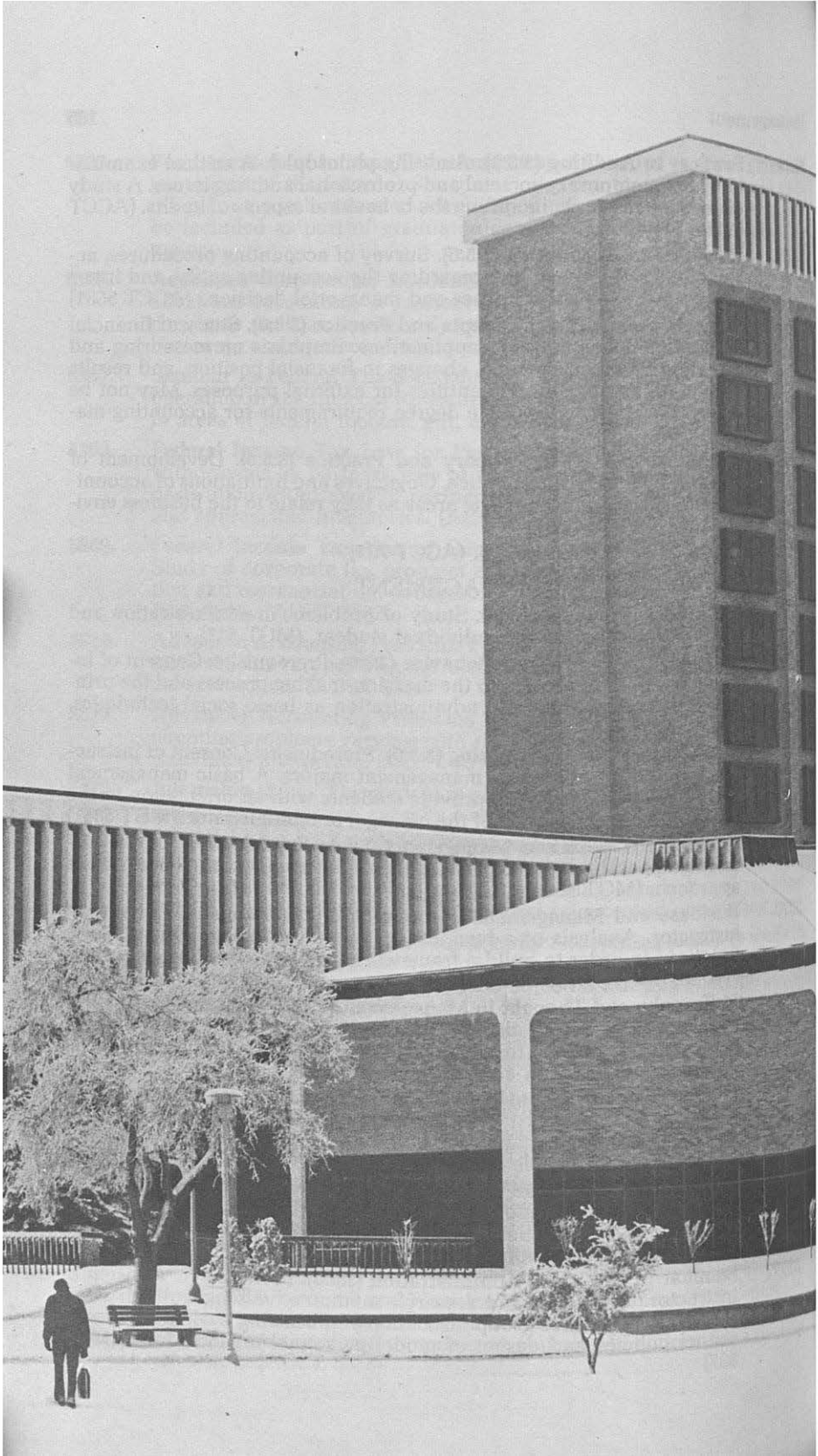
5373. **Business and Management Systems (3:3:0).** Prerequisite: Consent of instructor. Analysis of a business or enterprise in terms of its major functions in order to build a framework for an information or control system. (MGT 5313)

5374. **Philosophy and Thought in Management (3:3:0).** Prerequisite: Consent of instructor. An investigation into the forces and institutions which control and influence the exercise of managerial activities. Emphasis on history, ethics, and current thought. (MGT 5314)

5375. **Human Behavior in Business (3:3:0).** Prerequisite: Consent of instructor. Examines theories of social and behavioral sciences and emphasizes research and the analysis of problems involving the role and contributions of people in the business environment. (MGT 535)

5376. **Management of Human Resources (3:3:0).** Prerequisite: Consent of instructor. Examines factors involved in the selection, development, adjustment, and motivation of individual employees with emphasis on independent investigations and preparations by students. (MGT 536)

5377. **Seminar in Personnel Administration (3:3:0).** Prerequisite: Consent of instructor. A reading and research seminar involving individual research and reflective group discussion emphasizing evaluation of personnel policies and design of model personnel organizations. (MGT 537)



5378. **Advanced Production/Operations Management (3:3:0).** Complex problems encountered in managing production operations. Use of modern analytical techniques such as those of management science, operations research, and simulation. (MGT 538)

5379. **Seminar in Production/Operations Management (3:3:0).** Readings, individual research and reports, and group studies of operations policy and production problems. Complex problems requiring programming computers will be included. (MGT 539).

5380. **Individual Research in Management (3).** The student focuses research skills under individual supervision of a professor on a problem area in administration and human resources. (MGT 530)

5381. **Current Problems in Management (3:3:0).** Individualized study with consent of professor. (MGT 531)

5382. **Seminar in Labor and Collective Bargaining (3:3:0).** Study and analysis of collective bargaining theory as well as major labor relations problems and public labor policy dilemmas. (MGT 5318)

5383. **Project and R&D Management (3:3:0).** Technological and operational aspects of project and R&D management in light of project selection, resource allocation, personnel procurement, project planning and control will be presented, reviewed, and discussed relative to industry and government. (MGT 5319)

5384. **International Business Management (3:3:0).** Prerequisite: Consent of instructor. Comparative analysis of domestic, international, and multinational business operations, and the significance for organization and management. (MGT 5311)

5386. **Problems in Small Business Management (3:3:0).** The individually supervised study and analysis of problems associated with entrepreneurship. Special emphasis is placed on the small business and nascent enterprise. (MGT 5396)

6372. **Administrative Organization (3:3:0).** Prerequisite: Consent of instructor. Development of organization theory and applications in the analysis of organization design and the measurement of its effectiveness. (MGT 5352)

7337. **Research in Management (3).** (MGT 731)

FINANCE

5320. **Business Finance (3:3:0).** Prerequisite: B A 5500 and ECO 5331 or equivalent. An introductory course in finance for graduate students designed to cover concepts in business finance and investment. (FIN 5331)

5321. **Current Business Financial Practices (3:3:0).** Prerequisite: B A 3320 or 5320. Examines the general theory of financial administration with application to practical problems in business finance. (FIN 5341)

5323. **Financial Management in a Dynamic Economy (3:3:0).** Prerequisite: B A 4330 or 5321 or approval of instructor. Focuses on the application of financial theory to business problems in a changing economic and social environment designed primarily for the M.B.A. student. (FIN 5342)

5324. **Risk Administration (3:3:0).** Prerequisite: B A 3335 or equivalent. A consideration of various methods of risk treatment including retention, prevention, reduction, and transfer. (FIN 537)

5325. **Seminar in Investment Analysis (3:3:0).** Prerequisite: B A 4324 or equivalent. Security analysis and selected problems in individual and institutional portfolio analysis. (FIN 533)

5326. **Portfolio Theory and Capital Asset Pricing (3:3:0).** Prerequisite: B A 5321 and 5341 or equivalent. A study of portfolio theory and applica-

tions with emphasis on the theory and testing of the capital asset model. (FIN 534)

5327. Seminar in Contemporary Financial Theory (3:3:0). Prerequisite: Consent of instructor. An analysis of selected topics from various fields of finance. Each student is required to plan and to execute a research project related to the topic of the seminar. Course may be repeated for up to 9 hours credit, providing there is no duplication of topics. (FIN 538)

5328. Financial Problems of Entrepreneurship (3:3:0). Prerequisite: B A 5321 of approval of instructor. An examination of the theory of entrepreneurship with emphasis on the practical aspects of financing the nascent firm. Topics include sources of venture capital, control arrangements, tax considerations, strategies for growth, and public registration of securities. (FIN 5352)

5329. The Money and Capital Markets (3:3:0). Prerequisite: B A 4321 and 4330 or equivalent. A theoretical and empirical examination of saving and investment, financing and financial intermediaries, asset and portfolio structures, and interrelationship of financial and real variables of the economy. (FIN 536)

5330. Current Financial Problems (3:3:0). Prerequisite: Consent of instructor. Solution and presentation of approved problems involving individual research in the field of finance. (FIN 531)

5331. Seminar in Current Banking Problems (3:3:0). Prerequisite: B A 4323 or equivalent. Focuses on major problems currently affecting commercial banks and the banking system. Representative case problems are used as a basis for analysis and decision. (FIN 535)

5332. Advanced International Finance (3:3:0). Prerequisite: B A 4328 and ECO 338 or consent of instructor. Advanced study of the structure and functioning of the international monetary system with stress on the key currency role of the U.S. dollar, balance of payments theory, the adjustment process, and policy alternatives available to countries in equilibrium; presented within the context of current international financial developments. (FIN 532)

5333. History of Financial Thought (3:3:0). Prerequisite: Consent of instructor. A study of the evolution of thought concerning the finance function in the entire economy and in individual units in the economy. Attention is given to doctrinal development in monetary theory, monetary policy, banking, central banking, public finance, business finance, investments, financial institutions, and other macro and micro finance areas. (FIN 539)

6321. Financial Policies of Business (3:3:0). Prerequisite: B A 4330 or 5321. The financial policy of business organization with emphasis on the organization of the financial function, evaluation of the financial performances, and determination of the financial requirements. (FIN 5351)

6339. Seminar in Management Information Systems (3:3:0). Prerequisite: B A 5339 and consent of instructor. In-depth study of selected topics with emphasis on MIS project development and implementation.

7333. Research in Finance (3). (FIN 731)

INFORMATION SYSTEMS AND QUANTITATIVE SCIENCES

5140. Computer Usage for Business (1:1:0). This course examines business problems requiring computer applications. May be repeated for credit on approval. (B A 511)

5339. **Management Information Systems (3:3:0).** Advanced study of information systems: their design, implementation, and contribution to management planning, decision-making and control. (MGT 5317)

5340. **Statistical Methods in Business (3:3:0).** Topics covered include averages, dispersion, estimation, testing hypotheses, correlation, regression, analysis of time series, and applications of these techniques to decision making. (MKT 5332)

5341. **Advanced Statistical Methods (3:3:0).** Prerequisite: B A 5340 or 2445. A continuation of B A 5340. Emphasis on evaluation and use of analytical and interpretive statistical methods. (MKT 5342)

5342. **Computer Systems for Information Processing (3:3:0).** This course surveys the area of business data processing. Emphasis is placed on hardware, software, and programming as it relates to information systems.

5343. **Mathematical Programming for Business (3:3:0).** Prerequisite: B A 5345 or equivalent. Revised simplex, sensitivity, parametrics, dual simplex, primal-dual algorithm, decomposition, partitioning, integer programming, goal programming, separable programming, convexity, Kuhn-Tucker conditions, lagrangian, saddle points, quadratic programming. (MGT 5315)

5344. **Computer Models for Business, Industry, and Government (3:3:0).** The study, construction, and operation of computer simulations and other models as aids for management and administrative decisions. (MGT 5316)

5345. **Decision Theory and Management Science (3:3:0).** Prerequisite: Consent of instructor. An operative theory of decisions for business, including foundations in philosophy, logic, economics, and management science. (MGT 5351)

5346. **Quantitative Analysis for Business (3:3:0).** Prerequisite: B A 5345 or equivalent. Duality theory, non-linear optimization-search and root-finding techniques, dynamic programming, random number generation and tests, simulation problems. (MGT 533)

5347. **Advanced Business Forecasting (3:3:0).** Prerequisite: B A 5341. Statistical methods in business forecasting: multiple correlation and seasonal adjustment computer calculations; transformed variables; distributed lag structures; and multiple equation systems. (MKT 535)

5349. **Statistical Decision Making (3:3:0).** Prerequisite: B A 2445 or 5340. Bayesian decision analysis, involving probability theory incorporated in scientific business decisions. (MKT 5352)

6342. **Advanced Experimental Statistics (3:3:0).** Prerequisite: Consent of instructor. Business statistical problems involving experimental design and combining the methodology involved in experimentation. (MKT 5362)

6343. **Advanced Inference Problems (3:3:0).** Prerequisite: Consent of instructor. Business statistical problems involving inference, including inferences concerning proportions, variances, regression, correlation, and covariance. (MKT 5372)

6344. **Advanced Business Statistical Analysis I (3:3:0).** Prerequisite: B A 5341 or consent of instructor. Business statistical problems involving advanced techniques including activity analysis, factor analysis, and input-output analysis. (MKT 5382)

6345. **Advanced Business Statistical Analysis II (3:3:0).** Prerequisite: B A 5341 or consent of instructor. Further study of business statistical problems involving advanced techniques including step-wise regression,

discriminant analysis, spectral analysis, and network analysis. (MKT 5383)

6346. Applied Distribution-Free Statistics in Business (3:3:0). Prerequisite: B A 5341 or consent of instructor. Distribution-free statistical techniques of inference for small samples and non-normal parent populations applied to business statistical problems. (MKT 5392)

7334. Research in Information Systems and Quantitative Sciences (3).

MARKETING

5350. Marketing Foundations (3:3:0). Prerequisite: Consent of instructor. An examination of marketing functions and the institutions which perform them, choice of criteria for marketing strategy decisions, marketing structural relationships, and the role of marketing. (MKT 5331)

5353. Marketing Strategy I (3:3:0). Prerequisite: Consent of instructor. Product development decisions and channel distribution analysis evaluated in detail and related to management decisions. (MKT 5353)

5354. Marketing Strategy II (3:3:0). Prerequisite: Consent of instructor. Promotional policies and pricing policies evaluated in detail and related to necessary management decisions. (MKT 5354)

5355. Advanced Marketing Problems (3:3:0). Prerequisite: Consent of instructor. Study of contemporary marketing problems and resultant opportunities. Heavy emphasis on reading from current journals and other related publications. (MKT 531)

5356. Advanced Marketing Research (3:3:0). Prerequisite: Consent of instructor. Analysis of experimental design of research projects dealing with marketing problems. (MKT 532)

5357. Marketing Models and Measurement (3:3:0). Prerequisite: Consent of instructor. Study of the determination and arrangement of critical factors essential to achieving simplified representations of complex empirical marketing situations and phenomena, with special emphasis on understanding and analyzing phenomena and prediction outcomes. (MKT 5344)

5358. Sales Planning, Measurement, and Administration (3:3:0). Prerequisite: Consent of instructor. Analysis of the planning and measurement techniques which contribute to effective administration of the sales function. (MKT 5335)

5359, 5360. Individual Study in Marketing I & II (3:3:0 each). Prerequisite: Consent of instructor. Directed individual study of advanced marketing problems varying with the need of the particular student. Can be repeated for credit if subject matter is different. (MKT 536, 537)

5361. Marketing Administration (3:3:0). Prerequisite: Consent of instructor. A study of marketing planning, strategy, and tactics, including the organization, execution, and control of the marketing effort. Enrollment limited to non marketing majors. (MKT 5341)

5362. Multinational Marketing (3:3:0). Prerequisite: Consent of instructor. A survey of international marketing principles, cultural differences, world markets, and political restraints. (MKT 5336)

5363. Seminar in Industrial Marketing (3:3:0). Prerequisite: Consent of instructor. A study of marketing research, channels of distribution, promotional efforts, pricing, and control of marketing operations in industrial markets. (MKT 5343)

5364. **Advertising in a Contemporary Society (3:3:0).** Prerequisite: Consent of instructor. A broad perspective and penetrating study of advertising — its functions, its role, its challenges, and its opportunities for business and society. (MKT 5334)

5365. **Advanced Marketing Administration (3:3:0).** Prerequisite: Consent of instructor. Emphasis on the planning, organizing, and controlling of all marketing functions for which the busienss executive is responsible in a complex decision-making environment. (MKT 5360)

5367. **Advanced Consumer Behavior (3:3:0).** (MKT 5337)

5368. **Legal and Political Aspects of Marketing (3:3:0).** Prerequisite: Consent of instructor. A comprehensive survey of the governmental structures which pervade the marketing effort coupled with reflections on the existing state of the political environment. (MKT 538)

6352. **Marketing Thought (3:3:0).** Prerequisite: Consent of instructor. Evaluation of the contribution of marketing scholars to marketing thought, including the development of problems, theory, and principles. (MKT 5351)

6353. **Marketing Theory (3:3:0).** Prerequisite: Consent of instructor. A study of principles, theories, and problems in marketing from the social and the firm's point of view. (MKT 533)

6355. **Seminar in Current Marketing Problems (3:3:0).** Prerequisite: Consent of instructor. A critical analysis of selected current and future problems in the field of marketing. (MKT 5355)

7335. **Research in Marketing (3).** (MKT 731)

POLICY AND ENVIRONMENT

5390. **Legal Environment of Business (3:3:0).** The meaning, nature, and sources of the law, the factors which shape it, and substantive fields of law which affect business organizations. (BLAW 5331)

5391. **Business Policy (3:3:0).** Prerequisite: Consent of adviser. A course in policy formulation and policy implementation that integrates for the student the separate areas of business study. (B A 5342)

5392. **Business and Its Environment (3:3:0).** Prerequisite: A consideration of the position of today's business in the light of those concepts which are the foundations of our society. (B A 5351)

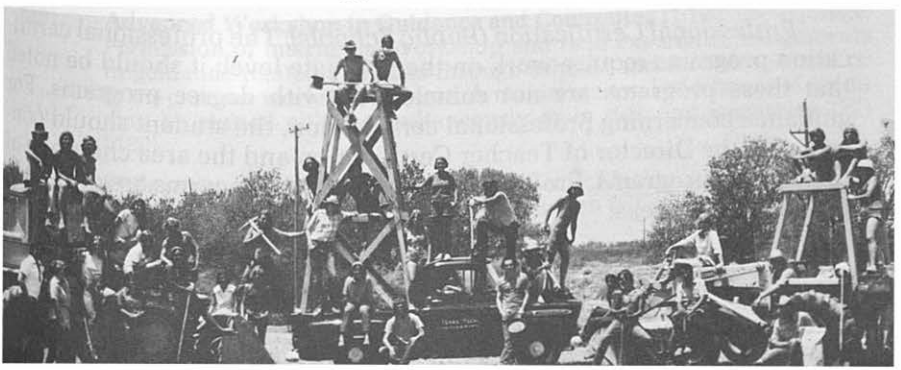
5394. **Administrative Planning and Strategy (3:3:0).** Prerequisite: Consent of instructor. An integrative and problem-solving course in organizational administration, planning, and strategy. Simulations and cases are utilized in diagnostic and decision-making exercises. (MGT 5312)

5395. **Practicum in Higher Education for Business (3:3:0).** Prerequisite: Consent of instructor. Supervised practice in teaching of business and administrative subjects. (B A 5353)

630. **Master's Report (3).**

631. **Master's Thesis (3).** Enrollment required at least twice.

831. **Doctor's Dissertation (3).** Enrollment required at least four times.



College of Education

Professor Robert H. Anderson, Dean

Professors Ainsworth, Askins, Balsley, Barnett, Beckner, Bensberg, Biggers, Bremer, Caskey, Cornett, Crowder, Evans, Fallon, Fleming, Freeman, Gilliam, Kelsey, Kirk, Mattson, McDonald, Nagle, Pasewark, Perry, Roberts, Rogers, Rooze, and Zintgraff; Associate Professors Cannell, Esteves, Filgo, Foerster, Hovey, Johnson, Juarez, Kimmel, Manley, Porter, Rebstock, Skoog, and Willingham; Assistant Professors Allen, Bloomer, Carter, Christian, Criscoe, Deethardt, Gee, Kiniry, Mehaffie, Murphy, Parr, Peterson, Purkerson, Reid, Simmons, and Trang.

The College of Education offers instruction and research programs leading to the degrees of Master of Education and Doctor of Education. The student may choose and emphasize the various special fields of study in working toward these degrees and should consult the office of the Associate Dean for Graduate Studies in Education for general information and referral to appropriate program advisors. Fields of study offered include:

- Counselor Education
- Curriculum and Instruction
  - Business Education
  - Early Childhood Education
  - Elementary Education
  - Instructional Technology
  - Reading
  - Secondary Education
- Educational Administration and Supervision
- Educational Foundations
  - Educational Psychology
  - Educational Research and Statistics
  - Educational Sociology
  - History of Education
  - Philosophy of Education
- Higher Education
  - Community-Junior College
  - Senior College and University
- Special Education

Professional Certification (Public Schools). The professional certification programs require work on the graduate level; it should be noted that these programs are not coincidental with degree programs. For guidance concerning professional certification, the student should consult with the Director of Teacher Certification and the area chairmen of the various programs. Professional certification programs are offered in the following areas:

Principal
Superintendent
Counselor
Educational Diagnostician
Professional Teacher's Certificates in approved fields in Elementary and Secondary Education
Reading Specialist
Supervisor
Visiting Teacher
(Graduate program endorsements are available for kindergarten, teaching the emotionally disturbed, mentally retarded, and in the areas of language and/or learning disabilities.)

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

(All courses in the College of Education have been renumbered. The former course numbers are shown in parentheses after course descriptions.)

Educational Foundations and Services

The Educational Foundations and Services Area offers a variety of programs for the major or minor on a master's or doctor's degree. Applicants for the master's degree may pursue courses of study in school counseling, student personnel work, and a composite of educational history, sociology, philosophy, psychology, research, and statistics. A doctoral program is offered which may emphasize one of several areas of interest: counselor education, school counseling, and the educational foundations composite.

The professional certificate in school counseling is available. Applicants must not only be admitted to graduate study in education, but must also be accepted by the faculty in counselor education. In addition, a comprehensive examination must be passed before recommendation for the certificate.

Courses in Educational Foundations and Services. (EDFS)

5191. **Advanced Workshop in Guidance and Counseling (1:1:0).** Prerequisite: Permission of instructor. Workshop and field experience assignments in guidance-related activities through schools and service agencies or in on-campus workshop groups. A maximum total of 6 hours of credit may be earned either simultaneously or in different semesters. (ED 5180)

5310. **Philosophy of Education (3:3:0).** Prerequisite: Major social philosophies and their application to the field of education in the United States. (ED 532)

5313. **Seminar in Philosophy of Education (3:3:0).** Prerequisite: EDFS 5310. Synthesis and analysis of philosophical theories, concepts, and studies related to the field of education. (ED 5352)

5314. **History of Education (3:3:0).** A study of the development of Western education with emphasis on pedagogical leaders and reformers. (ED 531)

5321. **Behavioral Sciences and Education (3:3:0).** Study and practice of behavioristic strategies as foundations for educational practice and innovation. (ED 535)

5323. **Advanced Educational Sociology (3:3:0).** Analysis of linkages between school and community with special reference to the impact of the selection/allocation functions of schooling on minority groups. (ED 534)

5326. **Seminar in Education Sociology (3:3:0).** Prerequisite: EDFS 5323. Concurrent sociological problems as related to the field of professional education. (ED 5354)

5331. **Human Development in Education (3:3:0).** Biological, social, and psychological interrelationships and implications for classroom teaching and learning. (ED 5331)

5332. **Advanced Educational Psychology (3:3:0).** Emphasis on the application of educational psychological principles to teaching at all levels. (ED 530)

5349. **Seminar in Educational Psychology (3:3:0).** Prerequisite: EDFS 5332. Research analysis and synthesis in the field of educational psychology. (ED 5364)

5350. **Introduction to Guidance and Personnel Services (3:3:0).** Survey of objectives, principles, and practices in guidance and personnel services in educational settings; the role and scope of activities within the personnel services. (ED 5381)

5352. **Guidance and Counseling in the Elementary School (3:3:0).** Philosophy, principles, and practice of guidance services in elemnetary schools. (ED 5385)

5353. **Guidance Services for Exceptional Children and Youth (3:3:0).** Provision of guidance and counseling services for students in school and agency programs for exceptional children. Identification and placement procedures. (ED 5386)

5354. **Group Techniques in Guidance (3:3:0).** A study of group techniques applicable to guidance and personnel services for teachers, supervisors, and administrators, as well as guidance workers. (ED 5384)

5355. **Information Services in Guidance (3:3:0).** Development informational materials, organization of informational services, and application of vocations, educational, and personal-social information to individual and group activities. (ED 5383)

5356. **Individual Appraisal in Guidance and Counseling Services (3:3:0).** Prerequisite: 9 semester hours of graduate guidance and counseling courses. Analysis and techniques of individual appraisal in guidance and counseling services. (ED 5387)

5357. **Techniques in School Guidance Services (3:3:0).** Prerequisite: 12 semester hours credit in guidance and counseling courses. Theory, simulation, and practice in techniques used in guidance programs with emphasis on educational, vocational, and developmental processes in working with students, teachers, parents, and agencies. (ED 5388)

5358. Organization and Administration of Guidance and Personnel Services (3:3:0). Prerequisite: 12 semester hours in graduate guidance and counseling courses. Theory and practice in management skills needed to develop and administer guidance and student personnel programs. (ED 5372)

5359. Student Personnel Services in Higher Education (3:3:0). An overview of student personnel programs and services in junior colleges, colleges, and universities. A study of the philosophy, role, problems, trends, organization, and administration of student personnel services in higher education. (ED 5389)

5360. Practicum in Guidance (3:3:0). Prerequisite: 12 semester hours in guidance and counseling and EDFS 5357. Assignment in a work setting for supervised experiences in guidance and counseling work. Application of theoretical principles and tape analysis will be expected. (ED 5390)

5361. Consulting Techniques in Counseling and Guidance (3:3:0). Prerequisite: 9 hours in graduate guidance and counseling courses. An examination of approaches to consultation with parents and teachers in behalf of the child and adolescent. Demonstrations and practice.

5369. Seminar in Guidance and Counseling (3:3:0). Prerequisite: Permission of instructor. A critical investigation and discussion of recent trends and developments in school guidance. Focus will be on the problems experienced by the practicing school counselor. (ED 5393)

5380. Introduction to Educational Statistics (3:3:0). An introductory course in statistics with major emphasis on univariate measures for analyzing educational data. (ED 5315)

5381. Advanced Educational Statistics (3:3:0). Prerequisite: 3 hours of educational statistics. Application of multivariate analysis to educational data. (ED 5323)

5384. Introduction to Educational Research (3:3:0). A course designed to acquaint the student with the nature of research and its relationship to educational thought and practice. Major emphasis on interpretation and use of research. (ED 5317)

5385. Foundations of Educational Research (3:3:0). Methods of educational research; methods of obtaining, processing, interpreting, and utilizing significant educational data. (ED 5322)

5387. Educational Evaluation (3:3:0). Bases and techniques of appraisal, tests, polls, measurement, data treatment, and interpretation. (ED 5373)

5389. Practicum in Educational Appraisal of Children and Youth (3:3:0). Prerequisite: Consent of instructor. The practicum aspects of the use of individual appraisal instruments and techniques in educational evaluation of children and youth.

5393, 5394. Internship in Education (3 each). (ED 635, 636)

5399. Individual Study (3). Prerequisite: Instructor approval. Individual study on special aspects of professional education. May be repeated once for credit. (ED 5321)

630. Master's Report (3). (ED 630)

631. Master's Thesis (3). Enrollment required at least twice. (ED 631)

6354. Practicum in Group Leadership Techniques (3:3:0). Prerequisite: Master's degree and permission of instructor. Supervised practice in conducting groups. Advanced theories in group techniques.

6360. Practicum for Counselor Educators (3:3:0). Prerequisite: Master's degree and permission of instructor. Advanced assignment in a school or agency for supervised experiences in guidance and counseling. An opportunity to assist the novice counselor will be provided.

6366. Counseling Supervision (3:3:0). Prerequisite: Master's degree and permission of instructor. Assignment of supervision responsibilities for counseling practicum students and field experience in a school setting. A supervised experience for the advanced doctoral student or guidance administrator.

731, 732. Research (3 each). (ED 731,732)

831. Doctor's Dissertation (3). Enrollment required at least four times. (ED 831)

Curriculum and Instruction

The Area of Curriculum and Instruction offers a variety of programs for advanced degrees designed to meet individual needs. Requirements may also be completed for elementary and secondary Professional Teacher's Certificates and endorsements on Provisional Teacher's Certificates, although certificate and degree programs may not coincide unless advisers assist with careful program planning. Emphasis may be in business education, early childhood education, educational media, elementary education, reading, secondary education, or some combination of these fields of study. For specific information and advisement students may consult appropriate program chairmen.

Courses in Curriculum and Instruction. (EDCI)

5190. Advanced Education Workshops in Early Childhood Education (1:1:0).

5191. Advanced Education Workshops in Elementary Education (1:1:0). Prerequisite: 18 hours of education and educational psychology and experience as a teacher. A maximum total of 6 hours of credit may be earned either simultaneously or in different semesters. (E ED 5138)

5192. Advanced Education Workshops in Secondary Education (1:1:0). Prerequisite: Experience as a teacher or administrator. A maximum total of 6 hours of credit may be earned either simultaneously or in different semesters. (S ED 5137)

5300. The Junior High School (3:3:0). The philosophy, organization, program, special problems, and emerging role of the junior high school. (S ED 5317)

5305. Seminar in Early Childhood Education (3:3:0).

5306. Seminar in Elementary Education (3:3:0). Prerequisite: 24 hours of education and educational psychology. Trends in modern elementary education. (E ED 5355)

5307. Seminar in Secondary Education (3:3:0). Trends in modern secondary education. (S ED 5356)

5310. Application of Studies in Maturation and Learning to Early Childhood Education (3:3:0). Study of the influence of environmental factors on the physical, emotional, social, and intellectual growth of young children. Observation required. (E ED 5332)


LIBRARY

5311. Analysis and Design of Programs in Early Childhood Education (3:3:0). Research study and laboratory observations to determine nature and need of school experiences for young children. (E ED 5333)

5312. Environmental Systems and Teaching Strategies in Early Childhood Education (3:3:0). Prerequisite: EDCI 5310 and 5311. Scientific study of facilities, equipment, materials, and methods designed for maximum development of the individual child. (E ED 5334)

5313. Research in Early Childhood Education (3:3:0). Prerequisite: 6 hours of early childhood education course work and teaching experience in public school kindergarten. Seminar on central issues and problems in early childhood education emphasizing identification and interpretation of salient research; investigation and discussion of readiness for systematic learning; concept development in the arts, mathematics, sciences, and language. (E ED 5337)

5314. Early Education for Culturally Diverse Children (3:3:0). Prerequisite: EDCI 5310 and 5311. Study of cultural differences, values, concepts, and language development of young children. Emphasis upon English as second language and/or a second dialect and parent involvement.

5320. Advanced Curriculum Development (3:3:0). Prerequisite: 18 hours of education and educational psychology. Fundamental bases for curriculum development. (ED 5346)

5323. Audiovisual Communications and Technology (3:3:0). A basic course on principles and bases of utilizing educational communications media and technology in instruction. (L S 5323)

5324. Selecting and Evaluating Instructional Materials (3:3:0). Commercially prepared audiovisual materials. Special emphasis given to selection, classification of films and filmstrips, and preparation of study guides. (ED 5318)

5325. Planning and Developing Instructional Materials (3:3:0). The design, development, preparation, testing, and application of educational communications media such as graphic, photographic, and programmed instructional materials. (ED 5319)

5326. Administration and Supervision of Educational Media Programs (3:3:0). State, regional, and local audiovisual programs; budgeting, selection, procurement, accounting, distribution, and care of audiovisual materials; preparation of personnel for audiovisual centers. (ED 538)

5327. Design and Application of Instructional Communications Systems (3:3:0). Prerequisite: 24 hours of education, including EDCI 4323 and two advanced courses in audiovisual education. Problems in planning audiovisual education programs for school systems and intermediate service agencies; research in the field of audiovisual education. (ED 5363)

5328. Development and Utilization of Programmed Instruction (3:3:0).

5329. Seminar in Educational Communications and Technology (3:3:0).

5330. Studies in Curriculum of English and Social Studies in Secondary Schools (3:3:0). Scope and sequence of curricula in the fields of social studies and English. Surveys of recent trends; selection of activities, resources, materials, and media. (S ED 5332)

5331. Improvement of Instruction in the Secondary School (3:3:0). A study of teaching behaviors, styles, and strategies. Instructional theories and teaching prescriptions are critically examined.

5333. Teaching the Educationally Deprived (3:3:0). An intensive study of the educationally deprived and effective ways of enabling them to learn. (ED 5348)

5335. Curriculum Problems: Overcoming Student Learning Difficulties (3:3:0). Prerequisite: EDCI 5320. An intensive study of analyzing and correcting or eliminating pupil learning difficulties of all students in school. (ED 5350)

5340. Foundations of Reading Instruction (3:3:0). Psychological and research bases of reading instruction. A foundations course. (E ED 5342)

5341. Problems, Trends, and Issues in Reading Instruction (3:3:0). Reading instruction in the elementary school. Problems, trends, and issues. (E ED 5326)

5342. Clinical Diagnosis of Reading Problems (3:3:0). Prerequisite: At least one course in teaching reading. Diagnostic procedures in reading instruction. A clinical course involving direct work with individuals who have reading problems. (E ED 5352)

5343. Clinical Teaching of Reading (3:1:4). Prerequisite: EDCI 5340 or EDCI 5344. Corrective and remedial teaching of children who have moderate to severe reading problems. A supervised practicum. (E ED 5362)

5344. Reading Instruction in Secondary School and College (3:3:0). Prerequisite: 12 hours of education and educational psychology. Emphasis on developing reading skills in content fields and establishing a comprehensive reading program. (S ED 5334)

5345. The Language Experience Approach in Reading Instruction (3:3:0). Theoretical bases, procedures, techniques, and materials for the language experience approach to reading instruction.

5346. The Individual Approach in Reading Instruction (3:3:0). Theoretical bases, classroom organization, procedures, techniques, and materials for individualized reading instruction.

5347. Supervision of Clinical Procedures in Reading (3:3:0). An advanced practicum in the diagnosis of reading problems and the clinical teaching of reading. May be repeated once for credit.

5350. Developing Language Arts Programs in Elementary Education (3:3:0). Prerequisite: 12 hours of English and 18 hours of education. Applications of research findings and modern theory to teaching and organizing the language arts in the elementary school. (E ED 5344)

5351. Children's Literature for Elementary School Teachers and Librarians (3:3:0). Prerequisite: 18 hours of education and educational psychology. Literature for children in the elementary school; selection, use and organization. (L S 5351)

5352. Studies in Youth Literature for Seconday School Teachers (3:3:0). Prerequisite: 6 hours of secondary education. Study of techniques for developing maturity in reading; selection of materials, media, and resources for secondary students. (L S 5352)

5354. Modern Linguistics in the Elementary School (3:3:0). Prerequisite: 18 hours of professional education and educational psychology. Methods and materials for helping children understand better and use more effectively the system of the English language. (E ED 5354)

5360. Developing Social Studies Programs in Elementary Education (3:3:0). Prerequisite: 18 hours of education. Objectives, patterns, and principles of organization of social studies in the elementary schools. (E ED 5345)

5370. Developing Arithmetic Programs in Elementary Education (3:3:0). Prerequisite: 18 hours of education and educational psychology. The development of arithmetic and its educative function in the elementary school curriculum. (E ED 5341)

5375. Developing Natural and Physical Environment Concepts in Elementary Education (3:3:0). Prerequisite: 18 hours of education and 6 hours of science. Methods and materials of helping children develop an understanding of their natural and physical environments. (E ED 5343)

5377. Science Curriculum and Instruction (3:3:0). Prerequisite: Experience in teaching science at the secondary level or permission of the instructor. A study of the evolving science curriculum with emphasis on innovative practices, methodology, organization for instruction, and evaluation. (S ED 533)

5380. Foundations of Business Education (3:3:0). A study of educational programs for careers in business and teaching at various educational levels. (B ED 530)

5381. Seminar in Business Education (3:3:0). In-depth study of selected problems in education for careers in business and/or business teacher education. May be repeated for credit. (B ED 535)

5382. Research and Improvement of Instruction in Bookkeeping (3:3:0). Study of research, practice, and literature pertinent to improvement of instruction in bookkeeping/accounting and related areas. (B ED 536)

5383. Research and Improvement of Instruction in Office Procedures (3:3:0). Study of research, literature, and practices pertinent to improvement of instruction in office procedures; COE/POE, and related areas. (B ED 537)

5384. Research and Improvement of Instruction in Shorthand and Transcription (3:3:0). Study of research, literature, and practices pertinent to improvement of instruction in shorthand theory, dictation, and transcription. (B ED 538)

5385. Research and Improvement of Instruction in Typewriting (3:3:0). Study of research, literature, and practices pertinent to improvement of instruction in typewriting and related areas. (B ED 539)

5386. Organization and Administration of Vocational Education (3:3:0). The objectives, principles, and procedures for organizing and administering voactional education programs in high school, junior college, and adult education programs. (B ED 5311)

5387. Cooperative Vocational Education Programs (3:3:0). The objectives, principles, and procedures for establishing, coordinating, and teaching cooperative work-study programs in high school, junior college, and adult education programs. (B ED 5312)

5388. Problems in Business Education (3:3:0). A study of specific contemporary business education problems. May be repeated for credit. (B ED 5331)

5393, 5394. Internship in Curriculum and Instruction (3 each).

5399. Individual Study (3). Prerequisite: Advanced graduate classification in education. Individual study on special aspects of professional education. May be repeated once for credit. (E ED 5321; S ED 5321)

630. Master's Report (3). (E ED 630; S ED 630)

631. Master's Thesis (3). Enrollment required at least twice. (E ED 631; S ED 631)

731, 732. Research (3 each). (E ED 731, 732; S ED 731, 732)

831. Doctor's Dissertation (3). Enrollment required at least four times. (E ED 831; S ED 831)

Courses in Library Science. (L S)

5323. **Audiovisual Communications and Technology (3:3:1).** A course on principles and bases of utilizing educational communications media and technology in instruction. (EDCI 5323)

5351. **Children's Literature for Elementary School Teachers and Librarians (3:3:0).** Prerequisite: 18 hours of education and educational psychology. Literature for children in the elementary school; selection, use, and organization. (EDCI 5351)

5352. **Studies in Youth Literature for Secondary School Teachers (3:3:0).** Prerequisite: 6 hours of secondary education. Study of techniques for developing maturity in reading; selection of materials, media, and resources for secondary students. (EDCI 5352)

Special Education

The Area of Special Education offers graduate programs which emphasize generic rather than categorical preparation, inasmuch as there exists a need for leadership personnel whose preparation transcends a limited category such as mental retardation. These generic programs are available at the master's and doctoral levels. Graduate work at the master's level may include sufficient coursework in one area of exceptionality to produce an endorsement on the basic provisional elementary or secondary certificate.

The master's level program to train the educational diagnostician also produces eligibility for the professional certificate or an endorsement on this existing certificate.

The area course offerings also apply to preparing the special education counselor, the special education administrator and/or supervisor, the special education visiting teacher, and the early childhood educator of the handicapped.

Courses in Special Education. (EDSP)

5191. **Advanced Education Workshops in Special Education (1:1:0).**

5300. **Exceptional Children and Youth (3:3:0).** Major categories of exceptional children and youth; psychological, sociological, and educational implications of exceptionality. (SPED 5310)

5301. **Educational Appraisal of Exceptional Children (3:3:0).** Appraisal instruments and techniques employed by relevant disciplines in determining appropriate educational placement and programming for exceptional children. (SPED 5311)

5302. **Use of Consultative Techniques with Parents of Exceptional Children (3:3:0).** The roles of professional personnel in bringing about parental understanding of their exceptional children and acceptance of special education placement. (SPED 5312)

5303. **Administration and Supervision of Special Education (3:3:0).** Philosophy, concepts, and problems in the administration and supervision of special education programs. (SPED 5313)

5305. Children and Youth with Multiple Disabilities (3:3:0). Psychological, sociological, and educational implications of multiple disability in children and youth. (SPED 5380)

5310. Gifted Children and Youth (3:3:0). Psychological, sociological, and educational implications of higher level intelligence and intellectual ability. (SPED 5382)

5320. Mentally Retarded Children and Youth (3:3:0). Psychological, sociological, genetic, medical aspects of retardation to include observation and participation. (SPED 5320)

5321. Curriculum and Methods for the Educable Mentally Retarded (3:3:0). Curriculum, methods, and materials in teaching educable level mentally retarded children. (SPED 5322)

5322. Curriculum and Methods for the Trainable Mentally Retarded (3:3:0). Curriculum, methods, and materials in teaching the trainable level mentally retarded. (SPED 5323)

5323. Vocational Adjustment of Mentally Retarded Youth (3:3:0). The programming for high school age retarded to expedite social and occupational adequacy. Contributions of special education and vocational rehabilitation service. (SPED 5326)

5324. Reading for the Mentally Retarded (3:3:0). The relationship of the learning characterisitcs of retarded children to acquisition of reading skills; research in reading for these children; evaluation of existing materials and technology. (SPED 5324)

5325. Advanced Curriculum Development for the Mentally Retarded (3:3:0). Examination of curricular theory, curricular approaches to subject matter, and development of the appropriate curriculum for retarded children at all levels. (SPED 5325)

5326. The Mentally Retarded in Society (3:3:0). Prerequisite: A study of all levels of adult retardates functioning in society. Emphasis is placed on community aspects of caring for retardates. (SPED 5327)

5327. Problems in Mental Retardation (3:3:0). General problems and problem areas in mental retardation. (SPED 5328)

5330. Language/Learning Disabilities in Children and Youth (3:3:0). Psychological, sociological, and educational implications of minimal brain disfunction. (SPED 5340)

5331. Education of Children with Language/Learning Disabilities (3:3:0). Adaptive curriculum, methods, and materials in minimal brain dysfunction. (SPED 5341)

5332. Advanced Methods and Materials for the Education of Children with Language/Learning Disabilities (3:3:0). Prerequisite: EDSP 4331 or 5331. (SPED 5342)

5333. Perceptual-Motor Development of Children with Language/Learning Disabilities (3:3:0). Techniques and programming designed to expedite the perceptual-motor functioning of these children. (SPED 5343)

5340. Physically Handicapped Children and Youth (3:3:0). Crippling conditions and other health problems. Medical, psychological, educational, and rehabilitation manifestation. (SPED 5330)

5341. Education of Physically Handicapped Children and Youth (3:3:0). Modifications of physical facilities, equipment, schedules, and procedures in education of physically disabled individuals. (SPED 5331)

5342. Visually Handicapped Children and Youth (3:3:0). Psychological, sociological, and educational implications of severe visual limitations and blindness. (SPED 5370)

5350. Deaf Children and Youth (3:3:0). The deaf in historical perspective; psychological, sociological, educational implications of severe hearing loss. (SPED 5350)

5351. Education of Deaf Children and Youth (3:3:0). Prerequisite: 9 hours of content courses in elementary education. (SPED 5351)

5353. Signs and Fingerspelling for the Deaf (3:3:0). Language of signs and fingerspelling. (SPED 5352)

5360. Emotionally Disturbed Children and Youth (3:3:0). The characterisitcs, psychology, and education of emotionally disturbed children. (SPED 5360)

5361. Education of Emotionally Disturbed Children and Youth (3:3:0). Adaptations of curriculum and methods, as well as educational settings in the education of emotionally disturbed children. (SPED 5361)

5390. Seminar in Special Education (3:3:0). Recent research practices and problem areas in special education. (SPED 5314)

5393, 5394. Internship in Special Education (3 each). (SPED 635, 636)

5399. Individual Study in Special Education (3). May be repeated for credit. (SPED 5321)

630. Master's Report (3). (SPED 630)

631. Master's Thesis (3). (SPED 631)

731, 732. Research (3 each). (SPED 731, 732)

831. Doctor's Dissertation (3). Enrollment required at least four times. (SPED 831)

Educational Administration and Supervision

Students may obtain experiences in the Area of Educational Administration and Supervison leading to the Master of Education and the Doctor of Education degrees with special emphases in administration or supervision at the elementary, secondary, or system level in the public schools. Work in related fields outside of the College of Education is encouraged.

Graduate work is offered in preparation for the professional certificate programs as follows:

Administrator
  Public School Superintendent
  Principal (Mid-Management)
Supervisor

Degree programs and certification programs have different requirements although there may be some overlap.

Courses in Educational Administration and Supervision. (EDAD)

5191. Advanced Education Workshops in Teaching and Administration (1). Prerequisite: 18 hours of education and educational psychology and experience as a teacher or administrator. A maximum total of 6 hours of credit may be earned either simultaneously or in different semesters. (ED 5139)

5300. General Public School Administration (3:3:0). Prerequisite: 18 hours of education and educational psychology. Principles and problems involved in the organization and administration of the public schools. (ED 533)

5301. Elementary School Administration (3:3:0). Prerequisite: 18 hours of education and educational psychology. Elementary school organization, personnel, curriculum, and details of modern administration and supervision. (ED 536)

5302. Secondary School Administration (3:3:0). Prerequisite: 18 hours of education and educational psychology. Curriculum function of administration, developing the master schedule, personnel, guidance finance, and related aspects of organization. (ED 537)

5303. Educational Administration: Mid-Management and the School Principalship (3:3:0). Prerequisite: EDAD 5300 or permission of the instructor. The development of competencies in the administration of staff mid-management positions and the elementary and secondary school units.

5304. Administration of Special Programs (3:3:0). Prerequisite: EDAD 5300 or permission of the instructor. The development of competencies in the administration of special education, reading, career education, and vocational-technical education.

5310. General Supervision (3:3:0). Prerequisite: 18 hours of education and educational psychology. Principles, planning, organizations, and processes of supervision in both elementary and secondary schools. (ED 5371)

5311. Supervision in the Elementary School (3:3:0). Prerequisite: 18 hours of education and educational psychology including EDAD 5310. Supervision in elementary school with emphasis on problems and procedures. (ED 5312)

5312. Supervision in the Secondary School (3:3:0). Prerequisite: 18 hours of education and educational psychology including EDAD 5310. Problems and procedures of supervision in the secondary school. (ED 5313)

5318. Seminar in Supervision (3:3:0). Prerequisite: 24 hours of education, including EDAD 5311 and 5312. Principles and current practices in the field of supervision. (ED 5359)

5320. Administration of School Business Services (3:3:0). Prerequisite: 18 hours of education and educational psychology, including EDAD 5300. Internal business management of schools, including activity funds, teacher welfare, special services, lunchroom, transportation, and purchasing and accounting. (ED 539)

5321. School Finance (3:3:0). Prerequisite: 18 hours of education and educational psychology including EDAD 5300, or equivalent. Basic theories, principles, and problems in school finance. (ED 5367)

5330. Organizing and Administering the Instructional Improvement Program (3:3:0). Prerequisite: 18 hours of education and educational psychology and EDCI 5320 or equivalent. Principles and procedures of organizing programs of system-wide curriculum and instructional imporvement. (ED 5349)

5340. Legal Bases of Education (3:3:0). Prerequisite: 18 hours of education and educational psychology and EDAD 5300. Legal structure of education in America, with emphasis on school laws in Texas. (ED 5325)

5350. The Administration of School Staff Personnel (3:3:0). Prerequisite: 18 hours of education including EDAD 5300. Principles and procedures in selection, organization, and administration of school personnel. (ED 5366)

5351. **School Public Relations (3:3:0).** Prerequisite: 18 hours of education including EDAD 5300. Cooperative development of school-community relationship and mutual understanding of the school's purposes, functions, achievements, and needs. (ED 5369)

5360. **School Housing (3:3:0).** Prerequisite: Limited to majors in educational administration, completion of 15 hours of advanced education, including EDAD 5300, 5301, and 5302. School building needs; educational and architectural services; evaluation of school facilities; school building master plan; the financial plan; contracting and construction; utilization; operation and maintenance. (ED 5368)

5361. **Seminar in Educational Administration (3:3:0).** Prerequisite: Permission of the instructor. A consideration of the interrelatedness of a school system and the integration of specialized competencies for effective administration of the total system.

5391. **Local, State, and Federal Interaction in Education (3:3:0).** Interactive and interdependent relationships between the local community, the state and federal governments in providing quality school programs.

5393, 5394. **Internship in Education (3 each).** (ED 635, 636)

5399. **Individual Study (3).** Prerequisite: Advanced graduate classification in education. Individual study on special aspects of professional education. May be repeated once for credit. (ED 5321)

630. **Master's Report (3).** (ED 630)

631. **Master's Thesis (3).** Enrollment required at least twice. (ED 631)

731, 732. **Research (3 each).** (ED 731, 732)

831. **Doctor's Dissertation (3).** Enrollment required at least four times. (ED 831)

Higher Education

Students may obtain experiences in the Area of Higher Education leading to the Master of Education and to the Doctor of Education degrees with a variety of special emphases, e.g., administration, college teaching. Candidates for graduate degrees in other fields of study may complete a minor in higher education without leveling work.

Professional preparation is offered for persons intending to occupy or occupying positions in universities, senior colleges, and community-junior colleges. Instruction related to administration, curriculum, teaching, counseling, educational planning, public relations, and other specialized aspects of higher education is available.

Significant internship programs are offered in the administration of higher education and in college teaching.

Courses in Higher Education. (EDHE)

5191. **Advanced Education Workshops in Higher Education (1:1:0).** Work designed for application of concepts and principles to practical problems in higher education. Enrollment in multiple sections permits 6 hours of credit in a semester.

5300. **The History of Higher Education in the United States (3:3:0).** An examination of the development of the American system of higher education — its origin, major characteristics, trends, and distinctive features.

5302. Comparative Higher Education (3:3:0). A comparative study of systems of higher education throughout the world and their counterparts in the United States.

5303. Critical Issues in Higher Education (3:3:0). An examination of current critical issues of higher education, e.g., finance and economics, free-acess, equitability for minorities, public acceptance, professional negotiations, etc.

5304. Higher Education (3:3:0). A survey of the significant features of American higher education.

5320. The Administration of the Community Junior College (3:3:0). Major principles, organizations, problems, techniques, and trends in the administration of these colleges.

5321. The Administration of Higher Education (3:3:0). Identification of administrative problems and successes in senior colleges and universities. Principles and procedures for good administration.

5322. Educational Planning (3:3:0). Institutional philosophy and purpose; the educational program; views of learning. Function, form, and cost in educational structures; financial planning. Systems approach and systems analysis in planning.

5323. Development Work in Higher Education (3:3:0). Internal development of ideas for educational improvement. Principles, procedures, organization, and staff for work with various constituencies. Aspects of fund raising; public relations; public information.

5330. The Student in Higher Education (3:3:0). Techniques and applications for in-depth group and individual student assessment in the cognitive and affective domains; a cultural, psychological, and sociological analysis for the purpose of improving college teaching.

5340. The Community Junior College (3:3:0). An introductory course to acquaint students with the purposes, programs, people, organization, control, and resources of these colleges.

5342. College Teaching (3:3:0). Study of various teaching styles. Development of course designs including purposes, objectives, learning experiences, instructional resources, and evaluation. Adaptations for community junior colleges, senior colleges, and universities.

5343. College and University Curriculum (3:3:0). Issues, problems, and basic considerations in curriculum development. The structure of knowledge. Developments and trends in liberal education, the disciplines, and professional education.

5390. Seminar in Higher Education (3:3:0). Students select, subject to the approval of the instructor, a major issue, trend, or problem in higher education for in-depth study and analysis based on professional literature, research reports, and good practice.

5393, 5394. Internship in Higher Education (3 each).

5399. Individual Study (3). Individual study of special aspects of higher education.

630. Master's Report (3).

631. Master's Thesis (3). Enrollment required at least twice.

731, 732. Research (3 each).

831. Doctor's Dissertation (3). Enrollment required at least four times.

College of Engineering

Professor John Ross Bradford, Dean

The College of Engineering offers programs of instruction and research leading to the master's degree and the doctor's degree with major work in Chemical, Civil, Electrical, Industrial, and Mechanical Engineering. The general regulations governing the graduate programs at Texas Tech University apply to these degrees.

In addition to the above conventional degree programs, work leading to the Master of Engineering and the Doctor of Philosophy (interdisciplinary) degrees is offered with the entire graduate faculty of the college participating. Certain special regulations apply to each.

The program leading to the Master of Engineering degree is an undifferentiated, nonthesis one designed primarily for practicing engineers. For such practicing engineers credit for graduate course work completed in residence at another accredited graduate school may be accepted for as much as one-half of the 36 semester hour requirement for the Master of Engineering degree. All work credited toward the degree must be completed within nine calendar years. Under certain circumstances, and with approval of the Dean of the Graduate School, regular on-campus students may be admitted to the undifferentiated Master of Engineering degree program. (In such cases, the regular six-year time limit will apply.) In addition to the regulations governing admission to the Graduate School, a baccalaureate degree in engineering, or its equivalent, is required for entrance to the Master of Engineering program.

The Doctor of Philosophy (interdisciplinary engineering) degree is also offered by members of the graduate faculty in the College of Engineering as a whole. In this doctoral program, a flexible variety of options is available which permits a measure of specialization in one of the conventional engineering fields as well as breadth through significant study in at least two additional engineering areas such as systems engineering, environmental control, operations research, and bioengineering. Sufficient course work is required in each of the areas of emphasis selected to develop understanding and competence, and the program as a whole, including research, must be interdisciplinary in nature. Thus conventional major and minor specifications are not applicable to this interdisciplinary program. Requirements for the degree do not specifically include a foreign language. However, development of research tool requirements, which may include foreign languages, is an integral part of the student's degree program as determined by his advisory committee. The program is administered through the Interdisciplinary Studies Committee of the College of Engineering, Professor A. J. Gully, Coordinator.

Courses in Engineering. (ENGR)

5121. Graduate Seminar (1).

5331. Special Studies in Advanced Engineering Topics (3).

630. Master's Report (3).

731, 732. Research (3 each). May be repeated for credit.

831. Doctor's Dissertation (3). Enrollment required at least four times.

Department of Agricultural Engineering

Professor J. Wayland Bennett, Acting Chairman.
Professors Grub and Ulich; Associate Professors Carpenter, Dvoracek, and Foerster.

MAJORS AND MINORS FOR THE MASTER'S DEGREE

This program is jointly administered by the College of Engineering and the College of Agricultural Science. See program, requirements, and course offerings under Agricultural Engineering, College of Agricultural Sciences.

Department of Architecture

Professor N. E. Barrick, Chairman.
Professors Sasser and Thompson.

MINORS FOR THE MASTER'S DEGREE

Persons wishing to minor in architecture should confer with the department chairman.

Courses in Architecture. (ARCH)

521. Research (2). Prerequisite: Departmental approval. Advanced research studies in assigned projects. May be repeated for credit.

531. Graduate Seminar (3:3:0). Prerequisite: Departmental approval. Organized discussion on assigned project. May be repeated for credit.

532. Techniques of Architectural Research, Restoration, and Preservation (3:2:3). Prerequisite: Departmental approval. Investigation of techniques of preserving examples of architectural and cultural heritage.

5331. Special Problems in City Planning (3). Individual studies in advanced architecture and city planning of special interest to student. May be repeated for credit.

Department of Chemical Engineering

Associate Professor James Edmund Halligan, Chairman.
Professors Bradford, Gully, and Meenaghan; Associate Professors Bethea, Halligan, Heichelheim, and Parker; Assistant Professors Bonner and Huffman.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

The Chemical Engineering Department offers master's and doctor's degree programs. Entering graduate students are expected to have a working knowledge of digital computation methods using a computer language such as FORTRAN, BASIC, or ALGOL. Students not having a working knowledge of digital computation methods will be required to pass undergraduate course work in digital computation before admission to a chemical engineering graduate program.

The master's program is a structured program requiring the five core courses denoted below by asterisks. The graduate student will be required to take one additional noncore course and at least two other courses as specified by his advisory committee. A total of 30 hours of course work and a written thesis are required for the master's degree. The master's candidate is also expected to pass a final oral examination in defense of his completed thesis.

The doctor's degree program includes, in addition to the doctoral course work in the major, the master's degree course work, a minor consisting of 18 hours of course work in a field other than chemical engineering, and a written dissertation. There is no language requirement for the doctor's degree. However, all doctor's degree plans supervised by the department must contain 9 to 12 hours of course work outside the major and minor fields. The doctoral candidate is expected to pass a comprehensive examination administered by the department and representatives of the minor field, and to present a successful oral defense of his completed dissertation.

Courses in Chemical Engineering. (CH E)

5121. **Graduate Seminar (1:1:0).** Required of all chemical engineering graduate students. May be repeated for credit.

*5310. **Advanced Chemical Engineering Techniques (3:3:0).** Application of ordinary and partial differential equations for solution of mass, momentum, and/or energy transfer and transport problems. Primary emphasis is on the mathematical analysis of unsteady state systems and chemical reacting systems.

*5311. **Transport Phenomena-Heat Transmission (3:3:0).** Fundamental relations governing energy, momentum, and mass transfer between phases, with special emphasis on heat transmission.

*5312. **Transport Phenomena-Fluid Dynamics (3:3:0).** Fundamental relations governing energy, momentum, and mass transfer between phases, with special emphasis on fluid dynamics.

5313. **Transport Phenomena-Diffusion Processes (3:3:0).** Fundamental relations governing energy, momentum, and mass transfer between phases, with special emphasis on diffusion processes.

5314. Process Dynamics and Automatic Control (3:3:0). Study of the transient behavior of process systems: methods of analysis; synthesis and simulation of control systems; introduction to analog and digital computer control.

5315. Textile Chemical Unit Process Theory (3:3:0). Thermodynamics and mass transport phenomena associated with transient and steady state textile chemical processes on natural and synthetic fibrous matrices.

5316. Textile Chemical Unit Operations Theory (3:3:0). Analysis of transport phenomena associated with textile chemical operations with emphasis on different mechanisms of heat and mass transfer. Variation of unit performance with primary system variables.

***5321. Advanced Chemical Engineering Thermodynamics (3:3:0).** Advanced topics in thermodynamics and its applications to processes and operations.

5322. Equilibrium Systems (3:3:0). General equations of equilibrium of multicomponent, multiphase systems; the concept of chemical potential and the phase rule; selected techniques for predicting physical and chemical equilibria in both ideal and nonideal systems.

5323. Digital Computation for Chemical Engineers (3:3:0). The development and testing of mathematical models of industrial chemical systems using conventional digital simulation techniques.

5331. Special Problems in Chemical Engineering (3:3:0). Prerequisite: Approval of department chairman. Individual study of theoretical projects under the guidance of a member of the staff. May be repeated for credit in different areas.

5332. Experimental Studies in Chemical Engineering (3:0:9). Prerequisite: Approval of department chairman. Individual study of experimental projects under the guidance of a member of the staff. May be repeated for credit in different areas.

***5341. Mass Transfer Operations (3:3:0).** Theory of equilibrium stage operations. Includes prediction of multiphase multicomponent distribution coefficients for real systems; theoretical and practical considerations in design of absorption, extraction, and distillation systems; and digital computation procedures and methods for stagewise process design.

5343. Reaction Kinetics (3:3:0). Theoretical and experimental aspects of the kinetics of uncatalyzed and catalyzed reactions and their mechanism. Rate theory and its application to the design of batch and flow reactors.

5351. Chemical Engineering Design (3:2:3). Design of the complete plant. Plant location, equipment design or selection, plant layout, building requirements, and estimation of the cost of the plant.

5360. Advanced Industrial Waste Treatment (3:3:0). A study of the modern methods of physical, chemical, and biological treatment of industrial waste waters. Special emphasis will be given to those methods of treatment which are considered to be tertiary in design.

5361. Biochemical Engineering (3:3:0). Principles of biochemical reaction systems and their applications in the chemical process industries. Enzyme systems, their sources, essential characteristics and employment in commercial chemical production (fermentation). Certain related topics (i.e. biological waste disposal, protein technology, etc.) introduced for illustration.

5362. Engineering Design and Economics for Pollution Abatement (3:2:3). The influence of pollution control standards on economics of alternate industrial plant designs will be determined. Changes in manufactured cost of consumer items made to meet pollution control specifications will be estimated. As a required term project each student will com-

plete an economics analysis of a solution to a pollution control problem in his area of interest; that is, air or water pollution or solid waste management and energy recovery.

5365. **Instrumental Analysis of Air Pollutants (3:2:3).** General and specialized instrumental techniques for atmospheric sampling and analysis. Includes mechanical measurement of particulates and aerosols, physical analysis of airborne pollutants by gas chromatographic and infrared spectroscopic techniques, chemical analysis of air pollutants by spectrophotometric procedures. Techniques for atmospheric sampling are included as an integral portion of the course.

5367. **Air Pollution Control for Chemical and Processing Industries (3:3:0).** This course treats the selection and application of air pollution control technology from engineering analysis and design points of view. Material covered includes factors affecting control approach selection; mechanisms of contaminant collection; survey in depth of ultimate disposal methods; detailed treatments of available technology for controlling particulate, gaseous, vaporous, and combined air pollutants; and criteria and methodology for performance testing.

5371, 5372. **Principles of Nuclear Engineering (3:3:0 each).** Prerequisite: Graduate standing in engineering, mathematics, or the physical sciences. This course is the basis for all other course work in the nuclear field.

630. **Master's Report (3).** Enrollment required at least twice.

631. **Master's Thesis (3).** Enrollment required at least twice.

731, 732. **Research (3 each).**

7121. **Doctoral Seminar (1:1:0).** Open discussions of recent advanced findings in any field of endeavor, with special attention to their relationship to the philosophy of chemical engineering.

7314. **Advanced Modelling of Chemical Processes (3:3:0).** Unsteady state mathematical descriptions of chemical processes; lumped and distributed parameter deterministic systems; stochastic techniques; system interactions.

7322. **Engineering Properties of Gases and Liquids (3:3:0).** Use of equilibrium statistical mechanics and thermodynamics to estimate and correlate engineering properties of liquids and gases.

7343. **Analysis of Heterogeneous Catalytic Reaction Systems (3:3:0).** Study of the development of reaction rate expressions for complex heterogeneous catalytic reactions and the application of these expressions in reactor design and analysis.

831. **Doctor's Dissertation (3).** Enrollment required at least four times.

Department of Civil Engineering

Professor Ernst Willie Kiesling, Chairman.
Horn Professor Wells; Professor Whetstone; Associate Professors Claborn, McDonald, Mehta, Smith, Sweazy, Vallabhan, and Vann; Assistant Professors Urban and Wagner.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

The graduate program in civil engineering offers instruction and research opportunities for students seeking the Master of Science in Civil Engineering and/or the Doctor of Philosophy degrees. The student

may choose and emphasize one or more of several areas of interest including environmental engineering, water resources, structural engineering, wind engineering, and engineering mechanics.

Students with a baccalaureate degree in engineering may enter the graduate program by obtaining general admission to the Graduate School and having their entrance credentials evaluated favorably by both the graduate dean and the department. For applicants with a baccalaureate degree in a basic science, certain leveling courses in engineering normally are required. Students desiring to enter the graduate program in civil engineering should consult with the chairman of the department.

All students entering the department's graduate program are required to establish English language proficiency by taking a written examination, administered by the department, during the first semester enrolled. Unsatisfactory results will necessitate a remedial course(s) as recommended by the department.

In addition to regulations established by the Graduate School, applicants to candidacy for the doctor's degree are required to demonstrate nominal proficiency in two research tool areas or high proficiency in a single research tool area. A research-related foreign language may be considered as a research tool at the discretion of the departmental advisory committee. Certification of competence at either level may be accomplished by one of the following methods:

1. Successful completion of a minimum of 6 hours of approved course work in a given subject area at the advanced undergraduate or graduate level for nominal proficiency or 12 hours for high proficiency.
2. Certification of competence may be based on examination by an appropriate academic department or testing agency. The level of competence shall be equivalent to the levels established in method 1.
3. A record of accomplished research which demonstrates the required level of competence in the research tool area will be considered for certification. The record must be substantiated by published articles, final research report, or papers presented at meetings of learned societies.

Courses in Civil Engineering. (C E)

5101. **Civil Engineering Seminar (1:1:0).** Individual study of engineering problems of special interest and value to the student.

5121. **Advanced Soil Engineering Laboratory I (1:0:3).** Laboratory determination and evaluation of the engineering properties of soils.

5122. **Advanced Soil Engineering Laboratory II (1:0:3).** Prerequisite: C E 5121. Laboratory determination of engineering properties of soils.

5310. **Numerical Methods in Engineering (3:3:0).** Prerequisite: MATH 336 or consent of instructor. Numerical techniques for the formulation and

solution of discrete and continuous systems of equilibrium eigenvalue and propagation problems.

5311. **Advanced Mechanics of Solids (3:3:0).** Stress and strain at a point; theories of failure; unsymmetrical bending; curved flexural members; beams on continuous support; energy methods.

5313. **Theory of Elastic Stability (3:3:0).** Theory of the conditions governing the stability of structural members, determination of critical loads for various types of members.

5314. **Theory of Plates and Shells (3:3:0).** Stress analysis of plates and shells of various shapes; small and large deflection theory of plates; membrane analysis of shells; general theory of shells.

5316. **Theory of Elasticity (3:3:0).** Analyses of stress and strain in rectangular and polar coordinates; stress functions; energy methods; finite difference equations; membrane analogy for torsion.

5317. **Continuum Mechanics (3:3:0).** Formulation and solution of various governing equations of engineering mechanics such as those of elasticity, viscoelasticity, plasticity, stress waves in solids, and hydrodynamics.

5318. **Finite Element Methods in Continuum Mechanics (3:3:0).** Theory of the finite element method-constant strain elements; plane stress or strain or axisymmetric problems; application to plate and shell problems; geometric and material nonlinearities; application to torsion, heat conduction and seepage; introduction to dynamic analysis.

5321. **Advanced Soil Engineering I (3:3:0).** Specialized topics in the theoretical and practical aspects of foundation and earthwork engineering.

5322. **Advanced Soil Engineering II (3:3:0).** Prerequisite: C E 5321. Earth pressure; stability of deep cuts; stability of dams; settlement of structures; anchored bulkheads.

5324. **Soil Dynamics (3:3:0).**

5331, 5332. **Advanced Work in Specific Fields (3 each).** Nature of course depends on the student's interest and needs. An individual study course. May be repeated for credit.

5333. **Advanced Work in Water Resources (3).** Individual studies in advanced water resources. May be repeated for credit.

5342. **Advanced Plastic Design (3:3:0).** Study of the theory of plastic design of steel frames and multistory buildings.

5343. **Advanced Structural Analysis (3:3:0).** Application of modern design methods to building frames, arches, rigid bents, continuous trusses.

5344. **Advanced Reinforced Concrete Design (3:3:0).** Design of complex reinforced concrete structures such as folded plates and shells.

5345. **Special Topics in Reinforced Concrete (3:3:0).** Yield-line theory for flat slab; plastic hinges; shear and diagonal tension; bond and other related topics in concrete.

5346. **Structural Dynamics I (3:3:0).** Dynamic response of multidegree of freedom systems; modal analysis of both lumped and continuous mass systems.

5347. **Matrix Methods of Structural Analysis (3:3:0).** Prerequisite: Proficiency in FORTRAN programming. Matrix operations, force method, and stiffness method with applications.

5348. **Structural Dynamics II (3:3:0).** Design considerations for structures subject to earthquake and wind forces; blast and moving loads.

5351. **Open Channel Hydraulics (3:3:0).** Channel geometry and parameters. Uniform and varied flow. Flood routing.

5352. Advanced Surface Hydrology (3:3:0). Prerequisite: C E 4354 or equivalent. A design-oriented study of the rainfall-runoff processes using watershed modeling techniques.

5353. Water Resources Engineering I (3:3:0). Problems in water resources conservation and utilization with particular emphasis on river basin and interbasin studies involving multiple water uses.

5354. Water Resources Engineering II — System Simulation and Analysis (3:3:0). Prerequisite: C E 5353 or consent of instructor. Application of modern decision making tools to the design and operation of water resource systems.

5355. Flow in Porous Media (3:3:0). Saturated and unsaturated flow in porous media, with emphasis on engineering applications.

5356. Earth Dams (3:3:0). Selection of dam sites; principles of design of earth dams; flow nets and seepage; selected topics.

5357. Water Resources Engineering III — Institutions (3:3:0). Prerequisite: C E 5353. A study of the various institutions which play a prominent role in water resource development.

5371. Limnological Aspects of Environmental Engineering (3:3:0). A study of the physical, chemical, and biological phenomena and interactions which occur in fresh and polluted surface waters, with emphasis on water pollution control.

5372. Advanced Water Treatment (3:3:0). Prerequisite: C E 4371. Water chemistry and microbiology; advanced methods for water quality control; renovation of water for reuse.

5373. Advanced Waste Treatment (3:3:0). Prerequisite: C E 4372. Advanced methods of waste treatment including municipal and industrial liquid and solid wastes.

5374. Water and Wastewater Analysis (3:1:6). Prerequisite: C E 4372 or consent of instructor. Laboratory procedures for the examination of water and wastewater including determination of concentrations of specific mineral and biological contaminants.

5375. Unit Processes Laboratory (3:0:9). Prerequisite: C E 5372, 5373, 5374. Operation and evaluation of water and wastewater treatment units for water quality control.

5376. Water Quality Networks (3:3:0). Prerequisite: C E 5372, 5373, 5374, or concurrent enrollment. Effects of wastewater discharges on quality of water in streams, lakes, reservoirs, bays, and estuaries; methods of surface water quality control.

5377. Special Studies in Sanitary Engineering (3). Prerequisite: C E 5374. Advanced work in specific fields of water quality control.

5378. Solid Waste Treatment (3:3:0). Prerequisite: Consent of instructor. Treatment and disposal of municipal, industrial, and agricultural solid wastes.

5379. Air Pollution Control (3:3:0). Prerequisite: Consent of instructor. Measurement and control of atmospheric pollutant emissions.

5381. Environmental Impact Analysis (3:3:0).

630. Master's Report (3).

631. Master's Thesis (3). Enrollment required at least twice.

731, 732. Research (3 each). May be repeated for credit.

831. Doctor's Dissertation (3). Enrollment required at least four times.

Department of Electrical Engineering

Professor R. H. Seacat, Chairman.
Professors Craig, Kristiansen, and Portnoy; Associate Professors Burke, Chao, Ferry, Hagler, Prabhakar, Reichert, Rowley, Saeks, and Vines; Assistant Professors Gundersen, Gustafson, Liberty, Trost, and Walkup; Adjunct Professors Gunther and Lipscomb.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

Before being recommended for admission to a degree program, the student may be required to take (without graduate credit) such undergraduate leveling courses as may be designated by the department. If the preliminary examination for admission to doctoral studies reveals deficiencies in the student's background, the student will be required to take remedial courses designated by the department.

Both masters and doctoral students must develop proficiency over the entire range of electrical engineering activities by taking courses in a variety of subjects determined by the department. Minor subjects are taken outside the department. Exceptions to the outside minor are permitted only with departmental approval.

All doctoral candidates are required to demonstrate proficiency in a foreign language, either by obtaining a grade of B or better in one of the special 6-hour programs for graduate students offered by the departments of foreign languages, or by examination.

Courses in Electrical Engineering. (E E)

5311. **Stability of Nonlinear Systems (3:3:0).** Analysis of nonlinear systems. Concepts of stability criteria based upon the methods of Liapunov.

5312. **Optimal and Adaptive Control Systems (3:3:0).** Prerequisite: Consent of instructor. Control systems and design techniques based upon Pontryagin's maximum principle. Variational calculus, Hamilton-Jacobi theory, least squares, and iterative numerical techniques.

5313. **Solid State Electronics I (3:3:0).** Energy bands and statistics, electrical transport theory of semiconductors, Hall effect and magnetoresistance, high electric field effects, p-n junction theory.

5314. **Solid State Electronics II (3:3:0).** Prerequisite: Consent of instructor. Principles and properties of semiconductor devices. Junction diodes and transistors, junction and insulated gate FET's. Hot carrier devices. Device modeling.

5315. **Sampled Data and Digital Control Systems (3:3:0).** Prerequisite: Consent of instructor. Sampling concepts, Z-transforms, signal flow graphs. State variable methods applied to discrete systems.

5317. **Advanced Transients (3:3:0).** Prerequisite: Graduate standing in electrical engineering. Transient analysis using transform methods, with emphasis on physical interpretations. Lumped constant linear approximations. Laplace, Fourier transformations. Convolution processes in real and complex domains.

5318. **Pulse and Timing Circuits (3:3:0).** Prerequisite: Graduate standing in electrical engineering or consent of instructor. Electron devices as

switching elements. R-C coupled circuits, multivibrators (bistable, monostable, and astable). Sweep circuits, pulse transformers, blocking oscillators, lines and pulse-forming networks.

5319. Electronic Circuits and Systems (3:3:0). Prerequisite: Graduate standing in electrical engineering or consent of instructor. Fundamentals of linear amplifiers, speed of step responses (sag, overshoot, etc.), distributed amplifiers, stagger-tuned amplifiers, synchronous-tuned amplifiers.

5321. Digital Systems (3:3:0). A detailed treatment of the concepts and procedures utilized in logical design of digital systems. Boolean algebra, number systems, codes, switching algebra, synchronous and asynchronous sequential machines.

5322, 5323. Advanced Network Theory I and II (3:3:0 each). Prerequisite: Graduate standing in electrical engineering or consent of instructor. Theory of two-terminal and four-terminal networks, impedance transformation, Foster's theorem and extensions.

5324. Symmetrical Components (3:3:0). Prerequisite: Graduate standing in electrical engineering or consent of instructor. The theory of the method of symmetrical components is reviewed and supplemented in detail.

5325. Information Theory (3:3:0). Prerequisite: Graduate standing in electrical engineering. Probability theory of finite systems. General properties of channels of various types. Transmission of information. Discrete channels with and without memory. Coding theorems.

5326. Network Applications of Linear Graph Theory (3:3:0). Prerequisite: E E 4322 or consent of instructor. The theory of linear graphs is presented in detail. Applications are made to topological formulations, flow graphs, contact networks and switching circuits.

5327. Multistage Decision Processes (3:3:0). Prerequisite: A working knowledge of FORTRAN. Linear programming, metric topology, convex programming, duality, game theory, Kuhn-Tucker theory, dynamic programming.

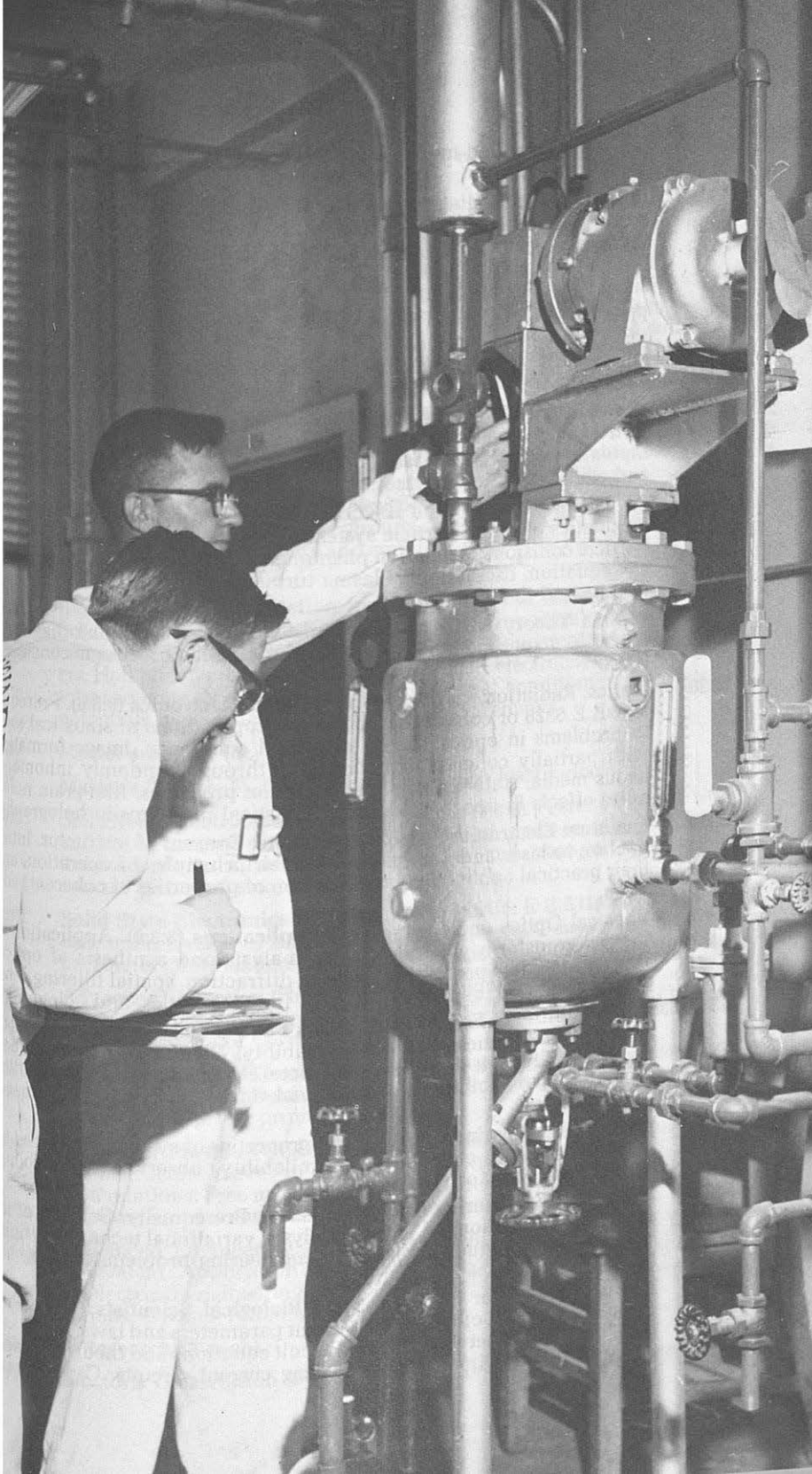
5328. Statistical Theory of Communications (3:3:0). Probability review, functions of random variables, density and distribution functions, random processes, correlations, power spectral density, linear systems with random inputs, mean square estimation, matched filters.

5331. Theoretical Investigations in Engineering Applications (3:3:0). Prerequisite: Graduate standing in engineering. An individual study course involving a rigorous theoretical investigation of some aspect of an engineering problem of current interest. A formal report is required.

5332. Experimental Investigations in Engineering Applications (3). Prerequisite: Graduate standing in engineering. An individual study course involving an experimental investigation of some aspect of an engineering problem of current interest. A formal report is required.

5341, 5342. Advanced Electromagnetic Theory I and II (3:3:0 each). Prerequisite: Graduate standing in electrical engineering or consent of instructor. Rigorous treatment of the boundary-value problems encountered in the analysis of systems for guiding electromagnetic waves. Reduction of wave-guide and obstacle problems to equivalent network problems.

5343. Radio Propagation (3:3:0). Prerequisite: Consent of instructor. Methods of treating reflection, transmission, absorption, dispersion, diffraction, and scattering from smooth and rough surfaces and from homogeneous and inhomogeneous media. Ray and wave theories, partial wave ex-



pansions, stratified media, optical resonators, ionospheric radio propagation.

5344. Antennas and Radiating Systems (3:3:0). Prerequisite: Consent of instructor. Antenna fundamentals, calculation of impedance, reciprocity, uniformly spaced arrays, aperture radiation, Huygen's principles, Babinet's principle, parabolic and spherical reflectors, aperture synthesis, multipole radiation.

5345. Field Theory of Guided Waves (3:3:0). Prerequisite: Consent of instructor. Theory of excitation and guiding of electromagnetic waves. Wave guides. VLF radio propagation, microstrip transmission lines, microwaves, fiber optics, cavity radiation modes.

5354. Direct Energy Conversion (3:3:0). Prerequisite: E E 4352 or consent of instructor. Plasma dynamics, foundations of the production and manipulation of ionized gases. Quantum theory applied to thermoelectric and electrochemical devices.

5355, 5356. Plasma Theory I and II (3:3:0 each). Prerequisite: E E 4318. Vector mechanics of many particle systems. Kinetic gas theory. Orbit theory. Particle collisions, ionization phenomenon. Radiation, Boltzmann-Vlasov equation, oscillations. Plasma turbulence and instabilities. Applications and devices.

5357. Plasma Theory III (3:3:0). Prerequisite: E E 5355. Plasma diagnostic methods, experimental techniques, fusion reactor design considerations.

5358. Optics, Radiation, and Noise in Quantum Electronics (3:3:0). Prerequisite: E E 5328 or consent of instructor. Applications of statistical tools to problems in optics: theory of partial coherence, image formation with partially coherent light, imaging through randomly inhomogeneous media, statistics of photo-detection processes, film grain noise, noise effects in image processing, statistical problems in holography.

5359. Quantum Electronics (3:3:0). Prerequisite: Consent of instructor. Introduction to laser and maser devices, their principles of operation, and their practical applications. Description of properties of coherent radiation.

5360. Physical Optics and Engineering Applications (3:3:0). Application of Fourier transform methods to the analysis and synthesis of optical imaging and data processing systems; diffraction, spatial filtering, lenses, coherent and incoherent imaging, film properties, and holography.

5361, 5362. Reliability of Electronic Systems I and II (3:3:0 each). Concepts of systems effectiveness and maintainability. Data analysis techniques. System analysis techniques applied to electronic systems including probability, reliability, and functional analysis. Reliability management concepts.

5363. Systems Engineering I (3:3:0). Basic properties of systems described by linear dynamical equations. Controllability, observability, stability, equivalence transformations.

5371. Advanced Engineering Analysis I (3:3:0). Prerequisite: Consent of instructor. Applications of Tensor analysis, variational techniques, finite difference techniques to electrical engineering problems. Orthogonal functions. Nonlinear oscillations.

5391. Circuit Theory for Behavioral and Biological Scientists (3:3:0). Prerequisite: Consent of instructor. Circuit parameters and laws, series and parallel circuits, network theory. Circuit equations and theorems, energy, and power. Direct and alternating current circuits. Capacitance,

inductance, reactance, impedance, and resonance. Charging circuits and transformers.

5392. **Feedback Control Systems II (3:3:0).** The study of control system design from the linear quadratic viewpoint with state variable models. State estimation via least squares theory. Sensitivity and stability of feedback control systems. Digital, analog, and hybrid simulation.

5393. **Digital Computer Design (3:3:0).** Computer systems are discussed in terms of functional blocks consisting of both hardware and software. The logical organization of the machine is stressed in terms of usage and capability.

5394. **Electronic Circuits for Behavioral and Biological Scientists (3:3:0).** Prerequisite: E E 5391 or equivalent and consent of instructor. Power supplies, rectifiers, and filters. Triodes and pentodes, transistors, audio amplifiers, power amplifiers, RF amplifiers, DC amplifiers. Noise and feedback. Sinusoidal and nonsinusoidal oscillators, modulation. Operational amplifiers. Switching circuits, logic circuits, multivibrators, and the Schmitt trigger. Scalars and counters, frequency meters, D to A and A to D converters.

5395. **Biomedical Instrumentation for Behavioral and Biological Scientists (3:3:0).** Prerequisite: Consent of instructor. Properties of physiological measuring systems. Resistive, displacement, and reactance transducers. Hall effect, piezoelectric, thermoelectric, electrochemical, and photransducers. Measuring circuits and signal conditioning. Bioelectric potentials, electrodes, physiological measurements.

630. **Master's Report (3).**

631. **Master's Thesis (3).** Enrollment required at least twice.

6311. **Solid State Electronics IV: Special Topics (3:3:0).** Prerequisite: E E 5313 or 5314 or consent of instructor. Specialized topics in solid state electronics such as superconductivity, advanced transport theory, advanced theory of semiconductors and solids.

6312. **Solid State Electronics III (3:3:0).** Prerequisite: E E 5314 or consent of instructor. Design of linear and digital integrated circuits, distributed parameters, fabrication techniques for functional arrays. IC modeling.

6321. **Advanced Detection Theory (3:3:0).** Prerequisite: E E 5325 or consent of the instructor. Filtering and detection of signals from noise. Optimal filter theory. Error correcting codes.

6322. **Switching Circuit Theory II (3:3:0).** Binary and sequential filters. Sequential networks. Detection of coherent and incoherent trains. A posteriori and a priori probability.

6351. **Theory of Plasma Waves (3:3:0).** Prerequisite: E E 5355 or consent of the instructor. Waves in cold and finite temperature plasmas. Dispersion relations. Free and forced oscillations. Landau damping. Topology of wave normal surfaces.

6371. **Advanced Engineering Analysis II (3:3:0).** Prerequisite: E E 5371 or equivalent. Application of ordinary and partial differential equations to electrical engineering problems. Stum-Liouville problem. Series solutions. Green's functions.

731, 732. **Research (3 each).**

831. **Doctor's Dissertation (3).** Enrollment required at least four times.

Department of Engineering Analysis and Design

Professor James Elson Archer, Chairman.
Professors Bradford and Griffith.

MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

The purpose of the graduate program in Engineering Analysis and Design is interdisciplinary, systems-oriented graduate studies. The department offers minor programs in general systems, in computer systems, and in the processes of technological innovation. The department participates in the interdisciplinary Master of Engineering and Doctor of Philosophy degrees administered by the office of the Dean of the College of Engineering.

Courses in Engineering Analysis and Design. (EA&D)

5314. **Analysis of Engineering Systems I (3:3:0).** Prerequisite: MATH 335 or its equivalent and consent of instructor. Analysis of linear and nonlinear engineering systems through transform methods and series solutions.

5315. **Analysis of Engineering Systems II (3:3:0).** Prerequisite: EA&D 5314 or consent of instructor. Continuation of analysis of linear and nonlinear engineering systems through partial differential equations. Matrix methods and finite differences.

5331. **Special Problems in Advanced Engineering Analysis and Design (3).** Individual studies in advanced applied engineering analysis and design. May be repeated.

5332. **Special Problems in System Engineering (3).** Prerequisite: Consent of instructor. Individual studies in the synthesis and analysis of engineering systems that require significant interdisciplinary knowledge.

5333. **Special Problems in Advanced Computer Science and Technology (3:3:0).** Individual studies in advanced computer science and technology. May be repeated.

5334. **Special Problems in Technological Innovation (3).** Prerequisite: Consent of instructor. Individual projects aimed at the definition of significant technological problems and pursuit of their solutions through analysis, design, and experimental development. May be repeated.

5350. **Programming, Systems, and Languages (3:3:2).** Prerequisite: Consent of instructor. An intensive introduction to the field of computer science. Designed to prepare graduate students without significant prior computing background to undertake other graduate-level courses in computer science and systems. Basic programming languages, applications, computer architecture, system software fundamentals.

5351. **Computer Logic Design and Switching Theory (3:3:0).** Prerequisite: EA&D 4353. Symbolic logic and Boolean algebra for the description and analysis of switching circuits through analysis; error detection and correction techniques, basic sequential circuits; digital systems design principles.

5352. **Computer Systems Organization and Programming I (3:3:0).** Prerequisite: Consent of instructor. A graduate-level course in programming

systems. The structure of languages and the relationships between software systems and languages. Monitors, compilers, assemblers, and loaders.

5353. **Computer Systems Organization and Programming II (3:3:0).** Prerequisite: EA&D 5352. Survey of hardware systems and components in relation to software systems. Optimization of systems for various types of job loadings. Simulation of computer configurations.

5354. **Simulation Techniques (3:3:0).** Prerequisite: Consent of instructor. Foundation course in computer simulation. Computer languages. Typical applications. Problems assigned in areas of student's major interest.

5355. **Heuristic Techniques (3:3:0).** Prerequisite: EA&D 5354. Distinction between heuristic and algorithmic methods; justification for heuristic approach; mathematical intuition; current research projects. Term project required.

5356. **Formal Computer Language (3:3:0).** Prerequisite: EA&D 5353. Mega languages; languages and grammars used as primitive models of material languages; properties of formal languages; syntactical analysis and compilation.

5357. **Information Retrieval I (3:3:0).** Prerequisite: EA&D 4353. Coding; storage; classification; automatic retrieval; error analysis and correction; Key variants; multikey files; searching strategy, indexing lattices; system performance measurement.

5358. **Introduction to Artificial Intelligence (3:3:0).** Prerequisite: EA&D 4353. Theories and techniques necessary to simulate and study goal-oriented behavior of natural or artificial systems; induction process and hypothesis formulation; learning and adaptive systems; pattern recognition; generalized problem solving.

5361, 5362. **Analysis and Synthesis of Complex Systems I, II (3:3:0 each).** Prerequisite: Consent of instructor. Generalized concepts and methodologies for the analysis and design of complex systems. Analytical frameworks for qualitative and quantitative analysis. System modeling and simulation. Centered on interdisciplinary approaches to complex system problems. Physical systems; socio-economic systems; logical systems.

5363. **Theory of Systems (3:3:0).** Prerequisite: Consent of instructor. Functional representation of systems. Discrete system representation via automata theory. Continuous system representation via ordinary or partial differential equations. Hierarchical systems modeling. Concepts of fuzziness and uncertainty. Quantification and modeling of goals, values, and objectives. Sensitivity analysis. Error analysis. Survey of optimization techniques.

5367. **Management of Technical Innovation (3:3:0).** Prerequisite: Consent of instructor. The goals, methodologies, and tools of intentional innovation. Disciplinary, multidisciplinary, and interdisciplinary research and development activities. Case studies drawn from diverse areas of industry and government.

5368. **Industrial Innovation (3:3:0).** Prerequisite: Consent of instructor. Industrial innovation as a product of the interaction of scientists, engineers, entrepreneurs, managers, and financiers. History of the technical entrepreneur. Establishment and development of technically-based businesses. Case studies and term project.

5370, 5371. **Information Systems I, II (3:3:2 each).** Prerequisite: EA&D 5352 or consent of instructor. Development and implementation of comprehensive computer-based information systems. Data and information struc-

tures and processes to satisfy organizational needs for consolidation and interchange of information.

5376. System Simulation (3:3:0). Modeling and simulation. System structure as a collection of interacting entities. Causal diagrams. Concept of "level," "rate," and "auxiliary" variables. Feedback principles. Representation of delays. Level, rate, and auxiliary equations. Linear interpolation. Studies of recent provocative simulation models. Model verification and validation. Applications to social, economic, political, business, biological, and/or industrial systems.

5381. Complex Analysis for Engineers (3:3:0). Prerequisite: MATH 336. Fundamentals and applications of analytic function theory for engineers.

5382. Engineering Applications of Generalized Fourier Series (3:3:0). Prerequisite: MATH 336. A mathematically concrete and intelligent application of the theories of harmonic analysis and generalized orthogonal series to engineering problems. Specific treatments of continuum dynamics, electromagnetic and heat fields are presented.

Department of Industrial Engineering

Horn Professor Richard Albert Dudek, Chairman.
Professors Ayoub and Sandel; Associate Professors Burford, Lambert, Martz, Ramsey, Smith, and Walvekar; Assistant Professors Panwalkar and Phillips.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

All candidates for graduate degrees are required to demonstrate a working knowledge of FORTRAN programming and Design of Experiments as research tools. No foreign language is required.

The department offers four major areas of study:

I. Biotechnology and Human Performance — Occupational Safety and Health, Work Physiology, Human Mechanics, Human Performance, Work Environments, Man-Machine Systems, etc.

II. Operations Research and Statistical Analysis — Simulation, Mathematical Programming, Optimization, Reliability, Design of Experiments, Stochastic Processes, Queuing, etc.

III. Management Systems and Controls — Inventory System, Sequencing/Scheduling, Project Management, Decision Theory, Engineering Economic Analysis, Management of Research, Engineering Management, Quality Control, etc.

IV. Manufacturing Science — Manufacturing Analysis, Manufacturing Engineering, Measurement Systems, etc.

All majors are required to take at least one course from three of the four major areas listed above in order to provide them some breadth in industrial engineering. Students are expected to design individualized programs (with the advice and aid of a graduate adviser) to prepare them for advanced level research or work in one of the above areas or sub-areas or in computer science; all are expected to take minor area

courses other than industrial engineering to provide them with exposure to nondepartmental courses and faculty.

Graduate examination (master's final examination; doctoral preliminary, qualifying, and final examinations) procedures and pertinent time requirements follow those presented earlier in this catalog.

Courses in Industrial Engineering. (I E)

512, 513. Seminar (1 each). Discussion will concern present research conducted in industrial engineering. Other special topics will also be considered. May be repeated.

535. Systems Safety Management (3:3:0). Prerequisite: Consent of instructor. Occupational Safety and Health standards and regulations. Accident statistics for injury and illness. Techniques of hazard analysis and systems safety. Management of total loss control programs.

5111, 5212, 5213, 5214. Industrial Engineering Case Analysis (1, 2). Prerequisite: Consent of instructor. Special studies and investigations in the application of various industrial engineering techniques.

5301. Biotechnology and Human Performance I (3:2:3). Prerequisite: Consent of instructor. Functional anatomy and physiology of the musculo-skeletal system and its relationship to work design, kinesiology, work physiology, anthropometry applications of biotechnology in industrial settings.

5302. Biotechnology and Human Performance II (3:2:3). Prerequisite: Consent of instructor. The study of mechanical and physical environments and their effects on man as well as his performance. These environments include thermal, noise, vibration, light, pressure, dusts, and toxins.

5303. Physiological Systems Analysis (3:2:3). Prerequisite: Consent of instructor. Introduction to biological control systems. Systems in general, transient analysis and frequency analysis of physical systems. The respiratory chemostat, the cardiovascular regulator, and neural modeling.

5304. Human Mechanics (3:2:3). Prerequisite: Consent of instructor. Introduction and historical development, theoretical fundamentals for a mechanics of the body. The link system of the body, kinematic aspects of extremity joints.

5305. Measurement of Human Performance (3:2:3). Prerequisite: Consent of instructor. Development and provision of important concepts, descriptions, definitions, measurement techniques, and applications of the complete measurement of man at work.

5307. Inventory Systems (3:3:0). Prerequisite: I E 3315 or equivalent or consent of instructor. Cost structure of inventory systems. The deterministic systems; dynamic inventory systems; stochastic systems. Inventory systems under deterioration and repairs.

5308. Activity Scheduling (3:3:0). Quantitative methods for scheduling of activities and resources. Activity sequencing algorithms; PERT-CPM networks. Measure of optimality, analytical and computational methods; otimizing and approximating techniques.

5311. Principles of Optimization (3:3:0). Prerequisite: I E 3321 or equivalent or consent of instructor. Convexity; Kuhn-Tucker conditions; theory of duality; convex programming; geometric programming.

5312. Queueing Theory (3:3:0). Prerequisite: I E 3325 or equivalent or instructor's consent. Waiting lines with deterministic or stochastic demand and service times. Arrival and service time distributions; queue

discipline; system state equations; analytical and simulations solutions; applications.

5313. Network Flows (3:3:0). Prerequisite: Consent of instructor. Elements of undirected and directed graphs; static flows; cuts; maximal flows; max flow-min cut theorem; feasibility theorems; Hitchcock problem; minimal cost flow problem; dynamic flows; multi-commodity flows.

5314. Multistage Decision Processes (3:3:0). Prerequisite: Instructor's consent. Calculus of variations; dynamic programming; markov-renewal programming; Markovian decision processes; adaptive control; maximum principle; minimax strategy and multistage decision processes; maximum transforms.

5315. Non-Linear Programming (3:3:0). Prerequisite: I E 3321 or instructor's consent. Quantitative procedures for optimization techniques; gradient methods, steepest ascent.

5316. Reliability Theory (3:3:0). Prerequisite: I E 3325 or equivalent or consent of instructor. Reliability analysis with emphasis on the exponential, Weibull, gamma, log normal and extreme value distributions; reliability of systems, redundancy; maintainability and availability.

5317. Design of Experiments (3:3:0). Prerequisite: I E 3325 or equivalent or consent of instructor. Analysis of variance, factorial experiments, randomized blocks, Latin squares, split-plot design, nested designs, confounding systems, fractional replication, multiple correlation, and the general linear model.

5318. Selected Topics in Advanced Statistics (3:3:0). Prerequisite: Instructor's consent. Selected topics chosen from such areas as nonparametric statistical methods; sequential analysis; multivariate analysis; etc. May be repeated in different areas.

5319. Engineering Stochastic Processes (3:3:0). Prerequisite: I E 3325 or equivalent or consent of instructor. Recurrent events; random walks; markov processes; birth-and-death processes; diffusion processes; branching processes. Normal processes; Weiner processes; spectral properties. Engineering applications of stochastic processes.

5321, 5322. Decision Theory and Management Science (3:3:0 each). Prerequisite: Instructor's consent. Concepts and principles of decision models; theory and practice of management planning and administrative control; decision theory and management science.

5331. Theoretical Studies in Advanced Industrial Engineering Topics (3). Prerequisite: Departmental approval. Individual theoretical study of advanced topics selected on the basis of departmental recommendation. May be repeated.

5332. Experimental Investigation in Advanced Industrial Engineering Topics (3). Prerequisite: Departmental approval. Individual experimental study of advanced topics selected on the basis of departmental recommendation. May be repeated.

5341. Simulation Models for Operations Analysis (3:3:0). Prerequisite: Instructor's consent. Application of simulation techniques to optimization of large scale operations. Production-distribution models; gaming techniques; model construction; validation of simulation models; limitations of simulation techniques.

5342. Statistical Analysis for Digital Simulation (3:3:0). Prerequisite: I E 3315 or equivalent or consent of instructor, knowledge of GPSS. Design of simulation experiments; stratified sampling; search patterns for locating optimal solutions. Methods for removing transients; determination of run length and number of runs; variance reduction techniques.

Methods for analyzing stochastic simulation data. Tests on random numbers.

5344. **Computerized Statistical Data Analysis (3:3:0).** Prerequisite: I E 3325 or equivalent or consent of instructor. Multivariate data analysis; regression analysis; analysis of variance; and time series analysis using the UCLA BMD Biomedical Computer Program Library.

5345. **Selected Topics in Linear and Integer Programming (3:3:0).** Prerequisite: I E 3321 or equivalent or consent of instructor. Theory of linear programming, revised simplex method, bounded variables, decomposition method, parametric LP. Integer programming, cutting plane and branch and bound techniques. O-I programming. Applications.

5351. **Manufacturing Analysis (3:2:3).** Prerequisite: Consent of instructor. Advanced topics in manufacturing processes and materials including metallurgical considerations, nonmetallic materials, casting theory, deformation processes, and metal removal theory.

5352. **Advanced Manufacturing Engineering (3:3:0).** Prerequisite: Consent of instructor. Analysis and design of manufacturing processes with emphasis on automated production systems; simulation models of production processes; manufacturing research and development.

5353. **Measurement and Instrumentation (3:2:3).** Prerequisite: Consent of instructor. Principles and application of measurement and instrumentation systems. Emphasis on industrial processes and human performance and response. Performance characteristics of instruments, measurement of physical and physiological parameters.

5361. **Advanced Engineering Economic Analysis (3:3:0).** Prerequisite: Consent of instructor. Continuation of Engineering Economic Analysis including funds flow, utility, price changes, investment, growth, replacement, taxes, capital budgeting and managerial economics.

5362. **Economic Decision Theory (3:3:0).** Prerequisite: I E 3325 or equivalent, I E 5361 or equivalent, or consent of instructor. Sources of information, prediction and judgment, subjective probability bidding policy. Statistical decision theory including utility functions, risk and uncertainty, minimax and Bayes strategy.

630. **Master's Report (3).**

631. **Master's Thesis (3).** Enrollment required at least twice.

731, 732. **Research (3 each).** May be repeated for credit.

831. **Doctor's Dissertation (3).** Enrollment required at least four times.

Department of Mechanical Engineering

Professor James H. Lawrence, Jr., Chairman.
Professors Davenport, Helmers, Koh, Newell, and Powers; Associate Professors Bell, Jordan, Kirby, and Reynolds; Assistant Professor Strickland.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

Students seeking master's or doctor's degrees in the Department of Mechanical Engineering should consult the chairman of the department about their programs before enrolling for any courses. Major programs are available in Energetics, Engineering Mechanics, and Multidisciplinary studies.

Before being recommended for admission to a master's degree program with a major in this department, the student may be requested to take a preliminary examination to determine proficiency in background for graduate work or may be required to take (without graduate credit) such undergraduate leveling courses as may be designated by the department.

If the preliminary examination for admission to doctoral studies reveals serious weaknesses in the student's subject matter background, the student may be required to take remedial courses designated by the graduate faculty of the department.

The department has no specific foreign language requirement. Research tools are included as an integral part of the degree program in the leveling, minor, or major courses of each student. All courses are determined by the student's doctoral advisory committee.

Courses in Mechanical Engineering. (M E)

5121. **Graduate Seminar (1).** May be repeated for credit in different areas.

5311. **Biothermodynamics (3:3:0).** Prerequisite: Consent of instructor. Application of thermodynamics to biological systems.

5314. **Stress Analysis I (3:2:3).** Prerequisite: C E 3311 or consent of instructor. Theory and application of photoelasticity to stress analysis.

5315. **Advanced Kinematics (3:3:0).**

5316. **Mechanical Vibrations I (3:3:0).** Prerequisite: M E 4316 or consent of instructor. Multi-degree of freedom systems; generalized coordinates, energy methods.

5317. **Mechanical Vibrations II (3:3:0).** Prerequisite: M E 4316 or consent of instructor. Analysis of complex multi-degree of freedom systems, continuous bodies, nonlinear vibrations.

5318. **Advanced Dynamics (3:3:0).**

5319. **Advanced Heat Transfer (3:3:0).**

5320. **Advanced Fluid Mechanics (3:3:0).**

5321. **Classical Thermodynamics (3:3:0).** Prerequisite: M E 4321 or equivalent. Logical structure of classical thermodynamics; state of multicomponent systems; systems in gravity fields; systems in electrostatic and electromagnetic fields.

5322. **Continuum Thermodynamics (3:3:0).** Prerequisite: M E 4321 or equivalent. Thermodynamic theory of continuous media; description of global systems in nonequilibrium states; analysis of transient processes from the macroscopic viewpoint.

5323. **Advanced Topics in Thermodynamics (3:3:0).** Prerequisite: Consent of instructor. May be repeated for credit in different areas.

5324. **Conduction Heat Transfer (3:3:0).** Prerequisite: M E 4315 or equivalent. The fundamental principles of heat transmission by conduction; boundary value problems, separation; transform, integral, and numerical methods.

5325. **Convection Heat Transfer (3:3:0).** Prerequisite: M E 4314 or 4315 or equivalent. Fundamental principles of heat transmission by convection; theoretical and empirical methods of analysis.

5326. **Radiation Heat Transfer (3:3:0).** Prerequisite: M E 4315 or equivalent. Fundamental principles of heat transmission by radiation; grey surfaces, network methods, absorbing media.

5327. **Gas Dynamics (3:3:0).** Prerequisite: M E 4314 or equivalent. External and internal compressible fluid flow, potential theory.

5328. **Boundary Layer Theory (3:3:0).** Prerequisite: M E 4314 or equivalent. Viscous and turbulent boundary layer theory of fluid flow; separation; introduction to thermal boundary layers.

5329. **Advanced Topics in Fluid Mechanics (3:3:0).** Prerequisite: Consent of instructor. May be repeated for credit in different areas.

5331. **Theoretical Studies in Advanced Topics (3).** Prerequisite: Consent of instructor. Individual theoretical study of advanced topics selected on the basis of the departmental adviser's recommendation. May be repeated for credit in different areas.

5332. **Experimental Studies in Advanced Topics (3).** Prerequisite: Consent of instructor. Individual experimental study of advanced topics selected on the basis of the departmental adviser's recommendation. May be repeated for credit in different areas.

5333. **Design I (3:2:3).** Prerequisite: Consent of instructor. Design of multicomponent systems — mechanical, thermal, and/or general; analysis and synthesis of systems at design, off-design, and transient conditions. May be repeated for credit in different areas.

5337. **Advanced Nuclear Engineering (3:3:0).**

5341. **Metallurgy I (3:3:0).** Prerequisite: M E 3341 or consent of instructor. Dislocations in metals; diffusion; phase transformations and precipitation; thermal, electronic, and structural properties of metals.

5342. **Corrosion Engineering (3:3:0).** Prerequisite: M E 3341 or consent of instructor. Corrosion and corrosion control, behavior of metals and alloys at elevated temperatures, field applications.

5351. **Boiling Heat Transfer (3:3:0).** Prerequisite: M E 5324 or 5325 or consent of instructor. Bubble dynamics; nucleate, transitional, and film boiling; critical heat fluxes, flow in boiling systems.

5361. **Control Systems Engineering (3:3:0).** Prerequisite: M E 5362 or consent of instructor. Basic techniques of feedback control, adaptive control, static and dynamic optimization.

5362. **Systems Engineering (3:3:0).** Prerequisite: M E 4333 or consent of instructor. Basic quantitative techniques of describing complex systems; simulation; modeling; systems performance and reliability prediction.

630. **Master's Report (3).**

631. **Master's Thesis (3).** Enrollment required at least twice.

731, 732. **Research (3 each).** May be repeated for credit.

831. **Doctor's Dissertation (3).** Enrollment required at least four times.

Department of Petroleum Engineering

Professor Herald W. Winkler, Chairman.
Associate Professor Crawford.

MINORS FOR THE MASTER'S DEGREE

Courses in Petroleum Engineering. (PETR)

5121. **Graduate Seminar (1:1:0).** May be repeated for credit.

5331. Special Problems in Petroleum Engineering (3:3:0). Prerequisite: Approval of departmental adviser. Individual experimental study of selected advanced topics. May be repeated for credit in different areas.

5332. Experimental Studies in Petroleum Engineering (3:1:6). Prerequisite: Approval of departmental adviser. Individual experimental study of selected advanced topics. May be repeated for credit in different areas.

Department of Textile Engineering

Professor Robert L. Newell, Acting Chairman.
Professor Parsons.

MINORS FOR THE MASTER'S DEGREE

Courses in Textile Engineering. (T E)

531, 532. Theory of Color Measurement I and II (3:2:3 each). Prerequisite: T E 434 or permission of department chairman. Theory of color perception and measurement. Mathematical analysis of color-order systems. Instrumentation including analog and digital computer utilization. Application to product color specification and process control.

535. Physical Properties of Textile Materials (3:3:0). Bulk, surface, and transfer properties, with emphasis on mechanical, frictional, rheological, electrical, optical, and thermal behavior.

536. Mechanics of Textile Protostructures and Structures (3:3:0). Derivation of structural geometry of yarns, fabrics, etc., and the effect of axially and radially directed forces on geometry. Theoretical and empirical methods of analysis as a means of predicting mechanical behavior. Translational considerations.

537, 538. Dynamics of Textile Protostructuring and Structuring I and II (3:3:0 each). Dynamics of the mechanical operations of formation, with emphasis in the effect of general machine variables, material physical properties, and system component interactions. Classical as well as nonclassical operations for forming yarns, woven and knitted fabrics, and other textile structures will be considered.

5331. Special Problems in Textile Engineering (3:3:0). Prerequisite: Approval of department chairman. Individual studies in advanced textile engineering or textile finishing.

5332. Experimental Studies in Textile Engineering (3:0:9). Prerequisite: Approval of department chairman. Individual laboratory studies in advanced textile engineering or textile finishing.

College of Home Economics

Professor Donald S. Longworth, Dean

The College of Home Economics offers majors and minors for the Master's degree in all departments. Persons interested in master's degree programs should see the departmental sections which follow. A program is also available leading to the Doctor of Philosophy degree in Home Economics. This program represents the cooperative efforts of the four departments within the college and draws upon related disciplines in each of the other colleges and schools of the University.

The doctoral program consists of a core requirement of at least 15 semester hours including interdepartmental home economics courses and a research collateral, an area specialization of 15 to 18 hours, and a dissertation on an original research project. An applicant for admission to the program must have the master's degree or its equivalent; such work may upon evaluation be considered as a part of the requirements of the doctoral program.

Persons interested in the doctoral program should consult earlier sections of this catalog for information concerning admission to the Graduate School. Applicants should also contact the Dean of the College of Home Economics since admission to the program requires a recommendation from the college as well as approval of the Graduate Dean.

Courses in Home Economics. (H E)

635. Issues in Development of Interpersonal Resources (3:3:0).

636. Issues in Development of Material Resources (3:3:0).

637. Professional Issues in Home Economics in Higher Education (3:3:0).

731. Research (3). May be repeated for credit.

831. Doctor's Dissertation (3). Enrollment required at least four times.

Department of Clothing and Textiles

Professor Norma E. Walker, Chairman.
Associate Professors Morrow, Roch, and Woodson; Assistant Professor Steadman.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND MINORS FOR THE DOCTOR'S DEGREE

The graduate faculty of the Department of Clothing and Textiles directs graduate programs of study leading to a Master of Science in Home Economics degree. Programs which include a thesis require completion of 30 semester hours of graduate study including basic courses in research methods and statistics; programs which do not include a thesis require completion of 36 semester hours of graduate study.

Acceptance into a program presumes completion of at least 18 semester hours or equivalent in clothing and textiles or related area undergraduate courses. Leveling work may be required in certain areas. Students who do not write a thesis will be required to complete a written comprehensive examination on their graduate course work. Students who write a thesis will be required to defend the thesis and related course work in an oral examination. Examinations are administered at the conclusion of the student's completion of course work just prior to graduation.

Courses in Clothing and Textiles. (C&T)

511. **Advanced Clothing Problems (1:0:3).** May be repeated for credit.

518. **Seminar in Clothing and Textiles (1:1:0).** May be repeated for credit.

530. **Clothing and Human Behavior (3:3:0).** Survey of sociopsychological theories related to human behavior, clothing practices, and consumer decisions.

531. **Special Problems in Clothing and Textiles (3).** May be repeated for credit.

532. **New Developments in Textiles (3:3:0).** Trends and developments in textile fibers, fabrics, and finishes.

536. **Advanced Clothing Design (3:1:4).** Prerequisite: C&T 436 or equivalent. Flat pattern techniques applied to advanced clothing design problems, including clothing for the physically handicapped.

539. **Economics of Textile and Clothing Industries (3:3:0).** Prerequisite: C&T 439 or 3 semester hours in economics. Factors affecting production and consumption of textiles and clothing in economically developed and underdeveloped areas of the world.

5302. **Cultural Bases of Clothing (3:3:0).** Influence of ethnic backgrounds of people of different socioeconomic levels in the selection and consumption of clothing.

5303. **Readings in Clothing and Textiles (3:3:0).** Survey of current literature in clothing and textiles including implications for the future.

5304. **Methods for Teaching Paraprofessionals in Clothing and Textiles (3:3:0).**

5335. **Textiles for Elementary Teachers (3:3:0).** Prerequisite: Graduate standing in elementary education. Consumer source materials; historical and recent developments in textiles; units of special significance for each elementary grade; special attention to consumer problems for the personal use of class members.

5340. **Tailoring Problems (3:1:4).** Evaluation and application of advanced tailoring concepts.

631. **Master's Thesis (3).** Enrollment required at least twice.

Department of Food and Nutrition

Professor Shiang P. Yang, Chairman.
Professors Kenney and Lamb; Associate Professor McPherson; Assistant Professors Cosper, Inano, and Williford.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND MINORS FOR THE DOCTOR'S DEGREE

A Master of Science degree requires 30 semester hours of graduate courses chosen in consultation with a faculty adviser selected by the student from the graduate faculty of the Department of Food and Nutrition. A minimum requirement is an average of B in all courses included in the degree plan. The student must have completed satisfactorily approximately 18 hours of undergraduate credits in Food and Nutrition and closely allied areas.

In conference with the chairman of the department, the student will select from the graduate faculty a professor under whose supervision he wishes to study. The major professor-student relationship should be mutually acceptable. The major professor automatically is the chairman of the student's advisory committee, which consists of two members from the Food and Nutrition Department and at least one from outside the department.

The Master of Science degree requires 30 semester hours of graduate courses chosen in consultation with the major professor. At least a B average is required for all courses in the degree plan. If the student has not already completed satisfactorily approximately 18 hours of undergraduate credit in food and nutrition and closely allied areas, appropriate leveling work will be required in addition.

With the agreement of the graduate faculty, the student will be recommended for the degree at the discretion of his advisory committee upon submission of a thesis based on original research and a final oral examination. The thesis problem may deal with an aspect of food science or experimental or applied nutrition.

The department also offers an area of specialization for the interdepartmental Ph.D. program in Home Economics.

Courses in Food and Nutrition. (F&N)

514. **Seminar in Food and Nutrition (1:1:0).** Prerequisite: Consent of instructor. May be repeated for credit.

516. **Nutrition and the Adolescent (1:1:0).** The nutritional needs, dietary habits, and motivation of the adolescent.

517. **World Nutrition (1:1:0).** A study of food supply for population groups with concern for their culture, customs, health, and nutritional needs.

518. **The Consumer and Food Technology (1:1:0).** Trends in food production and marketing; implications and guidelines for the consumer.

519. **Nutrition and Gerontology (1:1:0).** Nutrition in the physiology of aging; dietary management in geriatric institutions; dietary consultation for long-term care centers.

524. **Relations between Nutrition and Diseases (2:2:0).** Prerequisite: F&N 334 or 432 or consent of instructor. Physiological and metabolic bases for dietary modification in disease in which nutrition plays a major role in maintaining cellular homeostasis in man.

525. **Methods of Teaching Nutrition (2:2:0).** Prerequisite: Basic background knowledge of nutrition. Emphasis on community nutrition programs,

occupational training classes, and nutrition education of school age groups with consideration of different cultural and socioeconomic backgrounds.

526. **Advanced Problems in Food Service Management (2:2:0).** Prerequisite: Consent of instructor.

527. **Seminar in Food Service (2:2:0).** Prerequisite: Consent of instructor.

528. **Introduction to Food and Nutrition Research (2:2:0).** Prerequisite: Consent of instructor. Introduction to and critical evaluation of research designs and methodology. Guidance and individual experiences in planning and reporting a problem in food research and in nutrition research.

532. **Food Service Systems (3:3:0).** Prerequisite: Consent of instructor. Principles of food systems operations.

534. **Advanced Problems in Human Nutrition and Foods (3).** May be repeated for credit.

535. **Methods of Food Research (3:1:6).** Principles and use of specialized instruments and techniques. Execution, interpretation, and evaluation of results of individual problems.

536. **Methods of Nutrition Research (3:1:6).** Principles and use of instruments, techniques, and laboratory animals in research. Execution and evaluation of results of individual problems.

537. **Vitamins and Minerals (3:3:0).** Prerequisite: F&N 334 or 432 or consent of instructor. Nutritional roles, interrelationships, measurement of nutritional value, human requirements, and metabolic processes in health and disease.

538. **Proteins and Amino Acids (3:3:0).** Nutritional roles, interrelationships, measurement of nutritional value, human requirements, and metabolic processes in health and disease.

539. **Lipids and Carbohydrates (3:3:0).** Prerequisite: F&N 432, biochemistry. Nutritional roles and metabolism of lipids and carbohydrates; metabolic responses to various dietary practices.

5335. **Principles and Applications of Nutrition for Elementary Teachers (3:3:0).** Principles of nutrition, the nutrient requirements of the school child, and techniques for motivating children to sound food habits.

631. **Master's Thesis (3).** Enrollment required at least twice.

Department of Home Economics Education

Professor Camille Graves Bell, Chairman.
Professor Williams; Associate Professors Chamberlain and Kelly.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND MINORS FOR THE DOCTOR'S DEGREE

Students seeking a master's degree in home economics and majoring in home economics education should consult with appropriate graduate advisors of the department about their programs before enrolling in any courses. Major programs in home economics education are designed to meet individual needs of students.

Before being recommended for admission to a master's degree program with a major in this department, the student may be requested to take a preliminary examination to determine proficiency in background

for graduate work or may be required to take (without graduate credit) such undergraduate leveling courses as may be designated by the department.

A professional certificate program is also offered in the specialization area of home economics education. This certificate requires approximately 30 graduate semester hours as directed by certification policies but does not always coincide with the master's degree program. Students seeking the professional certificate must make application for the certificate in the Department of Home Economics Education.

The department also offers an area of specialization for the interdepartmental Ph.D. program in Home Economics.

Courses in Home Economics Education. (HEED)

514. **Specific Problems in Teaching Home Economics (1:1:0).** A study of the organization and presentation of selected areas or aspects of the home economics program. May be repeated for credit.

518. **Seminar in Home Economics (1:1:0).** Comprehensive consideration of research in home economics; presentation and consideration of current educational trends and their significance to home economics education.

530. **Readings in Home Economics Education (3:3:0).** A critical review of representative and authoritative literature dealing with philosophy, learning, curriculum innovation, evaluation in home economics. Focus may be on vocational education and intercultural aspects affecting teaching-learning.

531. **Administration and Supervision of Home Economics Education (3:3:0).** Administration and supervision of typical home economics programs; decision-making based on social and psychological factors affecting program emphasis.

532. **Curriculum Development in Home Economics (3:3:0).** Philosophy and development of vocational home economics programs for secondary schools or junior and senior colleges; survey of legislation, recent curriculum developments, and trends affecting home economics programs.

533. **Evaluation in Home Economics (3:3:0).** Procedures for appraisal of individual growth in all subject matter areas in home economics. Development of evaluative instruments for cognitive, affective, and psychomotor learning and interpretation of data in the evaluation of various types of home economics programs.

534. **Techniques of Research in Home Economics (3:3:0).** Methods and techniques of research in home economics; interpretation of findings and application to selected situations and problems.

535. **Analysis and Organization of Teaching Media (3:3:0).** Techniques for identifying, preparing, analyzing, and evaluating media for instructional purposes.

536. **Problems in Home Economics Education (3).** Individual and group problems according to special interests and needs of the student. May be repeated for credit.

537. **Techniques of Supervision in Home Economics (3:3:0).** Philosophy, responsibilities, and techniques of supervision in home economics. Designed for professional home economists.

538. Communication Designs in Teaching-Learning (3:3:0). Techniques of interaction and effective leadership. Information theory, cybernetics, and systems approaches applied to the classroom.

539. Organization and Administration of the Home Economics Gainful Employment Program (3:3:0). Designed to prepare teachers of vocational home economics wage earning programs.

5341. Vocational-Technical Curriculum Development (3:3:0). Basic principles of curriculum development applied to all vocational-technical education. Unique characteristics and contributions of each area of a total vocational-technical program evaluated in light of national trends and current sociological problems.

631. Master's Thesis (3). Enrollment required at least twice.

Department of Home and Family Life

Professors Fowler, Longworth, and Wallace; Associate Professors Ater, J. Henton, R. Henton, Larson, Pinder, and Woodson; Assistant Professors Bell, Coulter, Jenkins, Norton, Smith, and Vinson.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND MINORS FOR THE DOCTOR'S DEGREE

Students seeking a master's degree in Home Economics and majoring in one of the areas of home and family life should consult with the chairman of the department before enrolling in any courses. In consultation with the chairman, the student will select an adviser from the graduate faculty of his major area. The major program of study will be designed to meet individual needs.

Before being recommended for admission to a master's degree program, the student may be requested to take a preliminary examination to determine proficiency in background for graduate study or may be required to take (without graduate credit) such undergraduate leveling courses as may be designated by the department.

Courses in Home and Family Life. (H&FL)

631. Master's Thesis (3). Enrollment required at least twice.

Courses in Child Development. (C D)

518. Seminar in Child Development (1:1:0). Prerequisite: Graduate standing. May be repeated for credit.

530. History and Philosophy of Child Development (3:3:0). An interdisciplinary emphasis on the development of infants and preschool children with implications for the future.

531. Individual Study in Child Development (3). Readings and reports of literature; emphasis on increased responsibility for planning and guiding groups of young children through selected individual problems. May be repeated for credit.

532. Development of Basic Processes in Young Children: Psychomotor, Affective, Cognitive and Social (3:3:0) Studies of the development of the child from birth through early years.

533. **International and Intercultural Aspects of Child Development (3:3:0).** Readings in and experiences with other cultures and races in the United States and abroad. May be repeated for credit.

534. **Special Topics in Child Development (3:3:0).** Advanced study of current research in child development. May be repeated for credit.

536. **Planning Programs for Child Development Centers (3:3:0).** Planning educational experiences appropriate to the age level and background experiences of young children. Multidimensional aspect of the teacher's role in the preschool program.

Courses in Family Relations. (F R)

530. **Marriage Counseling (3:3:0).** Prerequisite: Consent of instructor. Designed especially for students whose professional aim or achievement places them in a counseling relationship with people in marital difficulty; touching areas of study including dynamics of personality development, theories of counseling and psycho-therapy, the dynamics of family living, and workable knowledge of ethics, values, and philosophy.

531. **Individual Study (3).** Prerequisite: Consent of instructor. Directed individual study for students majoring in child development and family relations. May be repeated for credit.

532. **Issues in Family Studies (3:3:0).** History, philosophy, and current issues in family life education. May be repeated for credit.

533. **Materials and Procedures in Teaching Family Life Education (3:3:0).** An evaluation of materials, resources, and procedures in family life education for teachers in schools, colleges, churches, and social agencies.

534. **Counseling in Family Problems (3:3:0).** A study of supportive counseling principles and methodology in the area of functional family problems and needs. Provides information for persons in helping relationships to assist people in their day to day problems.

535. **Practicum in Family Life Education (3:3:0).** Supervised teaching experience designed to prepare the student for involvement in family life education at the college level.

536. **Theory and Research in Family Life (3:3:0).** A survey of family theory and important empirical research.

5336. **Advanced Interpersonal and Family Relations (3:3:0).** Group processes; factors influencing personal family adjustment; methods and techniques of teaching and counseling.

Courses in Home Management. (HMGT)

511. **Individual Problems (1:1:0).** Individual study in home management, housing, equipment, family economics, or consumer education. May be repeated for credit.

518. **Seminar in Home Management (1:1:0).** Analysis and evaluation of research in home management, housing, equipment, or consumer education. May be repeated for credit.

530. **Individual Study in Home Management, Housing, and Consumer Education (3).** Directed individual study in the areas of home management, housing, or consumer education. May be repeated for credit.

532. Socioeconomic and Psychological Foundations of Home Management (3:3:0). Implications of the social sciences on family decisions and management in different cultural environment.

533. Work Analysis in the Home (3:3:0). Functional research basis for activities of the home.

534. Family Economics (3:3:0). Economic status of families at all income levels; factors influencing their standard of living; interrelationships with the economy.

535. Current Consumer Issues (3:3:0). Analysis of current consumer problems and decision-making responsibilities. Policies and programs for consumer protection and education.

536. Home Management and Housing for the Physically Disabled (3:1:4). Adaptation of managerial procedures and facilities to needs of the physically disabled.

5330. Readings in Current Housing Developments (3:3:0). A comprehensive and critical review of the literature and research data related to modern developments and issues in family housing.

5331. Socioeconomic and Psychological Factors in Family Housing (3:3:0). Implications from the social sciences as applied to analyzing causes and arriving at possible solutions to problems related to family housing in contemporary American society.

Interdisciplinary Programs

Arthropod Biology

Horn Professor R. W. Strandtmann, Chairman.
Professors Ashdown, Huddleston, and Mitchell; Associate Professors Atchley, Elliot, George, and Ward; Assistant Professors Foster, Hayes, and Pence.

OPTIONS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

This interdisciplinary program provides master's and doctor's degree level training designed to give the broadest possible background in agricultural and medical entomology, classical taxonomy, arthropod physiology, ethology, and all other phases of study related to arthropods, the most numerous animals on Earth.

The program will utilize a variety of existing courses offered by the Department of Biological Sciences in the College of Arts and Sciences, the Entomology Section in the College of Agricultural Sciences, and the Department of Preventive Medicine and Public Health in the Health Sciences Centers. Degrees offered under this program ordinarily will be the M.S. in Entomology and the Ph.D. in Biology.

Each student's curriculum will be determined through consultations with his graduate faculty advisory committee which will normally consist of at least three members for the master's and at least five members for the doctor's program. The chairman of the advisory committee will normally be from the department which reflects the student's principal specialization with committee representation from at least one other department.

The requirements for advanced degrees in arthropod biology shall be compatible with the minimum requirements of the Graduate School.

For course descriptions, see the listings under the various departments involved.

Courses in Biology. (BIOL)

532. Population Genetics (3:2:3).
538. Advanced Population Biology (3:2:3).
731. Research (3).
831. Doctor's Dissertation (3).

Courses in Botany. (BOT)

532. Vector Relationships in Plant Diseases for Advanced Students (3:2:3).

Courses in Entomology. (ENTO)

511. Seminar (1).

531. Entomology Research (3).
532. Literature and History of Entomology (3:3:0).
533. Advanced Insect Taxonomy (3:1:6).
534. Advanced Economic Entomology (3:3:0).
535. Systematic Entomology (3:3:0).
536. Advanced Insect Morphology (3:2:3).
537. Pesticides (3:3:0).
631. Master's Thesis (3).

Courses in Zoology. (ZOOL)

521. Selected Topics in Invertebrate Physiology (2:2:0).
531. Problems in Zoology (3).
534. Advanced Invertebrate Zoology (3).
538. The Arachnids (3:2:3).
5311. Biology of the Acarina (3:2:3).
631. Master's Thesis (3).
731. Research (3).
831. Doctor's Dissertation (3).

Chemistry (Biochemistry)

Professor Marvin R. Shetlar, Coordinator of Graduate Studies in Biochemistry. Professor Behal; Associate Professors Lloyd and Morrow; Assistant Professors Garner, Haller, Little, Pelley, Starnes, and Stocco; Consultant in Toxicology and Environmental Health Nau.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

The faculty of biochemistry was established in August 1974 and consists of those interested and qualified biochemists from the Department of Biochemistry, Texas Tech University School of Medicine, and from the Department of Chemistry, Texas Tech University. This faculty was charged with implementing a formal, broadly based program in chemistry (biochemistry), with sufficient flexibility and diversity to meet the needs of the University and its component colleges and the Health Sciences Centers and its component schools for graduate courses and graduate programs at the M.S. and Ph.D. degree levels in this area.

Students in the program will take a variety of course work offered by the departments of Biochemistry and Chemistry and by other departments with supporting courses. The student will be based in that department wherein the chairman of his or her advisory committee is located. However, admission to the program and establishment of student degree plans are matters determined by the faculty of biochemistry as a whole.

Each student in this program must take a preliminary examination. This examination will include an assessment of the student's background in physical, organic, and analytical chemistry to ascertain his comprehension of the fields. Satisfactory proficiency in one foreign

language or a tool subject and in statistical methods are required for the Ph.D. degree. The qualifying examination (for admission to candidacy for the Ph.D. degree) consists of a written integrated, five-part comprehensive examination given on successive days after most of the formal course work has been completed.

Students seeking information about or admission to the graduate program in chemistry (biochemistry) should contact Dr. Marvin R. Shetlar, Coordinator of Graduate Studies in Biochemistry, Department of Biochemistry, Texas Tech University School of Medicine.

For current course descriptions, see the sections of this catalog for the departments involved.

Courses in Biochemistry. (BCH)

(Department of Biochemistry)

5721. Biochemistry (7:5:2).
631. Master's Thesis (3).
6127. Seminar in Somatic Cell Genetics (1:1:0).
6320. Clinical Biochemistry (3:3:0).
6321. Biophysical Characterization of Macromolecules (3:3:0).
6322. Biomedical Radioisotope Techniques (3:3:0).
6324. Biochemical Basis for Inherited Disease (3:3:0).
6325. Advanced Genetics (3:3:0).
6326. Advanced Human Genetics (3:3:0).
6328. Biochemistry of the Mitochondrion (3:3:0).
6329. Advanced Immunochemistry (3:3:0).
6330. Special Topics in Environmental Biochemistry (3:3:0).
6331. Special Topics in Toxicological Biochemistry (3:3:0).
6332. Advanced Clinical Biochemistry (3:3:0).
6335. Topics in Biochemistry (3:3:0).
6521. Human Intermediary Metabolism and Its Regulation (5:5:0).
711. Biochemistry Seminar (1:1:0).
731. Biochemical Research (3).
831. Doctor's Dissertation (3).

Courses in Chemistry. (CHEM)

(Department of Chemistry)

531, 532. Research (3 each)
5332. Advanced Biochemistry (3:3:0).
5333. Proteins (3:3:0).
5334. Topics in Biological Chemistry (3:3:0).
5335. Physical Biochemistry (3:3:0).
5336. Biochemical Mechanisms (3:3:0).
5337. Enzymes (3:3:0).
5338. Biochemical Methods (3:1:6).
5339. Nucleic Acids (3:3:0).
631. Master's Thesis (3).
831. Doctor's Dissertation (3).

Other courses from the Department of Chemistry or from any other department also may be utilized in a student's program as deemed appropriate by the advisory committee and the department concerned.

Computer Science

Associate Professor Barry L. Bateman, Chairman.
Professors Archer, Barton, Griffith, and Rigby; Associate Professors Burford, Dock, Pitts, Smith, and Vines; Assistant Professor Gustafson.

MINORS AND OPTIONS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

The options for the master's degree and the doctor's degree are offered through majors in mathematics or engineering with a field of specialization in computer science.

Students seeking master's or doctor's degree specializations in computer science should consult the chairman of computer science about their programs before enrolling for any courses.

Before being recommended for admission to a master's degree program with a specialization in computer science, the student may be requested to take a preliminary examination to determine proficiency in background for graduate work or may be required to take (without graduate credit) such undergraduate leveling courses as may be designated by the computer science graduate faculty.

If the preliminary examination for admission to doctoral studies reveals serious weaknesses in the student's subject matter background, the student may be required to take remedial courses designated by the computer science graduate faculty. The student's advisory committee will make recommendations concerning language requirements and basic work in other disciplines.

For current course descriptions, see the listings of the various departments involved.

Courses in Computer Science. (C S)

511. Seminar (1:1:0).
531. Special Problems in Computer Science (3).
532. Computer Network Analysis (3:3:0).
533. Theory of Finite Automata (3:3:0).
534. Theory of Computability and Unsolvability (3:3:0).
535. Algebraic Linguistics Applied to Computer Languages (3:3:0).
536. Real Time and Time Sharing Systems (3:3:0).
537. Information Storage and Retrieval (3:3:0).
538. Computer Facility Operations (3:3:0).
539. Systems Organization and Evaluation (3:3:0).
5314. Design of Computer Languages (3:3:0).
5315. Heuristic Programming and Artificial Intelligence (3:3:0).
5319. Information Theory and Coding (3:3:0).

Courses in Business Administration. (B A)

5140. Computer Usage for Business (1:1:0).
5339. Management Information Systems (3:3:0).
5344. Computer Models for Business, Industry, and Government (3:3:0).
5373. Business and Management Systems (3:3:0).

Courses in Electrical Engineering. (E E)

5315. Sampled Data and Digital Control Systems (3:3:0).
5321. Digital Systems (3:3:0).
5325. Information Theory (3:3:0).
5393. Digital Computer Design (3:2:3).

Courses in Engineering Analysis and Design. (EA&D)

5350. Programming, Systems, and Languages (3:3:2).
5351. Computer Logic Design and Switching Theory (3:3:0).
5352. Computer Systems Organization and Programming I (3:3:0).
5353. Computer Systems Organization and Programming II (3:3:0).
5356. Formal Computer Language (3:3:0).
5357. Information Retrieval I (3:3:0).
5358. Introduction to Artificial Intelligence (3:3:0).
5370. Information Systems I (3:3:2).
5371. Information Systems II (3:3:2).

Courses in Industrial Engineering. (I E)

5341. Simulation Models for Operations Analysis (3:3:0).

Land Use Planning, Management, and Design

MAJORS AND MINORS FOR THE DOCTOR'S DEGREE

This interdisciplinary program provides doctoral-level training, with special emphasis on nonurban lands in arid and semiarid environments. The program includes study of the complex factors that influence the use of resources affecting the lives of individuals and communities.

The student will take a variety of courses in the colleges of Agricultural Sciences, Arts and Sciences, Business Administration, and Engineering and the School of Law. These courses will lead to areas of specialization in Public Policy Administration, Natural Resource Planning, or Resources Utilization and Management. The faculty is drawn from the participating academic units, and the program is administered through the Graduate School by a coordinating committee.

The program embodies a core of courses (including those listed below) of approximately 36 hours designed to provide the student with a base of fundamental knowledge upon which to build an area of spe-

cialization. The advisory committee for an individual graduate student will be appointed by the Dean of the Graduate School from three or more departments and two or more colleges. This committee and the student will arrange a program of study including the core and the courses comprising the area of specialization.

For current course descriptions, see listings of the various departments involved.

Core Courses.

P A 5336. Regional Resource Analysis (3:3:0). (Park Administration)

P A 5337. Field Studies in Regional Resource Analysis (3:3:0). (Park Administration)

P A 538. Contemporary Problems in Management of Renewable Natural Resources (3:3:0). (Park Administration)

GEOG 539. Seminar in Regional Analysis (3:3:0). (Geography)

R&WM 536. Ecology of Arid Lands (3:3:0). (Range and Wildlife Management)

POLS 5340. Seminar in Public Administration (3:3:0). (Political Science)

AECO 532. Agriculture and Public Policy (3:3:0). (Agricultural Economics)

ECO 537. Seminar in Public Finance (3:3:0). (Economics)

LAW 6213. Land Use Planning (2:2:0). (Law)

C E 5357. Water Resources Engineering III — Institutions (3:3:0). (Civil Engineering)

Microbiology

Associate Professor Stanley S. Lefkowitz, Coordinator of Graduate Studies in Microbiology.

Professors Behal and McKenna; Associate Professors Baugh, Felkner, Kuhnley, and Thayer; Assistant Professors Baskett, Evans, Fralick, and Jones.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

The faculty of Microbiology was established in August 1974 and was initially composed of those qualified microbiologists from the Department of Microbiology, Texas Tech University School of Medicine and from the Department of Biological Sciences, Texas Tech University. This faculty was charged with implementing a formal program in microbiology. The participating faculty offer a broadly based program with sufficient flexibility and diversity to meet the needs of the University and its component colleges and the Health Sciences Centers and its component schools, for graduate courses and graduate programs at the M.S. and Ph.D. degree levels in microbiology.

Admission to the program and establishment of student degree plans are matters determined by the faculty of microbiology as a whole. Students in this program will take a variety of courses offered by the Department of Microbiology, the Department of Biochemistry, and the

Department of Biological Sciences as well as within other departments with supporting courses.

The graduate student must meet the minimum requirements for the appropriate degree as defined in the catalog of the Graduate School. Course work for the degree will be determined primarily by the student's advisory committee, taking into consideration the needs and the background of each student.

Students seeking information about or admission to the graduate program in microbiology should contact Dr. Stanley Lefkowitz, Coordinator of Graduate Studies in Microbiology, Department of Microbiology, Texas Tech University School of Medicine.

For current course descriptions, see the listings of the departments involved.

Courses in Microbiology. (MBIO)

(Department of Biological Sciences)

521. Instrumental Methods of Microbiology (2:0:6).
531. Research in Microbiology (3).
532. Selected Topics in Microbiology (3:3:0).
533. General Virology (3:2:3).
534. Microbial Genetics (3:2:3).
536. Immunochemistry (3:2:3).
537. Microbial Metabolism (3:3:0).
5323. Laboratory Microbial Physiology (3:0:9).
5330. Advanced General Microbiology (3:2:3).
5332. Immunobiology (3:2:3).
5333. Advanced Bacterial Physiology (3:3:0).
631. Master's Thesis (3).
731. Research (3).
831. Doctor's Dissertation (3).

Courses in Microbiology. (MIB)

(Department of Microbiology)

5731. Medical Microbiology (7:5:3).
631. Master's Thesis (3).
6321. Tumor Immunology (3:3:0).
6322. Viral Oncology (3:3:0).
6323. Topics in Bacterial Genetics (3:3:0).
6347. Microbial Ecology (3:3:0).
711. Microbiology Seminar (1:1:0).
712. Literature Reviews Seminar (1:1:0).
731. Microbiological Research (3).
831. Doctor's Dissertation (3).

Museum Science

Professor Craig C. Black, Coordinator.
Associate Professors King and Robinson; Assistant Professor Genoways.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND MINORS FOR THE DOCTOR'S DEGREE

The master's program utilizes a variety of existing courses offered by various departments and programs within the University including anthropology, art, biological sciences, clothing and textiles, computer science, geography, geosciences, history, business administration, mass communications, and park administration. The program relies on graduate faculty in other departments and on other museum staff in teaching some of the core courses. A student will take at least 15 hours from the Museum Science core curriculum and up to 24 hours of related graduate-level work (for a total of at least 39 hours), plus 6 hours of thesis. A nonthesis option is available with 6 hours of independent study or internship.

Each student's curriculum will be tailored through consultation with his graduate faculty advisory committee which will normally be composed of one Museum Science faculty member and two members from related departments reflecting the student's program emphasis. This insures flexibility and allows each student to pursue his particular interests within the program.

A minor at the master's level in Museum Science consists of 9 hours in the core curriculum.

Courses in Museum Science. (MUSM)

531. **Research in Museum Science (3).** Tutorial, reading and/or field guidance for the student on a topic of his own choosing in consultation with an appropriate graduate faculty member.

532. **Museum Program Planning (3:3:0).** Consideration of the ways in which museums provide educational experience and their role in developing social awareness. Consideration will be given to school tours programs, workshops, summer field programs, and general education through exhibition.

533. **Museum Architectural Preservation (3:2:3).** The theory and practice of historic architectural preservation, restoration, and interpretation.

535. **Field Methods (3:1:6).** Problems of collecting museum specimens in the field and methods of handling material before it reaches the museum. Several two- to three-day field trips will be made.

536. **Museum Administration (3:3:0).** Study of administrative procedures in both public and private museums, small and large; types of support; interaction with local supportive groups.

537. **Museum Collection Management I (3:2:3).** Designed to introduce the student to the basic curatorial techniques and problems. All aspects of the collection will be studied from acquisition through preparation,

cataloging, and research requirements. Museum collections in art, history, and anthropology will be studied.

538. Museum Collection Management II (3:2:3). Designed to introduce the student to the basic curatorial techniques and problems. All aspects of the collection will be studied from acquisition through preparation, cataloging, and research requirements. Museum collections in biology, geology, and architecture will be studied.

543. Exhibit Design and Preparation (4:2:6). An introduction into the theory and practice of development of museum exhibit programs. Laboratory will include experience in exhibit preparation.

5310. Survey of Museum Management and Techniques (3:3:0). A one-semester course for nonmajors designed to give the student a working knowledge of the areas of museum administration, collection management, exhibit planning, and museum program planning.

631. Master's Thesis (3). Enrollment required at least twice.

Neuroscience

MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

Neuroscience is offered as an interdisciplinary minor at the graduate level to students who desire coordinated training in the physical basis of brain function. The program broadens the student's knowledge of the neural and behavioral sciences while giving him a sound academic background in basic areas such as the structure and function of the nervous system.

This is a new program and a faculty is currently being identified in the appropriate departments of both the University and the health sciences centers. Students interested in minor work in the neuroscience area should contact the Graduate School for further information.

Statistics

Professor Thomas L. Boullion, Chairman.
Professors Balsley, Chanda, Cornett, Conover, Lewis, Osborn, and Rigby; Associate Professors Atchley, Bethea, Chatfield, Cogan, Lee, Martz, Roy, Simpson, and Walvekar; Assistant Professors Anderson, Davenport, Duran, Liberty, Panwalker, Sennetti, and Watkins.

MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

A program in statistics is available as a minor for the master's or doctor's degree for graduate students in all colleges at Texas Tech. The program is administered by the statistics faculty. Students desiring minors in statistics should consult the chairman of the statistics faculty.

Courses not listed as statistics, but which may be defined as statistics-related, may be credited toward the minor with the approval of the statistics faculty and the academic department involved.

The master's minor requirements include STAT 5303 as well as 6 other hours in statistics or statistics-related areas.

The doctor's minor requirements include STAT 5303, 5304, and 5306 as well as 9 other hours in statistics or statistics-related areas.

The statistics course numbering system indicated in the left margin is for the internal use of the statistics faculty only. Students should enroll according to one of the departmental course numbers indicated in parentheses following the statistics course.

For current course descriptions, see listings of the various departments involved.

Courses in Statistics. (STAT)

5303, 5304. Intermediate Mathematical Statistics (3:3:0 each). (MATH 5383, 5384)

5306. Theory of Linear Statistical Models (3:3:0). (MATH 5372)

5308. Statistical Sampling Theory (3:3:0). (MATH 5379)

5310. Decision Theory (3:3:0). (MATH 5363, B A 5349)

5312. Stochastic Processes (3:3:0). (MATH 5373, I E 5319)

5314. Advanced Stochastic Processes (3:3:0). (MATH 5369)

5316, 5317. Advanced Mathematical Statistics I, II (3:3:0 each). (MATH 5374, 5375)

5318. Intermediate Probability Theory (3:3:0). (MATH 5380)

5320. Statistical Multivariate Analysis (3:3:0). (MATH 5378)

5322. Advanced Statistical Methods (3:3:0). (MATH 5367)

5330. Statistical Methods for Research Workers I (3:3:0). (B A 5340, ANSC 536)

5331. Statistical Methods for Research Workers II (3:3:0). (B A 5341)

5333. Design of Experiments (3:3:0). (MATH 5371, I E 5317, B A 6342, PSY 5384, R&WM 539, ANSC 543)

5337. Statistical Computer Packages and Their Use (3:3:0). (I E 5318, AECO 5313, ANSC 542)

5339. Nonparametric Statistical Inference (3:3:0). (MATH 5349, B A 6346)

5342. Economic Decision Theory (3:3:0). (I E 5362, AECO 5311)

5346. Reliability Theory (3:3:0). (I E 5316, E E 5361)

5348. Queueing Theory (3:3:0). (I E 5312)

5350. Inventory Systems (3:3:0). (I E 5307)

5353. Reliability of Electronic Systems II (3:3:0). (E E 5362)

5355. Feedback Control Systems II (3:3:0). (E E 5392)

5357. Information Theory (3:3:0). (E E 5325)

5359. Statistical Theory of Communication (3:3:0). (E E 5328)

5362. Inference Problems in Business (3:3:0). (B A 6343)

5364, 5365. Advanced Business Statistical Analysis I, II (3:3:0 each). (B A 6344, 6345)

5570. Biometry (5:4:3). (BIOL 552)

Texas Tech University Health Sciences Centers

Professor Richard A. Lockwood, Vice President
Professor George S. Tyner, Dean, School of Medicine

Development of a strong program of graduate education in the basic medical and related health sciences necessarily is one of the responsibilities and goals of the Texas Tech University Health Sciences Centers, because present-day medicine cannot exist outside the academic framework and intellectual discipline which the biological, chemical, and medical sciences provide. Graduate training in these areas is an integral component of the overall program of the Health Sciences Centers.

Opportunities for study and research leading to the Master of Science and Doctor of Philosophy degrees are offered in the fields of anatomy, chemistry (biochemistry),* microbiology,* and physiology. A Master of Science degree program with a concentration in health communications is offered through the Department of Mass Communications of the College of Arts and Sciences of Texas Tech University, and training in biomedical engineering is offered in collaboration with the College of Engineering. Individual program descriptions can be found within the specific department or program sections in this catalog.

The graduate courses listed in this section are available, with the consent of the instructor, to all graduate students in the Texas Tech University Complex.

Further information about graduate programs in the Health Sciences Centers may be obtained by contacting the appropriate basic science department chairman or Dr. Stanley F. Lefkowitz, who serves as Associate Dean of the Graduate School in addition to his duties in the School of Medicine.

Department of Anatomy

Professor William G. Seliger, Chairman.
Associate Professor Hillman; Assistant Professors Casady and Sterrett.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

The Department of Anatomy offers programs leading to the Master of Science and Doctor of Philosophy degrees in the anatomical sciences. The objective of this graduate training is to prepare superior students for careers in teaching and research in the field of anatomy. The major

*Joint programs between the School of Medicine and the Graduate School of Texas Tech University.

areas of employment for anatomists are in medical and paramedical professional schools and research institutes.

The Department of Anatomy offers a program emphasizing well-rounded training in gross anatomy, microscopic anatomy, developmental anatomy, and neuroscience. Specialized training is offered in areas such as histocytochemistry and ultrastructural morphology, including analysis of clinical specimens, mineralized tissue study, and instrumentation. Every effort is made to use the most modern concepts of teaching, stressing the relationships between structure and function.

Courses in Anatomy. (ANM)

5301. Clinical Applications of Electron Microscopy (3:1:6). Specimen preparation; theory and use of the electron microscope for clinical medicine, including specimen analysis and diagnosis of disease.

5303. Advanced Anatomical Studies (3:0:6). Advanced studies in surgical anatomy, gross anatomy, histology, embryology, neuroscience, or cell biology.

5304. Advanced Cytochemistry (3:3:1). Discussions and applications of current cytochemical theory and techniques.

5305. Medical Cell Biology (3:2:3). An interdepartmental course for graduate students in the biomedical sciences. Emphasis on the medical aspects of cell structure and function, including analysis of recent concepts and current literature. Techniques and methods of cell biology will also be examined in the laboratory.

5306. Biodynamics of Bone (3:3:0). Study of the morphology and cell biology of bone and bone changes.

5307. Surgical Anatomy (3:0:9). A study of the anatomy of the landmarks, approaches, and problems of the surgeon as related to the head and neck, musculoskeletal system, abdomino-pelvic cavity, and thoracic cavity.

5309. Biology of Reproduction (3:3:1). The various aspects of biological reproduction with an emphasis on human problems. The reproductive process will be taught from union of the gametes to the delivered fetus. Morphology will be stressed.

5310. Microscopy and Microscopic Technique (3:3:3). Prerequisite: BIOL 431 or equivalent. The theory, design, and use of the many various forms of light microscopes; and the theory, techniques, and practices of general histological and cytological preparations.

5311. Advanced Musculoskeletal System (3:1:9). Prerequisite: Consent of department. Study of the skeleton and muscles with models and gross dissection to present a detailed view of the skeleton and muscles and their interrelation to produce movement.

5316. Autonomic Nervous System (3:3:1). Prerequisite: ANM 5412 or equivalent. A study of the autonomic nervous system with major emphasis on the morphological, functional, and developmental aspects. Clinical applications are also stressed.

5318. Structure and Function of the Nervous System I (3:3:3). A detailed study of the neural system with an examination of both gross and fine structure, as well as cell biology of both the peripheral and central portions of the nervous systems.

5319. Structure and Function of the Nervous System II (3:3:3). Prerequisite: ANM 5318. Techniques and methods of measuring morphological, metabolic, and electrical properties of nervous tissue.

5412. Anatomy II (4:7:4). A detailed course of neuroscience, passing from the study of ultrastructural cytology, through the light microscopic gross and neuroanatomical aspects of the nervous system. Strong emphasis on the functional and clinical aspects of neuroscience.

5502. Histochemistry (5:5:4). Techniques and applications of histochemical techniques for light and electron microscopy.

5811. Anatomy I (8:8:14). A highly integrated introductory course of anatomy starting with the cell, passing through developmental and microscopic anatomy, and concluding with cadaver dissection. The course embodies the gross, radiological, microscopical, developmental, and clinical aspects of the body's systems and regions.

631. Master's Thesis (3). Enrollment required at least twice.

711. Anatomy Seminar (1:1:0).

731. Anatomical Research (3).

831. Doctor's Dissertation (3). Enrollment required at least four times.

Department of Biochemistry

Professor Francis J. Behal, Chairman.
Professor Marvin R. Shetlar, Coordinator of Graduate Studies in Biochemistry; Associate Professors Lloyd and Morrow; Assistant Professors Garner, Haller, Little, Pelley, Starnes, and Stocco; Consultant in Toxicology and Environmental Health Nau.

The faculty of the Department of Biochemistry and interested and qualified biochemists from other departments throughout the University offer an interdepartmental and broadly based program of advanced study and research leading to the Master of Science and Doctor of Philosophy degrees in Chemistry (Biochemistry) to meet the needs of the Medical Center and the University. This is a joint program between Texas Tech University School of Medicine and the Graduate School of Texas Tech University. More information about this interdisciplinary program and a statement of the admission requirements and the degree requirements for the M.S. or Ph.D. degrees in Chemistry (Biochemistry) are given in the Interdisciplinary Programs section of this catalog. The information presented below describes those aspects of the program of particular interest to students selecting to study and conduct research in areas of biochemistry traditionally found in a medical center. Such students will receive intensive training in medical and clinical biochemistry in addition to training in traditional areas of chemistry. They will be exposed to clinical biochemistry as they attend conferences and clinical rounds in the teaching hospital of the medical school; they will also have opportunities to work as team members with physicians on a variety of clinical research and patient care projects. Such opportunities will permit these students to prepare specifically for teaching and research careers in medical centers and health institutes and to meet the

eligibility requirements of, and to prepare for the examinations given by, the American Board of Clinical Chemistry.

Students seeking information about, or admission to, the interdisciplinary graduate program in Chemistry (Biochemistry) should contact Dr. Marvin R. Shetlar, Coordinator of the program. Those seeking information about financial assistance from, or research opportunities in, the Department of Biochemistry should contact the chairman of that department.

Courses in Biochemistry. (BCH)

5721. Biochemistry (7:5:2). Prerequisite: CHEM 335, 336 or equivalent. Human life processes at the molecular level with emphasis on biochemical homeostasis and control mechanisms. This course consists of a series of closely related lectures, laboratories, and clinical correlation sessions.

631. Master's Thesis (3). Enrollment required at least twice.

6127. Seminar in Somatic Cell Genetics (1:1:0). Prerequisite: Permission of instructor. May be repeated. Presentation of current research topics in the genetics and molecular biology of eukaryotic cells, and related areas: onocogenesis, differentiation, ageing.

6320. Clinical Biochemistry (3:3:0). Prerequisite: BCH 5721, CHEM 433, 436, 437, or equivalent. A study of clinical chemistry with emphasis on the interpretation of clinical laboratory data and concepts of laboratory-assisted diagnosis of human disease.

6321. Biophysical Characterization of Macromolecules (3:3:0). Prerequisite: BCH 5721, CHEM 443, 436, 437 or equivalent. A study of the characterization of macromolecules with major emphasis on the analytical ultracentrifuge and related instrumentation, consisting of lectures and laboratory exercises and familiarity with the analytical ultracentrifuge and interpretation of data.

6322. Biomedical Radioisotope Techniques (3:3:0). Prerequisite: BCH 5721, CHEM 433, 436, 437, or equivalent. Basic radioisotope techniques as used in biomedical research with special emphasis on liquid scintillation counting techniques.

6324. Biochemical Basis for Inherited Disease (3:3:0). Prerequisite: BCH 5721, CHEM 433, 436, 437 or equivalent. Biochemical and molecular basis of genetic disorders, genetic counseling, human population genetics, chromosomal defects, sex determination, and gene mapping in man.

6325. Advanced Genetics (3:3:0). Prerequisite: A course in genetics. Further development of concepts introduced in introductory course in genetics, molecular biology, gene mapping, extranuclear genetic systems, gene expression, population genetics.

6326. Advanced Human Genetics (3:3:0). Prerequisite: A course in genetics. Detailed consideration of population genetics, cytogenetics, molecular biology, and biochemistry as related to human heredity.

6328. Biochemistry of the Mitochondrion (3:3:0). Prerequisite: A course in general biochemistry. Subject areas involve structure-function relationships, ion and metabolite transport, enzyme and metabolite compartmentation, and enzyme regulation.

6329. Advanced Immunochemistry (3:3:0). A study of protein, carbohydrate, and complex antigens and the specificity of the immune response to them.

6330. Special Topics in Environmental Biochemistry (3:3:0). Prerequisite: Consent of instructor; organic chemistry recommended. May be repeated with change in content for a total of 6 hours. Reading, conferences, and/or laboratory work on selected chemicals which may exist in ambient air, water, or food—separation, identification, and physiological effects.

6331. Special Topics in Toxicological Biochemistry (3:3:0). Prerequisite: Consent of instructor; organic chemistry recommended. May be repeated with change in content for a total of 6 hours. A consideration of the uses, abuses, and potential biochemical effects of agricultural chemicals. Reading, conferences, and/or laboratory work.

6332. Advanced Clinical Biochemistry (3:3:0). Advanced study of the use of chemistry in laboratory medicine for diagnosing disease and evaluating therapy. Consideration of new methods in clinical chemistry, use of automated equipment, organ profiles, and other current developments in clinical biochemistry.

6333. Topics in Developmental Biochemistry (3:3:0). In-depth study of biochemical mechanisms in embryonic and post-embryonic development including biochemistry of cellular differentiation, biochemical mechanisms in growth and morphogenesis, development of specific enzyme systems, and endocrine mechanisms in development.

6335. Topics in Biochemistry (3:3:0). Prerequisite: Consent of instructor. Specific areas of biochemistry not normally included in other courses. May be repeated for credit with change in content.

6521. Human Intermediary Metabolism and Its Regulation (5:5:0). Prerequisite: BCH 5721, CHEM 433, 436, 437 or equivalent. Consideration of normal and abnormal human intermediary metabolism with major emphasis on biosynthetic and catabolic pathways and on modulation and control.

711. Biochemistry Seminar (1:1:0).

731. Biochemical Research (3).

831. Doctor's Dissertation (3). Enrollment required at least four times.

Department of Biomedical Engineering

Associate Professor Blair A. Rowley, Chairman.
Associate Professor Jarzembski.

Study leading to the Master of Engineering (Biomedical option with special permission) and Doctor of Philosophy degrees is offered in cooperation with the College of Engineering of Texas Tech University through their interdisciplinary study programs.

The courses listed below currently are offered by the School of Medicine faculty but are subject to revision as the interdisciplinary program undergoes further development. In addition, study programs utilize courses offered in the various departments of the College of Engineering.

Courses in Biomedical Engineering. (BME)

5101, 5201, 5301. Selected Topics in Biomedical Engineering (1:1:0; 2:2:0; 3:3:0). Material may vary from semester to semester. May be repeated for credit if different topics are covered for each registration.

5302. Function and Structure of the Human Body for Biomedical Engineers I (3:3:0). The basic micro and macro units of the human body. Biomedical engineering principles, anatomy, and physiology of cells, tissues, skeletal system, muscular system, and nervous system are presented.

5303. Function and Structure of the Human Body for Biomedical Engineers II (3:3:0). Prerequisite: BME 5302. This course presents six major systems of the human body; cardiovascular respiration, regulation of fluids, digestion, endocrines, and reproduction.

5304. Systems Analysis in Biomedicine (3:3:0). Using realistic yet simple physiological examples, analysis methods are developed in models and analogs; system properties of resistance and storage, step response, transfer functions, impedance, periodic signals, transient oscillations, resonance, and feedback.

6301. Bioelectric Phenomena (3:3:0). To introduce graduate students with backgrounds in the physical sciences and engineering to the electrical behavior of nerve and muscle using mathematical techniques to provide a quantitative basis for observed phenomena. Electrode theory, membrane structure and phenomena, propagated action potential, and electrocardiography.

731. Research (3). Prerequisite: Admission to doctoral study and consent of instructor. May be repeated for credit.

Courses suitable for graduate study programs are offered by the department faculty. There are no degree programs currently available through the department.

Department of Computer Medicine and Biomathematics

Associate Professor Blair A. Rowley, Chairman.
Associate Professor Jarzembski; Assistant Professor Anderson.

Courses in Computer Medicine and Biomathematics. (CMB)

5101, 5201, 5301. Selected Topics in Computer Medicine and Biomathematics (1:1:0; 2:2:0; 3:3:0). Material may vary from semester to semester. May be repeated for credit if different topics are covered for each registration.

5302. Intermediate Biostatistical Analysis for the Medical Sciences (3:3:0). Prerequisite: An introductory knowledge of calculus or statistics or consent of instructor. To provide graduate students in health-related areas with a working knowledge of commonly used statistical techniques for analyzing biological data. Emphasis on training the student to recognize the design of the experiment, what reasonable assumptions may be made, and to perform the necessary analysis.

731. Research (3).

Department of Health Communications

Professor Donald J. Brenner, Chairman.
Professor Sargent; Associate Professor Quesada; Assistant Professor Gould.

OPTIONS FOR THE MASTER'S DEGREE

The Department of Health Communications is cooperating with the Department of Mass Communications, Texas Tech University, in offering a master's degree option in Health Communications. This is a professionally oriented program consisting of 48 semester hours with an internship in lieu of a master's thesis.

The program is intended to prepare students from diverse backgrounds for employment in health care agencies, in medical and other health-related schools, and in health-related media. Concentrations include medical journalism, health information science, health media, and applications of communication theory and research to health communication.

The products of the program are conceived as professional communicators who will function as communications program developers and problem solvers in health care systems.

Courses in Health Communications. (HCOM)

537. Information Storage and Retrieval (3:2:2). Introduction to information organization and retrieval of natural language data. Computer techniques will be emphasized.

560. Health Communications Internship (6:4:0). Students will perform communication functions for eight weeks at Texas Tech University School of Medicine Regional Health Education Centers, under joint supervision of the chairman of the student's advisory committee and a faculty member at the center.

5115. Individual Problems in Health Communications (1:1:0). Individual research and reporting projects. May be repeated up to a maximum of 5 semester hours.

5117. Health Terminology (1:1:0). Medical and health terminologies most important to health communicators, presented in the framework of general health and medical concepts. Includes both the specialized professional languages and vernacular of the health professions.

5301, 5302. Health Communications Practicum in Health Sciences I and II (3:2:4 each). As a basis for understanding the work of health professionals and also as a basis for understanding the patients' viewpoint, correlated concepts from the physical, biological, and health sciences will be presented.

5310, 5311. Health Communications Seminar I and II (3:3:0 each). Introduction to the new discipline of health communication. Application of human communication theory to health care and health service systems. Emphasis on health care provider-consumer intercommunication and the communicational study of patienthood.

5312. **Medical Writing and Reporting I (3:1:3).** Application of reporting and news writing principles and techniques to the health field. Includes active criticism from medical and health professionals, including medical writers.

5313. **Medical Writing and Reporting II (3:1:4).** Prerequisite: HCOM 5312. Application of investigative reporting and news writing principles and techniques to more complex material in the health field. Lab practice in preparing feature-length materials and series. Criticism from health professionals.

5314. **Application of Communication Theory to Health Communications (3:3:0).** Application of diffusion theory, persuasion and learning theory, motivation research to the information systems of health and medicine.

5315. **Health Communications Research (3:3:0).** Critical examination and synthesis of past and ongoing research on the health communications process, focusing on mass communication research concerning health and medicine.

5316. **Introduction to Information Science (3:3:0).** Computer-oriented techniques for mechanized nonnumeric information processes, emphasizing medical bibliographic record systems. Automated information systems such as MEDLARS, MEDLINE, TOXICON, and others, and design of an information system.

5317. **Information Retrieval Systems Design (3:2:2).** Prerequisite: HCOM 537. Design of retrieval systems based on theories covered in HCOM 537. Topics covered include information dissemination process, information centers, file organization, search strategy, output operations, language design, and retrieval evaluation.

5319. **Seminar in Current Topics of Information Sciences (3:3:0).** This course will vary each semester emphasizing either information science topics or other topics in the health communications area.

5320. **Medical Photography (3:1:6).** Prerequisite: 6 hours of photography. Advanced applications in medical environment including specialized equipment and procedures.

5322. **Medical Television (3:1:6).** Prerequisite: A beginning course in television direction. Advanced applications in medical television involving the patient and medical personnel and unique problems in the health sciences.

5324. **Medical Illustration I (3:1:6).** Prerequisite: 12 hours of art and/or illustration. Advanced techniques involving illustration in medical education; evaluation of learning effect.

5325. **Medical Illustration II (3:1:6).** Prerequisite: HCOM 5324. Advanced techniques involving illustration in medical education; evaluation of learning effect.

5326. **Visual Techniques Practicum (3:1:3).** Introductory course involving media in health sciences education, research, and service programs. Working with the medical faculty and staff and patients in preparing instructional packages and ways to improve them.

5327. **Advanced Visual Techniques Practicum (3:1:6).** Prerequisite: At least two courses in medical photography, television, or illustration. Summary and practical course involving media in health sciences education, research, and service programs. Working with the medical faculty and staff and patients in preparing instructional packages and ways to improve them.

5328. Analysis and Preparation of Scientific Papers (3:3:0). Designed to improve scientific writing, particularly directness, comprehensibility, logical organization, and precision of expression. Requires a short journal article or equivalent during course.

Department of Health Organization Management

University Professor John A. Buesseler, Chairman.

The Department of Health Organization Management is developing several graduate-level programs. Currently it offers those courses which are designed to enhance and improve the academic offerings to students in cooperation with the College of Business Administration of Texas Tech University. These courses are designed to familiarize the student with current health organization administration theory and practice so that he will have a thorough understanding of the broad spectrum of management and administrative phenomena as they relate to health care organizations.

Courses in Health Organization Management. (HOM)

9308. Health Care Organization and Management (3:3:0). Prerequisite: Consent of instructor. Designed to provide an overview of the health care system, its managerial, social, behavioral, and economic aspects from a macroscopic viewpoint.

9309. Contemporary Issues in Health Organization Management (3:3:0). Prerequisite: Consent of instructor. Designed to analyze and evaluate selected contemporary problems, issues, and trends in organized health care delivery primarily at the micro level.

9310. Individual Research in Health Care Organization Management (3:3:0). Prerequisite: Consent of instructor. Directed research or investigation in which the student focuses on a problem area in health care organizations under individual supervision of a professor.

Department of Microbiology

Professor John M. McKenna, Chairman.
Associate Professor Lefkowitz; Assistant Professors Baskett, Evans, Fralick, and Jones.

The faculty of the Department of Microbiology and qualified microbiologists from other departments throughout the University offer an interdepartmental and broadly based program of advanced study and research leading to the Master of Science and Doctor of Philosophy degrees in Microbiology. This is a joint program between Texas Tech University School of Medicine and the Graduate School of Texas Tech University. More information about this interdisciplinary program in microbiology is given in the Interdepartmental Programs section of this catalog. The course work and information presented below describe those aspects of the program of particular interest to students selecting

to study and conduct research in the areas of microbiology traditionally found in a medical center.

Students seeking information about admission to the graduate program in microbiology should contact Dr. Stanley S. Lefkowitz, coordinator of the program.

Courses in Microbiology. (MIB)

5731. **Medical Microbiology (7:5:3).** A study of the role and place of bacteria fungi and viruses in human infectious disease processes, with emphasis on the interplay of the host and parasite relationships.

631. **Master's Thesis (3).** Enrollment required at least twice.

6321. **Tumor Immunology (3:3:0).** Prerequisite: Introductory courses in biochemistry, microbiology, pathology, and immunology, or permission of instructor. The various immunological, biochemical, and pathological parameters of tumor growth, both in animal model systems and in man will be presented. Emphasis will be placed on current concepts of tumor immunity, autoimmunity; immunological tolerance, surveillance, and enhancement; as well as on viral induced immunosuppression.

6322. **Viral Oncology (3:3:0).** Prerequisite: Introductory courses in microbiology, immunology, and virology or consent of instructor. Introduces the concept of a viral etiology of cancer through an examination of the effects of oncogenic viruses on intact animals as well as isolated cells in vitro.

6323. **Topics in Bacterial Genetics (3:3:0).** Prerequisite: General microbiology, microbial genetics, or equivalent, and consent of instructor. Lectures, demonstrations, and review of literature on inheritance in bacteria and their viruses with emphasis on aspects relevant to infectious diseases.

6324. **The Molecular Biology of Microorganisms (3:3:0).** Lectures and discussions illustrating how modern techniques of genetics and biochemistry are being used to elucidate the structure and function of DNA, RNA, and protein in prokaryotic cells. Courses in biochemistry and microbial genetics are suggested but not required.

6347. **Microbial Ecology (3:3:0).** Prerequisite: At least an introductory course in microbiology or permission of instructor. To provide an understanding of the place of microorganisms in nature and in human society. Bacteria, fungi, protozoa, and algae will be considered with regard to their structure, function, and role in a variety of ecosystems.

711. **Microbiology Seminar (1:1:0).**

712. **Literature Reviews Seminar (1:1:0).** Review of literature on special topics either assigned by instructor or selected by students. May be repeated for credit.

731. **Microbiological Research (3).**

831. **Doctor's Dissertation (3).** Enrollment required at least four times.

Department of Pharmacology

The Department of Pharmacology is under development at this time, and it has been approved for the M.S. and Ph.D. programs at such

time as its growth and development have reached a stage at which these graduate programs may be made operational.

Department of Physiology

Professor Maysie J. Hughes, Acting Chairman.
Associate Professors Crass, Hughes, and Kopetzky; Assistant Professors Davies, Holloway, and Lutherer; Consultant in Toxicology and Environmental Health Nau.

MAJORS AND MINORS FOR THE MASTER'S DEGREE AND THE DOCTOR'S DEGREE

The department offers a graduate program leading to the Master of Science degree and the Doctor of Philosophy degree. Training in physiology is provided in the following fields of study: cardiovascular physiology including autonomic receptors, hemodynamics, and metabolism; respiratory physiology; body fluid physiology; endocrine physiology. Research work is progressing in the department along each of these areas. The program is designed to train persons who will teach and conduct research in medical institutions.

Courses in Physiology. (PHY)

5822. **Physiology (8:7:4).** A study of human physiology with major emphasis on body-controlling systems and their interrelations. Pathophysiological mechanisms are also stressed.

631. **Master's Thesis (3).** Enrollment required at least twice.

6321. **Cardiodynamics (3:3:0).** Prerequisite: Medicine clerkship. A consideration of cardiac physiology and pathophysiology and its clinical application.

6322. **Fetal and Neonatal Physiology (3:3:0).** Emphasis on physiological mechanisms unique to life *in utero*, at birth, and during the first thirty days after birth.

6323. **Renal Physiology (3:3:0).** Discussion and correlation of recent advances in the normal and pathophysiological mechanisms of the kidney.

6324. **Endocrinology of Pregnancy (3:3:0).** Topics related to the role of endocrine glands in the support of the fetus, the maternal-fetal exchange, the development of endocrine function in the fetus, and the changes occuring at birth.

6325. **Physiology of Neuroeffector Systems (3:3:0).** A consideration of adrenergic, cholinergic, histaminic, and serotonin receptor systems and physiological applications.

6326. **Applied Environmental Physiology (3:3:0).** Physiological mechanisms involved in heat prostration, dehydration fever, cold exposure, and hypoxia.

6327. **Pathophysiology of Hypertension (3:3:0).** A study of current concepts of etiological mechanisms of hypertension.

6328. **Advanced Endocrinology (3:3:0).** Various endocrinopathies will be discussed in terms of recent advances in the areas of assay of endocrine gland function, control of hormone secretion, actions of hormones, mechanisms of action, and the interrelationships between hormones.

6329. **Pulmonary Circulation in Health and Disease (3:2:1).** The hemodynamics of the pulmonary circulation and the factors which control it will be presented, supplemented by an analysis of selected clinical cases. Lectures and student presentations of original papers.

6331. **Physiology of Muscle in Health and Disease (3:3:0).** Important aspects of muscle function and current information relating to the biochemistry of ischemic heart disease and hypertrophy, as well as to abnormalities of skeletal muscle metabolism.

6332. **Topics in Physiology (3:3:0).**

711. **Physiology Seminar (1:1:0).**

731. **Physiological Research (3).**

831. **Doctor's Dissertation (3).** Enrollment required at least four times.