



**The
University
of Texas
at
Arlington
Graduate
Catalog 72-73**

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June 1972





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The University of Texas at Arlington Annual Graduate Catalog '72-'73

Volume LV

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CAMPUS CALENDAR

FALL SEMESTER 1972

Aug. 30, 31, Sept. 1	Registration for Fall Semester 8 a.m. to 5 p.m. and 6 p.m. to 9 p.m.
Sept. 4	Labor Day (holiday)
Sept. 5	Classes begin 8 a.m.
Sept. 8	Late registration closes 9 p.m.
Sept. 16	Census date
Oct. 24	Midsemester
Nov. 23	Thanksgiving holidays begin 8 a.m.
Nov. 27	Thanksgiving holidays end 8 a.m.
Dec. 6	Dead Week begins
Dec. 13	Final examinations begin 5:30 p.m.
Dec. 19	Final examinations end 10 p.m.
Dec. 21	Semester ends

SPRING SEMESTER 1973

Jan. 10, 11, 12	Registration for Spring Semester 8 a.m. to 5 p.m. and 6 p.m. to 9 p.m.
Jan. 15	Classes begin 8 a.m.
Jan. 18	Late registration closes 9 p.m.
Jan. 27	Census date
March 6	Midsemester
March 12	Spring vacation begins 8 a.m.
March 19	Spring vacation ends 8 a.m.
April 25	Dead Week begins
May 2	Final examinations begin 5:30 p.m.
May 8	Final examinations end 10 p.m.
May 15	Commencement 8 p.m.

SUMMER SESSIONS 1973

June 4	Registration for day and night students
June 5	First day of classes 7:30 a.m.
June 6	Late registration closes 9 p.m.
June 8	Census date
July 4	Independence Day (holiday)
July 11, 12	Final examinations for first summer day session
July 16	Registration for second summer day session 8 a.m. to 5 p.m.
July 17	First day of classes, second summer day session 7:30 a.m.
July 18	Late registration closes 9 p.m.
July 20	Census date
Aug. 17	Final examinations begin for night sections
Aug. 21, 22	Final examinations for second summer day session
Aug. 24	Summer session ends



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GENERAL INFORMATION

GOVERNMENT

The government of The University of Texas at Arlington is vested in a nine-member Board of Regents of The University of Texas System, selected from different portions of the state, nominated by the Governor, and appointed by and with the advice and consent of the Senate. The Chancellor is the chief administrative officer of The University of Texas System. The chief administrative officer for the operations of UT Arlington is the President, under the authority of the Chancellor and the Board of Regents. A complete statement of the authority and duties of the Regents and of the several officers, together with an account of the organization of the system, is published in the "Rules and Regulations of the Board of Regents of The University of Texas."

The "Rules and Regulations" includes the following statement:

"With respect to the admission and education of students, with respect to the employment and promotion of teaching and non-teaching personnel, with respect to student and faculty activities conducted on premises owned or occupied by the University, and with respect to student and faculty housing situated on premises owned or occupied by the University, neither The University of Texas nor any of its component institutions shall discriminate either in favor of or against any person on account of his or her race, creed, color or sex."

LOCATION

The Arlington campus is located in the center of the Fort Worth-Dallas metropolitan area, a business and industrial complex comprising the counties of Tarrant and Dallas. The campus is situated a few blocks southwest of the downtown business area of Arlington.



THE GRADUATE SCHOOL

The Graduate School is essentially a body of professors and scholars designated as Members or Associates of the Graduate Faculty and of students duly admitted to pursue their studies beyond the baccalaureate degree.

In each academic area in which graduate work is offered at The University of Texas at Arlington, there is a graduate advisor who acts as the representative of the Graduate School Administrator (Dean of the Graduate School) in advising students. The graduate advisor gives information to students about graduate work in his area, counsels with them regarding their plans and progress and guides their proposed work toward a graduate degree until they have selected a supervising professor.

THE PURPOSE AND NATURE OF GRADUATE WORK

Graduate work at The University of Texas at Arlington is divided into programs which may differ from those of traditional departments in that they are broader in scope, involving courses and research in several departments. The candidate for an advanced degree presents work done in his chosen major area, but he may also be expected to have done supporting work of advanced level (upper-division or graduate) in one or more associated areas. There are three main components of graduate study: course work, independent study, and independent scholarly research leading to a report, thesis, or dissertation. No one of these components can be neglected by the graduate student, although the proportion of independent study to course work may vary according to the previous training of the individual student and the area of study. The objective of the doctoral program is to produce research scholars and scholarly teachers. The master's programs represent a stage on the road to this goal, but they also provide in themselves the possibility of a complete and useful accomplishment in advanced work.

GENERAL REQUIREMENTS AND PROCEDURES

ADMISSION TO THE GRADUATE SCHOOL

All correspondence concerning admission should be addressed to the Registrar and Director of Admissions. Applications for admission must be made on the appropriate printed form, which will be sent upon request.

Each applicant for admission (or transfer) to the Graduate School must take, at his own expense, the Aptitude Test of the Graduate Record Examinations administered by the Educational Testing Service. (The Admission Test for Graduate Study in Business is acceptable for the MBA and MPA programs.) The test scores will be used, with other data, to determine eligibility for admission and to aid in counseling the applicant after admission. The Graduate Record Examination is given at various centers throughout the United States on regularly established dates, usually in October, December, January, February, April and July. It is administered on each of the six dates at approximately 25 colleges or universities in Texas and at approximately 395 other designated centers in the United States and abroad. A bulletin of information describing the Graduate Record Examination and a test application blank may be secured from the Educational Testing Service, Box 1502, Berkeley, Calif., 94701, or from the Testing and Counseling Center at UT Arlington. Since applications for the test must be received in Berkeley about two weeks before each testing date, applicants should secure the bulletin of information at least a month in advance.

For admission to certain graduate programs, additional tests may be required or in some cases substituted for the Graduate Record Examination. This information is given under the individual program listings.

An applicant who holds a bachelor's degree from UT Arlington should apply to the Director of Admissions at least 30 days prior to the beginning of the semester or summer session in which he wishes to register. An applicant whose degree or degrees are from some other American college or university should file an application, with the required official transcripts of all previous college work, at least 60 days prior to the beginning of the semester or summer session in which he plans to register. A person holding a degree from a foreign university or residing abroad should apply early enough to allow ample time for correspondence to be completed 60 days prior to the beginning of the semester or summer session in which he plans to register. The Dean of the Graduate School and members of the academic area in which the applicant proposes to major will evaluate the record of work and will accept or reject the application for admission on the basis of the criteria outlined below.

Admission—In order to be admitted to the Graduate School, an applicant must: (1) hold a bachelor's degree from an accredited university or its equivalent from a foreign university; (2) make a satisfactory score on the Graduate Record Examination; (3) have demonstrated through previous academic performance the potential for graduate work in his chosen field.



After an applicant's file is complete, it will be reviewed by the graduate advisor in the applicant's major area and by the Dean of the Graduate School. Upon their recommendation, the Director of Admissions will accept the applicant, with or without conditions as recommended, or reject the applicant.

Permit to register in Graduate School—Upon the recommendation of the appropriate graduate advisor and the approval of the Dean of the Graduate School, the Director of Admissions may issue a permit to register in the Graduate School to an applicant who has not taken the Graduate Record Examinations Aptitude Test. This permit is valid for one semester of the long session or one summer session only. It requires that the applicant take and achieve a satisfactory score on the Graduate Record Examinations Aptitude Test during the semester or summer session for which he is issued a permit to register.

NOTE: If the applicant applies for admission prior to the last scheduled administration of the Graduate Record Examinations Aptitude Test before his indicated admission date, he will not be admitted under the above provisions.

PROCEDURE AFTER ADMISSION

Upon the approval of the application for admission, the Director of Admissions will notify the applicant and state in detail any conditions or prerequisites that must be absolved.

After being admitted, the student should confer with the graduate advisor of the proposed major area, preferably by personal interview, in order to become acquainted with specific departmental regulations, particularly in the case of areas that require additional examinations upon entrance. After receiving registration materials he should consult the graduate advisor in the proposed major area at the time and place indicated in his registration instructions concerning the details of registration, course program, and other routine. *It is important that a student wishing to take courses for graduate credit consult with the appropriate graduate advisor before registering, as each student's program of work for an advanced degree must eventually be approved by the graduate advisor, the student's supervising committee and the Dean of the Graduate School. Failure to consult with the graduate advisor could result in the student enrolling for courses which would not be applied toward his degree.*

RESTRICTION ON ADMISSION

Because there may be more applicants than facilities can accommodate, it may be necessary to limit the number of students accepted for graduate work in certain areas. See the prerequisites and requirements under each major area of concentration.

GENERAL INFORMATION AND REGULATIONS

Grades of scholarship — Subject to the following restrictions, graduate credit will be given for grades of A, B, or C for work done at UT Arlington:

- (1) The student must maintain a B average on all work in his major (not counting thesis).
- (2) He must maintain a B average on all work in his minor or minors.
- (3) He must maintain a B average on all advanced work (not counting thesis).

No student will be allowed to repeat a course in order to change a passing grade. A student may repeat a course only if that course is specifically designated as one that can be repeated for credit. A student who fails to receive credit (grade of D or F) may repeat a course in order to obtain credit, in which case both grades will count on the student's average.

Incomplete grade—A student who has been unable to complete all the class or laboratory assignments in a semester or term may, at the discretion of the instructor, receive an X designating a temporary grade. The incomplete grade must be removed by time of graduation or it will be changed to an F.

Credit for research or thesis courses—A final grade may be given in a research or thesis course only if the work is completed during the semester in which the student is registered in the course.

If the student is undertaking a research or thesis course and is not to receive a grade at the completion of the semester, he will receive a grade designation of R (research in progress). This grade designation is a permanent grade, but is not included in any academic evaluation and does not carry any credit value. A student receiving a grade of R must re-register for the course in order to obtain academic credit. This grade may be issued only to graduate students for the above-mentioned courses.

Course numbering system — The course listing shown below will serve as an example for the following explanation of the course numbering system, credits, and theory and practice hours at UT Arlington.

Biology 5341 (2-3) 3

1. "Biology" is the departmental designation for the specific course listed.
2. The first digit (5 in the above example) denotes the year in which the course is usually taken.
3. The second digit (3) denotes the semester hour credit of the course.
4. The third and fourth digits (4 and 1) distinguish the individual course; 01 through 39 indicate lecture only, 40 through 79 indicate lecture and laboratory combination, 80 through 89 indicate laboratory only, and 90 through 99 indicate individual or small group instruction and thesis.



5. The first figure in parentheses indicates the clock hours per week devoted to theory. Theory includes recitations and lectures.
6. The second figure in parentheses indicates the clock hours per week devoted to practice. Practice includes work done in the laboratory, shop, drawing room or field.
7. The final figure is the credit value of the course. The unit of credit is the "semester hour" which involves one hour of theory and/or from two to four hours of practice per week for one semester of 18 weeks.

Auditing—Auditing is a privilege open to any person (if space is available) who has credit in the course or has a demonstrated need. Auditing grants the privilege of hearing and observing only, and does not grant credit. Audit applications may be secured from the Registrar's Office and require the approval of the Dean or his representative. When the form has been completed and approved, the applicant if currently enrolled pays a fee of \$5 per course; if not enrolled, he pays \$25 per course.

Adding and dropping courses — A student who wishes to change his schedule by either dropping or adding a course must first consult with his graduate advisor. The following regulations pertain to adds and drops:

- (1) A student may not add a course after the end of late registration.
- (2) A student may not drop a course during the last two weeks of a semester.
- (3) A student dropping a course prior to the mid-semester date will receive a grade of W which will appear on the student's permanent records but will not be used in computing his grade point average. A student dropping a course after the mid-semester date will receive a grade of W only if he is at the time of the drop passing the course (has a grade of A, B, or C); otherwise he will receive an F.
- (4) A student who desires to drop all courses for which he is enrolled is reminded that such action results in his withdrawal from the University. He should indicate his intention to withdraw and drop all courses by filing a properly executed resignation form in the Office of Student Administration.

Withdrawal — A student who wishes to withdraw (resign) voluntarily from the University must execute the proper resignation form in the Office of Student Administration.

Maximum course load and work load—The maximum course load for graduate students is 15 semester hours; registration in excess of this maximum will be approved by the Dean only in exceptional circumstances. If the student is employed by UT Arlington as a teaching assistant, research assistant, or student assistant, the course load must be correspondingly reduced. The student should consult his graduate advisor about his combined course and work load

Continuation in the Graduate School—Regardless of conditions surrounding the student's admission, continuation from semester to semester in the Graduate School is permitted only if (1) satisfactory progress is made in absolving admission conditions, and (2) the student maintains a 3.0 average in all work undertaken while in Graduate School. If the student at any time fails to maintain an overall 3.0 grade point average on all work undertaken as a graduate student, he must during his next semester of attendance raise his average on all work taken while in Graduate School to a 3.0 grade point average. A Graduate student undertaking less than a full academic load (nine semester hours of advanced course work) will have his record evaluated the semester that he completes his first nine semester hours of course work at this institution. His academic record will thereafter be evaluated at the conclusion of each additional nine semester hours of course work. The carrying of less than a full load does not, however, absolve the student of the responsibility of meeting admission conditions within the prescribed period of time. Failure to meet the grade point requirement will result in automatic dismissal from Graduate School. Following such dismissal, the student may be readmitted for further graduate study in either the same or a different area only if his petition (accompanied by a complete record of all college or university work previously undertaken) has been approved by the appropriate Committee on Graduate Studies and the Dean of the Graduate School.

Extension—Work done in extension classes may be applied toward an advanced degree under the same conditions as apply to transfer work, except that credit for extension work is limited to six credit hours.

Correspondence course—Courses done by correspondence are not accepted for graduate credit.

Reservation of work by undergraduates for graduate credit—An undergraduate who needs not more than 12 semester hours in one semester (six semester hours in one summer session) to complete all of the requirements for a bachelor's degree may be allowed to register for work to count for graduate credit under the following conditions:

- (1) That all work for undergraduate credit be completed during that semester or summer session.
- (2) That the total registration for all work not exceed 15 semester hours in a semester (or 12 semester hours in the summer sessions).
- (3) That all work to be counted for graduate credit be approved before the end of the first two weeks of the semester or session by the graduate advisor and by the Dean.
- (4) That the Registrar certify to the Dean the work in question will not be counted for undergraduate credit. A form reserving courses may be secured from the Graduate School Office

Under certain circumstances, students holding an undergraduate degree but not admitted to the Graduate School may be



allowed to register for courses and to reserve them for graduate credit. Reservation of credit forms must be executed within the first two weeks of the semester and must be approved by the graduate advisor and the Dean of the Graduate School. A maximum of 12 hours of credit so received may be counted toward a graduate degree if approved as part of the degree program and only grades of A and B may be so applied, although all grades in reserved courses will be considered in computing a student's grade point average. Students must consult with their graduate advisor before registering for courses to be reserved for graduate credit.

Courses counted for another degree—No course to be counted toward an undergraduate degree may be counted toward any graduate degree, either directly or by substitution.

Transfer credit—Credit will be granted for equivalent course work from other institutions in The University of Texas System upon the approval of the appropriate Committee on Graduate Studies and the Dean of the Graduate School. Credit for graduate level work completed at other institutions of recognized standing may, upon the recommendation of the department or other academic unit concerned, be accepted for a maximum of one-half of the formal graduate level course work requirement for a master's degree. All work submitted for transfer credit must have been completed no more than five years before enrollment in the UT Arlington graduate program.

Graduation—Each graduate student must complete his degree requirements in accordance with the Catalog in force at the time he entered the Graduate School or the Catalog of any subsequent year in which he was a resident graduate student.

All the work for a master's degree must be completed within one six-year period (time in military service excluded).

No honorary degree will be conferred by The University of Texas at Arlington.

Degrees are awarded at the end of the Fall Semester, the Spring Semester, and either summer session, but formal public ceremonies are held only at the conclusion of the Spring Semester.

Routine for All Candidates for Master's Degrees—File in the Graduate School Office during the first 30 calendar days of the final semester or first six days of the final summer session:

- (1) A diploma name card (this must be refiled in case of postponement).
- (2) An application for candidacy, if not filed in an earlier semester.
- (3) A program of work, filed at the same time as application for candidacy.

Submit the thesis or approved substitute to the supervising committee not later than 30 days before graduation day of the final semester.

File in the Graduate School Office final copies of the thesis not later than 15 days before graduation day of the final semester.

EXPENSES

NOTICE: Due to conditions which may arise beyond the control of The University of Texas at Arlington, fees may be changed during the next year without notice. The University reserves the right to modify any fee in accordance with unforeseen conditions.

TUITION AND FEES*

REGULAR SESSIONS (& Summer Night Session)

Semester Hours	Resident Students	Non-Resident U.S. Citizen	Non-Resident Enrolled Spring 1971	Foreign Students
1	\$102.00	\$ 92.00	\$108.00	\$252.00
2	104.00	134.00	110.00	254.00
3	106.00	176.00	112.00	256.00
4	108.00	218.00	130.00	258.00
5	110.00	260.00	148.00	260.00
6	112.00	302.00	166.00	262.00
7	114.00	344.00	184.00	264.00
8	116.00	386.00	202.00	266.00
9	118.00	428.00	220.00	268.00
10	120.00	470.00	238.00	270.00
11	122.00	512.00	256.00	272.00
12	124.00	554.00	274.00	274.00
13	128.00	596.00	276.00	276.00
14	134.00	638.00	278.00	278.00
15	140.00	680.00	280.00	290.00
16	144.00	720.00	280.00	304.00
17	148.00	760.00	280.00	318.00
18	152.00	800.00	280.00	332.00
19	156.00	840.00	280.00	346.00
20	160.00	880.00	280.00	360.00

Each Additional hour 4.00 40.00 No Charge 14.00

*Includes \$50.00 Building Use Fee and \$2.00 per hour Student Activity Fee with a \$30.00 maximum.

SUMMER DAY SESSIONS

Semester Hours	Resident Students	Non-Resident U.S. Citizen	Non-Resident Enrolled Spring 1971	Foreign Students
1	\$52.00	\$ 67.00	\$ 52.00	\$127.00
2	54.00	109.00	79.00	129.00
3	56.00	151.00	106.00	131.00
4	58.00	193.00	133.00	133.00
5	60.00	235.00	135.00	135.00
6	62.00	277.00	137.00	137.00
7	67.00	319.00	139.00	139.00
8	72.00	360.00	140.00	152.00

*Includes \$25.00 Building Use Fee and \$2.00 per hour Student Activity Fee with a \$15.00 maximum.

Other Expenses—Students registering for the first time must make and maintain a \$10.00 Property Deposit Fee and pay a \$1.00 Photo Identification Card Fee per year in addition to a Parking Fee and Laboratory Fees as required.



Tuition Exceptions—State law provides for several exceptions to the tuition rates. Students qualified for a reduced rate in any of the following categories must have that eligibility certified prior to registration.

1. Any non-resident United States citizen who was enrolled for the Spring Semester of 1971 in any state institution may continue to enroll at the same institution at the same tuition rate that was effective at the time of his original enrollment until:
 - a. he receives the degree at the degree level (baccalaureate, master, etc.) toward which he was working during the Spring Semester 1971.
 - b. he voluntarily or involuntarily withdraws from the institution.
 - c. the end of the Spring Semester 1975.
2. Teaching assistants and associates, research assistants and associates, and certain other employee categories employed at least half-time in positions which relate to their degree programs will be charged the same rate as a Texas resident.
3. Holders of certain competitive scholarships in the amount of \$200.00 or more awarded through the UT Arlington scholarship committee will be charged the same rate as a Texas resident.
4. Certain non-resident students age 21 or under who have been classified as Texas residents at previous registrations will be charged the same rate as a Texas resident.

NON-RESIDENCE FEE

All students attending The University of Texas at Arlington who are non-residents of this state will be charged additional tuition in accordance with the state law.

According to interpretations by the Coordinating Board, Texas College and University System, of Article 2654c, Vernon's Civil Statutes, with amendments through 1969, the following information pertains: "An individual under twenty-one (21) years of age, living away from his family, and whose family resides in another state or has not resided in Texas for the 12-month period immediately preceding the date of registration shall be classified as a non-resident student; or an individual twenty-one (21) years of age or over who resides out of the state or who has come from outside Texas and who registers in an educational institution before having resided in Texas for a 12-month period shall be classified as a non-resident student."

A non-resident student classification is presumed to be correct as long as the residence of the individual in the state is primarily for the purpose of attending an educational institution. After residing in Texas for at least twelve (12) months, it is possible that a non-resident student may be reclassified as a resident student as provided in the rules and regulations adopted by the Coordinating Board, Texas College and University System.

Two of the most common exceptions included in the state statute are as follows: (1) A non-resident who marries a resident of Texas is entitled to pay the resident tuition fee regardless of the length of time he has lived in Texas; proof of marriage must be submitted to the Registrar's Office prior to registration. (2) Usually, a member of the United States Military Forces is entitled to pay the resident tuition fee for himself or his dependents, providing that each semester he submits to the fee assessors in registration a letter from his commanding officer stating that he is currently on permanent assignment in the state.

The responsibility of registering under and maintaining the proper residence classification rests on the student. If there is any question concerning his classification as a resident of Texas at the time of registration, or any time thereafter, it is the student's obligation to consult with the residence advisor in the Office of the Registrar and have his classification officially determined. All requests for reclassification should be submitted to the Registrar's Office at least 30 days prior to the registration period in question.

STUDENT ACTIVITY FEE

The Student Activity Fee is compulsory. It provides either free or reduced fees to intercollegiate events, formal convocation events, a copy of the yearbook, health services, newspaper, magazines, and activity programs in the E. H. Hereford Student Center.

PROPERTY DEPOSIT FEE

Every student registering at UT Arlington will be required to make and maintain a property deposit of \$10. The records will be reviewed from time to time, and if charges have been made against the deposit, the student will be required to bring the deposit up to \$10.

The deposit will be refunded only when the student withdraws from school or graduates.

PARKING FEES

Students will register their cars in a single payment for the entire school year or the balance of the school year in which they register, whichever is applicable (school year is September 1 through August 31). The following fees will be charged for autos at the initial period of registration: Fall Semester, day, \$15; night, \$8. Spring Semester, day, \$8; night, \$5. First Summer Session, day, \$4; night, \$3. Second Summer Session, day, \$3. For motorcycles, fees will be: Fall Semester, day, \$8; night, \$4. Spring Semester, day, \$4; night, \$2. First Summer Session, day, \$2; Summer night, \$2. Second Summer Session, day, \$1.

Commuting students have found that car pools are an economical way to travel between home and school. However, if the car pool rotates cars, each vehicle must be registered with the UT Arlington Police Department.

In the event that a student wishes to register two motor



vehicles in his own name, he must present proof of ownership of both vehicles, plus a receipt from the Business Office for the required amount of registration for the first car and a receipt for \$1 for registration of the second vehicle. The campus police office is open Monday through Friday from 6 a.m. to 10 p.m. Complete parking regulations are available at the office.

Students who are graduated at the end of the Fall Semester or who terminate their enrollment for other reasons at the end of the Fall Semester or beginning of the Spring Semester may receive a partial refund of the parking fee provided they turn in the remnants of their decal and that the transaction be made on or before the Spring Semester Census Date.

LATE REGISTRATION FEE

There shall be a compulsory fee for late registration of \$5 for the first day, plus \$2.50 for each additional late day, with the maximum amount being \$15 for any one semester or term.

REFUNDS

A student who withdraws from the University on or before the Census Date* of a semester will be refunded 50 per cent of fees paid. A student resigning after the Census Date will receive no refunds. This policy applies to tuition, laboratory fees, private instruction fees, building use fees, fees for extension courses, fees for the use of the bowling alley during regular physical training courses and residence hall room rent. The policy does not apply to other fees not specifically mentioned.

No refunds will be made until 10 days have elapsed from the time the fees were paid. No refund of special course fees will be made after the beginning of class work.

A student who has registered and paid the student activity fee for one regular semester and who is withdrawing from the University is entitled to a student yearbook if he pays an additional \$2.50. No additional fee is required, however, if the student is resigning and has paid student activity fees for two consecutive regular semesters.

The unused portion of the housing deposit will be refunded at the end of the lease period if the resident's room has been thoroughly cleaned and no damage has been incurred, inventory card completed and room key returned to the residence hall office. The Business Office will mail the refund to the student at the address specified on the inventory card.

*Sept. 16 in 1972 Fall Semester; Jan. 27 in 1973 Spring Semester; June 8 in 1973 Summer Semester (first day session and night session); July 20 in 1973 Summer Semester (second day session).

GRADUATION FEES

Upon graduation each student will be required to pay a \$2.50 diploma fee. This fee includes the cost of a diploma cover. For those students writing a thesis, there will be an additional fee of \$13.50 to cover the cost of binding three copies. One copy is placed in the University Archives, one in the Library and the third in the departmental files. Doctoral candidates will also be assessed a \$25.00 fee to pay for microfilming.

ASSISTANTSHIPS

Research and teaching assistantships are available. Such appointments may be held only by students officially admitted to the Graduate School. Prospective graduate students should see the appropriate chairman of department for further information.

THE LIBRARY

The Library, housed in a seven-story, air-conditioned building, contains a rapidly expanding collection of more than 450,000 books, including government documents and technical reports. In addition, the Library subscribes to more than 3,500 periodicals and newspapers and maintains a collection of recorded tapes, discs, microforms, motion pictures, film strips and slides for a total collection of library materials of over half a million items. Books are on open shelves, making it possible for students to locate research materials easily and to browse through related books. Seating for more than 1,700 students, about 1,000 at individual carrels, is provided.

The Library also maintains an audio-visual service with listening-recording booths, listening rooms and a projection room for motion pictures. Other services include provision of equipment for photographic duplication of printed materials and microfilm at a nominal charge and typewriters for use on a rental basis.

The Texas State AFL-CIO has designated the UT Arlington Library as official depository for its records. Many local unions are also depositing records. This valuable collection of archival material in the field of labor history is housed on the sixth floor.

Graduate students will find it helpful to become acquainted with the librarians assigned to their subject fields and to seek assistance in library research procedures. To supplement the library collection, the Inter-Library Loan Department attempts to locate and borrow research materials not in the UTA Library. For libraries in the Inter-University Council of the North Texas area, teletype inquiries will help to locate materials and to obtain much of it very quickly, often saving the student travel time to other campuses.

As an additional service to students enrolled in the doctoral program or whose current schedules include preparation of a master's degree thesis or its equivalent, the Inter-University Council Library Courtesy Card will enable such students to go directly to IUC libraries and to borrow materials needed in connection with their research. This card may be obtained by application to the Associate University Librarian. This courtesy card cannot be provided to all graduate students.

Library hours are:	Monday-Thursday	7:45 a.m.-11 p.m.
	Friday	7:45 a.m.- 5 p.m.
	Saturday	10:00 a.m.- 5 p.m.
	Sunday	2:00 p.m.-10 p.m.

DOCTOR OF PHILOSOPHY DEGREE

ENGINEERING

Programs leading to the Doctor of Philosophy degree in engineering are offered with opportunities for course work and research in the following areas: aerospace engineering, civil engineering, electrical engineering, engineering mechanics, industrial engineering, materials science, mechanical engineering, interdisciplinary areas.

GENERAL REQUIREMENTS

A student's program will consist of course work, independent study, and a dissertation in fields pertinent to his areas of interest in engineering. The program for each student will be planned by the student and a committee of faculty members.

ADMISSION

A student can participate in the doctoral program after he has satisfactorily completed 30 hours of graduate work at an accredited college or university. In addition, the student's undergraduate scholastic record and his score on the Graduate Record Examinations Aptitude Test must meet the requirements for admission to Graduate School. For the Doctor of Philosophy degree in engineering, the student's previous academic background should be in the field of engineering or a related field of science.

If an applicant holds a master's or higher degree (in engineering or a related field) from an accredited institution and has not yet taken the Graduate Record Examination, the graduate advisor in his major area may recommend that he be issued a temporary permit to register in the Graduate School. This permit is valid for one semester or one summer session only. It requires that the applicant take the Graduate Record Examinations Aptitude Test during the semester or summer session for which he is issued a permit to register.

EXAMINATIONS

The basic format of study for a doctoral student in engineering will involve the following three examinations:

- (1) **Diagnostic Examination**—to determine background information and suggested course work for the student. The diagnostic examination normally will not be given until the student has completed at least 30 hours past the bachelor's degree, including at least 12 hours at UT Arlington.
- (2) **Comprehensive Qualifying Examination**—to assure that the student has a sufficient background to begin his dissertation.
- (3) **Final Oral Examination**—over the dissertation and other parts of the student's program.



FOREIGN LANGUAGE REQUIREMENT

For the Doctor of Philosophy degree in engineering a reading knowledge of one foreign language applicable to the student's field of study is required. The foreign language requirement may be satisfied by one of the following methods:

- (1) Successfully passing a locally prepared examination.
- (2) Making an acceptable score on the Graduate School Foreign Language Test provided through the Educational Testing Service, Box 1502, Berkeley, Calif. 94701.
- (3) Petitioning to transfer credit for completion of the language requirement at another university.
- (4) Earning a grade of "B" or better in two semesters of a course in the language.

INQUIRIES AND APPLICATIONS

All doctoral students in engineering will be officially enrolled and advised in one of the departments of the School of Engineering. Each department has a graduate advisor who is the official delegate of the Dean of the Graduate School. A student whose area of interest logically falls within one of the areas listed earlier should address his initial inquiry to the graduate advisor or the chairman of the department containing that area. If the student is uncertain as to the department in which his interests lie, he should address his inquiry to the Associate Dean of Engineering, who will forward it to the appropriate graduate advisor(s). Graduate advisors and department chairmen to whom initial inquiries may be directed are:

Area	Graduate Advisor	Chairman
Aerospace Engineering	Dr. J. E. Fairchild	Prof. C. W. Files
Civil Engineering	Dr. J. E. Caffey	Dr. J. J. Haynes
Electrical Engineering	Dr. S. F. Crumb	Dr. F. L. Cash
Engineering Mechanics	Dr. K. L. Lawrence	
Industrial Engineering	Dr. H. W. Cortey	Dr. F. A. Meier
Materials Science	Dr. C. D. Wiseman	
Mechanical Engineering	Dr. C. C. Blackwell	Prof. C. W. Files
Interdisciplinary Areas	Dr. R. L. Tucker, Associate Dean of Engineering	

Formal applications for admission to Graduate School must be processed through the Office of the Registrar. Application forms can be obtained from the Office of the Registrar or from the Office of the Dean of the Graduate School. Completed application forms should be submitted to the Registrar who will review and evaluate each application and forward it to the appropriate graduate advisor.

Procedures for selection of supervising professor, selection of doctoral committee, publication of dissertation and other questions related to the doctoral program should be addressed to the appropriate graduate advisor.

PSYCHOLOGY

A program leading to the Doctor of Philosophy degree in psychology is offered with opportunities for course work and research in experimental psychology, in cooperation with Texas Christian University. The Psychology Department does not offer graduate programs in clinical or school psychology or in counseling, but courses may be taken at local institutions as part of the curriculum in experimental psychology at UT Arlington.

GENERAL REQUIREMENTS

The requirements for the Doctor of Philosophy degree ordinarily cannot be met in less than four years following the bachelor's degree, during which time the student must devote all his working time to his studies and research. Graduate credit earned at other institutions may be counted toward requirements for the higher degree if accepted by the major department and Graduate Assembly. However, the student must complete a minimum of two consecutive regular semesters totaling at least 24 semester hours in residence at The University of Texas at Arlington before undertaking dissertation research. This requirement may be waived in exceptional cases with the approval of the graduate advisor. Any semester during which a student is registered for at least nine semester hours will be counted as full residence provided that the student's full time is devoted to graduate work. The research and writing connected with the dissertation is understood to require at least one year of full-time work.

Upon entrance, each student will be advised by a faculty member who will review and monitor the student's completion of the M.A. core curriculum. Following completion of the M. A. core curriculum, or one year in residence for students entering with an M.A. from another institution, students may commit themselves to a major professor who will direct the remainder of the student's program. Students should consult the graduate advisor for selection of a major professor as soon as they have chosen a specialized area.

In conjunction with the major professor and the graduate advisor, the student will select a qualifying committee consisting of the major professor and at least two other faculty members. Two or more members of this committee must be members of the graduate faculty. The qualifying committee will be responsible for developing a specialized qualifying examination to assess the student's depth of knowledge in his specialized area as well as his ability to relate his specialty to other areas of psychology.

A major purpose of the doctoral program is to develop the student as a basic research psychologist. Most of the student's post-M.A. experience and much of his pre-M.A. experience will be in the laboratory. The student will serve in part as an apprentice to his major professor but is also expected to develop independence in his scientific perspective and thought.



The qualifying examination will normally be administered after two complete years of graduate work and will consist of a series of written examinations followed by a supplementary oral interview. The qualifying examination will be tailored to the student's needs.

After successfully completing the qualifying examinations and other basic requirements, the student will formally be admitted to candidacy for the doctor's degree. Before a student begins his dissertation research, he must submit a written prospectus for evaluation by the dissertation committee, graduate advisor and department chairman. The dissertation committee will normally, but not necessarily, consist of the qualifying committee plus one other faculty member. The prospectus may be submitted at any time; however, it is considered most appropriate that it be ready for submission after successful completion of the qualifying examination.

Upon completion of all other requirements, the candidate will be required to take a final oral examination covering the dissertation and related topics.

QUALIFYING EXAMINATION

A student's qualifying committee will develop a qualifying examination to be given the student. Each student will submit to his qualifying committee a list of topic areas and accompanying bibliographies which will define the range of the qualifying examination. The qualifying committee will approve, amend, or ask the student to justify his list of topic areas. The qualifying committee may approve the student's performance, suggest a further examination over some of the topic areas, or recommend a complete re-examination. A student will not be admitted to candidacy if he fails a re-examination.

DISSERTATION

After completing the qualifying exam and submitting a written prospectus to the graduate staff, the student will be formally admitted to candidacy and the graduate advisor will recommend to the Dean of the Graduate School the formal appointment of a dissertation committee consisting of at least three members from the major department and one additional member. A dissertation is required of all candidates for the Ph.D. degree. It must demonstrate that the candidate possesses superior research abilities, capacity for thoughtful and independent judgment and mastery of the literature relevant to his dissertation topic.

FINAL ORAL EXAMINATION

Upon completion of all other requirements the candidate will be required to take a final oral examination covering the dissertation and related fields. Only one re-examination will be permitted. If more than five years have elapsed since the date

of the qualifying examination taken by the candidate, he will be required to take another qualifying examination before the final oral examination can be scheduled.

COOPERATION WITH TEXAS CHRISTIAN UNIVERSITY

Due to their similarity in orientation and degree requirements, the psychology departments of The University of Texas at Arlington and Texas Christian University are cooperative. There is routine interchange of graduate teaching personnel and research facilities. Students enrolled at UT Arlington may elect to have one or more members of their qualifying and dissertation committees from among the TCU faculty although their major professor will normally be a member of the UT Arlington staff. Approved courses taken at other area institutions may also be applied to the graduate program requirements and faculty members of these institutions may also serve on committees. For further details, consult the graduate advisor.



MASTER'S DEGREES

GENERAL REGULATIONS

Residence—Each degree candidate must spend two semesters, or the equivalent, of full-time study in residence at The University of Texas at Arlington.

Registration—Each candidate for a graduate degree must register in the University, according to the official calendar for the registration of graduate students, during the semester or summer session in which he is to receive his degree. Any student who is receiving advice and assistance from a member of the faculty in the preparation of his thesis must register for the appropriate course even if the student is not present on the campus.

Registration for the master's thesis course must have covered a longer period than one semester (a summer session will be counted as equivalent to one-half of one semester) unless in an exceptional case the candidate's supervising committee unanimously recommends and the Dean of the Graduate School approves acceptance of the thesis after a shorter time of preparation.

DEGREE PLANS

There are three general programs leading to a master's degree at The University of Texas at Arlington. These are the degree program with a thesis, with thesis substitute and without thesis or substitute. Below are given the general regulations pertaining to each. Additional requirements or restrictions may be imposed by individual program areas and all three options may not be available in every field of study. For additional information, consult the individual program requirements in this Catalog or the appropriate Graduate Advisor.

Master's Degree with Thesis—A minimum of 30 semester credit hours is required including the thesis for which six hours credit is allowed. The total may include up to nine hours of advanced baccalaureate level work. The entire degree program must be approved by the appropriate Committee on Graduate Studies and the Dean of the Graduate School. The thesis must be approved by the instructor in charge and by a supervising committee appointed by the Dean; the thesis is subject also to final approval by the Dean.

Master's Degree with Thesis Substitute—In certain instances, substitutions for the formal thesis may be recommended to the Dean by the appropriate Committee on Graduate Studies. Such substitutions may include internship reports (where the internship is approved as an essential part of the graduate program by the Dean) or reports prepared in certain graduate seminar, conference or research courses. In such programs of work a minimum of 33 semester credit hours is required of which a maximum of six may be devoted to the thesis substitute. Thesis substitutes will be allowed only in those programs for which such an option is specifically indicated in the Graduate Catalog.

Master's Degree without Thesis—In a limited number of programs it is possible to obtain a degree without a formal thesis or thesis substitute. In such cases, a minimum of 36 semester credit hours is required, of which at least 24 must be in the major area of study and at least 27 at the graduate level. Degrees without a thesis or thesis substitute will be allowed only in those program areas which specifically indicate in the Graduate Catalog that such an option is available.

THE DEGREE OF MASTER OF ARTS (M.A.)

Prerequisite—For the degree of Master of Arts one prerequisite is a bachelor's degree from UT Arlington or its equivalent.

The prerequisite for majoring in any area is at least 12 semester hours of advanced courses in that area or school.

The Committee on Graduate Studies has the right to examine the candidate on the prerequisites to the major subject before his application for the degree is approved. The examination may be either written or oral, at the discretion of the committee.

Fields of study—UT Arlington is authorized to offer the Master of Arts degree in the following areas:

Biology	Government
Chemistry	History
Economics	Linguistics
English	Mathematics
Foreign Language	Physics
	Psychology

Requirements—The minimum requirements for the Master of Arts degree are the same as those given previously under the three possible degree plans.

Candidacy Requirements—Only those students who show promise of capacity to do work of the high standard set for graduate credit will be admitted as candidates for the master's degree. The departmental graduate studies committee of the student's major area has the right to inquire as to the applicant's undergraduate record and to examine him on the prerequisites for the major subject, and may require him to make up deficiencies in his undergraduate preparation before his application is approved. This examination may be either oral or written at the discretion of the departmental graduate studies committee. Application for candidacy must be approved by the Committee on Graduate Studies, Dean of the Graduate School and the major department graduate advisor.

THE DEGREE OF MASTER OF ARTS IN URBAN AFFAIRS (M.A.)

Prerequisite—An applicant for this degree must hold a bachelor's degree from UT Arlington or the equivalent and satisfy the requirements for admission to the Graduate School. Typically, but not exclusively, applicants will have undergraduate majors



in the social sciences: economics, government, sociology, history. Students with adequate preparation and interest in urban affairs may be admitted from such fields as law, architecture, planning, social psychology, engineering, and other disciplines.

Requirements—Satisfactory completion of 30 semester hours of course work and six hours for completion of a thesis or internship report will be required. These requirements will normally entail three regular semesters and one summer for full-time students. The Master's program in urban affairs is operated primarily for full-time students, but part-time students are not excluded.

THE DEGREE OF MASTER OF BUSINESS ADMINISTRATION (M.B.A.)

Prerequisite—A degree from The University of Texas at Arlington or an equivalent degree is required for admission. The general admission requirements of the Graduate School must also be met for admission to the Master of Business Administration program. A satisfactory score on the Graduate Record Examination or on the Admission Test for Graduate Study in Business is required. Foreign students whose native language is not English must satisfactorily complete the Test of English as a Foreign Language.

Requirements—The degree program has been designed to accommodate students of widely divergent backgrounds.

Background Category I: The first category includes those students who have had no prior academic work in business. They will enter the program of work and sequentially follow both the Foundation Program and the Advanced MBA Program (see explanation in the department's separate curricula elsewhere in this Catalog).

Background Category II: The second category includes those students with varying amounts of course work in business. For such individuals there is provided a mechanism for waiving those Foundation Program courses for which he has completed equivalent college work.

THE DEGREE OF MASTER OF PROFESSIONAL ACCOUNTING (M.P.A.)

Prerequisite—Admission to the Master of Professional Accounting degree program is based upon the general admission requirements of the Graduate School. A satisfactory score on either the Graduate Record Examination or the Advanced Test for Graduate Study in Business may qualify the applicant. In addition, the applicant must have satisfactorily completed the following minimum course requirements:

- (1) Principles of Accounting; Intermediate Accounting; Cost Accounting; Auditing; and a course in advanced accounting, accounting theory, or income tax. (This will normally involve a minimum of 21 semester hours.)
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- (2) A basic course in each of business law, management, marketing, finance, and statistics.
 - (3) Principles of Economics; Intermediate Macro-economic Theory; and Intermediate Micro-economic Theory. (This will normally involve a minimum of 12 semester hours.)
 - (4) College Algebra, and Mathematics for Business and Economic Analysis or the equivalent. (Representative topics covered in Mathematics for Business and Economic Analysis are linear equations, inequalities, probability, vectors, differentiation, and integration.)

Students with a bachelor's degree in business administration with a major in accounting will ordinarily have fulfilled the preceding requirements. A student not holding an undergraduate accounting degree will, with the assistance of his graduate advisor, determine the existing deficiencies and select appropriate remedial course work.

Requirements—The program requires a minimum of 30 semester hours of work. Not more than six may be represented by undergraduate courses, which must be approved by the student's graduate advisor. A minimum of 12 semester hours of accounting are to be selected from the courses offered. At least six semester hours in business administration and economics graduate courses are required, including an appropriate graduate course in statistics or management science. The program requirements include a six-hour thesis or an appropriate substitute.

MASTER OF SCIENCE (Geology)

The prerequisites and requirements of this degree are the same as those outlined for the Master of Arts degree.

THE DEGREE OF MASTER OF SCIENCE (Engineering)

Prerequisite—A degree of Bachelor of Science in engineering from The University of Texas at Arlington or the equivalent is prerequisite to the degree of Master of Science in engineering. A departmental committee of the student's major department may recommend additional requirements to be met by the student (see departmental requirements). These will be sent to the Dean for approval.

Fields of engineering study—The degree of Master of Science in engineering, with designation of the major branch in which it is given, is offered in the following:

- Aerospace Engineering
- Civil Engineering
- Electrical Engineering
- Engineering Mechanics
- Industrial Engineering
- Materials Science
- Mechanical Engineering

Candidacy requirements—A student desiring to become a candidate for the master's degree in any branch of engineering must



make application to the Dean of the Graduate School prior to the deadline of the semester in which he desires to receive this degree. He will be recognized as a candidate when he has satisfied the scholarship requirements given below and when his application and course of study have been approved by the Committee on Graduate Studies, Dean and the major department graduate advisor. Only those students who show promise of capacity to do work of the high standard set for graduate credit will be admitted as candidates for the master's degree. A departmental committee of the student's major area has the right to inquire as to the applicant's undergraduate record and to examine him on the prerequisites for the major subject and may require him to make up deficiencies in his undergraduate preparation before his application is approved. This examination may be either oral or written, at the discretion of the departmental committee.

Course requirements—Requirements in addition to those for the general master's degree are: At least one-half of the work, including a thesis or the equivalent, but not more than four-fifths, 24 semester hours, constitutes the major and must be done in one area of the School of Engineering. The remaining one-half, 15 semester hours, to one-fifth, six semester hours, depending upon the amount necessary to make up the total number of hours required, constitutes the minor, or minors, and must be selected outside the area in which the major is to be done but may be within the School of Engineering. Included in the major and minors must be at least 18 semester hours in engineering. The courses must be logically related and the whole section must be approved by the graduate advisor and the Dean.

THE DEGREE OF MASTER OF SCIENCE IN SOCIAL WORK (M.S. in S.W.)

Prerequisite—An applicant for this degree must hold a bachelor's degree from The University of Texas at Arlington or an equivalent degree, must meet the requirements for admission to the Graduate School, and should have an extensive background of general education. Intellectual maturity, emotional stability, and ability and interest in working with people are among the necessary personal qualifications. A personal interview may be required and letters of reference are required.

Applicants are admitted only at the beginning of the Fall Semester.

Requirements—The program leading to the degree of Master of Science in Social Work covers four semesters and requires the completion of 64 semester hours of graduate work. All work must be completed within one six-year period, and must be completed as a full-time student.

BIOLOGY

OBJECTIVE

The program leading to the degree of Master of Arts in biology is designed to provide graduate education which will prepare students to pursue vocations in industry, government, and teaching, and to pursue further graduate education leading to the doctorate.

DEGREE REQUIREMENTS

In order to be admitted to candidacy for the Master of Arts in biology a student must satisfy the general requirements stated elsewhere in this catalog and present to the department a satisfactory score on the Graduate Record Examination Advanced Test in biology. In addition, competency in a foreign language is required. This may be demonstrated by credit in an approved language at the sophomore level or by successful completion of an examination administered by the Foreign Language Department.

After completion of degree requirements the candidate will defend his thesis in a comprehensive examination to be administered by the student's committee at least three weeks prior to graduation.

5101. CURRENT TOPICS IN BIOLOGY (1-0) 1 hour credit—A seminar offering which deals with recent, significant biological research. May be repeated for credit. Prerequisite: permission of staff.

5210. EVOLUTION (2-0) 2 hours credit—A study of the origin of living systems and the mechanism of their evolution. Prerequisite: permission of instructor.

5211. HISTORY OF BIOLOGY (2-0) 2 hours credit—Trends of thought in the biological sciences with emphasis on notable contributors. Those philosophical systems dealing with biological concepts in western civilization are stressed. Prerequisite: permission of instructor.

5301. BACTERIAL METABOLISM (3-0) 3 hours credit — Study of the biosynthetic pathways producing major chemical components of the bacterial cell. Prerequisite: permission of instructor.

5320. BIOGEOGRAPHY (3-0) 3 hours credit — The role of natural and artificial transport, population pressure and limiting agencies are examined in the light of the patterns of distribution of living organisms. Prerequisite: permission of instructor.

5340. ANIMAL ECOLOGY (2-3) 3 hours credit—A study of the interrelationships of the environment and animal populations with emphasis on adaptive mechanisms, limiting factors and population phenomena. Prerequisite: permission of instructor. \$2 lab fee.

5341. PLANT ECOLOGY (2-3) 3 hours credit—Development and structure of plant communities; interactions of environmental factors and of organisms within a community; literature in plant ecology. Prerequisite: permission of instructor. \$2 lab fee.

5342. ICHTHYOLOGY (2-3) 3 hours credit — Classification, anatomy, physiology and natural history of fishes. Prerequisite: permission of instructor. \$4 lab fee.



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5343. **HERPETOLOGY** (2-3) 3 hours credit—Systematics, speciation and adaptive mechanisms of reptiles and amphibians. Prerequisite: permission of instructor. \$4 lab fee.
5344. **MAMMALOLOGY** (2-3) 3 hours credit—Taxonomy, population dynamics, distribution and evolution of mammals. The laboratory includes preparation and identification of specimens and the practice of field techniques. Prerequisite: permission of instructor. \$4 lab fee.
5345. **ORNITHOLOGY** (2-3) 3 hours credit—Anatomy, physiology, identification, population dynamics and ethology of birds. The laboratory includes field identification, preparation of specimens, and field study techniques. Prerequisite: permission of instructor. \$4 lab fee.
5348. **AQUATIC MICROBIOLOGY** (2-3) 3 hours credit — A consideration of the microorganisms occurring in aquatic environments and their activities under polluted and unpolluted conditions. Prerequisite: permission of instructor. \$2 lab fee.
5350. **PALYNOLOGY** (2-3) 3 hours credit—Emphasis is placed on modern pollen morphology and its application to systematics and pollen profiles. Prerequisite: permission of instructor. \$4 lab fee.
5353. **RADIOECOLOGY** (2-3) 3 hours credit—Emphasis is placed on radiotracer methodology and radiation effects in natural communities of organisms and in laboratory-contained communities. The ecological crisis created by demands for more energy will be discussed together with nuclear reactors, fusion power, activable tracers, symbiosis and mineral cycling. Prerequisite: biology 4353, or equivalent with permission of instructor. \$4 lab fee.
5359. **ADVANCED GENETICS** (2-3) 3 hours credit — In this course, linkage and crossing over, chromosome aberrations, gene mutations, extranuclear inheritance, hereditary factors and development, and certain aspects of microbial genetics will be considered. The laboratory will include experiments with *Drosophila* and *Neurospora*. Prerequisite: permission of instructor. \$4 lab fee.
- 5291, 5391. **INDIVIDUAL PROBLEMS IN BIOLOGY** 2 or 3 hours credit—Individual research projects supervised by a staff member. Prerequisite: permission of staff.
- 5193-5693. **RESEARCH IN BIOLOGY** 1-6 hours credit—This is a conference course in which the student undertakes intensive investigation of topics under the supervision of a staff member. Prerequisite: permission of instructor.
5446. **GENERAL PHYSIOLOGY** (3-3) 4 hours credit—This is a study of functional mechanisms as they pertain to transport and transformation of energy in living systems. Characteristics of excitable tissues are studied including mechanisms of muscle contraction and impulse propagation. Prerequisite: permission of instructor. \$8 lab fee.
5447. **ADVANCED BACTERIOLOGY** (3-3) 4 hours credit — Chemical composition, structure, growth and variation of the procaryotic cell. Prerequisite: permission of instructor. \$5 lab fee.
5451. **ACAROLOGY** (3-3) 4 hours credit — The taxonomy of mites and their near relatives, with particular emphasis on identification and biology. The laboratory deals with collection and processing of specimens as well as preparation of a collection. Prerequisite: permission of instructor. \$4 lab fee.
5698. **THESIS** 6 hours credit—Prerequisite: permission of staff.
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The following courses may be taken for graduate credit subject to approval by the student's committee and the limitations stated in the general requirements for the Master of Arts degree.

4340. PLANT PHYSIOLOGY (2-3) 3 hours credit—This course pertains to the relationship of plant metabolism to cellular organization and the interaction of environmental, metabolic and hormonal factors on vegetative growth and reproduction. Laboratory techniques applicable to specific problems in growth, development, nutrition, and metabolism are stressed. Prerequisite: general botany and one year of chemistry. \$4 lab fee.

4342. BACTERIAL ECOLOGY (2-3) 3 hours credit—The presentation considers the role performed by bacteria in various types of environments. Major emphasis will be given to the ecosystem concept. Laboratory activity will be directed toward studying and characterizing activities of bacteria from natural environments. Prerequisite: 12 hours of biology including microbiology, or permission of instructor. \$4 lab fee.

4348. AQUATIC BIOLOGY (2-3) 3 hours credit—This course deals with biological, physical and chemical interrelationships in fresh waters. The lab is designed to acquaint the student with pond, stream and reservoir habitats of the Southwest. Prerequisite: six hours of general inorganic chemistry plus 12 hours of biology including three hours of ecology. \$2 lab fee.

4353. RADIATION BIOLOGY (2-3) 3 hours credit—Studies of types of ionizing radiations, radioisotopes, half-life and radiological safety procedures will be followed by consideration of the effects of ionizing radiation on plants and animals at the organism, cellular and biochemical levels. The laboratory deals with use of radioactive isotopes in biological subjects, measurement, techniques of handling and study of radiation damage to living tissues. Prerequisite: 18 hours of biological science, six hours of physics and six of chemistry. \$4 lab fee.

4357. RESEARCH METHODS IN CELL BIOLOGY (2-3) 3 hours credit—This course surveys current methods of studying cells and tissues. The topics covered include the principles of light microscopy including phase interference, and fluorescence microscopy, the principles of electron microscopy, tissue preparation methods for both light and electron microscopy, staining, histochemical and cytochemical techniques, radioautography, fluorescent protein tracing, tissue and organ culture, and cell fractionation. Prerequisite: 18 hours of biological science, general physics, general chemistry or equivalent, organic chemistry and senior standing. \$2 lab fee.

4360. PHYSIOLOGY II (2-3) 3 hours credit—This is a course in which selected physiological processes of vertebrate organisms will be studied in depth. A systems analysis approach will be utilized in the study of homeostatic mechanisms at the tissue and organ-system level of organization. Laboratory exercises will include development of model systems and experimental testing of alterations in various parameters of the models. Prerequisite: biology 3340 or its equivalent, one year of calculus or consent of instructor. \$4 lab fee.

4440. BACTERIAL PHYSIOLOGY (3-3) 4 hours credit—The presentation is an advanced level introduction to nutrition, composition, growth, enzymes and fermentative capacities of bacteria. Prerequisite: 12 hours of biology including microbiology and organic chemistry, or permission of instructor. \$4 lab fee.



4680. FIELD BIOLOGY 6 hours credit—Studies in the behavior, ecology, and life histories of organisms under natural conditions. Offered only in the summer session. Prerequisite: senior or graduate standing. \$8 lab fee. A special fee may be assessed.

SUPPORTING COURSES

Supporting work outside the student's major area may be taken in botany, chemistry, geology, mathematics, microbiology, physics, and zoology. Approved courses in civil engineering, philosophy, psychology, and sociology may also be taken in support of the student's program.

CHEMISTRY

OBJECTIVE

The Master of Arts Degree in chemistry is awarded to students who demonstrate knowledge of the essential disciplines of chemistry and show superior attainment in a chosen field of research.

DEGREE REQUIREMENTS

A candidate for graduate study must satisfy the general admission requirements of the Graduate School and his academic record must show preparation for advanced work in chemistry.

A minimum of 30 semester hours exclusive of seminar is required. Six hours will be earned by completion of a thesis. A minimum of 18 hours in chemistry from courses listed in the graduate catalog will be required. Six hours may be senior division or graduate courses in a science or engineering subject selected by the candidate with the approval of the Department of Chemistry graduate advisor.

5101. SEMINAR IN CHEMISTRY (1-0) 1 hour credit — Required of all graduate students in each semester of residence.

5301. ADVANCED PHYSICAL CHEMISTRY (3-0) 3 hours credit—Prerequisite: chemistry 3442.

5303. SELECTED TOPICS IN ADVANCED PHYSICAL CHEMISTRY (3-0) 3 hours credit—May be repeated for credit when topics vary. Prerequisite: chemistry 5301, or equivalent with permission of instructor.

5305. ADVANCED ORGANIC CHEMISTRY (3-0) 3 hours credit — Prerequisite: chemistry 3454 (Organic Chemistry), chemistry 3442.

5307. SELECTED TOPICS IN ADVANCED ORGANIC CHEMISTRY (3-0) 3 hours credit—May be repeated for credit when topics vary. Prerequisite: chemistry 5305, or equivalent with permission of instructor.

5311. ADVANCED ANALYTICAL CHEMISTRY (3-0) 3 hours credit—Prerequisite: chemistry 4461.

5313. SELECTED TOPICS IN ADVANCED ANALYTICAL CHEMISTRY (3-0) 3 hours credit—May be repeated for credit when topics vary. Prerequisite: chemistry 5311, or equivalent with permission of instructor.

5315. ADVANCED INORGANIC CHEMISTRY (3-0) 3 hours credit—Prerequisite: chemistry 4456 or equivalent.

5317. SELECTED TOPICS IN ADVANCED INORGANIC CHEMISTRY (3-0) 3 hours credit—May be repeated for credit when topics vary. Prerequisite: chemistry 5315, or equivalent with permission of instructor.

5321. ADVANCED BIOCHEMISTRY (3-0) 3 hours credit — Prerequisite: chemistry 4312 or equivalent.

5323. SELECTED TOPICS IN BIOCHEMISTRY (3-0) 3 hours credit—Prerequisite: chemistry 5321, or equivalent with permission of instructor.

5331. FLAME CHEMISTRY (3-0) 3 hours credit—A discussion of fundamental chemical species and reactions occurring in flames; appropriate theoretical equilibrium calculations; and techniques of sampling and chemical analysis used for combustion sources. Prerequisite: permission of instructor.



5191-5691. READINGS IN CHEMISTRY (variable credit from one to six hours as arranged)—A conference course which may be repeated for credit, with credit granted according to work performed. Prerequisite: permission of instructor.

5192-5692. RESEARCH IN CHEMISTRY (variable credit from one to six hours as arranged)—A conference course with laboratory with credit granted according to work performed. May be repeated for credit. Prerequisite: permission of instructor.

5698. THESIS 6 hours credit — Prerequisite: permission of instructor.

A limited number of the following courses may be applicable toward the graduate program if approved in advance by the graduate advisor.

3441. PHYSICAL CHEMISTRY (3-3) 4 hours credit — Solids, liquids, gases, thermochemistry, thermodynamics, and solutions. Prerequisites: chemistry 2451 (Quantitative Analysis) or permission of instructor, mathematics 2325 (Calculus II) or 2335 (Analysis III), eight hours of physics. \$8 lab fee.

3442. PHYSICAL CHEMISTRY (3-3) 4 hours credit—Chemical equilibria, chemical kinetics, electrochemistry, colloids, quantum mechanics, and nuclear chemistry. Prerequisite: chemistry 3441. \$8 lab fee.

4182. LABORATORY TECHNIQUES IN BIOCHEMISTRY (0-4) 1 hour credit—This course is designed to introduce the student to biochemical laboratory methods and will include a practical approach to the properties of carbohydrates, proteins, enzymes and nucleotides. Prerequisite: chemistry 4311.

4216. PROPERTIES AND REACTIONS OF INORGANIC SYSTEMS (2-0) 2 hours credit—Chemistry of the elements, correlations of use in predicting chemical behavior, physical and chemical methods of structure determination. Prerequisite: chemistry 4315.

4301. ANALYTICAL CHEMISTRY (3-0) 3 hours credit— This is a study of sampling and separation techniques including decomposition and dissolution and physical and chemical methods of separation. Prerequisite: chemistry 3442.

4311. GENERAL BIOCHEMISTRY (3-0) 3 hours credit—Applications of chemistry to life processes. Prerequisite: chemistry 3454 (Organic Chemistry).

4312. GENERAL BIOCHEMISTRY (3-0) 3 hours credit—Further study of the relation of chemistry to life processes. Prerequisite: chemistry 4311.

4315. PHYSICAL INORGANIC CHEMISTRY (3-0) 3 hours credit—Electronic structure, bonding, acid-base theory, structure of ionic and molecular compounds, equilibria, reaction mechanisms, stabilization of oxidation states and periodicity of chemical behavior. Prerequisite: chemistry 3441. Corequisite: chemistry 3442.

4321. PHYSICAL ORGANIC CHEMISTRY (3-0) 3 hours credit —Acidity functions, general and specific acid and base catalysis, kinetic methods, linear free energy relationships, and solvent effects will be studied as they apply to organic reaction mechanisms. Prerequisite: chemistry 3442 and 3454 (Organic Chemistry).

4331. PHYSICAL CHEMISTRY (3-0) 3 hours credit—This is a study of selected topics in physical chemistry including quantum theory of atoms and molecules, statistical mechanics and

absolute reaction rate theory. Numerical methods as well as theoretical consideration are emphasized. Prerequisite: chemistry 3442 or permission of the instructor.

4346. **ADVANCED SYNTHETIC METHODS (1-6)** 3 hours credit—Methods and techniques for the synthesis and characterization of organic, inorganic, and organometallic compounds. Prerequisite: chemistry 4216.

4461. **INSTRUMENTAL ANALYSIS (2-6)** 4 hours credit — Principles involved in the operation of modern analytical instruments and the laboratory use of such instruments. Prerequisite: chemistry 3442. \$8 lab fee.



ECONOMICS

OBJECTIVE

The general purpose of the Master of Arts in economics program is to provide students an opportunity to obtain a better understanding of the economic aspects of modern society and a greater depth of training in the discipline of economic science than is possible in a baccalaureate degree program. Specific objectives of the program are to prepare students for careers in government, business, research, and teaching and for further graduate study.

DEGREE REQUIREMENTS

Applicants meeting the general admission requirements of the Graduate School are automatically admitted to the program. Other applicants may be admitted if approved by the graduate advisor in economics and the Graduate Dean. Applicants admitted but not having 12 semester hours of advanced courses in economics or not meeting prerequisite requirements for core courses are admitted subject to conditions assessed by the graduate advisor in economics.

A minimum of 30 semester hours, including credit for the thesis, is required. The thesis is normally six hours credit, but may be extended to nine hours credit with permission of the graduate advisor in economics. The total may include up to 12 hours in supporting subjects within or outside the department. Nine hours of the total course work may be advanced undergraduate courses, but not more than six hours of such courses may be in either the major or the supporting area. A minimum of 18 hours, including the thesis, shall be taken in economics, including a core of economics 5306, 5310, and 5312. Enrollment in courses, other than this core, will be with the approval of the graduate advisor in economics.

5301. ECONOMIC DEVELOPMENT (3-0) 3 hours credit—Analysis of selected problems in the economic growth of countries at various stages of maturity. Prerequisite: permission of graduate advisor in economics.

5304. ADVANCED PUBLIC FINANCE (3-0) 3 hours credit—Application of welfare theory to government budget policy in terms of resource allocation and income distribution; economic effects of particular taxes. Prerequisite: permission of graduate advisor in economics.

5306. STATISTICAL METHODS IN ECONOMICS (3-0) 3 hours credit—This course deals primarily with the application of statistics to economics. Subject matter includes index numbers, the analysis of economic time series, the measurement of economic aggregates, and the application of regression and correlation analysis to economic problems. Prerequisite: permission of graduate advisor.

5308. ECONOMIC HISTORY OF THE UNITED STATES (3-0) 3 hours credit—An analysis of the development of the major economic institutions accompanying the industrial growth of the U. S. economy in the 19th and 20th Centuries. Prerequisite: permission of graduate advisor in economics.

5309. ECONOMIC ANALYSIS I (3-0) 3 hours credit—This is an accelerated course in fundamental economic analysis for students enrolled in graduate programs other than the Master of Arts in economics. The basic analytical concepts of price theory and their application to managerial decisions are developed. The course includes the theory of consumer behavior, theory of the firm, and market structure. This course cannot be counted for credit toward the M.A. economics degree.

5310. MICROECONOMIC THEORY (3-0) 3 hours credit — Theories of consumer choice and of the firm; marginal productivity and functional distribution; general equilibrium of production, consumption, and exchange. Prerequisite: permission of graduate advisor in economics.

5311. ECONOMIC ANALYSIS II (3-0) 3 hours credit — This is an accelerated course in fundamental economics for students enrolled in graduate programs other than the Master of Arts in economics. The ideas of economics — related to aggregate production, income, the under-utilization or over-utilization of resources, and the operation of the monetary system — are developed carefully. This course cannot be counted for credit toward the M.A. economics degree.

5312. MACROECONOMIC THEORY (3-0) 3 hours credit — A study of the aggregate approach to the economy and the tools of analysis used for the solving of national economic problems. Prerequisite: permission of graduate advisor in economics.

5313. MANAGERIAL ECONOMICS (3-0) 3 hours credit—Application of economic analysis in formulating business decisions, drawing upon the theoretical foundations of the concepts of demand, cost, production, profits, and competition, with special emphasis on case studies. Prerequisite: economics 3310 or 5309.

5316. MATHEMATICAL ECONOMICS (3-0) 3 hours credit—Mathematical methods useful in economics; differential calculus; determinants and matrices. Prerequisite: permission of graduate advisor in economics.

5321. INTERNATIONAL ECONOMICS (3-0) 3 hours credit—International trade and policy issues; balance-of-payments and adjustment processes; international monetary arrangements; contemporary problems in international economics. Prerequisite: permission of graduate advisor in economics.

5324. MONETARY AND FISCAL ECONOMICS (3-0) 3 hours credit — Analysis of the effects of central bank policy and government spending and taxation on income and employment; public debt management. Prerequisite: permission of graduate advisor in economics.

5326. HISTORY OF ECONOMIC THOUGHT (3-0) 3 hours credit — Traces the development of economic ideas and systems of thought from earliest times to the founding of political economy as a distinct discipline, with emphasis upon the classical school, marginalism, socialism, institutionalism, and the Keynesian analysis. The various schools of thought are set against the social and political events of their times. Prerequisite: permission of graduate advisor in economics.

5331. URBAN ECONOMICS (3-0) 3 hours credit—An analysis of urban problems and goals with special attention given to those factors that influence the economic development of urban communities and the quality of urban life. Attention is given to



policy formulation as a means for urban problem solving. Prerequisite: economics 2305 and 2306 (Principles of Economics) and consent of instructor.

5335. ADVANCED LABOR ECONOMICS (3-0) 3 hours credit — An analysis of the major forces influencing the supply of and the demand for labor and the economic rationale governing the determination of factor income. Prerequisite: permission of graduate advisor in economics.

5336. ECONOMETRICS (3-0) 3 hours credit — Adaption of mathematical and statistical methods to analysis of economic problems; estimation problems in time-series, e. g., autocorrelation, least square bias and colinearity; contemporary econometric work. Prerequisite: permission of graduate advisor in economics.

5338. SEMINAR (3-0) 3 hours credit — Topics covered to vary from semester to semester. Prerequisite: permission of graduate advisor in economics.

5191, 5291, 5391. RESEARCH AND SPECIAL TOPICS IN ECONOMICS (Variable credit as arranged).

5398, 5698, or 5998. THESIS 3, 6 or 9 hours credit. Prerequisite: permission of graduate advisor in economics.

ACCOUNTING

5301. ACCOUNTING ANALYSIS I (3-0) 3 hours credit — Concepts, terminology, statements, measurement of income, basic cost accounting; profit planning and control; statement analysis. Prerequisite: permission of graduate advisor in economics.

5302. ACCOUNTING ANALYSIS II (3-0) 3 hours credit — Continuation of Accounting Analysis I. Prerequisite: accounting 5301 or equivalent and permission of graduate advisor in economics.

MANAGEMENT

5311. BEHAVIORAL SCIENCES IN MANAGEMENT (3-0) 3 hours credit — An examination of the managerial uses of concepts and findings from the disciplines of sociology, psychology and cultural anthropology. Consideration is given to the functions of the personnel administration area, and to supervision-leadership, morale motivation problems, communication and labor relations. Prerequisite: permission of instructor and graduate advisor in economics.

A limited number of the following advanced undergraduate courses may be applicable toward the graduate program if approved in advance by the graduate advisor.

ECONOMICS

4301. THE ECONOMICS OF GROWTH AND DEVELOPMENT (3-0) 3 hours credit — This course surveys theoretical explanations and historical factors of economic development and underdevelopment. Policies for accelerating development in poor countries and in rich countries are analyzed. Prerequisite: economics 2305 and 2306 (Principles of Economics) or equivalent.

4304. STATE AND LOCAL FINANCE (3-0) 3 hours credit — A study of fiscal problems at the state and local levels of govern-

ment including the division of functions and revenues between these levels of government, the taxing, spending, and borrowing structures of state and local government. Prerequisite: economics 3304 (Public Finance) or equivalent.

4313. PUBLIC UTILITY ECONOMICS (3-0) 3 hours credit — The character of public utility industries is examined with emphasis on regulations, valuation, rate-making and financing. Legislative enactments, the growth of regulatory commissions and significant judicial decisions are surveyed to provide a framework for understanding the major problems in this field. Prerequisite: economics 2305 and 2306 (Principles of Economics) or equivalent.

4320. REGIONAL ECONOMIC ANALYSIS (3-0) 3 hours credit — The analysis of intranational regions including consideration of regional accounts, regional income determination, regional growth, interregional trade, and public policy for development of regions. Prerequisite: economics 3312 (Macroeconomics) or equivalent.

4321. INTERNATIONAL TRADE (3-0) 3 hours credit—This course examines the principles underlying economic relations among nations. Emphasis is placed upon investment and capital movements, foreign exchange, balance of trade, population changes, tariff policies and recent developments in international trade or monetary policies. Prerequisite: economics 2305 and 2306 (Principles of Economics) or equivalent.

4322. INTERNATIONAL FINANCIAL RELATIONS (3-0) 3 hours credit—This course examines the nature and instruments of international payments. Emphasis is placed upon international financial institutions and arrangements. Prerequisite: three hours of economics beyond 2305 and 2306 (Principles of Economics).

4324. MONETARY AND FISCAL POLICY (3-0) 3 hours credit —This course involves study of the effects of money on production and national income; quantity and commodity theories of money; various theories of interest rates; instruments and policies of Federal Reserve monetary action; proposals for monetary reform. Central bank systems are compared. Prerequisite: economics 2305 and 2306 (Principles of Economics) or equivalent.

4325. ECONOMIC FLUCTUATIONS AND FORECASTING (3-0) 3 hours credit—The purpose of this course is to examine the phenomenon of economic fluctuations, utilizing historical and theoretical points of view to develop an understanding and appreciation of the significance of Gross National Product calculations and their implication for levels of business activity. Prerequisite: economics 2305 (Principles of Economics), three hours of advanced economics and junior standing or consent of instructor.

4335. LABOR RELATIONS AND THE LAW (3-0) 3 hours credit—Historical development of public policy toward labor standards and regulation of the employer-employee relationship. Laws, court decisions, and administrative decisions affecting unions and collective bargaining; laws regulating wages, hours, and working conditions. Analysis of economic implications of legislation. Prerequisite: economics 3335 or consent of the instructor.

ACCOUNTING

4311. ADVANCED ACCOUNTING (3-0) 3 hours credit—This course is a study of advanced accounting theory and procedures



applicable to partnerships, installment and consignment sales, branch office operations and consolidations. Prerequisite: accounting 3312 (Intermediate Accounting) or equivalent.

4313. ACCOUNTING THEORY (3-0) 3 hours credit — An examination of the fundamental structure of accounting theory through the study of the concepts, principles, and postulates upon which accounting theory rests. Prerequisite: permission of instructor.

BUSINESS ADMINISTRATION

4322. BUSINESS POLICY AND ADMINISTRATION (3-0) 3 hours credit — This course provides an integrative learning experience through the solving of numerous business policy cases and the use of other decision simulation methods. Policy consideration will be given to the organic business functions and to management functions with particular attention to administrative control. Prerequisite: three hours of management.

FINANCE

4313. INVESTMENTS (3-0) 3 hours credit — This course deals with the principles governing the proper investment of personal and institutional funds, information sources, security analysis, exchanges and regulations. Prerequisite: finance 3313 (Business Finance).

4314. FINANCIAL INSTITUTIONS AND MARKETS (3-0) 3 hours credit — Study of the flow of funds in the aggregate financial system, the structure of financial markets and the interaction of aggregate financial factors and the policies and operations of financial institutions. Topics to be covered are accounting for flow of funds, structure and interaction of demand and supply of funds in money and capital markets, structure of interest rates, the role of financial intermediaries in the financial system, impact of Federal Reserve and U. S. Treasury monetary policies on the money market and impact of government regulation of securities markets on capital markets. Prerequisite: economics 3303 (Money and Banking) and finance 3313 (Business Finance).

4315. ADVANCED BUSINESS FINANCIAL ANALYSIS (3-0) 3 hours credit—The purpose of this course is to develop an ability to recognize financial problems, analyze financial data, formulate alternative solutions, and render financial decisions. Case materials are used in studying financial problems. Types of financial problems studied are management of investment in current and fixed assets, planning of profits, forecasting of cash requirements, capital budgeting, planning of methods of financing and capital structure, dividend policy, valuation of assets and mergers. Prerequisite: finance 3313 (Business Finance).

MARKETING

4311. MARKETING RESEARCH (3-0) 3 hours credit — Students investigate the methods and techniques used for the solution of marketing problems. A combination of text readings and case analysis offers a management perspective on the contribution research can make to the solution of marketing problems. Areas covered include research design, the use of statistical

sampling in data collection, sales analysis, advertising and new product development. Prerequisite: marketing 3321 (Principles of Marketing) and business administration 3321 (Business Statistics).

4322. ADVANCED MARKETING (3-0) 3 hours credit — This is a capstone course which stresses the integration of the firm's marketing program. Emphasis is placed on the investigation of markets, market behavior, new product planning, dynamics of channel interaction, pricing policy, effectiveness of promotional expenditures and government influence on marketing action. Prerequisite: marketing 3321 (Principles of Marketing) and six semester hours of marketing.

ENGLISH

OBJECTIVE

Study toward the Master of Arts in English at The University of Texas at Arlington aims at professional competency in literature and language. In literature the student is directed toward sound critical judgment of English and American writings in context. He is trained in the techniques of research, teaching, and writing as preparation for a career suited to his personal inclinations. In language he is schooled in historical and contemporary approaches to the development and description of English. The aims are an understanding of linguistic phenomena and the application of this knowledge to teaching at various levels and to using the language precisely, appropriately, and imaginatively. Sufficient variety in course offerings allows the student to direct his degree plan toward a terminal Master of Arts degree or toward further graduate study.

DEGREE REQUIREMENTS

For the Master of Arts degree in English, 30 semester hours are required: a six-hour thesis and 24 hours of course work at the 5000 level.

The course work of the master's candidate will be approved in advance by the graduate advisor, who should be consulted on all problems related to the student's program. Three regular counseling sessions will be scheduled each year, in December, April, and August. Notification of specific time and place will be sent to all students who have been accepted in the graduate program.

Each student will select his thesis topic in consultation with the supervising professor. Before the student registers for English 5698, the names of the readers, the title of the thesis, a prospectus, and bibliography of major sources must be approved by the Graduate Studies Committee.

With the prior permission of the graduate advisor, the master's candidate may submit six hours of course work in an appropriate graduate minor field outside the Department of English.

Graduate standing is prerequisite for the courses listed below. Any course may be repeated for credit as often as its subject matter changes.

- 5301. MEDIEVAL ENGLISH LITERATURE (3-0) 3 hours credit.
 - 5302. TUDOR AND JACOBAN LITERATURE (3-0) 3 hours credit.
 - 5303. 17TH-CENTURY ENGLISH LITERATURE (3-0) 3 hours credit.
 - 5304. 18TH-CENTURY ENGLISH LITERATURE (3-0) 3 hours credit.
 - 5305. THE ROMANTIC PERIOD (3-0) 3 hours credit.
 - 5306. THE VICTORIAN PERIOD (3-0) 3 hours credit.
 - 5307. 20TH-CENTURY ENGLISH LITERATURE (3-0) 3 hours credit.
 - 5308. SHAKESPEARE (3-0) 3 hours credit.
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5309. **ENGLISH DRAMA EXCLUSIVE OF SHAKESPEARE** (3-0) 3 hours credit.
5310. **THE ENGLISH NOVEL** (3-0) 3 hours credit.
5321. **AMERICAN LITERATURE, 1800-1860** (3-0) 3 hours credit.
5322. **AMERICAN LITERATURE, 1860-1910** (3-0) 3 hours credit.
5323. **AMERICAN LITERATURE, 1910 TO THE PRESENT** (3-0) 3 hours credit.
5330. **THE COMPUTER AND NATURAL LANGUAGE** (3-0) 3 hours credit—This course is also listed as Linguistics 5330 and Computer Science 5330. Credit will be granted for one of the courses only.
5331. **HISTORY OF THE ENGLISH LANGUAGE** (3-0) 3 hours credit.
5333. **APPLIED ENGLISH LINGUISTICS** (3-0) 3 hours credit.
5335. **RESEARCH METHODS AND BIBLIOGRAPHY** (3-0) 3 hours credit.
5391. **GRADUATE READINGS IN LITERATURE** (3-0) 3 hours credit.
5698. **THESIS** 6 hours credit — The graduate student must be registered for this course (a) when in consultation over the thesis with the supervisory committee, and (b) in the semester or term in which the Master of Arts degree will be conferred. Prerequisite: permission of graduate advisor in English.

FOREIGN LANGUAGES AND LINGUISTICS

OBJECTIVES

Foreign Languages

The Master of Arts degree program in foreign languages is designed to enhance the student's competence in the language and literature of his major language field. The specific objectives are to prepare the student for a career in teaching or in any area in private or public life in which the knowledge of a foreign language is essential, and to help him to develop the techniques of independent research necessary for work beyond the master's level.

Courses are available in French, German, Portuguese, Russian, Spanish, and linguistics. The program will permit Master of Arts degrees in French, Spanish, and German.

Linguistics

The Master of Arts degree program in linguistics is primarily designed for those with a background in one or more foreign languages and/or a background in the linguistic aspects of the English language, but others who are willing to fulfill the listed prerequisites are invited to apply. Linguistic science has applications in language learning and teaching, literary analysis and criticism, psychology, communication, anthropology, philosophy, neurology, sociology, and some other areas.

DEGREE REQUIREMENTS

A total of 30 semester hours beyond the bachelor's degree (24 hours of course work plus a six-hour thesis*) is required.

There shall be an examination, oral and/or written, on the thesis, course work, and general area of study.

A minor is required for a degree in foreign languages. The minor may be in an appropriate area outside the Department of Foreign Languages, or in linguistics, or in an appropriate language or literature area within the department.

Foreign Languages

Those wishing to major in a foreign language or literature must upon admission have a baccalaureate degree with a major in that foreign language or have a minimum of 18 advanced hours, or the equivalent in language proficiency and course content.

A knowledge of a second foreign language will be required, including listening, speaking, reading, and writing skills, as demonstrated by the successful completion of two semesters of course work beyond the intermediate level or by an appropriate examination.

*A substantial research paper and six additional graduate hours may, under certain conditions, substitute for a formal thesis.

Linguistics

Candidates upon admission or early in the graduate program must present the following prerequisite undergraduate courses (or pass appropriate examinations): introduction to descriptive linguistics, introduction to historical and comparative linguistics, history of a language, advanced grammar of a language, two upper-level intensive courses in a non-Indo-European language (or four lower-level courses), a course in phonological analysis, and a course in grammatical analysis. Up to nine hours of these prerequisite courses may be taken for credit toward a graduate degree.

FRENCH

5135. INTRODUCTION TO ROMANCE BIBLIOGRAPHY AND METHODS OF RESEARCH (1-0) 1 hour credit — This course is designed to aid graduate students in preparing theses or dissertations. Required for all Master of Arts degree candidates.

5300. HISTORY OF THE FRENCH LANGUAGE (3-0) 3 hours credit.

5301. OLD PROVENCIAL (3-0) 3 hours credit—A study of the phonology of Old Provençal followed by readings in Old Provençal love lyrics.

5304. STUDIES IN FRENCH LINGUISTICS (3-0) 3 hours credit.

5315. STRUCTURE OF THE FRENCH LANGUAGE (3-0) 3 hours credit.

5320. STUDIES IN FRENCH LITERATURE THROUGH THE RENAISSANCE (3-0) 3 hours credit.

5325. STUDIES IN FRENCH LITERATURE OF THE 17TH AND 18TH CENTURIES (3-0) 3 hours credit.

5330. STUDIES IN FRENCH LITERATURE OF THE 19TH AND 20TH CENTURIES (3-0) 3 hours credit.

5331. FRENCH FOR GRADUATE STUDENTS (3-0) 3 hours credit—This course is designed for graduate students preparing for the foreign language reading examinations. The basic elements of grammar and syntax are presented with emphasis on rapid and accurate translation. This course may not be counted toward the fulfillment of the undergraduate language requirement. Graduate students majoring or minoring in French may not take this course for credit.

5391. CONFERENCE COURSE IN FRENCH LINGUISTICS AND LITERATURE 3 hours credit.

5698. THESIS 6 hours credit.

A course may be repeated for credit when the topic changes.

GERMAN

5300. HISTORY OF THE GERMAN LANGUAGE (3-0) 3 hours credit.

5304. TOPICS IN GERMANIC LINGUISTICS AND PHILOLOGY (3-0) 3 hours credit.



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5305. MIDDLE HIGH GERMAN I (3-0) 3 hours credit— A study of the language and an introduction to the literature of Middle High German.
5306. MIDDLE HIGH GERMAN II (3-0) 3 hours credit—The Middle High German Epic. Prerequisite: German 5305.
5317. METHODS IN THE STUDY OF GERMAN LITERATURE AND LINGUISTICS (Fundamentals of Scholarship) (3-0) 3 hours credit.
5318. BACKGROUND OF GERMAN CULTURE (3-0) 3 hours credit.
5320. TOPICS IN GERMAN LITERATURE (3-0) 3 hours credit.
5321. GERMAN DRAMA I (3-0) 3 hours credit—11th to 19th century.
5322. GERMAN DRAMA II (3-0) 3 hours credit—19th and 20th centuries.
5323. GERMAN PROSE I (3-0) 3 hours credit—14th to 19th century.
5324. GERMAN PROSE II (3-0) 3 hours credit—19th and 20th centuries.
5325. GERMAN LYRIC (3-0) 3 hours credit.
5331. GERMAN FOR GRADUATE STUDENTS (3-0) 3 hours credit—This course is designed for graduate students preparing for the foreign language reading examinations. The basic elements of grammar and syntax are presented with emphasis on rapid and accurate translation. This course may not be counted toward the fulfillment of the undergraduate language requirement. Graduate students majoring or minoring in German may not take this course for credit.
5391. CONFERENCE COURSE IN GERMANIC LINGUISTICS AND LITERATURE 3 hours credit.
5698. THESIS 6 hours credit.
- A course may be repeated for credit when the topic changes.

SPANISH

5135. INTRODUCTION TO ROMANCE BIBLIOGRAPHY AND METHODS OF RESEARCH (1-0) 1 hour credit — This course is designed to aid graduate students in preparing theses or dissertations. Required for all Master of Arts degree candidates.
5300. HISTORY OF THE SPANISH LANGUAGE (3-0) 3 hours credit—The development of the Spanish language from its earliest forms to the present.
5301. READINGS IN OLD SPANISH (3-0) 3 hours credit—The reading and linguistic analysis of early texts.
5304. STUDIES IN SPANISH LINGUISTICS (3-0) 3 hours credit—This course will treat a selected topic of linguistic investigation.
5315. STRUCTURE OF THE SPANISH LANGUAGE (3-0) 3 hours credit—This course will treat phonology, morphology, or syntax. May be repeated for credit when topic varies.
5320. STUDIES IN SPANISH LITERATURE THROUGH THE RENAISSANCE AND GOLDEN AGE (3-0) 3 hours credit This course covers such topics as: the drama of the Golden Age, Cervantes, the Picaresque novel, the *Celestina*, and mysticism. The course may be repeated for credit when the topic varies.
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5324. SPANISH LITERATURE SINCE 1700 (3-0) 3 hours credit—This course covers such topics as: the generation of '98, selected 20th century writers, post Civil War literature, the 19th century realistic novel, modern drama, modernism, and the essay. The course may be repeated for credit when the topic varies.

5330. STUDIES IN SPANISH AMERICAN LITERATURE (3-0) 3 hours credit—This course covers such topics as Fernandez de Lizardi, modernism, contemporary short story, Jorge Luis Borges, and the contemporary novel. The course may be repeated for credit when the topic varies.

5391. CONFERENCE COURSE IN SPANISH LINGUISTICS AND LITERATURE 3 hours credit.

5698. THESIS 6 hours credit.

A course may be repeated for credit when the topic changes.

LINGUISTICS

5301. PHONOLOGICAL THEORY (3-0) 3 hours credit.

5303. GRAMMATICAL THEORY (3-0) 3 hours credit.

5305. FIELD METHODS (3-0) 3 hours credit.

5306. APPLIED ANALYSIS (3-0) 3 hours credit.

5307. TOPICS IN LINGUISTICS AND LANGUAGE TEACHING (3-0) 3 hours credit.

5310. ACOUSTIC PHONETICS (3-0) 3 hours credit.

5320. HISTORICAL LINGUISTICS (3-0) 3 hours credit.

5330. THE COMPUTER AND NATURAL LANGUAGE (3-0) 3 hours credit.

5332. SURVEY OF LINGUISTIC THEORIES (3-0) 3 hours credit.

5333. READINGS IN LINGUISTICS (3-0) 3 hours credit.

5334. ADVANCED LINGUISTIC ANALYSIS (3-0) 3 hours credit.

5335. AREA LINGUISTICS (3-0) 3 hours credit.

5336. LINGUISTICS AND LITERACY (3-0) 3 hours credit.

5337. TOPICS IN NEUROLINGUISTICS (3-0) 3 hours credit.

5391. CONFERENCE COURSE IN LINGUISTICS 3 hours credit.

5631. LINGUISTIC WORKSHOP (6-0) 6 hours credit.

5698. THESIS 6 hours credit.

A course may be repeated for credit when the topic changes.

OTHER LINGUISTIC COURSES (Especially suitable for minor work)

ENGLISH

4301. HISTORY AND DEVELOPMENT OF THE ENGLISH LANGUAGE (3-0) 3 hours credit.

4302. CONTEMPORARY SYSTEMS OF ENGLISH LANGUAGE STUDY (3-0) 3 hours credit.

5331. HISTORY OF THE ENGLISH LANGUAGE (3-0) 3 hours credit.

5333. APPLIED ENGLISH LINGUISTICS (3-0) 3 hours credit.



FRENCH

5300. HISTORY OF THE FRENCH LANGUAGE (3-0) 3 hours credit.
5304. STUDIES IN FRENCH LINGUISTICS (3-0) 3 hours credit.
5315. STRUCTURE OF THE FRENCH LANGUAGE (3-0) 3 hours credit.

GERMAN

5300. HISTORY OF THE GERMAN LANGUAGE (3-0) 3 hours credit.
5304. TOPICS IN GERMANIC LINGUISTICS AND PHILOLOGY (3-0) 3 hours credit.

SPANISH

5300. HISTORY OF THE SPANISH LANGUAGE (3-0) 3 hours credit.
5304. STUDIES IN SPANISH LINGUISTICS (3-0) 3 hours credit.
5315. STRUCTURE OF THE SPANISH LANGUAGE (3-0) 3 hours credit.

RUSSIAN

5321. RUSSIAN TECHNICAL AND SCIENTIFIC TRANSLATION (3-0) 3 hours credit—This is an intensive service course designed primarily to prepare Ph.D. candidates and other graduate students in the functional use of the Russian language. Emphasis is placed on translating current, non-adapted Soviet publications by training the student to develop rapid translation techniques, approved short cuts, and an in-depth understanding of key grammatical concepts. Undergraduate students will be admitted only upon consent of the department.
5322. ADVANCED RUSSIAN TECHNICAL AND SCIENTIFIC TRANSLATION (3-0) 3 hours credit—This is a continuation of Russian 5321 and is designed primarily to prepare Ph.D. candidates for the Graduate School Foreign Language Examination. Prerequisite: Russian 5321 or consent of the department.

GOVERNMENT

OBJECTIVE

The program leading to a Master of Arts Degree in government emphasizes preparation for service in many areas of our national life, both public and private. Students interested in careers in teaching and research or in leadership roles in the public or private sectors may pursue programs adapted to their individual objectives. The Department of Government endeavors to equip students with the research techniques and subject pursuits undertaken beyond the master's level. Particular attention is given newer methodologies and approaches employed by scholars in the field.

DEGREE REQUIREMENTS

A minimum of 30 semester hours credit beyond a bachelor's degree (24 hours of course work and six hours of thesis preparation) is required.

Twenty-four hours of course work must include three hours of the conference course in Scope and Methods in Political Science for those who have not had government 4329 or its equivalent. Of the remaining 21 hours, at least three hours must be taken from each of four of the following six areas:

- Area I: Political Behavior and Processes
- II: Comparative Politics
- III: International Politics and Organization
- IV: Public Law and Jurisprudence
- V: Public Administration
- VI: Political Theory (Thoughts and Methodology)

Six hours of supporting work from upper-division undergraduate courses or graduate courses in other disciplines may be substituted for course work in government on the advice of the departmental graduate advisor. No more than three semester hours of advanced undergraduate work shall be taken in the area of supporting work.

A maximum of nine semester hours of advanced undergraduate work in government and supporting areas may be included.

All candidates for the Degree of Master of Arts with a major in government shall pass an oral examination over the candidate's graduate course work, as determined by the Department of Government.

All candidates for the Master of Arts Degree with a major in government shall attain a grade of *B* or better in the thesis course.

5310. FEDERALISM AND INTERGOVERNMENTAL RELATIONS (3-0) 3 hours credit—This course examines the theory and practice of federal systems, with attention paid to selected contemporary problems of intergovernmental relations arising under American federalism.

5320. CONTEMPORARY JUDICIAL POLITICS AND BEHAVIOR (3-0) 3 hours credit—This course examines the proc-



ess and decision-making of the American judiciary with emphasis on contemporary constitutional issues.

5330. THE ADMINISTRATIVE SYSTEM (3-0) 3 hours credit—This course examines the role and scope of administration in public organizations and in various cultural contexts. The system's characteristics as a decision-making mechanism will be analyzed, with emphasis upon processes, regulations, and responsibility.

5331. URBAN GOVERNMENT ADMINISTRATION (3-0) 3 hours credit—This course analyzes the problems of governmental administration at all levels—national, state, and local—in urban areas, with emphasis on metropolitan and regional approaches in political decision-making.

5336. THE POLITICAL SYSTEM OF THE SOVIET UNION (3-0) 3 hours credit—This course covers the development of Soviet political theory and social, political, and governmental structure from 1917 to the present.

5339. EMPIRICAL THEORY AND METHODOLOGY (3-0) 3 hours credit—This course examines selected empirical theories and research methods. Systems theory, structural-functional theory, and other empirical theories and such methodological concerns as research design, data collection, and data analysis and interpretation are studied.

5391. CONFERENCE COURSE IN POLITICAL SCIENCE 3 hours credit—Research and reading in a specialized field under the direction of a member of the graduate faculty.

5392. SELECTED TOPICS IN POLITICAL SCIENCE (3-0) 3 hours credit—Topics will vary each semester and will be drawn from the following fields of study:

1. Political Behavior and Processes
2. Comparative Politics
3. International Politics and Organization
4. Public Law and Jurisprudence
5. Public Administration
6. Political Theory (Thoughts and Methodology)

A seminar in each of the basic fields will be offered at least once in any four semester span. The course may be repeated for credit as the topic changes.

5698. THESIS 6 hours credit—Original research designed to augment existing studies of problems or topics related to one of the major fields of study. A written report conforming to institutional and departmental standards is required.

HISTORY

OBJECTIVE

The general purpose of the Master of Arts in history program is to provide the student with a greater breadth of understanding of both the past and the contemporary world and a greater depth of experience in the methods and techniques of the discipline. Specific objectives are to prepare the student for a career in business, government, research, teaching and further graduate study.

DEGREE REQUIREMENTS

A total of 30 semester hours of credit beyond the baccalaureate degree (24 hours of course work and six hours of thesis preparation) is required. Up to six hours of advanced history undergraduate course work may be reserved for graduate credit if a minor is elected, and as many as nine hours of advanced history undergraduate course work may be reserved for graduate credit if all course work is to be done in the field of history.

Competency in a foreign language is required. This may be demonstrated by credit in an approved language at the sophomore level or by successful completion of an examination administered by the Foreign Language Department.

With the approval of the graduate advisor, as many as six semester hours of graduate and/or advanced courses in disciplines other than history may be taken to satisfy the minimum requirement of 30 hours.

Satisfactory completion of an oral examination covering course work and defense of the thesis is required at least one month prior to the end of the semester during which the candidate is to graduate.

Certificate in Archival Administration — Students desiring a certificate in archival administration in addition to the M.A. degree in history must take an additional six hour internship. This may be taken in conjunction with the thesis with archival training projects in the internship program tailored to the student's field of thesis research.

All students minoring in archival work are required to take history 5339. Other archival administration courses are history 5317, 5319, 5120, and 5692.

No credit will be granted for courses in which the grade is lower than B.

NOTE: Graduate standing is a prerequisite to all of the following courses.

A course may be repeated for credit when the topic changes.

5301. COLONIAL HISTORY (3-0) 3 hours credit—The causes of European colonization of America, and the political, economic, religious, social, intellectual and ethnic aspects of American colonial history to 1783.

5303. EARLY NATIONAL PERIOD (3-0) 3 hours credit—The political, economic, social and religious development of the United States from 1783 to the Civil War.



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5307. **SOUTHERN HISTORY (3-0)** 3 hours credit—Developments which have distinguished the South from other sections with special emphasis on the contemporary South.
5308. **SOUTHWESTERN HISTORY (3-0)** 3 hours credit—The political, economic, religious, social, intellectual and ethnic aspects of the American Southwest from prehistoric times to the present.
5309. **AGE OF ENTERPRISE, 1876-1900 (3-0)** 3 hours credit —The post-Reconstruction period with emphasis on agricultural, industrial, diplomatic, and intellectual developments which shaped present-day America.
5310. **20TH CENTURY AMERICAN HISTORY (3-0)** 3 hours credit—Progressivism, World War I, Normalcy, the New Deal, World War II, and domestic and diplomatic crises of the 1950s and 1960s.
5311. **WESTWARD EXPANSION (3-0)** 3 hours credit — The genesis of Manifest Destiny and the history of the completing of the present continental boundaries of the United States.
5312. **AMERICAN SOCIAL AND INTELLECTUAL HISTORY (3-0)** 3 hours credit — The dominant patterns of American thought, both serious and popular, as well as the life and works of selected American intellectuals.
5315. **U.S. DIPLOMATIC HISTORY (3-0)** 3 hours credit — American relations with Europe, Africa, Latin America, and the Far East. The acquisition of an overseas empire, and the U.S. as a world power in the 20th Century, with emphasis on the conflict between isolationism and internationalism.
5316. **U.S. LABOR HISTORY (3-0)** 3 hours credit—A study of organized labor's involvement in the political, economic, and social history of America, especially since the late 19th century.
5317. **HISTORICAL DEVELOPMENT OF ARCHIVES AND MANUSCRIPTS COLLECTIONS (3-0)** 3 hours credit—An in-depth study of record making and record keeping from the advent of writing to the present age with particular attention to the development of archival institutions and principles.
5319. **ARCHIVAL PROCEDURES AND TECHNIQUES (3-0)** 3 hours credit—An intensive study of archival procedures and techniques as they apply to both public and private records.
5120. **HISTORICAL AGENCIES AND RESEARCH FACILITIES (1-0)** 1 hour credit—A survey of public research facilities and historical agencies and their services.
5321. **ANCIENT HISTORY (3-0)** 3 hours credit—The beginnings of civilization in Mesopotamia and Egypt, developments in Asia Minor, the rise and decline of Greece, the Hellenic world, and the Roman Empire to the reign of Constantine the Great.
5324. **MEDIEVAL AND RENAISSANCE HISTORY (3-0)** 3 hours credit—Developments from Constantine the Great to the eve of the Protestant Reformation, including the decline of the Roman Empire, Byzantium, Islam, the Crusades, Feudalism, and the rise of the nation-state system.
5326. **MODERN EUROPE (3-0)** 3 hours credit—The history of Europe from 1600 to 1950, with emphasis on the political, economic, social, and intellectual currents which formed Modern Europe.
5327. **TOPICS IN TEACHING AMERICAN HISTORY (3-0)** 3
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hours credit—A bibliographic study of a selected area of United States history, with particular emphasis on those aspects of historical research which can provide fresh viewpoints and new approaches to teaching the American heritage and values essential for effective citizenship.

5328. TOPICS IN TEACHING TEXAS HISTORY (3-0) 3 hours credit—This course identifies human and geographical concepts which have shaped Texas history, examines resource material, and suggests a useful framework for the teaching of Texas history.

5331. BRITISH HISTORY (3-0) 3 hours credit — A study of British political, social, economic, religious, and intellectual life, emphasizing constitutional developments and the growth of the common law.

5334. AFRICAN HISTORY (3-0) 3 hours credit—The development of Africa with special emphasis on the colonial period, the African Revolution and states of independent Africa.

5336. LATIN AMERICAN HISTORY (3-0) 3 hours credit — The history of Mexico and Peru; the ABC Powers; the Caribbean; and the United States and Latin America.

5337. RUSSIA AND THE MIDDLE EAST (3-0) 3 hours credit —The national and international problems and issues of Modern Russia, and the development of the Middle East since the introduction of the Islamic faith.

5338. FAR EAST (3-0) 3 hours credit—Political, social and cultural issues in Far Eastern national and regional histories since the 19th Century.

5339. HISTORIOGRAPHY (3-0) 3 hours credit—A survey of historical writings and the contributions of leading American and European historians with emphasis on research techniques.

5691. SEMINAR IN AMERICAN POLITICS (6-0) 6 hours credit—Examines fundamental concepts of American civilization, the development of political parties and of constitutional government, and the principles, processes, and problems of government in a free society.

5692. ARCHIVAL INTERNSHIP (6-0) 6 hours credit—Supervised in-service training at the Federal Records Center in Fort Worth, the Texas Labor Collection and the UT Arlington Archives. Open only to students who have completed history 5339 and history 5317 or 5319.

5698. THESIS 6 hours credit—Original research on a problem of some significance including a written report of findings.

MATHEMATICS

OBJECTIVE

The objective of the Mathematics Department's program at the master's level is to develop the student's ability to do independent research and prepare him for more advanced study in mathematics, to give advanced training to professional mathematicians, mathematics teachers, and those employed in engineering, scientific and business areas in which mathematics at this level is requisite for efficient performance.

Graduate work will be offered in algebra, complex and real variables, differential equations, functional analysis, topology, geometry, numerical analysis, logic, probability and statistics.

There are graduate assistantships and fellowships available in teaching and research. Inquiries should be addressed to the head of the Mathematics Department.

DEGREE REQUIREMENTS

Admission to the Master of Arts program in mathematics is based upon the completion of the general admission requirements of the Graduate School.

The general requirements for the Master of Arts degree may be found in another section of this Catalog. However, students wishing to major in mathematics must satisfy one of the plans listed below as well as the following additional requirements.

Upon entering Graduate School, it is the student's responsibility to consult with the mathematics graduate advisor.

The student must at some time during his undergraduate or graduate studies complete the material contained in mathematics 4321 or 4331, and in mathematics 4334 or 4335.

Not more than six hours from mathematics 5391 or 5392 will be applicable toward a graduate mathematics program.

Depending on the plan selected, a graduate mathematics program must include certain of the following sequences:

Group A	Group B
5317 and 5318	5307 and 5308
5322 and 5323	5309 and 5310
5331 and 5332	5312 and 5313
	5320 and 5321
	5325 and 5326
	5327 and 5328

- Plan I. Master's Degree with Thesis**—A minimum of 30 hours total, including at least one sequence from Group A, an additional sequence from Group A or B, and a thesis.
- Plan II. Master's Degree with Thesis Substitute**—A minimum of 33 hours total, including at least one sequence from Group A, an additional sequence from Group A or B, and an approved thesis substitute.
- Plan III. Master's Degree without Thesis**—A minimum of 36 hours total, including at least one sequence from Group A, and two additional sequences from Group A or B.
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Each graduate mathematics program must be approved by the departmental Graduate Studies Committee before the student's final semester.

Each master's candidate will have an oral examination, open to the Graduate Faculty, administered by his committee. This examination will take place after his thesis or approved substitute has been submitted to his supervising committee, or in the case of a student working under Plan III, during the student's last semester.

5301. SET THEORY (3-0) 3 hours credit — This course deals with cardinal numbers, ordinal numbers, and equivalences of the Axiom of Choice. Prerequisite: mathematics 4321 or 4331, and 4335.

5304. GENERAL TOPOLOGY (3-0) 3 hours credit — This course is an introduction to the fundamentals of general topology. The topics to be studied include product spaces, the Tychonoff theorem, Tietzes Extension theorem, and metrization theorems. Prerequisite: mathematics 4304 or 4335.

5307. POINT-SET THEORY I (3-0) 3 hours credit — The foundations of topology are developed by means of careful study of the properties of certain sets of points. These properties will be derived axiomatically. Prerequisite: mathematics 3335 (Analysis V) or 4303.

5308. POINT-SET THEORY II (3-0) 3 hours credit — A continuation of mathematics 5307. Prerequisite: mathematics 5307.

5309. THEORY OF ITERATIVE PROCESSES (3-0) 3 hours credit—This course is a study of the design and characterization of general iterative processes which will afford approximate solutions to equations. Topics considered will be of special interest to the practicing numerical analyst. Prerequisite: mathematics 3335 (Analysis V) and 4338.

5310. APPROXIMATION THEORY (3-0) 3 hours credit—This course is a study of uniform approximations, best approximations, and least square approximations. Prerequisite: mathematics 4335.

5311. PROBABILITY THEORY (3-0) 3 hours credit — The course includes a systematic development of the theory of random variables as well as a discussion of the classical probability distributions by means of the method of characteristic functions. The basic limit theorems are developed. Applications of basic theory are made to Markov chains and stochastic processes. Prerequisite: mathematics 3335 (Analysis V) and 4311.

5312. MATHEMATICAL STATISTICS I (3-0) 3 hours credit —A study of the basic ideas of probability theory, discrete and continuous univariate and multivariate families of distributions, mathematical expectation, sampling theory, and derived distribution theory. Prerequisite: mathematics 4311 or 4334 and 4335.

5313. MATHEMATICAL STATISTICS II (3-0) 3 hours credit — A study of parametric estimation theory, decision theory, statistical hypotheses testing, linear regression, and analysis of variance. Prerequisite: mathematics 5312.

5314. EXPERIMENTAL DESIGN (3-0) 3 hours credit—A study of completely randomized and randomized complete block designs with fixed and random effects, Latin Squares, factorial experiments, and analysis of covariance. Emphasis will be placed on the development of the models from underlying experimental



situations and the use of the appropriate analysis of variance table. Prerequisite: mathematics 4313 or 5312.

5317. **REAL VARIABLES I** (3-0) 3 hours credit—This course includes the study of such topics as point sets, measurable sets, measurable functions, Lebesgue integral, Stieltjes integral, and indefinite Lebesgue integral. Prerequisite: mathematics 4335.

5318. **REAL VARIABLES II** (3-0) 3 hours credit—This is a continuation of Real Variables I with an introduction to abstract measure theory. Prerequisite: mathematics 5317.

5320. **DIFFERENTIAL EQUATIONS** (3-0) 3 hours credit — This course is a study of linear and non-linear systems. The asymptotic behavior of solutions and the concept of stability are investigated as well as some important existence and uniqueness theorems. Prerequisite: mathematics 4335.

5321. **PARTIAL DIFFERENTIAL EQUATIONS** (3-0) 3 hours credit—This course is the classification of second order partial differential equations, characteristics, canonical forms, the Fredholm alternative, and Green's functions. Prerequisite: mathematics 4324 or 4334 or 4335.

5322. **COMPLEX VARIABLES I** (3-0) 3 hours credit—Fundamental theory of analytic functions. residues, conformal mapping and applications. Prerequisite: mathematics 4334 or 4335.

5323. **COMPLEX VARIABLES II** (3-0) 3 hours credit—Analytic continuation. Riemann surfaces, velocity and stream functions with applications, elliptic functions. Prerequisite: mathematics 5322.

5324. **APPLIED COMPLEX VARIABLES** (3-0) 3 hours credit —This course is a study of applications of complex variables in potential theory, ordinary differential equations, transform theory, and asymptotic expansions. Prerequisite: mathematics 4322 or 5322.

5325. **OPERATIONAL MATHEMATICS** (3-0) 3 hours credit —This course will be concerned with the study of integral transformations such as the Laplace, Bilateral Laplace, and Hankel. The applications of these transforms to boundary value problems will also be investigated. Prerequisite: mathematics 3335 (Analysis V) or 4325.

5326. **OPERATIONAL MATHEMATICS** (3-0) 3 hours credit —This course consists of a study of Fourier Analysis: including Fourier Series, Fourier integrals, and special functions: including gamma functions, Bessel functions and other orthogonal functions. Prerequisite: mathematics 3335 (Analysis V) or 4325.

5327. **FUNCTIONAL ANALYSIS I** (3-0) 3 hours credit—This course is the study of basic topological and metric properties with emphasis toward normed linear spaces, closed graph theorem, theorems of uniform boundedness, Hahn-Banach theorem and their application. Prerequisite: mathematics 4335.

5328. **FUNCTIONAL ANALYSIS II** (3-0) 3 hours credit — A continuation of mathematics 5327. Prerequisite: mathematics 5327.

5329. **ENGINEERING MATHEMATICS** (3-0) 3 hours credit —This course is designed to acquaint the scientist and engineer with vector analysis, matrices, determinants, tensors, probability, statistics, and numerical methods. Prerequisite: mathematics 3318 (Differential Equations). (Credit is not given on an M.A. degree in mathematics.)

5331. **ABSTRACT ALGEBRA I** (3-0) 3 hours credit — This course will investigate groups, rings, fields and modules with emphasis on structure theorems. Prerequisite: mathematics 4321.

5332. ABSTRACT ALGEBRA II (3-0) 3 hours credit — This course will investigate linear and multilinear algebra of modules with emphasis on structure theorems. Prerequisite: mathematics 5331.

5334. DIFFERENTIAL GEOMETRY (3-0) 3 hours credit — This course is an introduction to the theory of curves and surfaces in three dimensional Euclidean space. Prerequisite: mathematics 4334 or 4335.

5336. LOGIC (3-0) 3 hours credit—The concept of a normal system and propositional and functional calculi are considered. Prerequisite: mathematics 3335 (Analysis V) or 3336 (Introduction to Mathematical Logic).

5338. NUMERICAL ANALYSIS I (3-0) 3 hours credit—This course is a treatment of the solution of equations, interpolation and approximation, numerical differentiation and quadrature, and the solution of ordinary differential equations. Prerequisite: mathematics 3345 (Numerical Analysis and High Speed Computer Applications).

5339. NUMERICAL ANALYSIS II (3-0) 3 hours credit—This course is a rigorous treatment of numerical aspects of linear algebra and the numerical solution of boundary value problems in ordinary differential equations; also, an introduction to the numerical solution of partial differential equations. Prerequisite: mathematics 3345 (Numerical Analysis and High Speed Computer Applications).

5391. SPECIAL TOPICS IN MATHEMATICS (3-0) 3 hours credit—Topics in mathematics are assigned individual students or small groups. Faculty members closely supervise the students in their research and study. In areas where there is only three hours offered, the special topics may be used by students to continue their study in the same area. Prerequisite: permission of instructor.

5392. SELECTED TOPICS IN MATHEMATICS (3-0) 3 hours credit — The material covered may vary from semester to semester depending upon need and interest of the students. This course may be repeated for credit. Prerequisite: permission of instructor.

5695. SPECIAL PROJECT 6 hours credit—Prerequisite: permission of graduate advisor.

5398 or 5698. THESIS 3 or 6 hours credit—Prerequisite: permission of graduate advisor.

A limited number of undergraduate mathematics courses may be applicable to a graduate program in mathematics if approved in advance by the graduate advisor. These must be chosen from the following list and shall not exceed six hours total credit.

4303. INTRODUCTION TO TOPOLOGY (3-0) 3 hours credit —This is a first course in topology from the axiomatic point of view. Prerequisite: mathematics 3335.

4311. MATHEMATICAL PROBABILITY (3-0) 3 hours credit —An introduction to stochastic processes and, in particular, Markov chains. Applications to the fields of science and engineering will be given to illustrate the theory. Prerequisite: mathematics 3313 (Probability and Mathematical Statistics).

4313. APPLICATIONS OF MATHEMATICAL STATISTICS (3-0) 3 hours credit—This course is a continuation of mathematics 3313. Further theory of testing of hypotheses, regression, correlation, experimental designs, nonparametric statistics, and



selected topics will be studied. Prerequisite: mathematics 3313 (Introduction to Probability and Mathematical Statistics).

4320. ADVANCED DIFFERENTIAL EQUATIONS (3-0) 3 hours credit—This is a study of the existence and properties of solutions of differential equations. Prerequisite: mathematics 3318 (Differential Equations) or 3319 (Differential Equations and Linear Algebra).

4321. INTRODUCTION TO ABSTRACT ALGEBRA II (3-0) 3 hours credit—This course is a continuation of mathematics 3321. Prerequisite: mathematics 3321 (Introduction to Abstract Algebra I).

4322. INTRODUCTION TO COMPLEX VARIABLES (3-0) 3 hours credit—This course is an introduction to the theory of functions of a complex variable and also an introduction to applications including uses of the residue theory, contour integration and conformal mapping. Prerequisite: mathematics 2326 (Calculus III) or 2336 (Analysis IV).

4323. VECTOR ANALYSIS (3-0) 3 hours credit—This course is an introduction to the algebra and calculus of vectors and includes such topics as the theorems of Green, Gauss, and Stokes with applications to differential geometry and the physical sciences, and an introduction to tensor analysis. Prerequisite: mathematics 2326 (Calculus III) or 2336 (Analysis IV) and three hours of advanced mathematics.

4324. INTRODUCTION TO PARTIAL DIFFERENTIAL EQUATIONS (3-0) 3 hours credit—This course treats methods of solutions of selected elliptic, parabolic, and hyperbolic partial differential equations with reference to physical applications. Prerequisite: mathematics 3318 (Differential Equations) or 3319 (Differential Equations and Linear Algebra).

4325. OPERATIONAL MATHEMATICS (3-0) 3 hours credit—This course is a study of Laplace and Fourier Transforms, partial differential equations, Bessel Functions and orthogonal polynomials such as Hermite and Legendre. Prerequisite: mathematics 2326 (Calculus III) or 2336 (Analysis IV) and 3318 (Differential Equations) or 3319 (Differential Equations and Linear Algebra).

4331. INTRODUCTION TO LINEAR ALGEBRA (3-0) 3 hours credit—This course is a study of the theory of finite dimensional vector spaces and linear transformations. Prerequisite: mathematics 3321 (Introduction to Abstract Algebra I).

4334. ADVANCED MULTIVARIABLE CALCULUS (3-0) 3 hours credit—This course treats the properties of continuous mappings from N-dimensional Euclidean space to M-dimensional Euclidean space and an introduction to differential forms and vector calculus, based upon line integrals, surface integrals, and the general Stokes' theorem. Prerequisite: mathematics 3335 (Analysis V).

4335. ANALYSIS VI (3-0) 3 hours credit—This course is a continuation of mathematics 3335. Prerequisite: mathematics 3335 (Analysis V).

4338. INTRODUCTION TO NUMERICAL ANALYSIS II (3-0) 3 hours credit—This course is a continuation of mathematics 3338. This course will present solutions of linear systems, functional approximations, and solutions of eigen-value problems. Prerequisite: mathematics 3330 (Introduction to Matrix Algebra) and 3338 (Introduction to Numerical Analysis I).

PHYSICS

The two programs of study in physics are detailed below. Course offerings apply to either but must be approved in advance by the graduate advisor.

Physics

OBJECTIVE

The objectives of the Physics Department's program at the master's level is to prepare the student for either industrial employment or further educational endeavors. This objective is accomplished by formal course offerings and laboratory research, including theoretical investigations. The courses are of sufficient quantity that a student may develop an interest in particular areas, while the active research programs are of sufficient breadth to allow a student to accomplish research in his selected areas of interest.

DEGREE REQUIREMENTS

For admission to the Master of Arts program in physics, the candidate must satisfy the general admission requirements of the Graduate School. In addition, the candidate must have satisfactorily completed at least 24 hours of advanced physics and supporting courses. Deficiencies must be removed.

A minimum of 30 hours is required for the Master of Arts degree, of which 18 hours, including a six hour thesis, will be in physics, and 12 hours may be selected from physics, mathematics, chemistry, geology, biology or engineering as approved by the graduate advisor.

Radiological Physics

OBJECTIVE

The objective of the radiological physics program is to prepare candidates to fill the existing needs for radiological physicists in medical centers.

DEGREE REQUIREMENTS

For admission to the radiological physics program, the applicant must satisfy the general admission requirements of the Graduate School. In addition, he must be accepted for the program by an appointed committee from the Physics Department of The University of Texas at Arlington and the Department of Radiology of the Southwestern Medical School at Dallas. The applicant's undergraduate major should be in physics or mathematics, or he must have an acceptable background in a closely related field.

A minimum of 30 semester hours is required of which at least 18 hours, inclusive of the thesis, will be in the major area, and



at least six hours will be in supporting subjects outside physics or radiology areas.

The program is a cooperative effort between The University of Texas at Arlington and the Southwestern Medical School, and is designed to be completed in two academic years. The first will provide courses in advanced physics and mathematics, radiological physics, introductory radiation biology, and courses necessary to overcome deficiencies. The second year, together with the intervening summer, will involve applied radiological physics, physical and biological research techniques, seminar, research and thesis courses. Appropriate investigative problems will be designated, and will be supervised by a group selected from the Southwestern Medical School and The University of Texas at Arlington faculties with the research to be conducted on either or both campuses.

Students will be expected to have or to establish a background in electronic circuits, statistical analysis, biology, and computer techniques. Courses by which this background may be met are available at The University of Texas at Arlington.

5306. CLASSICAL MECHANICS (3-0) 3 hours credit — The general principles of analytical mechanics, the kinematics of rigid bodies, canonical transformations. Hamilton-Jacobi theory. Prerequisite: physics 4319 (Advanced Mechanics) or permission of graduate advisor.

5307. QUANTUM MECHANICS I (3-0) 3 hours credit — Matrix formulation theory of radiation, angular momentum, perturbation methods. Prerequisite: permission of graduate advisor.

5308. QUANTUM MECHANICS II (3-0) 3 hours credit—Approximate methods. symmetry and unitary groups, scattering theory. Prerequisite: physics 5307 or permission of graduate advisor.

5309. ELECTROMAGNETIC THEORY I (3-0) 3 hours credit — A modern tensorial treatment of classical electrodynamics, force on and field of a moving charge, derivation and application of 4-vector potential. Maxwell's equations in tensor form, field momentum, and radiation. The mathematical tools are developed as needed. Prerequisite: physics 4324 (Advanced Electricity and Magnetism) or permission of graduate advisor.

5310. STATISTICAL MECHANICS (3-0) 3 hours credit — Fundamental principles of statistical mechanics, Liouville theorem, entropy, Fermi-Dirac distribution, Bose-Einstein distribution, Einstein condensation, density matrix, quantum statistical mechanics, kinetic methods, and transport theory. Prerequisite: physics 4315 (Heat and Thermodynamics) or permission of graduate advisor.

5311. MATHEMATICAL METHODS IN PHYSICS I (3-0) 3 hours credit—A study of algebraic and analytical methods used in modern physics. Algebra, matrices, groups, and tensors, with application to quantum mechanics, the solid state, and special relativity. Analysis: vector calculus, ordinary and partial differential equations, with applications to electromagnetic and seismic wave propagation. Prerequisite: permission of graduate advisor.

5312. MATHEMATICAL METHODS IN PHYSICS II (3-0) 3 hours credit— A continuation of physics 5311 with a selection from the following topics. Algebra: matrix representations of

the symmetric and point groups of solid state physics, matrix representations of the continuous groups $O(3)$, $Su(2)$, $Su(3)$, $SL(2,C)$, general covariance. Analysis: further study of analytic functions, Cauchy's theorem, Green's function techniques, orthogonal functions, integral equations. Prerequisite: physics 5311 or permission of graduate advisor.

5314. ELECTROMAGNETIC THEORY II—ADVANCED OPTICS (3-0) 3 hours credit — Electromagnetic wave equations, waves in isotropic and anisotropics of metallic boundaries; theory of diffraction, radiation scattering, and dispersion. Prerequisite: physics 5309 or permission of graduate advisor.

5315. SOLID STATE I (3-0) 3 hours credit—Crystal structure, lattice vibration, thermal properties, and band theory of solids. Prerequisite: permission of graduate advisor.

5316. SOLID STATE II (3-0) 3 hours credit—Electrical and magnetic properties of crystalline solids, magnetic resonance, and optical phenomena. Prerequisite: permission of graduate advisor.

5317. RELATIVITY (3-0) 3 hours credit — The geometry of special relativity; particles in fields; collisions of particles; experiments and applications of relativity in optics, electrical engineering, atomic and nuclear physics, and space physics; fluids; fields; introduction to general relativity and the needed differential geometry. Prerequisite: permission of graduate advisor.

5318. ADVANCED NUCLEAR PHYSICS (3-0) 3 hours credit — Properties of nuclei, nuclear two-body problems, meson theory of nuclear forces, nuclear models, nuclear structure, and nuclear transitions. Prerequisite: physics 3446 (Nuclear Physics), physics 4326, or permission of graduate advisor.

5320. THEORETICAL PHYSICS (3-0) 3 hours credit—Meaning of physical theory. space and time in physics, the foundations of mechanics, probability and statistics, and continua. Prerequisite: physics 5306 or permission of graduate advisor.

5321. MODERN PHYSICS (3-0) 3 hours credit—This course will present a unified approach to the principle fields of modern physics, relativity, quantum mechanics, atomic spectroscopy, quantum statistics, solid state physics, particle physics, and nuclear physics. Prerequisite: permission of graduate advisor.

5323. ELEMENTARY PARTICLES (3-0) 3 hours credit—Production, detection, and classification of elementary particles. Qualitative study of strong, electromagnetic, and weak interactions, and their respective conservation laws. Semi-quantitative treatment of the $SU(3)$ symmetry. Prerequisite: physics 5307 or permission of graduate advisor.

5325. QUANTUM FIELD THEORY (3-0) 3 hours credit — A study of the quantized field description of elementary particles and their interactions, developed from the principles of quantum mechanics and Lorentz invariance. Quantitative applications to electromagnetic and weak interactions. Prerequisite: physics 5308 or permission of graduate advisor.

5328. THEORETICAL SEISMOLOGY (3-0) 3 hours credit—Analysis of body and surface seismic waves utilized in industrial seismic exploration and in earthquake seismology for investigation of the deep interior of the earth. Rock elastic properties; reflection, refraction, interference, and diffraction of waves; seismic energy; wave amplitude, frequency, and velocity. Prerequisite: mathematics 3318 (Differential Equations) and physics 1442 (General College Physics) or 1444 (General Technical Physics) or permission of graduate advisor.



5350. SPECIAL TOPICS IN PRECOLLEGE PHYSICAL SCIENCE INSTRUCTION (1-6) 3 hours credit—This course is designed for experienced teachers of precollege physical science and/or physics. The intent of the course is to consider special problems in precollege physical science instruction and to expose teachers to new laboratory-oriented precollege curricula. This course may be repeated for credit as the subject matter changes. This course may not be used to satisfy any of the requirements for the Master of Arts degree in physics. Prerequisite: a bachelor's degree, teaching experience or an intent to teach, and permission of graduate advisor.

5391. SPECIAL TOPICS IN PHYSICS (3-0) 3 hours credit—Topics in physics, particularly from areas in which active research is being conducted, are assigned to individuals or small groups for intensive investigations. This course may be repeated for credit. Prerequisite: permission of graduate advisor.

5392. SELECTED TOPICS IN PHYSICS (3-0) 3 hours credit—Topics in this course may be varied from semester to semester depending on the needs and interest of the students. This course may be repeated for credit. Prerequisite: permission of graduate advisor.

5193-5693. READINGS IN PHYSICS (variable credit from one to six hours as arranged)—A conference course which may be repeated for credit. Prerequisite: permission of instructor.

5194-5694. RESEARCH IN PHYSICS (variable credit from one to six hours as arranged)—A conference course with laboratory which may be repeated for credit. Prerequisite: permission of instructor.

5698. THESIS 6 hours credit — Prerequisite: permission of graduate advisor.

The following courses may be applicable toward the graduate program if approved in advance by the graduate advisor.

4325. SOLID STATE PHYSICS (3-0) 3 hours credit—Classification of crystalline solids; elastic and thermal properties; electric and magnetic properties and electronic properties of solids are covered in this course as well as an introduction to current research problems. Prerequisite: physics 4315 (Heat and Thermodynamics).

4326. INTRODUCTION TO QUANTUM MECHANICS (3-0) 3 hours credit—This course includes the experimental need for quantum mechanics. Schrodinger's equation and implications, the free particle, the one-electron atom, potential barrier and perturbation theory are introduced. Prerequisite: physics 4319 (Advanced Mechanics).

PSYCHOLOGY

OBJECTIVE

The objective of graduate work in psychology is to educate the student in the methods and basic content of the discipline and to give him an apprenticeship in the execution of creative research.

Graduate work in the doctoral and master's programs will be offered in general experimental. Student's individual programs may be arranged to give emphasis to a particular aspect of the general program.

Some financial support for graduate students is available through the department in the form of assistantships.

Deadline for Financial Aid Applications—Students who wish to be considered for assistantships must have their application and departmental form sent to The University of Texas at Arlington by April 1 for the Fall Semester and November 1 for the Spring Semester. Students who do not desire financial aid may apply at any time up to one month before the semester in which they plan to enroll.

GENERAL DEGREE REQUIREMENTS

In addition to the requirements outlined elsewhere, the Psychology Department will require a satisfactory score on the Miller Analogies Test and will review each applicant's file prior to admission. Before entering graduate work in psychology a student is required to have a basic core of knowledge in the field. Undergraduate courses in statistics and in experimental methods are required but may be taken as deficiency courses. If the student's record indicates inadequate preparation in other major areas of psychology, the student may be required to make up such deficiencies through additional course work or through supervised readings and conferences.

Degree requirements for the Doctor of Philosophy

The degree of Doctor of Philosophy in experimental psychology requires distinguished attainments both in scholarship and original research, and the deep understanding of the strategic role of thoughtful experimentation in the development of an empirical science. Although the student must meet the minimum requirements of a planned course of study, the ultimate basis for conferring the degree must be his demonstrated ability to do independent and creative work and his exhibition of a profound grasp of the subject matter of his field.

Foreign Language—There is no foreign language requirement.

Course requirements—Each student must take:

- (a) Advanced Statistics (psychology 5301—3 hours)
- (b) Experimental Design (psychology 5302—3 hours)
- (c) Quantitative Methods (psychology 5303—3 hours) or Research Methods (psychology 5304)
- (d) Five core area courses (15 hours) from among those numbered psychology 5304 through 5336.



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- (e) Two six-hour research courses. These may be taken from among psychology 5698 and psychology 5640 through 5645. Students who plan to obtain the M.A. should elect psychology 5698 as one of the research courses and students who do not plan to obtain the M.A. should select their courses from the latter set of courses. In either event, one of the two research courses should be completed before the student takes the qualifying examination. The two research courses are a minimum requirement. Students are also strongly encouraged to take psychology 5391 before taking one of the six-hour courses.
 - (f) Three three-hour seminar courses (psychology 6304 through 6337—9 hours)
 - (g) Additional hours of course work for a total of approximately 60 course hours including work done towards the M.A.

The total of 60 hours is not a formal requirement and is only designed to serve as a guideline for students. The exact number of hours will be determined by the qualifying committee, and the qualifying committee may require course work outside of the Department of Psychology.

Comparable courses taken at other graduate institutions may be substituted for one or more core courses, as may psychology 5389 (Contemporary Problems) or psychology 5191, 5291, or 5391 (Research in Psychology), providing the 15-hour requirement is met.

Completion of an M.A. thesis and consequent possession of the M.A. degree is recommended but is not obligatory. Students will normally complete the equivalent of an M.A. thesis in one of their two research courses and may submit the research in thesis form in order to complete the M.A. degree.

A student has completed the core requirements when he has:

- (a) Received at least a B average in his core area courses.
- (b) Received at least a B average in all other courses.
- (c) Received a positive evaluation in his two major research courses.

Degree Requirements for the Master of Arts Degree

The degree of Master of Arts in experimental psychology requires scholarly attainment in the basic subject matter of psychology as a science and the ability to demonstrate that attainment through an original piece of research. Although the M.A. program is designed to form the basis of the doctoral program, it is also open to those seeking a terminal master's degree.

General Curriculum and Research Requirements—Completion of the master's degree will require a minimum of 30 semester hours of acceptable work. Twenty-four of these hours will normally be course work and the remaining six will be thesis research. Psychology 5301 (Advanced Statistics) will be required of all students. In addition, students will be required to take nine hours of core courses numbered psychology 5306 through 5335. Up to nine hours of approved undergraduate courses may be applied to the M.A. requirements provided these are taken out-

side the Psychology Department. No undergraduate course in psychology may be taken for graduate credit.

Each time it is offered, psychology 5389 (Contemporary Problems in Psychology) will be treated as a core course. Psychology 5391 (Research in Psychology) may also be designated as a core course.

As soon as practicable a student should decide on his area for concentration and research. After discussion with a staff member, and with the staff member's consent, the student selects a supervising professor. With the aid and advice of the supervising professor the student will prepare and present a proposed program to the proper committee within the department. The objective of the program is to give the student a broad exposure to various areas in psychology in addition to his area of concentration.

Students who are not enrolled in the Graduate School must obtain the permission of the instructor and the graduate advisor before enrolling in any graduate level courses in psychology.

5301. ADVANCED STATISTICS (3-0) 3 hours credit—A study of parametric and nonparametric statistical techniques with emphasis on statistical inference.

5302. EXPERIMENTAL DESIGN (3-0) 3 hours credit — A study of the statistical aspects of complex experimental designs used in psychological research. Prerequisite: Psychology 5301.

5303. QUANTITATIVE METHODS (3-0) 3 hours credit—A survey of techniques for analyzing multivariate data; particular topics include partial and multiple correlation, factor analysis, and the linear discriminant function.

5304. RESEARCH METHODS (3-0) 3 hours credit.

5310. MATHEMATICAL MODELS IN PSYCHOLOGY (3-0) 3 hours credit—Elementary probability theory, matrix algebra, and theory of linear difference equations applied to theoretical problems in learning, signal detection, decision processes, and social interactions.

5311. LEARNING THEORY (3-0) 3 hours credit—A survey of the basic theories of learning.

5312. ANIMAL LEARNING (3-0) 3 hours credit—A survey of contemporary problems in animal learning.

5313. COGNITIVE PROCESSES (3-0) 3 hours credit—An application and extension of basic concepts of psychology to more complex behavior. An investigation of such behaviors as concept formation, problem solving, and creative thinking.

5314. PSYCHOLINGUISTICS (3-0) 3 hours credit — An investigation of language in terms of its function, content and structure, with an emphasis on learning, perception, and generation of linguistic units.

5321. PERSONALITY AND BEHAVIOR DYNAMICS (3-0) 3 hours credit—Research in personality processes; particular topics include unconscious processes, anxiety, and conflict.

5322. ADVANCED SOCIAL PSYCHOLOGY (3-0) 3 hours credit—Problems in social psychology emphasizing integration of experimental design, research findings and theoretical formulations.

5323. ADVANCED DEVELOPMENTAL PSYCHOLOGY (3-0) 3 hours credit—A survey of development of behavior in both humans and sub-humans.



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- 5325. THEORIES OF MOTIVATION (3-0) 3 hours credit**—This course surveys the current literature and theory on emotion and the neural and physiological basis for motivation. Material to be covered will include both biological drives, such as hunger and thirst, and interpretations of drives less immediately related to the underlying biological processes.
- 5331. PERCEPTUAL PROCESSES (3-0) 3 hours credit**—A survey of methods and findings dealing with perception; emphasis will be upon behavioral rather than physiological considerations; particular topics include signal detection theory, form and pattern recognition, and attentional mechanisms.
- 5332. SENSORY PROCESSES (3-0) 3 hours credit**—Structure, function, and neural processes in the various sense modalities. Emphasis is placed upon the current literature and theory on vision, audition, somathesis, taste, and smell and their relationship to perception and behavior.
- 5333. ADVANCED PHYSIOLOGICAL PSYCHOLOGY (3-0) 3 hours credit**—The biological and physical processes underlying behavior. Emphasis is placed upon neurophysiological, biochemical and endocrinological mechanisms serving as a foundation for behavior. Other topics covered are the neural and chemical basis for conditioning and learning, intelligence and language, reflexes and motor performance, and abnormal behavior.
- 5335. ANIMAL BEHAVIOR (3-0) 3 hours credit**—A phylogenetic approach to some basic problems in behavior, with special emphasis on unlearned behavior.
- 5337. MAN-MACHINE SYSTEMS (3-0) 3 hours credit**—The study of man-machine systems and human factors research; topics include response latency as a factor in equipment design, tracking behavior, vigilance decrement, and absolute judgment phenomena.
- 5340. TEACHING UNDERGRADUATE PSYCHOLOGY (2-2) 3 hours credit**—A survey of the approaches to teaching general psychology, course organizations, sources of knowledge, and keeping current with contemporary developments. The definition of objectives and evaluation of teaching effectiveness are also analyzed in their application. \$2 lab fee.
- 5389. CONTEMPORARY PROBLEMS IN PSYCHOLOGY (3-0) 3 hours credit**—Topics vary; may be repeated for credit with permission of graduate advisor.
- 5181. LABORATORY IN PHYSIOLOGICAL PSYCHOLOGY (0-2) 1 hour credit**—A laboratory examination of research techniques and methodology in physiological psychology. Includes neurological and psychopharmacological procedures.
- 5182. INSTRUMENTATION IN PSYCHOLOGY (0-3) 1 hour credit**—An introduction to the basic principles of mechanics, electricity, and electronics with emphasis upon their application to psychological research. Includes a survey of and familiarity with psychological apparatus.
- 5191, 5291, 5391. RESEARCH IN PSYCHOLOGY (variable credit from 1 to 3 semester hours as arranged)**—Independent research under the supervision of an individual faculty member; may be repeated for credit with permission of graduate advisor.
- 5640. RESEARCH IN HUMAN PERFORMANCE AND PERCEPTION (2-12) 6 hours credit.**
- 5641. RESEARCH IN LEARNING OR MOTIVATION (2-12) 6 hours credit.**
- 5642. RESEARCH IN PHYSIOLOGICAL PSYCHOLOGY (2-12) 6 hours credit.**
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5643. RESEARCH IN DEVELOPMENT (2-12) 6 hours credit.
5644. RESEARCH IN MATHEMATICAL PSYCHOLOGY (2-12) 6 hours credit.
5645. RESEARCH IN GROUP PROCESSES (2-12) 6 hours credit.
5698. THESIS 6 hours credit — Prerequisite: 12 hours of advanced psychology and permission of the graduate advisor.
6304. SEMINAR IN MATHEMATICAL PSYCHOLOGY (3-0) 3 hours credit.
6311. SEMINAR IN LEARNING (3-0) 3 hours credit.
6313. SEMINAR IN COGNITIVE PROCESSES (3-0) 3 hours credit.
6322. SEMINAR IN SOCIAL PSYCHOLOGY (3-0) 3 hours credit.
6323. SEMINAR IN DEVELOPMENTAL PSYCHOLOGY (3-0) 3 hours credit.
6325. SEMINAR IN MOTIVATION (3-0) 3 hours credit.
6331. SEMINAR IN PERCEPTION (3-0) 3 hours credit.
6333. SEMINAR IN PHYSIOLOGICAL PSYCHOLOGY (3-0) 3 hours credit.
6337. SEMINAR IN HUMAN PERFORMANCE (3-0) 3 hours credit.
6699. DISSERTATION 6 hours credit.



URBAN AFFAIRS

OBJECTIVES

The activities of the Institute of Urban Studies are organized into three broad, functional areas: graduate instruction and related research; applied research and services provided public and private groups and officials; and criminal justice programs. The applied research and service activities are viewed as important adjuncts to the graduate instruction program. Graduate students in urban affairs may have involvement in research and service projects that are relevant and timely in relation to contemporary urban problems. Other students in need of part-time employment may find it in these areas. Many data and research materials will be assembled and can be made available to graduate students. Members of the applied research and service staff may serve as resource specialists to graduate students and members of the graduate instructional staff. The wide contacts of institute staff members with public officials and agencies and private groups outside the University and involved in urban affairs can be helpful in arranging internships and for placing graduates in positions of employment.

The Master of Arts degree in urban affairs is organized around a subject matter area, city or urban phenomena, rather than one of the traditional disciplines. Emphasis is placed on issues, problems, and public policy questions related to life in urban communities. Urban problems are viewed as complex and requiring the understanding and skills of many disciplines. Therefore, the program is multi-disciplinary or interdisciplinary in character, curriculum content, teaching staff, and enrollment of students. Students in the program will specialize in the sense that they concentrate on urban or city subject matter but will be broadly educated in that they will study cities as economic, governmental, and social entities, and as physical environments. The urban subject matter orientation does not preclude attention to development of intellectual skills and capacities for analysis and the manipulation of methodological techniques.

Broad and intensive graduate education in urban affairs can introduce graduates to a variety of rewarding and profitable careers and positions. With the increased urbanization of Texas and the nation, new career opportunities, many of them recent in origin, are becoming available.

By educating young men and women for urban affairs careers, the program seeks to help provide society with the "brain power" needed to deal with increasingly complex and urgent city problems.

DEGREE REQUIREMENTS

The Master of Arts degree in urban affairs seeks to provide students with understanding of cities in five general and interrelated areas of knowledge:

Cities as economic entities

Cities as governmental and political entities

Cities as social entities

Cities as physical environments

Historical and research approach to cities

Students will be expected to take seminars in each of these five areas and, to the extent possible, will be encouraged to develop a concentration in one particular area.

Satisfactory completion of 30 semester hours of courses or seminars will be required and completion of a thesis or report on internship, carrying six semester hours credit, will be necessary to receive the degree. Completion of degree requirements in the case of full-time students will normally entail 18 months of graduate work or three regular semesters and one summer. The program is organized and operated primarily for full-time students, but part-time students are not excluded.

Seminars Emphasizing Governmental and Political Aspects of Cities

5301. URBAN AND METROPOLITAN POLITICS (3-0) 3 hours credit—This course deals with politics, political parties, and pressure groups in cities and among units of local government within metropolitan areas. The relationships between national parties and political activities and cities and metropolitan areas will be studied.

5302. POLITICS OF MINORITY GROUPS (3-0) 3 hours credit—This seminar is a continuation of the course listed above, and concentrates on recent developments related to partisan activities and political involvement of minority groups in cities and metropolitan areas. Emphasis will be on roles of black and Mexican American groups and individuals.

5303. GOVERNMENT AND ADMINISTRATION OF METROPOLITAN AREAS (3-0) 3 hours credit—Problems and issues related to the proliferation of units of government in larger metropolitan areas and analysis of various proposals for rationalizing government in metropolitan areas will be studied. These problems and issues will be examined in the context of emerging patterns of federalism, state government-local government relationships and intergovernmental relations in general.

5304. URBAN PUBLIC POLICY AND INTERGOVERNMENTAL RELATIONS (3-0) 3 hours credit—This seminar focuses on a critical analysis of federal government and selected state and local government policies and programs designed to influence the course of change or the future development of cities and urban areas. The problem of formulating national government and state government urban development policies and goals will be studied. Difficulties of anticipating the effects of new policies and programs and measuring "improvements" or "progress" will be examined.

5390. SPECIAL TOPICS IN URBAN POLITICS AND GOVERNMENT (3-0) 3 hours credit—This course will deal with different topics each semester from such areas as: interest groups in urban community, the judicial system, political conflict, and outputs of the political system. The seminar may be repeated for credit as the topic changes.

Seminars Emphasizing Cities and Urban Areas as Social Entities

5310. URBAN SOCIAL PATHOLOGIES (3-0) 3 hours credit—This seminar deals with the nature and extent of major types of social pathologies and deviant behavior in cities and urban areas: family disorganization, crime and delinquency, poor



health, lack of education, and unemployment. Newer concepts and techniques for maintaining "social accounts" and information systems for monitoring changes in socio-economic well-being will be studied.

5311. MINORITY GROUP RELATIONS AND SOCIAL PROBLEMS (3-0) 3 hours credit — Special problems of minority groups, primarily black and Mexican American groups, will be studied. The phenomenon of racial discrimination and the causes and consequences of violence and direct action or confrontation tactics will be examined, with emphasis on recent and contemporary problems and issues.

5312. SOCIAL THEORIES OF URBAN SYSTEMS (3-0) 3 hours credit—Several theoretical perspectives of the community and community organization are examined in this course. Special emphasis is given to theories from human ecology, organization and stratification, and social welfare.

5391. SPECIAL TOPICS IN URBAN SOCIETY (3-0) 3 hours credit—This course will deal with different topics each semester and will focus on such selected urban sociological problems as criminology, housing, and transportation. It may be repeated for credit when the topic changes.

Seminars Emphasizing Urban Areas as Economic Entities

5320. URBAN ECONOMY (3-0) 3 hours credit—This seminar examines the structure and functioning of urban economies and the relationships between regions and the national economy. Principal methods of regional economic analysis will be explored.

5322. URBAN PUBLIC FINANCE AND INTERGOVERNMENTAL FISCAL RELATIONS (3-0) 3 hours credit—This seminar will emphasize tax, revenue, and fiscal problems of cities and local governments in metropolitan areas. Problems of matching costs and benefits in providing public services as among different local governments will be analyzed. The increasingly complex web of federal-state-local fiscal and grant-in-aid relationships will be studied.

5392. ECONOMICS OF SELECTED URBAN PROBLEMS (3-0) 3 hours credit—This seminar will deal with different topics each semester selected from such areas as: poverty, housing, urban transportation, manpower, and economic development. The seminar may be repeated for credit as the topic changes.

Seminars Emphasizing Cities and Urban Areas as Physical Environments

5330. ORIENTATION TO URBAN AND REGIONAL PLANNING (3-0) 3 hours credit—This seminar deals with the nature of the planning process in cities and urban regions and with concepts and techniques used by professional planners and planning organizations. Emphasis will be on understanding the role, limitations, and political aspects of urban planning as opposed to instruction in how to practice the art of planning.

5331. ORIENTATION TO URBAN DESIGN (3-0) 3 hours credit—This seminar seeks to provide understanding and appreciation on the part of serious and systematic non-architecture students of the concepts and skills of architects and physical design specialists. The importance of design, form, and visual or aesthetic factors will be studied. The interdependence of physical design and aesthetic and governmental policies and social problems in urban areas will be explored.

5332. PROTECTION OF QUALITY OF URBAN ENVIRONMENTS (3-0) 3 hours credit—The interdependence of man and the physical environment will be studied. Trends and problems related to pollution of the environment will be studied. Problems and issues of public policy and regulatory mechanisms to cope with pollution will be examined. The approach of ecologists and other disciplines concerned with the physical environment will be explored.

5393. SPECIAL TOPICS ON URBAN ENVIRONMENT (3-0) 3 hours credit—This course will deal with different topics each semester and will focus on selected environmental problems, such as water quality, air quality, and noise abatement. This seminar may be repeated for credit as the topic changes.

Seminars Emphasizing Historical and Research Approaches to the Urban Community

5335. URBAN HISTORY (3-0) 3 hours credit—This seminar involves extensive reading primarily in the history of urbanization and metropolitanization of the people of the United States. The historical method as exemplified in the works of leading historians will be analyzed. Examples of the scholarship of selected historians and treatises on selected cities, regions, and urban institutions will be studied.

5336. METHODS OF SOCIAL RESEARCH AND ANALYSIS (3-0) 3 hours credit—This seminar concentrates on research methodology and statistical techniques useful in analysis of urban trends and problems. Newer concepts and procedures for use of computers in social research will be studied. Special problems and methods of evaluative research related to programs and policies for coping with urban problems will be explored.

5394. SPECIAL TOPICS IN URBAN RESEARCH (3-0) 3 hours credit—This seminar will deal with different topics each semester and will concentrate on a variety of methodological techniques and research strategies, such as demographic research and survey techniques.

5396. CONFERENCE COURSE IN URBAN AFFAIRS (3-0) 3 hours credit—Reading and research in a specialized area of urban affairs under the direction of a member of the graduate faculty.

5697. INTERNSHIP REPORT 6 hours credit—Under special conditions, a student may elect an internship report in lieu of the thesis requirement. The report on the internship will meet the same standards of scholarship and writing applied to the traditional thesis.

5698. THESIS 6 hours credit—A thesis conforming to university and departmental requirements may be prepared by graduate students in urban affairs.

CRIMINAL JUSTICE PROGRAM

The Institute of Urban Studies graduate program contains courses designed for advanced education in criminal justice. Students will receive coverage of the total criminal justice system with specific courses oriented to special areas of interest. The program is multi-disciplinary and draws heavily from political science, sociology, law, psychology, economics, public ad-



ministration, and business administration. Faculty members have diverse backgrounds normally covering several of these areas of study with practical experience in and advanced study of the criminal justice process.

The program is designed for both the practitioner and the student expecting to pursue further study at the doctoral level. An extensive range of courses in administration is offered with supporting courses in special areas of study. Psychological, sociological, and behavioral courses emphasize the human and behavioral environment of criminal justice agencies and provide instruction in the most advanced methods of group and personal communication skills. Current research and innovative techniques for utilizing modern technology serve as the basis for the entire program.

Seminars Emphasizing Criminal Justice Theory

5305. CRIME AND THE URBAN COMMUNITY (3-0) 3 hours credit—An analysis of the interaction between crime and society considering the concepts of social control, law, deviance, crime and the criminal as these relate to social change, bureaucratization and the political and social ideologies.

5306. THE NATURE OF CRIME (3-0) 3 hours credit—Surveys available data and theories relating to the scope and nature of the crime problem, to the characteristics of offenders, and to factors that are correlated with crime and which increase the probability of criminal careers. Special attention is given to social institutions that play significant roles in the amelioration of the crime problem as it exists in the United States and other cultures. In dealing with individual offenders, the course will emphasize environmental and personality factors that influence criminal behavior, and trace such behavior over time. Attempts to arrive at meaningful and useful classifications of both the individual offender and collective criminal behavior will be undertaken.

5307. DEVIANT BEHAVIOR (3-0) 3 hours credit—Analysis of the psychological and sociological factors involved in delinquent and criminal behavior. Crime and criminal behavior is viewed as one of the many forms of deviation from political, moral and conduct norms of the majority culture. Studies the parallel genesis of crime and other prevalent forms of deviance. Studies the forces that produce conformity and indirectly promote deviation.

5308. ANALYSIS OF PERSONALITY (3-0) 3 hours credit—Examination of personality and the factors leading to growth and development. Emphasizes the problems of personality development relevant to criminal justice agency organization and function. Focuses on operational problems stemming from inadequate personality growth, individual needs, perceived personal insecurity, immaturity, and anxiety.

5309. PUBLIC ORGANIZATIONAL THEORY (3-0) 3 hours credit—Analysis, evaluation, and application of organizational theory to public organizations with an emphasis on criminal justice organizations. Classical organization theory, systems theory and behavioral theory will be emphasized with special reference to the organizational process, personnel mobilization, behavioral change, motivation, and human relations.

Seminars Emphasizing Criminal Justice Administration

5315. THE ADMINISTRATION OF JUSTICE (3-0) 3 hours credit—Analysis of the administrative practices and procedures of criminal justice agencies. Emphasis is placed on the administrative structures of various components of the criminal justice process and the functioning and interrelationships of these units within the total criminal justice system. Topics to be covered will include police administration, judicial administration, and parole, probation, and corrections administration. Students will be expected to select one area of administration for special study.

5316. LAW ENFORCEMENT ADMINISTRATION (3-0) 3 hours credit—Coverage of selected topics involved in law enforcement administration with emphasis on management practices, organizational structure, interorganizational relations, personnel practices, recruiting, evaluation, training, and dismissal. Current practices will be examined from the perspectives of size, composition, responsibilities, and social setting.

5317. JUDICIAL ADMINISTRATION (3-0) 3 hours credit—Description, analysis, and evaluation of the judicial process from prosecution to final disposition. Subjects to be covered include law enforcement role in judicial administration, the prosecutory function, court administration, and final disposition. Emphasis will be placed on courts as central judicial units interacting with a variety of criminal justice agencies for process control.

5318. PROBATION, PAROLE, AND CORRECTIONS ADMINISTRATION (3-0) 3 hours credit—Analysis of the administrative practices and procedures in probation, parole, and corrections programs. Structures, processes, and procedures will be examined for their efficiency in accomplishing the custody and rehabilitative functions. Students will be expected to select one area for special study.

Seminars on Special Topics in Criminal Justice

5325. THE POLITICAL BASIS OF THE CRIMINAL JUSTICE SYSTEM (3-0) 3 hours credit—Examination of political relationships between the components of the criminal justice system, between these agencies and external influence centers, and between these agencies and private influential organizations. Inter-organizational relations, political support, legislative relations, administrative relations, and community support will be examined. Emphasis will be placed on the political setting of criminal justice agencies and the nature of effective patterns of behavior in the political process.

5326. CONSTITUTIONAL ISSUES, INDIVIDUAL RIGHTS, AND JUDICIAL BEHAVIOR (3-0) 3 hours credit—Analysis of national and state constitutional issues in regard to protection of individual rights, criminal justice agencies constraints imposed by constitutional guarantees, impact on the criminal justice process, and judicial behavior. Court decisions are examined for their relevance to criminal justice agency operations and for their influence in changing social attitudes and organizational processes.

5327. JUVENILE DELINQUENCY, YOUTH CRIME, AND THE YOUTH CULTURE (3-0) 3 hours credit — Examines the meaning of the concept of juvenile delinquency, the relationship between social attitudes and definitions of law violations, the various forms of delinquency, the youth culture and youth attitudes,



and juvenile rights. Emphasis is placed on effective means for official interaction with various subcultures within the youth population and the patterns of behavior necessary for positive attitude development.

5328. DEVELOPMENT OF INTERPERSONAL SKILLS (3-0)
3 hours credit—Provides methods and techniques for facilitating understanding between and among individuals. The purpose of the course will be to increase coping behavior in emotional situations to facilitate understanding of possible solutions. Students will learn how to react in traumatic situations and how to act as stabilizing forces. Verbal and non-verbal communication will be thoroughly examined, in order to demonstrate the impact of personal interaction. Prerequisite—Urban Affairs 5386.

5329. CRIMINAL JUSTICE INFORMATION SYSTEMS (3-0)
3 hours credit—This course emphasizes current and anticipated developments in the area of computerized criminal justice information systems. Current systems at the national, state, regional, and local levels throughout the United States are examined. The course focuses on the system design, purpose, utilization, file content and structure, and security and access limitations. Prerequisite: one introductory course in data processing.

Seminars on Research and Statistics for Criminal Justice

5338. CRIMINAL JUSTICE RESEARCH AND METHODS (3-0)
3 hours credit—Examination of criminal justice research and methodology. Emphasis will be placed on significance and import of research topics, methodological adequacy, theoretical contributions, problems in the conduct of criminal justice research, public policy implications, and problems of implementation. The course will cover data collection techniques, construction of interview schedules and questionnaires, observation techniques, and data processing and analysis.

5339. STATISTICS AND STATISTICAL TECHNIQUES IN CRIMINAL JUSTICE RESEARCH (3-0)
3 hours credit—An introduction to statistical techniques appropriate for use in criminal justice research. Descriptive statistics; scales of measurement; measures of central tendency, variability, and association. Introduction to statistical inference including sampling distribution and tests of significance. Analysis and evaluation of current criminal justice statistical reporting systems. Prerequisite: one course in statistics and one course in data processing.

5395. SPECIAL TOPICS IN CRIMINAL JUSTICE (3-0)
3 hours credit — This course will deal with different topics each semester. The seminar may be repeated for credit as the topic changes.

5396. CONFERENCE COURSE IN URBAN AFFAIRS (3-0)
3 hours credit — Reading and research in a specialized area of urban affairs under the direction of a member of the graduate faculty.

5697. INTERNSHIP REPORT 6 hours credit—Under special conditions, a student may elect an internship report in lieu of the thesis requirement. The report on the internship will meet the same standards of scholarship and writing applied to the traditional thesis.

5698. THESIS 6 hours credit—A thesis conforming to University and departmental requirements may be prepared by graduate students in urban affairs.

ACCOUNTING

OBJECTIVE

The objective of the Master of Professional Accounting Degree program is to prepare students for careers as professional accountants, either in public, private, or government accounting, and, as a part of this larger objective, to provide them with the educational background to become Certified Public Accountants. In addition, the program is designed to provide the student with a sound understanding in selected fields such as finance, management, behavioral sciences, management sciences and economics. Thus, the program seeks to provide the student with a broad perspective, which is a requisite to success both as a professional accountant and as a top-level financial or business executive.

DEGREE REQUIREMENTS

Admission to the Master of Professional Accounting Degree program is based upon the general admission requirements of the Graduate School. However, for the Master of Professional Accounting Degree program, a satisfactory score on either the Graduate Record Examination or the Advanced Test for Graduate Study in Business may qualify the applicant. In addition, the applicant must have satisfactorily completed the following minimum course requirements.

- (1) Principles of Accounting; Intermediate Accounting; Cost Accounting; Auditing; and a course in Advanced Accounting, Accounting Theory, or Income Tax. (This will normally involve a minimum of 21 semester hours.)
- (2) A basic course in each of Business Law, Management, Marketing, Finance, and Statistics.
- (3) Principles of Economics; Intermediate Macro-economic Theory; and Intermediate Micro-economic Theory. This will normally involve a minimum of 12 semester hours.
- (4) College Algebra, and Mathematics for Business and Economic Analysis or the equivalent. (Representative topics covered in Mathematics for Business and Economic Analysis are linear equations, inequalities, probability, vectors, differentiation, and integration.)

Students holding a bachelor's degree in business administration with a major in accounting will ordinarily have fulfilled the preceding requirements. A student not holding an undergraduate accounting degree will, with the assistance of his graduate advisor, determine the existing deficiencies and select appropriate remedial course work. Provisional admission to the program may be granted while the applicant is taking course work to remove deficiencies.

The program requires 30 semester hours of work if the student chooses to write a thesis. If the student prefers not to write a thesis, 33 semester hours are required. The program is characterized by flexibility so as to accommodate students having diverse undergraduate backgrounds and diverse career interests.



Each student, with the assistance and consent of his graduate advisor, will develop a course of study designed to meet his educational needs in light of previous academic work and career objectives.

Of the semester hours required, not more than six semester hours may be represented by undergraduate courses. Undergraduate courses submitted for graduate credit must be approved by the student's graduate advisor. A minimum of 12 semester hours of accounting are to be selected from the courses offered. If undergraduate courses in accounting are approved for graduate credit, these courses would be a part of the minimum accounting requirements. At least six semester hours in business administration and economics graduate courses are required, including an appropriate graduate course in statistics or management science. The program requirements include a six-hour thesis or an appropriate substitute.

5313. ACCOUNTING THEORY (3-0) 3 hours credit—A basic theory course which treats the history and development of accounting theory, the forces which have influenced this development, different concepts of income which have been expressed over the years, and significant problem areas in asset and liability measurement and income determination. Substantial use is made of Accounting Research Studies, Opinions of the Accounting Principles Board and its predecessor, pronouncements of the American Accounting Association, and readings in the literature of accounting and economics.

5315. TAX PLANNING AND RESEARCH (3-0) 3 hours credit—An intensive study of the more complex provisions of the internal revenue code pertaining to individuals, partnerships, corporations, and estates and trusts. Tax planning for the business enterprise is emphasized throughout the course, as is student research into tax problem areas. Prerequisite: accounting 3315 (Federal Income Tax).

5318. STUDIES IN AUDITING (3-0) 3 hours credit—A critical analysis of generally accepted auditing standards; the nature of auditing and its application in opinion audits, internal audits, management audits, and S.E.C. reporting; and special problems such as legal liability, professional conduct, communications and human relations, sampling and auditing E.D.P. Prerequisite: accounting 4318 (Auditing).

5321. CASES IN FINANCIAL ACCOUNTING (3-0) 3 hours credit—This course is designed to improve the student's ability to deal with complex problem areas in financial accounting and to sharpen his understanding and application of accounting concepts and principles. A variety of significant and complex accounting cases and problems are considered and analyzed in detail during this intensive study of financial accounting topics. Prerequisite: accounting 4311 (Advanced Accounting).

5322. ACCOUNTING FOR MANAGEMENT PLANNING AND CONTROL (3-0) 3 hours credit—A comprehensive study of information and reporting needs of contemporary management for planning and control of operations. The viewpoint taken is that of the chief financial officer. Topics include the process of setting corporate objectives and the ensuing measurement and behavioral problems; the nature of capital budgeting and profit-plan-

ning and their relationships to corporate objectives; the purposes and methodology of cash budgeting; and the use of quantitative tools of analysis such as inventory models, linear programming, and corporate financial models. Extensive use is made of both library materials and university computer facilities. Prerequisite: accounting 3301 (Managerial Accounting) or 3313 (Cost Accounting) or 5302.

5324. ADVANCED STUDIES IN PLANNING AND CONTROL (3-0) 3 hours credit—Representative topics include inter-industry studies of planning and control, PERT/Cost systems, corporate financial models and planning and control. The emphasis of the course and topics will vary. Prerequisite: accounting 3314 (Accounting in Managerial Planning and Control) or 5322.

5327. CONTEMPORARY ISSUES IN ACCOUNTING THEORY (3-0) 3 hours credit—This course is designed to familiarize the student with the significant problems currently facing the accounting profession, to examine in depth the various solutions proposed by accounting scholars and others, and to strengthen and mature the student's understanding of today's critical issues in accounting theory. Prerequisite: accounting 3312 (Intermediate Accounting).

5329. INFORMATION SYSTEM ANALYSIS (3-0) 3 hours credit — Studies in the structure, functions, and objectives of accounting and related information systems. Both theoretical and implementive aspects of systems are explored. Special consideration is given to the impact of system structure on individual and group motivation. Prerequisite: six hours of accounting.

5330. INTERNATIONAL ACCOUNTING AND FINANCIAL REPORTING (3-0) 3 hours credit — Primary emphasis in this course is on comparative and analytical study and research in the problems of obtaining, interpreting, and using financial information in international business. Consideration will also be given to reporting and controlling foreign operations, international auditing standards and practices, the role of accounting in economic development and other dimensions of international accounting as time permits. Prerequisite: accounting 5302 or nine hours of undergraduate accounting.

5191, 5291, 5391. RESEARCH COLLOQUIUM 1, 2, or 3 hours credit—Provides the vehicle for presentation of research by the candidate and an arena for his examination by faculty and other candidates. The research colloquium may with appropriate permission be used as a partial substitute for the traditional type of thesis work.

5192, 5292, 5392. SELECTED TOPICS IN ACCOUNTING 1, 2, or 3 hours credit—In depth study of selected topics in accounting. This course may be repeated when topics vary. Prerequisite: consent of instructor.

5698. THESIS 6 hours credit. Prerequisite: permission of graduate advisor.

BUSINESS ADMINISTRATION

OBJECTIVE

The Master of Business Administration program is broad in nature and is aimed at general competence for overall management.

Modern managers increasingly move across functional lines as they reach higher positions of responsibility. The ability to reason and solid habits of learning aid in the creation of a general management frame of reference and balanced managerial performance.

The professional manager's ability to contribute constructively to change in business, and to make and successfully execute wise decisions, is in large part derived from his sensitivity to the factors which make up the problems with which he is faced. Management competence increasingly requires a willingness to face the challenge of living in an environment of uncertainty, in which innovation occurs at an ever-increasing rate and in which inter-individual and intergroup relationships are becoming more complex.

DEGREE REQUIREMENTS

Admission to the Master of Business Administration program is based upon the completion of the general admission requirements of the Graduate School.

For the Master of Business Administration program the general requirement may be a satisfactory score on the Graduate Record Examination or on the Admission Test for Graduate Study in Business.

Many people in business seek to enhance their career opportunities by broadening their knowledge and understanding of the overall management field. Since it is impossible for them to leave their responsibilities and return to academic work on a full-time basis, the School of Business Administration offers a complete program in the evening as a service to the community. Evening classes are taught by full-time faculty members and the same academic standards required of full-time students are maintained. The same course sequence is planned for evening students as for the full-time students. All of the course work required for the degree is offered in the evening hours. It is expected that the student will progress through the program at a pace that is commensurate with the time available for him to study.

The program has been designed to accommodate students of widely divergent backgrounds.

BACKGROUND CATEGORY I: The first category includes those students who have had no prior academic work in business. They will enter the program of work listed for Semester I and will continue sequentially through both the Foundation Program and the Advanced MBA Program.

BACKGROUND CATEGORY II: The second category includes those students with varying amounts of work in the business area; for such individuals there is provided a mechanism for

waiving those Foundation Program courses for which he has completed equivalent college work.

FOUNDATION PROGRAM

The following courses constitute the Foundation Program, credit for which will not be given in the Advanced MBA Program.

Semester I	Semester II
Accounting Analysis I (Acct. 5301)	Accounting Analysis II (Acct. 5302)
Economic Analysis I (Eco. 5309)	Economic Analysis II (Eco. 5311)
Statistics (B.A. 5301)	Marketing (Mkt. 5311)
Decision Models and Information Systems (M.S. 5311)	Finance (Fin. 5311)
Behavioral Science in Manage- ment (Mgt. 5311)	Management (Mgt. 5312)

ADVANCED MBA PROGRAM

The Advanced MBA Program consists of 36 hours of course work to be selected by the student and approved by the graduate advisor and the faculty counselor in his concentration area as described below. However, in no case is a student's program to exceed 60 hours and in those few cases where it is deemed advisable for the student to take the entire Foundation Program, he will be allowed to waive six hours of electives in the advanced program.

Required MBA Courses: The following advanced MBA courses are required of all students—business administration 5333; 5191, 5291, or 5391; and either 5330 or 5337. The Research Colloquium (business administration 5391) is taken in the MBA Program in lieu of a thesis.

Concentration Areas: A concentration of not more than 12 semester hours may be taken in one of the following curriculum areas: accounting, economics, finance, management, management science, marketing. A student who wishes to take a program of courses in a wider range of areas may choose not to take a concentration.

Elective Areas: An MBA student may take elective courses in any of the curriculum areas of the MBA Program. He may take no more than six semester hours in advanced courses in an area other than the concentration field.

ACCOUNTING

5301. ACCOUNTING ANALYSIS I (3-0) 3 hours credit—An introductory study of the concepts, terminology, purposes, and methodology of financial and managerial accounting.

5302. ACCOUNTING ANALYSIS II (3-0) 3 hours credit — Continuation of Accounting Analysis I.

5313. ACCOUNTING THEORY (3-0) 3 hours credit—A basic theory course which treats the history and development of accounting theory, the forces which have influenced this development, different concepts of income which have been expressed over the years, and significant problem areas in assets and liabil-



ity measurement and in income determination. Prerequisite: accounting 5302 or nine semester hours of undergraduate accounting.

5315. TAX PLANNING AND RESEARCH (3-0) 3 hours credit—An intensive study of the more complex provisions of the Internal Revenue Code pertaining to Individuals, Partnerships, Corporations, and Estates and Trusts. Tax planning for the business enterprise and the Gift Taxes, are emphasized throughout the course, as is student research into tax problem areas. Prerequisite: accounting 3315 (Federal Income Tax).

5318. STUDIES IN AUDITING (3-0) 3 hours credit—Requirements of the Securities and Exchange Commission, methods of applying statistical techniques to auditing problems, the auditing of records maintained on computers, and internal auditing problems. This course is designed to complete, insofar as possible, a student's formal education in auditing. Prerequisite: accounting 4318 (Auditing).

5321. CASES IN FINANCIAL ACCOUNTING (3-0) 3 hours credit—This course is designed to improve the student's ability to deal with complex problem areas in financial accounting and to sharpen his understanding and application of accounting concepts and principles. A variety of significant and complex accounting cases and problems are considered and analyzed in detail during this intensive study of financial accounting topics. Prerequisite: accounting 4311 (Advanced Accounting).

5322. ACCOUNTING FOR MANAGEMENT PLANNING AND CONTROL (3-0) 3 hours credit—A comprehensive study of information and reporting needs of contemporary management for planning and control of operations. The viewpoint taken is that of the chief financial officer. Representative topics include the process of setting corporate objectives and the ensuing measurement and behavioral problems; the nature of capital budgeting and profit-planning and their relationships to corporate objectives; the purposes and methodology of cash budgeting; and the use of quantitative tools of analysis such as inventory models, linear programming, and corporate financial models. Extensive use is made of both library materials and university computer facilities. Prerequisite: accounting 3301 (Managerial Accounting) or 3313 (Cost Accounting) or 5302.

5324. ADVANCED STUDIES IN PLANNING AND CONTROL (3-0) 3 hours credit—Representative topics include inter-industry studies of planning and control. The PERT/Cost systems, corporate financial models, and planning and control. The emphasis of the course and topics will vary. Prerequisite: accounting 3314 (Accounting in Managerial Planning and Control) or 5322.

5327. CONTEMPORARY ISSUES IN ACCOUNTING THEORY (3-0) 3 hours credit—Financial accounting at any point in time is confronted with a variety of unresolved issues. This course is designed to familiarize the student with the significant problems currently facing the accounting profession to examine in depth the various solutions proposed by accounting scholars and others, and to strengthen and mature the student's understanding of today's critical issues in accounting theory. Prerequisite: accounting 3312 (Intermediate Accounting).

5329. INFORMATION SYSTEM ANALYSIS (3-0) 3 hours credit—Studies in the structure, organization functions and objectives of accounting and related information systems. Both theoretical and implementive aspects of systems are explored.

Special consideration is given to the impact of system structure on individual and group motivation. Prerequisite: six hours of accounting.

5330. INTERNATIONAL ACCOUNTING AND FINANCIAL REPORTING (3-0) 3 hours credit—Primary emphasis in this course is on comparative and analytical study and research in the problems of obtaining, interpreting, and using financial information in international business. Consideration will also be given to reporting and controlling foreign operations, international auditing standards and practices, the role of accounting in economic development, and other dimensions of international accounting as time permits. Prerequisite: accounting 5302 or nine hours of undergraduate accounting.

5192, 5292, 5392. SELECTED TOPICS IN ACCOUNTING (1, 2, or 3 hours credit)—In depth study of selected topics in accounting. This course may be repeated when topics vary. Prerequisite: consent of instructor.

BUSINESS ADMINISTRATION

5301. STATISTICS (3-0) 3 hours credit — An introduction to statistics designed to prepare the student for quantitative analysis of business problems. Topics include probability, random variables, sampling distributions, confidence intervals, tests of hypotheses, regression theory and application, and Bayesian inference. Prerequisite: mathematics 1314 (Mathematics for Business and Economics Analysis) or equivalent.

5302. MATHEMATICS FOR MANAGEMENT SCIENCES (3-0) 3 hours credit—A study of the quantitative techniques of use in the functional courses and operations research. Topics include matrix algebra, linear systems, differential and integral calculus, and differential equations. This course may not be counted as an MBA Foundation Program course nor as an elective.

5330. LEGAL ENVIRONMENT OF BUSINESS (3-0) 3 hours credit—A study, in a conceptual framework, of the ideas and social and political forces that have led to changes in the business legal environment and legal institutions including current and historical developments affecting the business corporation. The legal framework for business in serving diverse interests of investors, creditors, the sovereign, the general public, and others is studied along with modern social legislation affecting business.

5333. BUSINESS POLICY (3-0) 3 hours credit—This course provides an integration of the master's of business administration curriculum into a cohesive whole. The several elements of business administration are treated by use of business policy cases and decision simulation methods.

5337. BUSINESS AND SOCIETY (3-0) 3 hours credit — An examination of the interaction of the organizations of industry and commerce, government, labor, and other institutions within our society. Prerequisite: permission of graduate advisor.

5190, 5290, 5390. CONCENTRATION SEMINAR 1, 2, or 3 hours credit—In this course the students explore in depth some of the key problems in their area of concentration. Research effort is initiated for the investigation of critical problems in the area. Prerequisite: permission of the instructor.

5191, 5291, 5391. RESEARCH COLLOQUIUM 1, 2, or 3 hours credit—Provides the vehicle for presentation of research by the candidate and an arena for his examination by faculty and other



candidates. (On occasion the Concentration Seminar plus the Research Colloquium may, with appropriate permission, be used as a substitute for the traditional type of thesis work). Prerequisite: permission of graduate advisor.

5398, 5698, 5998. **THESIS 3, 6, or 9 hours credit.** Prerequisite: permission of graduate advisor.

ECONOMICS

5304. **ADVANCED PUBLIC FINANCE (3-0) 3 hours credit**—Application of welfare theory to government budget policy in terms of resource allocation and income distribution; economic effects of particular taxes. Prerequisite: permission of graduate advisor in economics.

5309. **ECONOMIC ANALYSIS I (3-0) 3 hours credit**—This is an accelerated course in fundamental economic analysis for students enrolled in graduate programs other than the Master of Arts in economics. The basic analytical concepts of price theory and their application to managerial decisions are developed. The course includes the theory of consumer behavior, theory of the firm, and market structure.

5311. **ECONOMIC ANALYSIS II (3-0) 3 hours credit**—This is an accelerated course in fundamental economic analysis for students enrolled in graduate programs other than the Master of Arts in economics. The ideas of economics—related to aggregate production, income, the underutilization or overutilization of resources, and the operation of the monetary system—are developed carefully.

5313. **MANAGERIAL ECONOMICS (3-0) 3 hours credit**—Application of economic analysis in formulating business decisions, drawing upon the theoretical foundations of the concepts of demand, cost, production, profits, and competition, with special emphasis on case studies. Prerequisite: economics 3310 (Microeconomics) or 5309.

5321. **INTERNATIONAL ECONOMICS (3-0) 3 hours credit**—International trade and policy issues; balance-of-payments and adjustment processes; international monetary arrangements; contemporary problems in international economics. Prerequisite: permission of graduate advisor in economics.

5324. **MONETARY AND FISCAL ECONOMICS (3-0) 3 hours credit**—Analysis of the effects of central bank policy and government spending and taxation on income and employment; public debt management. Prerequisite: permission of graduate advisor in economics.

5331. **URBAN ECONOMICS (3-0) 3 hours credit**—An analysis of urban problems and goals with special attention given to those factors that influence the economic development of urban communities and the quality of urban life. Attention is given to policy formulation as a means for urban problem solving. Prerequisite: economics 2305 and 2306 (Principles of Economics) and consent of instructor.

5335. **ADVANCED LABOR ECONOMICS (3-0) 3 hours credit**—An analysis of the major forces influencing the supply of and the demand for labor and the economic rationale governing the determination of factor income. Prerequisite: permission of graduate advisor in economics.

5191, 5291, 5391. **RESEARCH AND SELECTED TOPICS IN ECONOMICS (1, 2, or 3 hours credit)**—In depth study of selected topics in economics. This course may be repeated when topics vary. Prerequisite: consent of instructor.

FINANCE

5311. BUSINESS FINANCIAL MANAGEMENT (3-0) 3 hours credit—This course is a study of the function of providing the business firm with funds necessary for its operation and of achieving effective utilization of funds. Primary emphasis is on financial decision-making within the business firms, and techniques of financial analysis and forecasting that aid in optimum decision-making. Subject matter is developed to focus attention on the nature and significance of the variable factors involved in the main types of financial decisions and on methods of analyzing and evaluating these factors. Prerequisite: accounting 5301 and economics 5309 or equivalents.

5320. SEMINAR IN CENTRAL BANKING (3-0) 3 hours credit—Emphasis is placed on the development of the Federal Reserve System and the purposes and functions which justify its existence. Contemporary evidence of the incidence of monetary policy is analyzed, and the effects of the Fed's policies on business and financial institutions, the attractiveness of investment alternatives, capital markets, and related areas are examined. Prerequisite: finance 5311 or equivalent.

5322. ADVANCED BUSINESS FINANCIAL PROBLEMS (3-0) 3 hours credit—Analysis of financial problems of business concerns, presented in case materials. Types of problems considered are: determination of capital needs, choosing among alternative capital investments, planning methods of financing new capital expenditures, and planning recapitalizations, mergers, and reorganizations. Prerequisite: finance 5311 or equivalent.

5323. INVESTMENT MANAGEMENT PROBLEMS (3-0) 3 hours credit—Application of principles and techniques of investment management in solving investment problems of individuals and financial institutions. Types of problems considered are: apportionment of investment funds among alternative types of securities in planning portfolios, analysis of risk exposure in particular securities, valuation of securities, timing of security acquisitions, and shifting funds among classes of securities held in portfolios. Prerequisite: finance 5311 or equivalent.

5324. SEMINAR IN FINANCIAL THEORIES (3-0) 3 hours credit—Intensive research in selected areas of business finance, investment analysis and management, financial markets, commercial banking, and non-bank financial institutions. Prerequisite: finance 5311 or equivalent.

5325. MANAGEMENT OF FINANCIAL INSTITUTIONS (3-0) 3 hours credit—General management problems and policies of financial institutions, emphasizing the role of the major financial institutions. Use of analytical techniques through case method of instruction as an aid to the solution of significant financial problems. Approximately one-third of the course devoted to commercial banks and two-thirds devoted to principal non-bank financial institutions such as life and casualty insurance companies, savings associations, mutual and stock investment companies, pension funds, etc. Prerequisite: finance 5311 or equivalent.

5192, 5292, 5392. SELECTED TOPICS IN FINANCE (1, 2, or 3 hours credit)—In depth study of selected topics in finance. This course may be repeated when topics vary. Prerequisite: consent of instructor.



MANAGEMENT

5311. BEHAVIORAL SCIENCES IN MANAGEMENT (3-0) 3 hours credit—An examination of the managerial uses of concepts and findings from the disciplines of sociology, psychology and cultural anthropology. Consideration is given to the functions of the personnel administration area, and to supervision-leadership, morale-motivation problems and communication.

5312. MANAGEMENT (3-0) 3 hours credit — This course is designed as a basic exploration of management concepts. The student is exposed to the significant systems and environments of the organization that materially affect the decision-making process. Prerequisite: management 5311.

5320. ORGANIZATIONAL BEHAVIOR (3-0) 3 hours credit— This course provides a systematic study of behavioral problems in the complex organization. The course analyzes the interaction of environmental and internal factors in their effects upon organizational behavior. The course is placed within the context of the organization process. Prerequisite: management 5312 or equivalent.

5321. ADVANCED MANAGEMENT THEORY (3-0) 3 hours credit—This course is designed to provide the foundation for an in-depth knowledge of the management process. The course will relate the empirical findings and theoretical hypotheses concerned with goal setting, planning, and control to functions of management in a profit-related organization. Prerequisite: management 5312 or equivalent.

5324. GROUP AND INTERGROUP RELATIONSHIPS (3-0) 3 hours credit—This course analyzes the operation of groups in the organization. Effects on productivity and morale of such work group attributes as cohesiveness, group norms, group pressures, and leadership are examined. The effects of the group in individual behavior is considered. Intergroup problems involving union-management relations, interdepartmental conflicts, and international relations are analyzed. Prerequisite: business administration 5312 or equivalent.

5325. INDUSTRIAL RELATIONS (3-0) 3 hours credit — Examines union-management relations and considers the structure and functioning of the economic and social forces of importance at the policy level within both the firm and the union. Non-union employee relationships are also considered. Prerequisite: management 5312 or equivalent.

5327. SEMINAR IN MANAGEMENT (3-0) 3 hours credit—Independent research by the student with emphasis upon depth of penetration into the chosen topic. Prerequisite: management 5312 or equivalent.

5328. OPERATIONS MANAGEMENT (3-0) 3 hours credit — An analysis of managerial decisions in the production function with consideration of the planning and design of systems and processes. Prerequisite: business administration 5301 and 5302, and management 5312 or equivalent.

5192, 5292, 5392. SELECTED TOPICS IN MANAGEMENT (1, 2, or 3 hours credit)—In depth study of selected topics in management. This course may be repeated when topics vary. Prerequisite: consent of instructor.

MANAGEMENT SCIENCE

5311. DECISION MODELS AND INFORMATION SYSTEMS (3-0) 3 hours credit—The study of system concepts, analysis of systems operations, and the formulation of system models considering the acquisition of data, the processing of information, and the utilization of algorithms and decision models in information systems for the administration of operations. Prerequisite: mathematics 1314 or three hours calculus or business administration 5302 or concurrent enrollment.

5321. INTRODUCTION TO MANAGEMENT SCIENCES (3-0) 3 hours credit — An introduction to the scientific approach to management problems. Special topics with applications taken from the areas of probability theory, linear programming, game theory, simulation, queuing theory, inventory theory, Markov chains, network analysis and other areas of management sciences 5302 and economics 5306 or business administration 5301 or equivalents.

5323. APPLIED DECISION THEORY (3-0) 3 hours credit—A thorough investigation of the analysis of decisions under risk and uncertainty. Concepts of both classical and Bayesian statistics will be integrated and applied to the decision-making process. The course will include a treatment of subjective probability, utility theory, risk analysis, and the value of information. Prerequisite: business administration 5302, and economics 5306 or business administration 5301, or equivalent.

5325. ADVANCED STATISTICAL METHODS IN BUSINESS ADMINISTRATION (3-0) 3 hours credit — The study of advanced topics in regression, correlation, experimental design, sampling methods, and other statistical methods with emphasis on the application of these topics to problems in the administration of operations. Prerequisite: business administration 5301.

5326. SIMULATION AND BUSINESS MODELS (3-0) 3 hours credit—A study of the theory and practices in the simulation of stochastic and mathematical models of business and industrial processes. An application of mathematical methods to problems of resource allocation, economic analysis, inventory systems, management planning models, queuing systems. Investigation of mathematical and statistical methods such as Monte Carlo simulation, process generators, and other simulation techniques. Emphasis will be placed on the formulation, construction and simulation of realistic business problems. Prerequisite: management science 5321.

5327. APPLIED MATHEMATICAL PROGRAMMING (3-0) 3 hours credit—A study of optimization techniques including linear, quadratic, non-linear, dynamic integer, and geometric programming. Emphasis will be on problem identification, technique association, and solution formulation. Applications of game theory will also be investigated. Prerequisite: management science 5321.

5328. GENERAL SYSTEM MODELS AND ANALYSIS (3-0) 3 hours credit — The study of concepts of the general system theory, isomorphic models and contributions from the various disciplines for the analyses of systems and the optimal design of system models. Prerequisite: business administration 5302.

5192, 5292, 5392. SELECTED TOPICS IN MANAGEMENT SCIENCE (1, 2, or 3 hours credit)—In depth study of selected topics in management science. This course may be repeated when topics vary. Prerequisite: consent of instructor.



MARKETING

5311. MARKETING (3-0) 3 hours credit—A survey of all the activities involved in marketing. Emphasis is placed on developing a managerial point of view in planning and evaluating marketing decisions of the firm. Decisions with respect to products, price, channel, and promotional variables are analyzed, and questions relating to cost efficiency, demand and regulations are appraised.

5320. BEHAVIORAL SCIENCE IN MARKETING (3-0) 3 hours credit—This course employs the case method to acquaint a student with the importance of sociological and psychological applications in marketing analysis. Cases used cover a wide range of marketing problems including product decisions, promotional decisions, pricing decisions, and distribution channel decisions. The emphasis is on applications rather than technique, the students being assumed to have sufficient knowledge of behavioral science techniques from the outset. Prerequisite: marketing 5311 and management 5311 or equivalent.

5321. MANAGEMENT SCIENCE IN MARKETING (3-0) 3 hours credit—A case course designed to demonstrate applications of differential and integral calculus, matrix algebra, Bayesian statistics, Markov chains, queuing models and linear programming in marketing decision-making. The emphasis is on applications rather than technique, the students being assumed to have command of the techniques from the beginning. Prerequisite: marketing 5311 and management science 5321 or equivalent.

5322. PLANNING AND POLICY MAKING IN MARKETING (3-0) 3 hours credit—This course stresses the design and development of marketing programs. Communication problems, channel questions, and price and product policies are covered in depth. Emphasis is on developing a substantive framework within which alternative marketing decisions can be considered and evaluated. Prerequisite: marketing 5311 or equivalent.

5323. MARKETING STRATEGY (3-0) 3 hours credit—A case course designed to give the student an opportunity to utilize the material and analytical tools that he has acquired. Detailed case studies are used which require a realistic diagnosis of company problems, development of alternative courses of action, and the formulation of specific recommendations. Stress is placed on developing a more tangible recognition of the interrelationships of the various aspects of the marketing mix as well as showing how marketing operations affect and are affected by other functional areas. Prerequisite: marketing 5311 or equivalent.

5324. SEMINAR: CONTEMPORARY MARKETING PROBLEMS (3-0) 3 hours credit —Emphasis is placed on projects based on a wide range of marketing developments and trends. Each student is required to write and present a research paper dealing in depth with marketing topics of current or potential interests. Prerequisite: marketing 5311 or equivalent.

5192, 5292, 5392. SELECTED TOPICS IN MARKETING (1, 2, or 3 hours credit)—In depth study of selected topics in marketing. This course may be repeated when topics vary. Prerequisite: consent of instructor.

GEOLOGY

OBJECTIVE

The graduate program in geology is designed primarily to extend the basic foundation and to offer research experience in preparation for professional work or further graduate studies elsewhere. Secondly, the design aims to provide flexible support for several other disciplines.

DEGREE REQUIREMENTS

In addition to the general requirements for the Master of Science degree, the program in geology requires: (1) reading competence in a foreign language as demonstrated by examination or by collegiate credits at the sophomore level and (2) thesis defense as prescribed by the Departmental Committee on Graduate Studies.

5301. URBAN AND ENVIRONMENTAL GEOLOGY (3-0) 3 hours credit—This course deals with current geologic problems as related to both urban planning and development and the environment.

5302. TECTONICS (3-0) 3 hours credit—A study of regional structural features and their origin and development.

5309. GEOCHEMISTRY (3-0) 3 hours credit — Quantitative study of chemical equilibrium, oxidation-reduction and pH in geologic environments. Application of thermodynamics to the study of natural geologic environments. Geochemistry of weathering, sedimentation, igneous and post-magmatic fluids. Processes controlling distribution of the elements.

5341. INTRODUCTION TO MICROPALAEONTOLOGY (2-3) 3 hours credit—A survey of selected taxa with emphasis upon the foraminifers. \$2 lab fee.

5342. PALEOBIOLOGY (2-3) 3 hours credit—Analysis of fossils as biologic systems: the species concept, formal systematic procedures, ontogeny, population statistics, functional morphology, and speciation. \$2 lab fee.

5343. IGNEOUS AND METAMORPHIC PETROGRAPHY (2-3) 3 hours credit—A study of the classification and genesis of igneous and metamorphic rocks. Emphasis on metamorphic minerals and facies; origin of magmas, volcanic rocks, plutonic bodies, and relations to tectonic environment. Prerequisite: geology 3345 (Optical Mineralogy) or equivalent. \$2 lab fee.

5344. SEDIMENTARY PETROGRAPHY (2-3) 3 hours credit —A study of sedimentary materials from origin through lithification, with emphasis on sedimentary environments. Prerequisite: geology 3345 (Optical Mineralogy) or equivalent. \$2 lab fee.

5345. PALEOECOLOGY (2-3) 3 hours credit—A study of the origin of fossil assemblages, definition and environmental significance of fossil associations, interpretation of ancient marine communities, and reconstruction of depositional environments. \$4 lab fee.

5346. ADVANCED MINERALOGY (2-3) 3 hours credit — A study of the classification and associations and identification of minerals using X-ray and differential thermal analysis. \$2 lab fee.



5347. **PETROLEUM GEOLOGY (2-3) 3 hours credit**— A study of the origin, migration, and entrapment of hydrocarbons. \$2 lab fee.

5349. **AIR PHOTO AND MAP INTERPRETATION (2-3) 3 hours credit**—This course includes the geologic analysis of selected areas using vertical aerial photographs, topographic maps, oblique satellite photography, and radar imagery. \$2 lab fee.

5351. **EARTH SCIENCE EDUCATION I (2-3) 3 hours credit**—This course introduces the teacher to the physical aspects of geology and related sciences. The program emphasizes study of the fields of mineralogy and petrology, structure and geomorphology, and meteorology. Weekly field trips are designed to integrate lecture and laboratory work. This course is offered during the summer only and cannot be taken for credit toward an M.S. degree in geology. Prerequisite: permission of instructor. \$2 lab fee.

5352. **EARTH SCIENCE EDUCATION II (2-3) 3 hours credit**—An introduction to earth history and the relationship between man and his environment. The program emphasizes astronomy, paleontology and stratigraphy, oceanography, and various aspects of environmental geology. Weekly field trips are designed to integrate lecture and laboratory work. This course is offered during the summer only and cannot be taken for credit toward an M.S. degree in geology. Prerequisite: geology 5351 or concurrent enrollment. \$2 lab fee.

5191, 5291. **SPECIAL STUDIES IN GEOLOGY 1 or 2 hours credit**—This course will vary in credit according to the work performed. It may be repeated for credit when the topics change. 5192, 5292, 5392. **TOPICS IN GEOLOGY 1, 2 or 3 hours credit**—In-depth study of selected topics in geology. This course may be repeated for credit when topics vary. Prerequisite: consent of instructor.

5698. **THESIS—6 hours credit**—Research for and preparation of the master's thesis.

AEROSPACE ENGINEERING

OBJECTIVE

The overall objective of the aerospace graduate program is to develop in a student the ability to define a technical problem, establish an appropriate mathematical or experimental model based on a firm understanding of the physical nature of the problem, analyze the problem by computer-oriented analysis or experimental techniques, and evaluate the results. Although this ability is developed in the context of aerospace problems, it is applicable to the engineering of any physical system. The program is designed for a student with any of the following specific objectives:

1. A sound foundation in advanced mathematics, science, and engineering which will equip him well for research and development work or for further advanced study toward a doctoral degree in engineering.
2. A program of advanced study which allows specialization in one of the following areas:
 - a. Atmospheric flight mechanics
 - b. Stability and control
 - c. Theoretical or applied aerodynamics
 - d. Turbulence
 - e. Aerospace propulsion
3. A balanced but non-specialized program of advanced study in aerodynamics, astronautics, flight dynamics, structural analysis, propulsion, and modern mathematical analysis.

DEGREE REQUIREMENTS

The general degree requirements for the Master of Science degree have been presented in another section. Students wishing to major in aerospace engineering should have the Bachelor of Science degree in aerospace engineering from an approved school. Students with degrees in other disciplines will be required to take undergraduate courses which are deemed by the graduate faculty to be appropriate prerequisites for a proposed program of graduate study. All students will be expected to have some proficiency in FORTRAN programming. No graduate credit will be granted for courses that are required in the undergraduate aerospace engineering curriculum.

5301. ADVANCED AERODYNAMICS (3-0) 3 hours credit—This course may be repeated for credit as topics change. Topics include the following: hypersonic aerodynamics, transonic aerodynamics, unsteady aerodynamics and optimum aerodynamic shapes.

5302. ADVANCED FLIGHT MECHANICS (3-0) 3 hours credit—Topics covered are basic dynamics of vehicles, the role of environment in the control of space and aerospace vehicles, flight trajectory analysis and optimization. This course may be repeated for credit as topics change. Prerequisite: permission of department

5303. AERODYNAMICS OF WINGS AND BODIES (3-0) 3 hours credit—This course is the application of classical potential



theory to the analysis of the aerodynamics of wings and bodies. A knowledge of complex variable theory is assumed.

5304. INTERNAL AERODYNAMICS (3-0) 3 hours credit — Review of one-dimensional internal aerodynamics, introduction to method of characteristics solutions, internal boundary layer flow patterns, and viscous-inviscid flow interactions. Study of interactions between internal and external flow fields, consideration of propulsion system matching problems for aerospace vehicles.

5305. BOUNDARY LAYER THEORY I (3-0) 3 hours credit— This course contains fundamental laws of motion for a viscous fluid and laminar boundary layer theory from an advanced standpoint. Some aspects of incompressible turbulent boundary layers are introduced.

5306. BOUNDARY LAYER THEORY II (3-0) 3 hours credit — This course is a continuation of 5305. It contains a study of transition phenomena and turbulent boundary layers from an advanced standpoint. The influence of compressibility on boundary layer characteristics is presented. Prerequisite: aerospace engineering 5305.

5307. APPLIED AERODYNAMICS FOR DESIGN (3-0) 3 hours credit— This course introduces non-aerospace engineering majors to sufficient fundamentals of aerodynamics theory to critically evaluate the effect of design features on aerodynamic performance, stability and control.

5308. ADVANCED V/STOL AERODYNAMICS (3-0) 3 hours credit— This course assumes an introductory knowledge of rotary wing aerodynamics. The emphasis is on the more sophisticated aspects of V/STOL aerodynamics. Included are the effects of rotor system dynamics and kinematics, more exact representation of induced velocity fields, and wing-rotor interferences.

5311. ADVANCED ASTRONAUTICS (3-0) 3 hours credit — This course is a continuation of aerospace engineering 4302 (Astronautics). It considers the more sophisticated aspects of orbital mechanics, gyrodynamic, inertial navigation, and centers on the space vehicle as a spinning, variable mass body stabilized by passive means.

5312. ADVANCED DYNAMICS OF FLIGHT (3-0) 3 hours credit— This course may be repeated for credit as topics change. Topics to be considered are matrix-tensor analysis of flight vehicle motion, prediction of piloted vehicle flying qualities, and V/STOL stability and control analysis. This course assumes a comprehensive modern undergraduate course in stability and control.

5316. ADVANCED APPLIED AIRFOIL THEORY (3-0) 3 hours credit— This course is concerned with the application of potential flow theory and boundary layer theory to the problem of optimum design of airfoils, wings, bodies and combinations thereof.

5318. INTRODUCTION TO TURBULENCE (3-0) 3 hours credit— The phenomenological approach is taken to develop the classical methods for understanding turbulent flows; for example jet, wake, and boundary layer flows. A survey is made of modern approaches to predictive and correlative techniques. Emphasis is upon development of the student's intuition for treating natural turbulent flows. Prerequisite: approval of the instructor.

5319. HOMOGENEOUS TURBULENCE (3-0) 3 hours credit — The mathematics and intuitive foundations of turbulence are

emphasized. Probability theory is used to describe homogeneous turbulent flow characteristics such as velocity co-variances and the kinetic energy spectrum. Prerequisite: approval of the instructor.

5320. NON-HOMOGENEOUS TURBULENCE (3-0) 3 hours credit—Homogeneity assumption is omitted so that theoretical results may be applied to flows of interest to the practicing engineer. The "Law of the Wall," "Eddy Viscosity," and "Mixing Length" concepts are applied to "real" turbulent flows, e.g.—over flat and curved surfaces including roughness and pressure gradients, pipe and channel flow, the lower atmosphere, and the upper ocean. Prerequisite: approval of instructor.

5321. LARGE-SCALE STRUCTURE OF TURBULENT SHEAR FLOWS (3-0) 3 hours credit—A relaxation of usual assumptions is required to study realistically the non-linearities ("Large Eddy" and "Spectral Transfer") of "real" turbulence and their implications for design of submerged vehicles. Non-Newtonian flows, fluid pollution and plasma turbulence are discussed. "Second" and "third" order approaches have been successful in predicting, from first principles, quantitatively the values and variation of the "eddy viscosity" function.

5330. FLOW STABILITY AND TRANSITION TO TURBULENCE (3-0) 3 hours credit—Laminar flow stability is predicted by the linear methods of small perturbation theory and integral techniques for arbitrary strength and form of disturbance so that transition-onset and development can be calculated. Matched asymptotic expansion techniques are developed for singular perturbation problems. Prerequisite: approval of instructor.

5340. EXPERIMENTAL METHODS IN TURBULENCE I (2-3) 3 hours credit (May be repeated for credit)—Techniques presented include hot-wire and hot-film anemometers, laser-Doppler and laser-interferometer, hot-thermister, "high response" pressure sensors, fluid "tracers" and other techniques. Student will participate actively in the selection, design, and execution of flow experiments. Typical data are mean and fluctuating velocities, temperatures, pressures, and correlations. Data processing include analog and digital Fourier Transform of correlations to produce the "energy density spectrum" or PSD ("Power Spectral Density"). Prerequisite: approval of instructor.

5191, 5291, 5391. ADVANCED STUDIES IN AEROSPACE ENGINEERING (Variable credit from 1 to 3 semester hours as arranged). May be repeated for credit.

5398 or 5698. THESIS 3 or 6 hours credit—Prerequisite: graduate standing in aerospace engineering.

6197-6997. RESEARCH IN AEROSPACE ENGINEERING (Variable credit from 1-9 hours)—This course may be repeated for credit.

6699. DISSERTATION (6 semester hours)—Prerequisite: admission to candidacy for the Doctor of Philosophy degree.

CIVIL ENGINEERING

OBJECTIVE

The course offerings provide the graduate student with an opportunity to strengthen his knowledge in one or more areas of civil engineering. The student, with the assistance of a faculty advisor, may plan a program in the following fields of specialization within civil engineering.

1. Environmental Health and Sanitary
2. Highways and Traffic
3. Hydraulics and Hydrology
4. Soil Mechanics and Foundations
5. Structures
6. Urban Planning

The program is designed to satisfy the needs of those planning to continue graduate work as well as those who seek to increase their specialized knowledge related to their engineering profession.

DEGREE REQUIREMENTS

The general degree requirements for the Master of Science and Doctor of Philosophy degrees have been presented in other sections. Students wishing to major in civil engineering should have the Bachelor of Science degree in civil engineering from an approved school. Students with degrees in other disciplines may qualify for graduate study in civil engineering after the completion of a faculty approved program of undergraduate courses.

5309. THIN SHELL CONCRETE STRUCTURES (3-0) 3 hours credit—This course covers the general theory of thin shells including membrane theory for domes of double curvature such as hyperbolic and elliptic paraboloids, cylindrical shells and folded plates. Analysis and design are included. Prerequisite: civil engineering 4347 (Reinforced Concrete Design).

5310. NUMERICAL METHODS IN STRUCTURAL DESIGN (3-0) 3 hours credit—This course applies Newmark's approximate method and the finite difference method to the following topics: forces and deformations in flexural members, stiffness, carry over factors and fixed end moments, temperature effects on structures, inelastic deformations, analysis of beam-columns, buckling loads, beams on elastic foundations, frequencies of vibration, thin elastic plates, theory of elasticity problems, plate buckling, flexible bulkheads. Extra polation of approximate results and structural analysis including axial load effects are also covered. Prerequisite: computer science 3201 (Introduction to Computer Science) and civil engineering 3444 (Structural Analysis).

5311. ADVANCED STRUCTURAL STEEL DESIGN I (3-0) 3 hours credit—Plastic analysis and design of frames, arches, trusses, and multistory steel structures are considered as well as current column theories. Prerequisite: civil engineering 4348 (Structural Design in Metals).

5312. ADVANCED STRUCTURAL CONCRETE DESIGN I (3-0) 3 hours credit—This course deals with structural components such as beams, columns, slabs, footings and walls using the ultimate strength method. Building code requirements for reinforced concrete are explained and applied. Flat slabs, flat plates and

other two-way systems are studied. Yield line theory, torsion, and shear-friction are also studied. Prerequisite: civil engineering 4347 (Reinforced Concrete Design).

5313. STRUCTURE-SOIL INTERACTION (3-0) 3 hours credit—Methods of analysis of structure-soil behavior are considered. Numerical techniques are included. Physical problems reviewed include beams and slabs on elastic and inelastic foundations.

5314. SLOPES, EMBANKMENTS, AND EARTH STRUCTURES (3-0) 3 hours credit—A study will be made of the states of stress and analysis techniques associated with cuts, fills, dams, and retaining structures. Conventional analytical and graphical approaches will be considered along with numerical techniques.

5315. FOUNDATION ANALYSIS AND DESIGN (3-0) 3 hours credit—Behavior characteristics of several types of foundations will be studied. Footings, rafts, piles and piers will be covered. Bearing capacity, settlement and behavior of working load levels will be considered.

5321. SUPPLY AND TREATMENT OF WATER (3-0) 3 hours credit—This course covers the pertinent physical, chemical, and biological properties of water and considers the hydrology, statistics, and planning necessary to develop water supplies. Physical and chemical water treatment methods are presented.

5322. WASTE WATER TREATMENT (3-0) 3 hours credit—This course presents the methods used in conducting municipal and industrial waste surveys, and the physical, chemical, and biological techniques used in the purification of waste waters.

5325. GROUND-WATER HYDROLOGY (3-0) 3 hours credit—This course will consider the occurrence and movement of ground water from a geologic viewpoint as preparation for the application of general hydrologic equations to such problems as safe yield, hydraulics of wells, well design, and artificial recharge.

5326. ADVANCED HYDROLOGY (3-0) 3 hours credit—Elements affecting the runoff hydrograph, generation of the runoff hydrograph, flood flow characteristics, determination of the design flood, and flood damage alleviation methods will be studied. Other hydrologic principles will be developed as required to support the topics named and statistical and computer methods introduced wherever appropriate. Prerequisite: civil engineering 5348, and 6307 and three hours of Statistics-Probability.

5330. CHARACTERISTICS OF TRAFFIC (3-0) 3 hours credit—The fundamental elements of traffic—the driver, the vehicle, and the roadway—are considered and then extended into studies of streams of traffic flow. Emphasis is placed on speed, volume, and density relationships and methods of measuring each. Capacity and levels of service are introduced along with some basic theories of traffic flow. Parking and parking terminal concepts are included as well as accident studies. Prerequisite: civil engineering 4301 (Highway Engineering).

5331. TRAFFIC ENGINEERING OPERATIONS (3-0) 3 hours credit—Methods of traffic regulation and control optimization are considered. Topics such as traffic intersection design and control are included as well as the operation of traffic signal network systems. Techniques of conducting traffic engineering studies are introduced along with a study of traffic engineering functions and administration. Analysis and design techniques involving capacity and the level of service concept are included. Prerequisite: civil engineering 4301 (Highway Engineering).

5332. HIGHWAY DESIGN (3-0) 3 hours credit—This course emphasizes geometric considerations necessary for the design of



city streets, highways, and freeways such as the cross sections, vertical and horizontal alignment, sight distances as well as the design of maneuver areas, ramps, intersections, and interchanges. The design of pavements is also covered including both flexible and rigid pavement types. Prerequisite: civil engineering 4301 (Highway Engineering).

5337. URBAN TRANSPORTATION PLANNING (3-0) 3 hours credit — The theory and application of comprehensive urban transportation planning technology are included in this course. The basic studies of population, urban economics, land use, simulation models, forecasting trip generation and distribution, traffic assignment modal split, system design and evaluation, mass transit characteristics, and special problems in the operation of transportation systems, are covered. Prerequisite: civil engineering 4302 (Transportation Engineering).

5338. URBAN PLANNING THEORY AND STUDIES (3-0) 3 hours credit — The course covers the relationship of physical planning to the general theory and process of planning, real estate, economics and normative theory of urban organization, urban land use planning and forecasting, and urban landscape. Site engineering and transportation geography related to aesthetic values, the relationship of environmental engineering and urban ecological patterns, application of engineering processes to the social system, housing, and the total cultural milieu are also included. Prerequisite: civil engineering 4318.

5339. METROPOLITAN PLANNING AND ADMINISTRATION (3-0) 3 hours credit—The history of planning controls in the United States, organization and structure of local and regional planning administration, theory and functions of management and principles of organization, are covered in this course. The engineering systems approach related to problems in population growth, social stratification, and governmental fragmentation problems are studied. Principles of municipal public works administration and capital improvements programming, and planning and engineering techniques related to contemporary political science in urban America are also included.

5345. ADVANCED METHODS IN SANITARY ENGINEERING (2-3) 3 hours credit — This course includes the standard laboratory techniques used to characterize wastes and introduces advanced sanitary engineering theories and practices. Current research topics and methods are included.

5347. ADVANCED HYDRAULIC ENGINEERING (2-3) 3 hours credit—Advanced concepts concerning water transmission via confined and free surface systems will lead to design problems for unsteady flow in open channels, surges and fluid transients in closed conduits, energy dissipation, spillway flows and similar topics. Prerequisite: civil engineering 6307.

5348. SURFACE-WATER HYDROLOGY (2-3) 3 hours credit —This course encompasses the study of the hydrologic cycle, elements of hydrometeorology, infiltration and soil moisture, runoff, rainfall-runoff relationships and the effects of these factors with regard to utilization and conservation of water resources.

5350. FLEXIBLE PAVEMENT DESIGN (2-3) 3 hours credit —This course involves a study of the loads on pavements, stress analysis in flexible pavements, and design practices. Certain laboratory procedures involved in the design of flexible pavements are included.

5352. DESIGN OF WATER AND WASTE WATER TREAT-

MENT UNITS (2-3) 3 hours credit—Problems encountered in the design of water and wastewater treatment plants are covered in this course.

5360. PROPERTIES OF PLAIN CONCRETE (2-3) 3 hours credit—Theories used in the design of concrete and the factors affecting the properties and behavior of the material and of test specimens are considered. Behavior of plain concrete under different types of environment and of loading, such as long-time, repeated, and tri-axial, are emphasized. The studies involve critical reviews of experimental and analytical investigations. Prerequisite: civil engineering 4347 (Reinforced Concrete Design).

5191, 5291, 5391. ADVANCED STUDIES IN CIVIL ENGINEERING (Variable credit from 1 to 3 semester hours as arranged)—It may be repeated for credit when the topics change. **5398 or 5698. THESIS 3 or 6 hours credit**—Research and preparation pertaining to the master's thesis. Prerequisite: graduate standing in civil engineering.

6301. TRAFFIC MODELING (3-0) 3 hours credit — The theory and application of advanced techniques in statistics, simulation, aerial photogrammetry, and data processing are considered in connection with the solution of problems in transportation and traffic design and research. Prerequisite: computer science 3201 (Introduction to Computer Science), mathematics 3313 (Introduction to Probability and Mathematical Statistics) or equivalent.

6302. HIGHWAY CAPACITY (3-0) 3 hours credit — Rational methods for the determination of highway and street capacities are considered. Emphasis is given to street intersection capacities, ramp and weaving section capacities, and freeway capacities. The level of service concept is utilized and factors affecting the level of service as well as the capacity are considered.

6303. RIGID PAVEMENT DESIGN (3-0) 3 hours credit—The theory of rigid pavement design is covered in this course along with current design practices and methods of construction.

6304. HYDROMETEOROLOGY (3-0) 3 hours credit—Among topics to be covered are these: general meteorology and climatology, atmospheric variables, cloud and precipitation physics, techniques of precipitation analysis, probable maximum precipitation, rainfall frequency and weather modification.

6305. WATER RESOURCES PLANNING (3-0) 3 hours credit—Historical and present concepts in water development. Systems approach to development of water resources. Current problems and policies with regard to water resources allocation and administration. General principles and procedures of water resource planning within a regional, multi-purpose context with economic considerations.

6306. DESIGN OF DAMS AND APPURTENANCES (3-0) 3 hours credit—Principles used in the design of large earth and concrete dams, diversion works and appurtenances. Prerequisite: civil engineering 5347 and 6307.

6307. OPEN CHANNEL FLOW AND SEDIMENTATION (3-0) 3 hours credit—Steady flow in open channels. Basic principles, velocity formulas, backwater curves, flow through transitions, obstructions, and bends. Unsteady flow in open channels. Nature of water-borne sediment and sediment transport.

6308. FOUNDATION DESIGN PRACTICES (3-0) 3 hours credit—Subsoil investigations, sheeting and bracing, control of



ground water, shallow foundations, bridge abutments, economic considerations.

6309. THEORETICAL SOIL MECHANICS (3-0) 3 hours credit—Concepts of stress, strain and stress distribution in soils, shearing properties of saturated soils, consolidation for multidirectional flow and time—dependent loading, physiochemical properties, secondary consolidation, partially saturated soils.

6310. SOIL DYNAMICS (3-0) 3 hours credit—Vibrations of simple oscillators, wave propagation in elastic media, dynamically loaded foundations, blast and earthquake resistant design of foundations.

6311. ROCK MECHANICS (3-0) 3 hours credit—Elements of elasticity, rock properties and behavior. Theories of failure for brittle, jointed and anisotropic rocks, theory of in-situ and laboratory testing.

6312. THEORY OF STRUCTURES I (3-0) 3 hours credit—This is a course in the analysis of statically indeterminate elastic structures and will cover the following topics: Maxwell's law of reciprocal displacements, Castigliano's theorems, real work, virtual work, method of consistent deformations, column analogy, elastic center, influence lines, three-moment theorem, approximate analysis of structural frames. Credit will not be given for both civil engineering 6312 and civil engineering 4310. Prerequisite: civil engineering 3444 (Structural Analysis).

6313. THEORY OF STRUCTURES II (3-0) 3 hours credit—A continuation of Theory of Structures I, this course presents a study of the theory of arches, rings, rigid frames, three dimensional frames and trusses, cable supported structures, long span continuous structures and statically indeterminate continuous trusses. Classical methods and energy methods are emphasized. Prerequisite: civil engineering 6312 or consent of instructor.

6314. MOMENT AND SHEAR DISTRIBUTION (3-0) 3 hours credit—This course presents theoretical methods for obtaining stiffness coefficients, carry-over factors and fixed-end moments for continuous-beam columns and beams and frames with elastic supports. Modified moment distribution methods are utilized to obtain solutions to complex problems. Prerequisite: civil engineering 3444 (Structural Analysis).

6316. FINITE ELEMENT METHOD FOR STRUCTURES (3-0) 3 hours credit—This course presents the finite element method for analyzing complex structures. Topics include structural stiffness, finite elements of a continuum, plane stress and strain, axi-symmetric stress analysis, element shape functions, and applications to plate and shell structures. Prerequisite: civil engineering 6317.

6317. MATRIX METHODS FOR STRUCTURES (3-0) 3 hours credit—This course covers the fundamentals of matrix algebra, the solution of simultaneous linear equations and the application of matrix algebra to the stiffness and flexibility methods of structural analysis. Credit will not be granted for both civil engineering 4346 and 6317. Prerequisite: civil engineering 3444 (Structural Analysis).

6318. BEHAVIOR OF STRUCTURES UNDER DYNAMIC LOADS (3-0) 3 hours credit—This course includes the following topics: Idealization of structures for dynamic analysis, natural and forced vibrations of single and multiple degrees of freedom systems, response of structures subjected to blast, wind, and earthquakes. Prerequisite: civil engineering 4310 or 6312.

6319. APPLIED ELASTICITY (3-0) 3 hours credit — This course presents the theory of elasticity from the point of view of mathematical concepts as well as its application in structural design. Closed methods of solution and relaxation methods are utilized to solve problems dealing with beams, columns and other members with respect to shear, flexure and torsion. Prerequisite: civil engineering 3444 (Structural Analysis) and mathematics 2326 (Calculus III).

6320. STABILITY OF STRUCTURES (3-0) 3 hours credit— This course considers the theory concerning elastic and inelastic stability and its application in structural design. Buckling loads are obtained for various types of structural elements having a variety of support conditions. Credit will not be granted for both civil engineering 6320 and engineering mechanics 5322. Prerequisite: civil engineering 4310 or 4324 (Mechanics of Materials II) or 6312.

6321. PLATE STRUCTURES (3-0) 3 hours credit—This course presents a study of plates and slabs considering various materials. Methods of analysis and design are emphasized after theoretical concepts are fully developed. Flat plates and folded plates are considered using various support conditions. Prerequisite: civil engineering 4310 or 6312.

6322. PRESTRESSED CONCRETE (3-0) 3 hours credit—This course includes discussions concerning materials and methods used in prestressing; design of sections for flexure, shear and anchorage; camber, deflections and cable layouts. Simple spans, continuous beams, prestressed piles and prestressed tanks are included in the topics discussed. Prerequisite: civil engineering 4347 (Reinforced Concrete Design).

6323. PRINCIPLES OF ENVIRONMENTAL HEALTH ENGINEERING (3-0) 3 hours credit—This course is concerned with man and his environment and presents engineering methods of controlling communicable disease vectors, epidemiology, and a survey of public health engineering.

6324. INDUSTRIAL HYGIENE AND TOXICOLOGY (3-0) 3 hours credit—Industrial health hazards and methods of controlling them will be studied. The course includes a survey of health hazards in industry, the toxicity of industrial gases, vapors, and dusts, and methods of eliminating hazards.

6325. AIR POLLUTION SOURCES AND CONTROL (3-0) 3 hours credit—The types and sources of atmospheric pollutants, techniques used to predict the dispersion of pollutants, and methods used to control atmospheric emissions are included in this course.

6326. INDUSTRIAL WASTE TREATMENT (3-0) 3 hours credit—This course presents the specialized physical, chemical, and biological treatment schemes required to treat specific industrial wastes.

6327. HIGHWAY PLANNING, ECONOMICS AND FINANCE (3-0) 3 hours credit—This course is a study of the nature of highway transport, needs studies, planning surveys, classification and administration, forecasting and programming, the basis of economic analysis and feasibility studies, vehicle operating costs, appointment formulas and other considerations of finance. The functioning of highways as a regional system will be stressed. Prerequisite: civil engineering 4302 (Transportation Engineering).

6328. PLANNING AND DESIGN OF AIRPORTS (3-0) 3



hours credit—This course is a study of the growth and demand of air transport, air traffic control systems, airport site selection and configuration, geometric design of runways and taxiways, terminal areas, lighting, structural design of pavements and drainage problems. The design of heliports and special short take-off facilities are also considered.

6329. WATER WAVE MECHANICS (3-0) 3 hours credit — Selected topics in surface and wave motion are introduced. Linear solutions to the partial differential equations of surface motions for deep and shallow waves in bodies of water are included. Waves in constrained flows, numerical solution methods, wave forces and flood routing may be included.

6331. ADVANCED STRUCTURAL STEEL DESIGN II (3-0) 3 hours credit—This course will include the following topics as applied to steel members: torsional design of beams, beams with web holes, composite design of beams, lateral-torsional buckling of beams, plate buckling, column design and behavior, frame stability, bracing requirements for compression members. Prerequisite: civil engineering 4348 (Structural Design in Metals).

6332. ADVANCED STRUCTURAL CONCRETE DESIGN II (3-0) 3 hours credit—This course deals with structural systems such as continuous beams, arches, continuous frames, box girders, vierendeel trusses, shear walls with columns, caissons and mat foundations. Computer methods of analysis and design are utilized to study building and bridge structures. Beam methods for long shells are discussed. Prerequisite: civil engineering 5312.

6197-6997. RESEARCH IN CIVIL ENGINEERING (variable credit as arranged)—This course may be repeated for credit.

6699. DISSERTATION (6 semester hours)—Preparation pertaining to the doctoral dissertation. Prerequisite: admission to candidacy for the doctor of philosophy degree.

A limited number of the following courses may be applicable toward the graduate degree if approved in advance by the graduate advisor.

4310. ANALYSIS OF STATICALLY INDETERMINATE STRUCTURES (3-0) 3 hours credit—This course is a study of statically indeterminate structures such as continuous trusses, continuous arches on elastic piers, non-prismatic members, continuous beam columns, and cable-supported structures. These studies include such effects as sidesway, settlement of supports, temperature, flexibility, and dynamic response to earthquakes or blast forces. Numerical methods for solving simultaneous and differential equations as well as iteration techniques are considered.

4313. TRAFFIC ENGINEERING (3-0) 3 hours credit—This is a study of vehicle characteristics, traffic flow, traffic control and the geometric design of intersections and interchanges; traffic speed, volume and density relationships.

4315. ENVIRONMENTAL HEALTH ENGINEERING (3-0) 3 hours credit—This course presents the engineering aspects of public health and environmental sanitation. Sources and vectors of infection, epidemiology, toxicology, collection and disposal of municipal refuse, industrial hygiene and air pollution are included.

4318. CITY PLANNING (3-0) 3 hours credit—This course includes a study of the development of cities, forms of municipal

government, functions of the city manager, urban land-use planning, city finance, public services and utilities, public health and welfare, and housing. The procedures utilized in the formulation and execution of master plans are included.

4321. FOUNDATION ENGINEERING (3-0) 3 hours credit—Several aspects of foundations are considered. These include slopes and embankments, interaction between soils and structures, bearing capacity theories, consolidation and settlement and seepage problems. In addition, numerical analysis techniques are applied to some of these problems.

4344. SOIL STABILIZATION (2-3) 3 hours credit—Techniques and procedures used to improve the rheological properties of foundation materials are studied. Both mechanical processes and chemical additives are considered.

4346. SELECTED TOPICS IN STRUCTURAL ENGINEERING (2-3) 3 hours—This course includes the design and analysis of engineering structures utilizing reinforced concrete, structural steel and timber. The current developments in structural engineering techniques are covered such as prestressed concrete design, ultimate strength design, limit design, plastic analysis and related topics. The course entails the use of matrix algebra and electronic computers for solutions of problems involving multi-story buildings and frames, continuous bridges and arches, and structures having variable moments of inertia.

4351. WATER RESOURCES: SANITARY ENGINEERING DESIGN (2-3) 3 hours credit—This course involves the study of principles of design used by civil engineers in planning the water supplies, water distribution systems, sewers, and sewage treatment facilities. Short problems concerning the design and construction of such facilities are included.

4355. PAVEMENT ANALYSIS AND DESIGN (2-3) 3 hours credit—The theory of rigid and flexible pavement design, design criteria such as traffic loads, natural forces and materials are studied and supplemented by the use of current laboratory design practices.

4357. WATER RESOURCES: ENGINEERING HYDROLOGY (2-3) 3 hours credit—Hydrographs of runoff, streamflow routing, frequency and duration studies, and sedimentation theories will be studied. The acquired fundamentals will then be applied to solution of problems encountered in the provision of water supplies and control of flood flows.

4358. WATER RESOURCES: CONVEYANCE SYSTEMS (2-3) 3 hours credit—Further theories are introduced for solution of more complex closed conduit and open channel flow problems. Theories will be applied to the analysis and design of water conveyance systems, open and closed aqueducts, and pumpage facilities.

4360. ELEMENTS OF PHOTOGRAMMETRY (2-3) 3 hours credit—Photogrammetry, optics and characteristics of aerial cameras are studied as an introduction to characteristics of aerial photographs, map projections, radial plot mosaics and mapping from oblique photographs. Ground control and interpretation of aerial photographs are also included. Emphasis will be placed on the use of stereoscopic plotting instruments and associated data processing units. Prerequisite: civil engineering 2342 (Advanced Surveying), computer science 3201 (Introduction to Computer Science) and senior standing.



ELECTRICAL ENGINEERING

OBJECTIVE

The course offerings provide the student with an opportunity to broaden as well as to intensify his knowledge in a number of areas of electrical engineering. The student, with the aid of a faculty advisor, may plan a program in any one of a number of fields of specialization within electrical engineering or from the offerings of related departments in science and engineering.

Graduate study and research are offered in the areas of:

1. Analysis and Synthesis of Circuits, Networks and Systems
2. Electromagnetic Fields and Related Topics
3. Electronics—Solid State Theory, Device and System Theory
4. Power System Analysis—Computer Applications and Transform Theory
5. Information Transmission and Communication Systems
6. Digital Logic and Systems
7. Interdisciplinary Programs in Materials Science, Direct Energy Conversion, Stability and Control/Automatic Controls, and Bioengineering.

The program is designed to satisfy the needs of students pursuing masters and doctoral degrees and to provide for the student seeking to increase his knowledge in areas of electrical engineering related to his engineering profession.

DEGREE REQUIREMENTS

The general degree requirements for the Master of Science and Doctor of Philosophy degrees have been presented in other sections. Students wishing to major in electrical engineering should have the Bachelor of Science degree in electrical engineering from an approved school. Students with degrees in other disciplines may qualify for graduate study in electrical engineering after the completion of a faculty-approved program of undergraduate courses.

No senior courses required in the present program for the Bachelor of Science degree in electrical engineering may be used in a graduate electrical engineering program.

5301. ANALYSIS OF AIRCRAFT ELECTRICAL SYSTEMS (3-0) 3 hours credit—A study of aircraft electrical power systems and related topics, including flight control systems and autopilots.

5302. PRINCIPLES OF COMPUTER-AIDED DESIGN (3-0) 3 hours credit—Mathematical theory and numerical techniques of problem-oriented languages, optimization, pattern generation, etc. Modeling and analysis of nonlinear and complex systems.

5303. SEMICONDUCTOR ELECTRONICS I (3-0) 3 hours credit—Quantitative description of physical processes relevant to semi-conductor diode and transistor performance, including large signal and high frequency performance.

5304. FUNDAMENTALS OF POWER SYSTEM ENGINEERING (3-0) 3 hours credit—Matrix representations and characteristic values and vectors of power systems elements.

5305. ADVANCED COMPUTER METHODS IN POWER SYSTEM ANALYSIS (3-0) 3 hours credit — Advanced computer methods in short circuit and load flow studies. Prerequisite: electrical engineering 5304 or equivalent.

5306. ADVANCED COMPUTER METHODS IN POWER SYSTEM ANALYSIS (3-0) 3 hours credit — Advanced computer methods in economical load dispatching and power system stability. Prerequisite: electrical engineering 5304 or equivalent.

5307. ADVANCED ELECTRICAL MACHINE THEORY (3-0) 3 hours credit—Advanced studies of rotating machines including dynamic and steady state behavior in combination with the connected power system.

5310. STATISTICAL TECHNIQUES IN POWER SYSTEM ENGINEERING (3-0) 3 hours credit—Introduction to probability theory as applied to power system analysis. Reliability study of power systems.

5311. STATE ESTIMATION THEORY AND COMPUTER CONTROL OF POWER SYSTEMS (3-0) 3 hours credit—Discussion of topics in power system state estimation and computer control of power systems.

5312. PROPAGATION OF ELECTROMAGNETIC WAVES (3-0) 3 hours credit—Diffraction, reflection and refraction of electromagnetic waves at plane and spherical boundaries; propagation in ionized media. Prerequisite: electrical engineering 3312 (Electrical Science V) or equivalent.

5313. ADVANCED ENGINEERING ANALYSIS (3-0) 3 hours credit—A problem course dealing with selected analytical methods not normally included in undergraduate electrical engineering curricula.

5314. NON-LINEAR SYSTEMS ANALYSIS (3-0) 3 hours credit — Introduction to analytical and topological methods of non-linear analysis, including phase plane, limit cycles, describing functions, sub-harmonic oscillations, etc.

5315. SYSTEMS ENGINEERING (3-0) 3 hours credit—An introductory course in the mathematical foundations of systems engineering. Both continuous and discrete data systems are considered. Prerequisite: consent of instructor.

5316. STATISTICAL DESIGN OF LINEAR SERVOMECHANISMS (3-0) 3 hours credit—Analysis and synthesis techniques applicable to feedback control systems in which portions of the system and/or its input signals are nondeterministic. Prerequisite: electrical engineering 4314 or equivalent.

5317. DISCRETE DATA SYSTEMS (3-0) 3 hours credit—The analysis of non-continuous dynamic systems described by difference equations, Z-transform theory, and including applications of signal flow graph theory. Prerequisite: electrical engineering 4314 or equivalent.

5318. NETWORK SYNTHESIS II (3-0) 3 hours credit — A continuation of passive network driving point and transfer function synthesis, extending the introductory material of electrical engineering 4317. Prerequisite: electrical engineering 4317 and mathematics 4322 (Complex Variables).

5319. NETWORK SYNTHESIS III (3-0) 3 hours credit—A continuation of passive network synthesis, with emphasis on transfer function synthesis. Related topics such as predistortion, single and double terminations, and low-pass to band-pass transformations are included. Prerequisite: electrical engineering 5318 or equivalent.



5320. MODERN CONTROL THEORY (3-0) 3 hours credit—Linear algebra, Euclidean spaces, properties of sets, vector functions, function space and related mathematical notions. The concept of system state, finding the state representation for dynamical systems, definition of the control problem, and the concepts of controllability and observability. Conditions for optimality, the variational approach to the control problem, the maximum principle of Pontryagin, and the Hamilton-Jacobi equation. Prerequisite: electrical engineering 4314 or equivalent.

5321. MODERN CONTROL DESIGN TECHNIQUES (3-0) 3 hours credit—Minimum time problems, minimum fuel problems, minimum energy problems and the derivation of necessary conditions. The design of time optimal and fuel optimal systems, and the design of optimal linear systems with quadratic criteria. Prerequisite: electrical engineering 5320.

5322. RANDOM SIGNALS AND NOISE (3-0) 3 hours credit—Probability, random variables, stochastic processes in physical systems, signal detection, design of optimum filters are included.

5323. STATISTICAL DETECTION AND ESTIMATION THEORY (3-0) 3 hours credit—Statistical detection or decision theory and estimation theory as applied to modern communications systems, radar/sonar systems, stochastic control theory, and data processing systems. Prerequisite: electrical engineering 5322.

5326. ADVANCED COMMUNICATION THEORY (3-0) 3 hours credit—Continuation of study of communications problems and techniques, with emphasis shifting to specific areas such as radar detection, space communications, etc. Prerequisite: electrical engineering 5322, 5323.

5327. INFORMATION THEORY AND CODING (3-0) 3 hours credit—Transmission of information over noisy channels, Shannon's coding theorems, techniques of coding and decoding for reliable transmission over noisy channels, error-detecting and error-correcting codes. Prerequisite: electrical engineering 5322.

5328. LOGIC CIRCUITS II (3-0) 3 hours credit—Systems design of digital machines, including general purpose computers, with special emphasis on control units and arithmetic units. Prerequisite: electrical engineering 5442 or equivalent.

5329. DIGITAL SIGNAL PROCESSING (3-0) 3 hours credit—Study of discrete linear systems; design and analysis of digital filters; high speed convolution and correlation with applications to digital filtering and linear filtering. Prerequisite: electrical engineering 5334 or consent of instructor.

5330. APPLICATIONS OF OPTIMIZATION THEORY (3-0) 3 hours credit—Various search techniques for obtaining numerical solutions to the two-point boundary value problem are developed. Linear (simplex), nonlinear, and dynamic programming methods are applied. Prerequisite: electrical engineering 5320 or equivalent.

5334. DISCRETE ORTHOGONAL TRANSFORMS AND THEIR APPLICATIONS (3-0) 3 hours credit—Development of discrete orthogonal transforms such as DFT, BIFORE, Complex BIFORE, and Chirp Z-Transforms, and the application of such transforms in signal processing. Also, the development of efficient algorithms for fast computation of transforms will be discussed. Prerequisite: graduate standing and consent of instructor.

5335. MICROWAVE SYSTEMS ENGINEERING (3-0) 3 hours credit—Study of the relationships between system parameters

and system performance in pulsed, C-W, doppler and monopulse radars.

5336. PROTECTION OF ELECTRICAL POWER SYSTEMS (3-0) 3 hours credit—Fundamentals of power system protection. Primary, local, and remote back-up protection. Application of fault detection instruments.

5339. SEMICONDUCTOR ELECTRONICS II (3-0) 3 hours credit—A comprehensive study of systematic modeling procedures for semiconductor devices. Prerequisite: electrical engineering 5303 or consent of instructor.

5340. INTEGRATED CIRCUIT DESIGN AND TECHNOLOGY (1-6) 3 hours credit—An introduction to the layout and processing of integrated circuits, with emphasis on monolithic circuits. Extensive laboratory experience. Prerequisite: electrical engineering 3304 (Electronic Circuits) or equivalent.

5392. SELECTED TOPICS IN ELECTRICAL ENGINEERING (3-0) 3 hours credit—The material covered may vary from semester to semester. Topics included will be from one of the following fields:

1. Electronics
2. Power Systems Analysis
3. Information Theory
4. Plasma Engineering
5. Servomechanisms and Controls
6. Electromagnetic Theory and Practices
7. Engineering Analysis

This course may be repeated for credit if different topics are covered for each registration.

5442. LOGIC CIRCUITS I (3-3) 4 hours credit—Fundamental theory of logic circuits, including binary arithmetic, Boolean algebra, Karnaugh map, minimization and synthesis methods. Laboratory included. \$5 lab fee.

5445. SYNTHESIS OF LINEAR SERVOMECHANISMS (3-3) 4 hours credit—An extension of the introductory material in electrical engineering 4314, with emphasis on compensation techniques and a-c carrier systems. Laboratory included. Prerequisite: electrical engineering 4314 or equivalent. \$5 lab fee.

5452. ELECTROMAGNETIC RADIATION (3-3) 4 hours credit—The theory of electromagnetic radiation at microwave frequencies. \$5 lab fee.

5191, 5291, 5391. RESEARCH IN ELECTRICAL ENGINEERING (Variable credit from 1 to 3 semester hours as arranged)—Individually approved research projects leading to preparation and submission of a master's thesis in electrical engineering. **5398 or 5698. THESIS 3 or 6 hours credit**—Prerequisite: graduate standing in electrical engineering.

6197, 6297, 6397, 6697, 6997. RESEARCH IN ELECTRICAL ENGINEERING (1, 2, 3, 6 or 9 hours credit)—Individually approved research projects leading to a doctoral dissertation in the area of electrical engineering.

6699. DISSERTATION (6 hours credit)—Preparation and submission of a doctoral dissertation in an area of electrical engineering. Prerequisite: admission to candidacy for the PhD in engineering.



A limited number of the following courses may be applicable toward the graduate program if approved in advance by the graduate advisor.

4312. ELECTROMAGNETIC FIELDS (3-0) 3 hours credit — This course is a study of the application of advanced mathematical techniques for the formulation and solution of problems in electromagnetic fields. Prerequisite: electrical engineering 3312 (Electrical Science V) or equivalent.

4314. SERVOMECHANISMS AND CONTROLS (3-0) 3 hours credit—This course is a study of transfer functions and the analysis of closed loop systems utilizing frequency response analysis. Design analysis and synthesis techniques are developed for the study of system performance. Electrical, mechanical and hydraulic systems are considered. Prerequisite: electrical engineering 3316 (Circuits).

4317. INTRODUCTION TO NETWORK SYNTHESIS (3-0) 3 hours credit—A major portion of this course is concerned with the realizability conditions and systematic realization procedures for 1-port and 2-port networks. Generally, the discussion is restricted to passive networks. Prerequisite: electrical engineering 3316 (Circuits).

4326. MICROWAVES (3-0) 3 hours credit—This course is a study of microwave generators, modulators, detectors and transmission systems. Prerequisite: electrical engineering 3312 (Electrical Science V) or equivalent.

4327. THEORY AND DESIGN OF ANTENNAS (3-0) 3 hours credit—This course is a study of the basic theory of antennas and is presented with emphasis on design factors and the engineering application of antennas. Prerequisite: electrical engineering 3312 (Electrical Science V) or equivalent.

4331. EFFECTS OF NOISE IN COMMUNICATION SYSTEMS (3-0) 3 hours credit—Introduction to statistical methods, sources of electrical noise, analysis methods for noisy circuits, signal-to-noise comparison for common modulation methods, threshold detection, matched filtering, power spectral density, correlation functions. Prerequisite: electrical engineering 4330 (Information Transmission) or equivalent.

4332. ELECTRONIC DEVICES (3-0) 3 hours credit — This course is a study of various important electronic devices, including controlled rectifiers, photoelectric devices, integrated circuit devices, and others. Both theory of device operation and important circuit applications are discussed. Prerequisite: electrical engineering 3304 (Electronic Circuits).

4333. INTRODUCTION TO THREE-PHASE POWER SYSTEMS (3-0) 3 hours credit—This course is a study of the network matrices, representation of power systems, theory of network transformation, and application of symmetrical components and alpha-beta-zero components to solution of power system problems. Prerequisite: senior standing.

4334. COMPUTER METHODS FOR POWER SYSTEM ANALYSIS (3-0) 3 hours credit—This course is a study of load flow, short circuit calculation, power system stability and economic operation of power systems. Prerequisite: electrical engineering 4333.

4336. DIGITAL CIRCUITS (3-0) 3 hours credit—Binary arith-

metic, Boolean algebra, and Karnaugh maps are discussed at the beginning of the course. Then, various logic circuits such as AND, OR, NAND and NOR gates are studied in detail. These circuits are used in the synthesis of combinational logic circuits. Also included in the courses are studies of multivibrators, counters and shift registers. Prerequisite: electrical engineering 3303 (Electrical Science IV).

4337. COMPUTING CIRCUITS (3-0) 3 hours credit — This course is a study of the methods of applying analog computers to determine the response of dynamic systems. Programming techniques for linear, nonlinear and time-variable systems are considered. Set-up and checkout procedures are discussed. Methods are presented to determine probable solution errors, and techniques or error analysis are presented. Prerequisite: mathematics 3318 (Differential Equations).

4339. DESIGN OF ELECTRONIC CIRCUITS (3-0) 3 hours credit—Analysis techniques are applied to electronic circuits to obtain design equations. The use of parametric studies in design decision making is discussed. Design techniques, including worst-case design, are illustrated in several design projects in which the student designs a circuit to meet practical specifications. The effects of cost, reliability, and environment on design are stressed. Prerequisite: electrical engineering 3304 (Electronic Circuits).



ENGINEERING MECHANICS

OBJECTIVE

The graduate program in engineering mechanics is designed to provide students with an understanding of the fundamentals of mechanics and prepare them for research in engineering problems involving mechanics or for careers in industry. Students desiring to study mechanics should have a high level of interest and aptitude in mathematics and analysis.

Candidates for a Master of Science degree in engineering mechanics and candidates for a Doctor of Philosophy degree in engineering may elect programs emphasizing solid mechanics, fluid mechanics, or dynamics and vibrations. The program is interdisciplinary. In addition to the engineering mechanics courses, applicable courses may be found in the areas of aerospace, civil, electrical, mechanical engineering, and materials science.

DEGREE REQUIREMENTS

The general degree requirements for the Master of Science and Doctor of Philosophy degrees have been presented in other sections.

Prior to admission as a degree candidate, the student must have, as a minimum, credit for statics, dynamics, mechanics of materials, advanced calculus, differential equations, basic fluid mechanics, and thermodynamics. In addition, each student must consult his graduate advisor to plan his program of course work and research.

5302. ENGINEERING MECHANICS SEMINAR (3-0) 3 hours credit—Semiformal discussion between faculty and students on progress and results of current research and on significant developments in the mechanics field. Prerequisite: permission of instructor.

5311. THEORY OF ELASTICITY I (3-0) 3 hours credit — Theories of stress, strain equilibrium and compatibility in three dimensions are developed. Plane stress and plane strain, and their application, included. Prerequisite: permission of instructor.

5312. THEORY OF ELASTICITY II (3-0) 3 hours credit — Continuation of Theory of Elasticity I, curvilinear coordinates, variational methods, axially symmetric stress distribution problems, stress waves in solids studied. Prerequisite: engineering mechanics 5311.

5313. THEORY OF PLASTICITY (3-0) 3 hours credit—Stress-strain relations in three dimensions presented. Three-dimensional yield conditions and flow law, thick-walled tube and sphere discussed; limit analysis and approximate theories. Prerequisite: permission of instructor.

5314. THEORY OF PLATES AND SHELLS (3-0) 3 hours credit—The theory is developed for the stress analysis of elastic plates and shells of revolution. Composite structures are considered in addition to the homogeneous and isotropic case. Prerequisite: permission of instructor.

5315. AEROELASTICITY (3-0) 3 hours credit—This course is a study of the interaction of aerodynamic (or hydrodynamic), inertia and elastic forces acting on vehicles moving through a

fluid such as airplanes, missiles or submarines. Investigations of flutter and divergence are included. Prerequisite: aerospace engineering 4331 (Mechanical Vibrations) or equivalent; aerospace engineering 3303 (Aerodynamics I) or equivalent, or permission of instructor.

5317. STRUCTURAL STATICS (3-0) 3 hours credit — Static response of complex structures by use of finite element methods is discussed. The matrix displacement and matrix force methods are applied to determine deflections and stresses. Analytical methods are emphasized and computer applications are undertaken. Prerequisite: engineering mechanics 5311 or consent of instructor.

5318. STRUCTURAL DYNAMICS (3-0) 3 hours credit—Free, transient, and random response of elastic structural systems are discussed. Computational aspects of these problems are studied. Prerequisite: engineering mechanics 5323 or consent of instructor.

5320. THEORY OF THIN ELASTIC SHELLS (3-0) 3 hours credit—Elements of differential geometry used in the general shell theory are introduced. Basic assumptions are discussed and fundamental elastic shell equations are formulated for shells of arbitrary shape. Specific equations and stress resultants are derived from the general formulation for cylindrical shells and shells of revolution. Prerequisite: engineering mechanics 5311 or consent of instructor.

5321. ADVANCED DYNAMICS (3-0) 3 hours credit—Hamilton's Principle, Lagrange's Equation and Hamilton — Jacobi Equation are introduced. Dynamics of rigid body and theory of gyroscope are studied. Prerequisite: permission of instructor.

5322. THEORY OF ELASTIC STABILITY (3-0) 3 hours credit—Elastic stability of bars, buckling of plates and shells are discussed. Both classical and numerical solutions included. Prerequisite: permission of instructor.

5323. ADVANCED MECHANICAL VIBRATIONS (3-0) 3 hours credit — Application of generalized coordinates and Lagrange equations are studied. Free and forced vibrations of elastic systems with many degrees of freedom are considered including damping effects. Prerequisite: aerospace engineering 4331 (Mechanical Vibrations) or equivalent.

5324. ENERGY METHODS IN APPLIED MECHANICS (3-0) 3 hours credit—Virtual displacements, minimum potential energy, principle of complementary energy, Castigliano's Theorem, action integral, variational principles, Hamilton's principles and Lagrange's equations presented. Applications are made to solve problems in stress analysis, elastic stability, vibration and related topics. Prerequisite: permission of instructor.

5325. DYNAMIC STABILITY OF ELASTIC SYSTEMS (3-0) 3 hours credit — The regions of dynamic instability of elastic systems due to parametric excitation are presented. Influence of damping is included. Prerequisite: permission of instructor.

5326. INTRODUCTION TO NONLINEAR MECHANICS (3-0) 3 hours credit—Nonlinear differential equations governing various phenomena of mechanics are derived. Physical and mathematical implications of linearizations discussed. Analytical, graphical and numerical methods of solutions to the free oscillations of systems having nonlinear characteristics are discussed. Response curves and stability considerations for forced oscillations included. Prerequisite: permission of instructor.



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5327. **DYNAMICS OF SPACE VEHICLES (3-0) 3 hours credit**—The two-body problem, geometry of spatial orbits, orbit determination, trajectory modification, introduction to perturbation theory, equation of motion for thrusting rocket, boost trajectories and related topics will be treated. Prerequisite: aerospace engineering 4336 (Intermediate Dynamics) or equivalent.
5328. **FLUID DYNAMICS (3-0) 3 hours credit**—An advanced study of the kinematics and dynamics of Newtonian fluid motion, stresses in fluids, and surface flow. Prerequisite: mechanical engineering 3313 (Fluid Mechanics) or equivalent.
5330. **NUMERICAL VIBRATION ANALYSIS (3-0) 3 hours credit**— In this course, the theories developed in engineering mechanics 5323 are applied to practical situations where numerical answers are required. All widely used methods for solving linear, nonlinear, and transient vibration problems numerically will be utilized in connection with computer programming. Prerequisite: engineering mechanics 5323 and a reasonable proficiency in computer programming and the consent of the instructor.
5331. **SIMILITUDE AND THEORY OF MODELS (3-0) 3 hours credit**— Similitude models, dimensional analysis, nomographs and graphical aids to analysis. Prerequisite: permission of instructor.
5341. **EXPERIMENTAL MECHANICS (2-3) 3 hours credit**— This course includes experimental and analytical methods in structural mechanics. Various analogies are studied. Experimental methods of determining stress, strain, force, and displacement are studied. Prerequisite: permission of instructor. \$4 lab fee.
5343. **PHOTOELASTICITY (2-3) 3 hours credit**—Methods of experimentally determining stress (or strain) fields are studied using birefringent plastic models and coatings. Techniques of model manufacture, data acquisition and reduction, use of the polariscope, interferometry and holography are studied. Prerequisite: graduate standing or consent of the instructor.
- 5191, 5291, 5391. **ADVANCED STUDIES IN ENGINEERING MECHANICS (Variable credit from 1 to 3 semester hours as arranged)**—Topics selected from various branches of engineering mechanics, particularly those in which active research is being conducted. Prerequisite: permission of instructor or graduate advisor.
- 5398 or 5698. **THESIS 3 or 6 hours credit**— Prerequisite: 12 hours of advanced engineering mechanics and approval of graduate advisor.
- 6197-6997. **RESEARCH IN ENGINEERING MECHANICS (Variable credit 1 to 9 semester hours as arranged)**—This course may be repeated for credit.
6699. **DISSERTATION (6 semester hours)**—Prerequisite: admission to candidacy for the Doctor of Philosophy.
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INDUSTRIAL ENGINEERING

OBJECTIVE

This program makes available the study in depth of the areas of 1) human factors, 2) operations research, 3) systems design, and 4) economic decisions. The pursuit of graduate work in these areas will provide the student with a quantitative understanding leading to sound operating decisions.

DEGREE REQUIREMENTS

The general degree requirements for the Master of Science and Doctor of Philosophy degrees have been presented in other sections. Students with degrees in other disciplines may qualify for graduate study in industrial engineering after the completion of a faculty-approved program of undergraduate courses. Applicants are expected to have by way of formal course work or by industrial experience the content of introductory courses in operations research, probability theory, and human factors.

5301. ADVANCED OPERATIONS RESEARCH (3-0) 3 hours credit—Advanced techniques in operation research are studied. Current research areas are identified. Prerequisite: industrial engineering 5323 or equivalent.

5302. ADVANCED HUMAN FACTORS I (3-0) 3 hours credit—A study and application of the principles of systems analysis, human factors and systems evaluation to man-machine systems with emphasis upon the human component as he interacts with the machine.

5305. LINEAR PROGRAMMING AND EXTENSIONS (3-0) 3 hours credit—A study of the theory of linear programming including the simplex method, duality, sensitivity analysis, decomposition principles, the transportation problem, and integer programming.

5306. DYNAMIC OPTIMIZATION (3-0) 3 hours credit—Multi-stage decision problems are characterized as dynamic programming problems. Numerical approximation schemes for dynamic programming problems are discussed. The solution of variational problems is studied both from a classical and dynamic programming approach.

5307. THEORY OF QUEUES (3-0) 3 hours credit—This course continues the study of the theory of queues with particular emphasis on its application to inventory, production and maintenance as well as direct applications. Prerequisite: industrial engineering 5317 and 5323 or equivalent.

5308. ADVANCED RESEARCH METHODS (3-0) 3 hours credit—The purpose of this course is to provide the theory and methodology of experimental research so that valid conclusions can be formulated in research work. Methods and theory of planning experiments and evaluating results are presented.

5309. ANALYSIS OF STOCHASTIC PROCESSES (3-0) 3 hours credit—The course provides a background for other work using probability model building. Such topics as stationary and non-stationary processes, counting processes, renewal theory, Markov chains, and random walk are studied. Prerequisite: industrial engineering 5317 and 5323 or equivalents.

5310. PRODUCTION SYSTEMS DESIGN (3-0) 3 hours credit—A study of problems and methods of systems design will be



made. Particular emphasis is given to the construction of models representing the system, their optimization and the presentation of results. Prerequisite: industrial engineering 5441 or equivalent.

5311. STATISTICAL METHODS FOR INDUSTRIAL DECISIONS (3-0) 3 hours credit—This course is a study of statistical decision theory with applications. Prerequisite: industrial engineering 5317 or equivalent.

5312. ADVANCED PRODUCTION AND INVENTORY CONTROL SYSTEMS (3-0) 3 hours credit—A continuation of the undergraduate course. The emphasis will be placed on mathematical model building and optimization.

5313. SYSTEM RELIABILITY, MAINTAINABILITY, AND SAFETY (3-0) 3 hours credit — Methods of reliability, maintainability, and safety analysis, measurements, prediction, and design integration are presented. Associated human factors are considered, as well as quantitative methods for isolating, reporting, and predicting failure mechanisms induced by man and/or machine in complex systems. Consideration is also given to cost-effectiveness trade-offs, and systems operability confidence. Prerequisite: industrial engineering 5317 or equivalent.

5314. SYSTEMS AND CONTROL PRACTICE (3-0) 3 hours credit—This course embodies the study and evaluation of current concepts and trends in planning, design, and control of large scale systems. Methods for analyzing and evaluating industrial, governmental, and military systems will be presented. Prerequisite: industrial engineering 5317 and 5323 or equivalent.

5315. DATA PROCESSING IN OPERATIONS RESEARCH (3-0) 3 hours credit—A study of selected topics in the application of electronic computers to operations research activities. Emphasis is on the use of simulation techniques.

5316. ECONOMIC DECISION MAKING (3-0) 3 hours credit—A study of the criterion used for making decisions about proposed capital investments and the implementation of selected criteria in engineering design and investment decisions. Emphasis is on model building and optimization. Prerequisite: industrial engineering 5323 or equivalent.

5317. ENGINEERING PROBABILISTICS, STOCHASTICS, AND STATISTICS I (3-0) 3 hours credit—Sets and set algebra; sample spaces; combinatorics; absolute and conditional probability; discrete and continuous random variables; increment and density functions; fundamental statistical concepts; significance tests, confidence limits, binomial and normal distributions, and Bayesian inference, with descriptive statistics. Prerequisite: mathematics 2325 (Calculus).

5318. ENGINEERING PROBABILISTICS, STOCHASTICS, AND STATISTICS II (3-0) 3 hours credit — Laplace-Fourier transforms; law of large numbers; central limit theorems; discrete and continuous stochastic processes; efficient computational procedures; risk, power functions, operating characteristic curves; simple and multiple regression; bivariate normal distribution; analysis of variance; applications in engineering and industry. Prerequisite: industrial engineering 5317.

5320. INDUSTRIAL PLANNING AND FORECASTING (3-0) 3 hours credit— Analysis of the theory and practice of the managerial function of planning and forecasting in industrial operations. Long-range planning and development of organizational

objectives and strategies. Resource allocation planning. Prerequisite: industrial engineering 3316 or equivalent.

5321. HUMAN FACTORS IN ORGANIZATION AND MANAGEMENT SYSTEMS (3-0) 3 hours credit—Traditional organization and management theory is reviewed, and the systems approach to management is presented. The managerial system is approached via decision-making processes in planning and control of organizational activities. Both computational techniques and the behavioral aspects of decision making are considered. Prerequisite: industrial engineering 3316 (Engineering Administration and Organization) or equivalent.

5322. SIMULATION AND OPTIMIZATION I (3-0) 3 hours credit—The course includes a survey and applications of computer languages suitable for Monte Carlo simulation of random processes. Optimization and search techniques of functions will be introduced. Prerequisite: industrial engineering 3301 or mathematics 4311 or consent of instructor.

5323. OPERATIONS RESEARCH (3-0) 3 hours credit—An introduction for graduate students to the techniques of operations research. Prerequisite: probability and statistics, calculus.

5324. HUMAN FACTORS EVALUATION OF PRODUCTION PROCESSES (3-0) 3 hours credit—Means of determination of the adequacy of production machinery from a human engineering standpoint, the adequacy and availability of job aids, and analysis of the speed and accuracy with which required communications and technical information are transmitted and utilized in production. The consideration of production as a man-machine system. Prerequisite: industrial engineering 5331.

5325. INDUSTRIAL INFORMATION SYSTEM (3-0) 3 hours credit—The application of electronic computers and associated input/output devices is studied. Decision processes and data evaluation are considered along with the design of systems which gather the data. Prerequisite: knowledge of a computer programming language and consent of the instructor.

5327. SYNTHESIS OF MAN/MACHINE SYSTEMS (3-0) 3 hours credit—Systems as products of intentional interdisciplinary innovation in complex problem areas. Interdisciplinary development of complex systems of men and machines. Structures, frameworks, and methodologies are studied. Team projects will be required.

5328. ANALYSIS OF MAN/MACHINE SYSTEMS (3-0) 3 hours credit—Concepts, methodologies, and tools for use in determining functional capabilities of systems and their subsystems and subsystem interaction. Quantitative and qualitative prediction and measurement of the performance of complex systems of men and machines.

5330. DIGITAL PROCESS CONTROL AND MATHEMATICAL MODELING OF INDUSTRIAL SYSTEMS (3-0) 3 hours credit—This course describes the present status of automatic control in industry with emphasis on the application of digital control. Problems involved in the use of both supervisory and discrete digital control systems will be presented and the development of process control by mathematical problems will also be covered.

5331. ERGONOMICS (3-0) 3 hours credit—A study of man in relation to his working environment. Physiological and anatomical characteristics of man. Considerations of fatigue, accidents,



and other human problems in industry. Prerequisite: industrial engineering 4344 (Human Factors Engineering) or 5302.

5332. NONLINEAR PROGRAMMING (3-0) 3 hours credit—Optimization theory for unconstrained, equality constrained, and inequality constrained problems is first developed. Specific techniques are then studied. Convex programming, geometric programming, quadratic programming, and optimum seeking methods are presented.

5333. ENGINEERING ADMINISTRATION (3-0) 3 hours credit—To provide an understanding of engineering managers' role in the overall corporate budgeting process to include operational as well as capital budgeting. Analysis of engineering operations and design part in finance from a non-financial point of view. These views are to be analyzed in terms of utility management as part of various corporate management philosophies.

5334. ADVANCED SYSTEMS ANALYSIS AND DESIGN (3-0) 3 hours credit—A rigorous treatment of analytical methods used in systems engineering. Prerequisite: industrial engineering 5314 and 5317.

5341. DESIGN WITH HUMAN FACTORS (2-3) 3 hours credit—A study is made of those factors that affect the design of a system at the man/machine interface. Topics include physiological limitations and capability under normal and hostile environments. Design and research projects will be undertaken. Prerequisite: industrial engineering 5343.

5342. JOB DESIGN AND STANDARDIZATION (2-3) 3 hours credit—An advanced study of work center design and methods of improving human work. Factors affecting work, such as fatigue, learning and physiological, will be considered.

5343. ENVIRONMENTAL BIOTECHNOLOGY (2-3) 3 hours credit—Physical, physiological, and psychological aspects of the interaction between man and thermal, atmospheric, radiant, and mechanical agents and energies in the environment. Biological and physical requirements for engineering design and control of the environment; applications to design of complex systems. Prerequisite: industrial engineering 4344 (Human Factors Engineering) or 5302 or consent of instructor.

5344. HUMAN FACTORS IN SYSTEMS DEVELOPMENT (2-3) 3 hours credit—A study of human engineering, staffing, training, testing and evaluation is made in relation to systems theory. The psychological, physiological, and social factors relevant to systems planning, design, analysis, and management. Methods of increasing systems effectiveness by consideration of personnel subsystems during total system development. Prerequisite: industrial engineering 4344 (Human Factors Engineering) or equivalent and industrial engineering 5343.

5441. INDUSTRIAL ENGINEERING ANALYSIS AND DESIGN (3-3) 4 hours credit—Introduction and survey of the classical and current techniques of work measurement, analysis and planning. Topics in plant design will be considered along with plant location concepts. A study will also be made of production planning and control.

5442. INDUSTRIAL ENGINEERING ADMINISTRATION (3-3) 4 hours credit—A combination of lecture and seminar in current topics of management and organization as they relate to industrial engineering activities. Such topics as labor regulation and relations, organization, management, and control as they relate to the industrial engineering functions will be discussed.

5191, 5291, 5391. ADVANCED STUDIES IN INDUSTRIAL ENGINEERING (Variable credit from 1 to 3 semester hours as arranged) — Individually approved research projects selected from the various branches of industrial engineering.

5398 or 5698. THESIS 3 or 6 hours credit—Prerequisite: graduate standing in industrial engineering.

6197-6997. RESEARCH IN INDUSTRIAL ENGINEERING (Variable credit from 1 to 9 semester hours as approved)—Individually supervised research projects directed toward the dissertation. Prerequisite: graduate standing in industrial engineering and approval of advisor.

6699. DISSERTATION 6 hours credit—Prerequisite: Admission to candidacy for the Doctor of Philosophy degree.

A limited number of the following courses may be applicable toward the graduate program if approved in advance by the graduate advisor.

4302. LABOR REGULATION AND PRODUCTION ACTIVITY (3-0) 3 hours credit—This course presents the interplay of the industrial engineering determination of production standards, the labor union movement and legislative regulation considering the effects of such factors as automation, incentive payment systems and machine pacing. Prerequisite: industrial engineering 4344 (Human Factors Engineering).

4306. ANALYSIS, PLANNING AND CONTROL OF PRODUCTION SUPPORT FUNCTIONS (3-0) 3 hours credit — A study is made of the problems and methods of attack in the planning, management, conduct and control of operations in such areas as research and development, maintenance, etc. Prerequisite: industrial engineering 4305 (Human Factors Engineering).

4307. INFORMATION THEORY (3-0) 3 hours credit — This course is concerned with the development of measures of information, and its rate of transfer under various conditions. Consideration is given to sampling, encoding, indiscrete and continuous systems and the noise problems. Prerequisite: industrial engineering 3301 (Engineering Probability).

4308. STATISTICAL QUALITY CONTROL (3-0) 3 hours credit—This course includes a study of process control plans, control charts for non-normal distributions, economics of sampling, sequential and continuous sampling plans. Prerequisite: industrial engineering 3241 (Quality Control), 3301 (Engineering Probability), and 4205 (Engineering Research Methods).

4310. INDUSTRIAL AND PRODUCT SAFETY (3-0) 3 hours credit—This course includes a study of methods to reduce hazards in industry and its products. A survey of methods for testing product safety and problems of manufacturer liability will be presented. Prerequisite: junior standing.

4314. INDUSTRIAL ENGINEERING SYSTEMS ANALYSIS (3-0) 3 hours credit—A rigorous mathematical treatment of the systems engineering techniques required by the modern industrial engineer. Prerequisite: industrial engineering 3315 (Operations Research I) and mathematics 3318 (Differential Equations).

4315. OPERATIONS RESEARCH II (3-0) 3 hours credit — This course is a continuation of industrial engineering 3315. Applications of queuing theory, inventory theory, Markov chains, advanced topics in linear programming, and nonlinear programming are covered. Prerequisite: industrial engineering 3315 (Operations Research I).



MATERIALS SCIENCE

OBJECTIVE

The graduate program in materials science is designed to provide students with a fundamental understanding of phenomena occurring in engineering materials and their associated mechanical, physical and chemical properties. It will prepare students for professional careers in materials science or for additional studies at the doctoral level.

The program is an interdisciplinary one and relates closely to the fields of engineering, chemistry and physics.

DEGREE REQUIREMENTS

The general degree requirements for the Master of Science and Doctor of Philosophy degrees are presented in other sections. Students with Bachelor of Science degrees in non-engineering disciplines, such as chemistry or physics, may qualify for graduate study in materials science upon the completion of a faculty-approved program of undergraduate courses.

5301. PHYSICS OF ENGINEERING MATERIALS (3-0) 3 hours credit—The free electron and zone theories of metals and their applications to electrical conductivity, ferromagnetism, cohesion and crystal structure will be developed. Prerequisite: permission of instructor.

5310. DISLOCATION THEORY (3-0) 3 hours credit—The theory of dislocations and their reactions and interactions in crystalline materials is developed and extended into a basic understanding of mechanical properties of crystalline materials. Prerequisite: permission of instructor.

5311. ADVANCED DISLOCATION THEORY (3-0) 3 hours credit—Development of the theories of work hardening, fatigue, and creep of crystalline materials based on the generation, movement and interactions of dislocation with themselves and other crystalline defects. Prerequisite: materials science 5310 and permission of instructor.

5312. MECHANICAL METALLURGY (3-0) 3 hours credit—Relationships of microstructure to the plastic deformation of single crystal and polycrystalline materials with emphasis on mechanical properties, embrittlement and fracture.

5313. ADVANCED PHYSICAL METALLURGY (3-0) 3 hours credit—Theory of ferrous and non-ferrous systems as related to physical and mechanical properties. Fracture mechanisms in metals and non-metals. Preferred orientation. Strengthening mechanisms.

5314. FRACTURE MECHANICS (3-0) 3 hours credit—The theory and applications of linear elastic fracture mechanics are discussed. Topics include stress analysis of cracks, crack-tip plasticity, fatigue and stress corrosion. Applicability to materials selection, failure analysis and structural reliability is reviewed. Prerequisite: permission of instructor.

5320. METALLURGICAL THERMODYNAMICS (3-0) 3 hours credit—Applications of thermodynamics to the study of metals, thermodynamic properties of liquid and solid solutions and their relationship to surfaces and crystalline defects. Prerequisite: permission of instructor.

5321. THEORY OF PHASE TRANSFORMATIONS (3-0) 3 hours credit—Theory of homogeneous and heterogeneous transformations, nucleation and growth, martensitic transformations, heat treatment and control of microstructure. Prerequisite: materials science 5320 and permission of instructor.

5322. KINETICS OF PHASE CHANGES (3-0) 3 hours credit — Kinetics of nucleation and growth of phases in metallurgical and ceramic systems including the effects of surfaces, stacking faults, dislocations and strain energy. Prerequisite: materials science 5320 and permission of instructor.

5123. PHASE DIAGRAMS (1-0) 1 hour credit—Construction and interpretation of multicomponent equilibrium diagrams, prediction of solidified structures and application to current processes. Prerequisite: permission of instructor.

5224. THEORY OF ALLOYS (2-0) 2 hours credit—Structural approach as applied to metallic alloys. Equilibrium, free energy, electron compounds, intermediate phases and order-disorder. Prerequisite: permission of instructor.

5227. HIGH TEMPERATURE PROPERTIES OF MATERIALS (2-0) 2 hours credit—Oxidation, oxidation resistance and other high temperature properties of materials and their relationships with structure will be discussed. Prerequisite: permission of instructor.

5229. ADVANCED X-RAY STUDIES (2-0) 2 hours credit—The kinematical and dynamical theories of x-ray and electron scattering will be discussed. The application of x-rays to crystal structure determination and other research problems will be emphasized. Prerequisite: materials science 5342 and permission of instructor.

5315. SOLIDIFICATION (3-0) 3 hours credit—Application of phase diagrams to solidification. Principles and practices of casting and solidification. Nucleation, heat flow, chemical homogenization and structure of cast metals. Prerequisite: material science 3343.

5330. CORROSION (3-0) 3 hours credit—The quantitative application of electrochemical principles to corrosion reactions is developed. The effects of metallurgical factors and environmental conditions on oxidation, erosion, and cracking are discussed along with materials selection. Prerequisite: permission of instructor.

5342. X-RAY METALLURGY (2-3) 3 hours credit—The theory and techniques of x-rays as applied to the study of crystalline solids. Production of x-rays, their scattering, absorption and diffraction. Special topics, such as stress analysis, crystal perfection, precision lattice constant determination and phase diagrams, will be studied. Prerequisite: permission of instructor.

5181. ELECTRON MICROSCOPY (0-3) 1 hour credit—Laboratory techniques for using the electron microscope will be demonstrated. Specimen preparation for replica and transmission studies will be performed. Prerequisite: permission of instructor.

5698. THESIS 6 hours credit—Prerequisite: approval of graduate advisor.

6197-6397. ADVANCED STUDIES IN MATERIALS SCIENCE (Variable credit from 1 to 3 semester hours)—Course may be repeated for credit. Prerequisite: approval of graduate advisor.

6699. DISSERTATION 6 hours credit—Prerequisite: admission to candidacy for the Doctor of Philosophy degree.



MECHANICAL ENGINEERING

OBJECTIVE

Graduate course offerings in mechanical engineering encompass study of the thermal sciences and systems and controls. The student with the aid of a faculty advisor may plan a program in a number of fields of specialization in mechanical engineering or in various interdisciplinary areas.

Graduate study and research are offered in the areas of:

1. Heat Transfer
2. Fluid Mechanics
3. Thermodynamics
4. Systems Engineering
5. Automatic Controls
6. Design

DEGREE REQUIREMENTS

General degree requirements for the Master of Science and Doctor of Philosophy degrees are presented in other sections. Students wishing to major in mechanical engineering should have the Bachelor of Science degree in mechanical engineering from an approved school. Students with degrees in other disciplines may be required to take certain undergraduate courses depending on their particular graduate program.

Letters in parentheses at the end of the course descriptions refer to the semester in which the course will be scheduled to be offered: (F), Fall; (SP), Spring; (NS), Night Summer.

5301. TRANSPORT PROCESSES (3-0) 3 hours credit—The theory and application of the transport processes, heat, mass, and momentum, are covered in this course. May be repeated for credit as topics change. Prerequisite: mechanical engineering 3302 (Heat Transfer) and 3311 (Thermodynamics I).

5302. ADVANCED THERMODYNAMICS (3-0) 3 hours credit—Such topics as thermostatics, micro and macro thermodynamics, energetics and their applications are covered. The course may be repeated for credit as topics change. Prerequisite: mechanical engineering 3312 (Thermodynamics II).

5303. CLASSICAL METHODS OF CONTROL SYSTEMS ANALYSIS AND SYNTHESIS (3-0) 3 hours credit— This course is intended to equip the student with a detailed familiarity with the historically significant tools of the control engineer. Detailed discussion of block diagram algebra, signal flow algebra, the amplitude ratio-frequency and phase shift angle-frequency plots, the Bode diagram, the Nyquist diagram, the Nichols chart and the root locus is presented.

5304. ADVANCED MECHANICAL ENGINEERING SYSTEMS (3-0) 3 hours credit—This course is a continuation of the undergraduate mechanical engineering systems course. Topics covered in greater depth are fluid control systems, optimization methods, and methods of synthesis. This course may be repeated for credit as topics change.

5305. DYNAMIC SYSTEMS MODELING (3-0) 3 hours credit—The purpose is to equip the student with the capability of determining the necessary equations to model a system of mixed physical types in an orderly, logical fashion. The framework of

the linear graph is used to pursue the modeling equations of mechanical, thermal, fluid, and electrical lumped parameter systems (some discussion of less frequently encountered systems is included).

5306. FLUID POWER CONTROL (3-0) 3 hours credit—Mathematical models for hydraulic and pneumatic control components and systems are synthesized including hydraulic pumps, motors and spool valves. Application of electrohydraulic and hydromechanical servomechanisms for position and velocity control are treated. Theory is supported by laboratory demonstrations and experiments. Prerequisite: mechanical engineering 4310 (F).

5307. MODERN METHODS OF CONTROL SYSTEMS ANALYSIS AND SYNTHESIS (3-0) 3 hours credit—This course is intended to equip the student with knowledge of systems applications of the state-space concept and real-time solution techniques. State-space formulations, reference trajectory, linearization, linear vector spaces, the state transition matrix and its properties; and the controllability and observability concepts are treated.

5309. INTRODUCTION TO SYSTEMS OPTIMIZATION (3-0) 3 hours credit—The fundamental theorems of the classical calculus of variations, and of the Maximum Principle of Pontryagin are the essential content of this course. Examples from the area of mechanical engineering systems serve to demonstrate the applications.

5310. PLASMA DYNAMICS (3-0) 3 hours credit — The elements of electromagnetic field theory, kinetic theory and statistical mechanics of gases are applied to electrical conduction in ionized gases and the derivation of MHD flow equations (F).

5311. GAS DYNAMICS (3-0) 3 hours credit—The laws of mechanics and thermodynamics are applied to problems of fluid flow. One-dimensional phenomena such as shock, flow with friction, diabatic flow and subsonic and supersonic flows are treated (NS).

5312. PHYSICAL GAS DYNAMICS (3-0) 3 hours credit—The fundamentals of high-speed, high-temperature flow of a gas are presented from the molecular view. Simple kinetic theory, chemical thermodynamics, and the physical and chemical bases of rate processes are presented.

5313. FLUID DYNAMICS (3-0) 3 hours credit—Fluid Dynamics is an advanced study of the kinematics and dynamics of fluid motion, stresses in fluids and surface flow (F).

5314. MAGNETOGASDYNAMICS (3-0) 3 hours credit—Magnetogasdynamics is a continuation of mechanical engineering 5310. The MHD flow equations are applied to such areas as power generation, space propulsion, boundary layer phenomena, and control of re-entry bodies.

5316. THERMAL CONDUCTION (3-0) 3 hours credit—Thermal Conduction is a study of the fundamental laws, initial and boundary conditions, basic equations for isotropic and anisotropic media, related physical problems and steady and transient temperature distributions in solid structures (F).

5317. CONVECTION HEAT TRANSFER (3-0) 3 hours credit—The equations of motion of viscous fluids are reviewed and the energy equations are introduced. Exact and approximate solutions are made for forced convective problems with non-isothermal and unsteady boundaries. Free convection and combined free- and forced-convection problems are solved (SP).



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5318. **RADIATIVE TRANSFER** (3-0) 3 hours credit — The general equations of radiative transfer are derived and solved for special problems, and the elements of atomic, molecular and continuum radiation are introduced (NS).
5319. **HEAT TRANSFER DESIGN** (3-0) 3 hours credit—Heat transfer design is the application of fundamental principles toward the analysis and synthesis of complex thermal systems such as rocket nozzles, nuclear reactors and ablation heat shields (SP).
5321. **ADVANCED CLASSICAL THERMODYNAMICS** (3-0) 3 hours credit — The fundamentals of thermodynamics are reviewed. Different treatments of principles are studied, compared and formal relationships are developed and applied to chemical, magnetic, electric and elastic systems (F).
5323. **STATISTICAL THERMODYNAMICS** (3-0) 3 hours credit—Statistical mechanics and kinetic theory are related to thermodynamics and Maxwell-Boltzman, Bose-Einstein and Fermi-Dirac statistics are introduced and applied (SP).
5325. **COMBUSTION** (3-0) 3 hours credit—Combustion is the fundamental treatment of problems involving simultaneous occurrence of chemical reaction and transfer of heat, mass, and momentum.
5326. **PROPULSION** (3-0) 3 hours credit—Air-breathing and rocket engines are analyzed and advanced propulsion systems including nuclear and electrical are introduced. Component and system performance calculations are stressed.
5327. **NUMERICAL CONTROL OF MACHINE TOOLS** (3-0) 3 hours credit—The basic elements of numerical control of metal processing systems are studied; programs for point to point and contouring machines are developed; the interactions between geometry and machinability decisions are determined.
5328. **ADVANCED MANUFACTURING ANALYSIS I** (3-0) 3 hours credit—Studies are made of the technical aspects of manufacturing, emphasizing process design and equipment. Prerequisite: mechanical engineering 4307 (Manufacturing Analysis) or equivalent.
5329. **FORMING OF METALS** (3-0) 3 hours credit—Theoretical studies are made of various metal forming processes; elastic and plastic stress-strain relations are developed; the effects of strain hardening are considered.
5330. **METAL CUTTING** (3-0) 3 hours credit—Metal cutting operations are studied with special emphasis on machine tool, cutting tool and work material behavior.
5331. **ANALYTIC METHODS IN ENGINEERING** (3-0) 3 hours credit—In this course an introduction to advanced analytic methods is given. These are applied transform and matrix methods, and the elements and engineering applications of complex variables. Prerequisite: undergraduate degree in engineering, physics, or mathematics.
5332. **ENGINEERING ANALYSIS** (3-0) 3 hours credit—Engineering Analysis involves the construction of mathematical models of physical situations of interest to the engineer and the subsequent reduction of the mathematical problem to a numerical solution.
5333. **MECHANICAL ENGINEERING ANALYSIS TECHNIQUES** (3-0) 3 hours credit—The purpose of this course is to add depth to the students' capability in the use of general transform techniques. Topics which are treated include the Fourier,
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Laplace, and Z transforms as well as the computer-oriented Fast Fourier transforms. Prerequisite: undergraduate degree in engineering, physics, or mathematics.

5334. PROBABILITY THEORY AND STOCHASTIC PROCESSES (3-0) 3 hours credit—The concept of probability and application to random processes are discussed. Techniques for determining the response characteristics of dynamic systems with random initial conditions and inputs and parameter uncertainties are treated.

5335. OPTIMAL LINEAR SYSTEMS (3-0) 3 hours credit—Optimal Linear Systems is a detailed coverage of the work to date on that type of problems. Subjects are the Kalman Regulator and others in this class, optimal parameters, non-analytic criteria and gradient techniques. Prerequisite: mechanical engineering 5309.

5336. DESIGN AND CREATIVITY (3-0) 3 hours credit—This course is an introduction to the philosophy of comprehensive design. The creative process and the factors that influence it are emphasized with a discussion of the attitudes and viewpoints of the designer and an investigation of techniques of analysis, synthesis, and evaluation.

5337. DESIGN ANALYSIS I (3-0) 3 hours credit—Common machine elements and mechanisms are analyzed and limitations on analysis arising from modeling techniques are considered.

5338. DESIGN ANALYSIS II (3-0) 3 hours credit—Design concepts, life design, fatigue and failure, thermal stress and the elements of optimal design are studied.

5341. CONTROL SYSTEM COMPONENTS (2-3) 3 hours credit—Hydraulic, pneumatic, and electro-mechanical component and system characteristics are determined, and systems are simulated on analog and digital computer equipment.

5345. DESIGN PROJECT I (2-3) 3 hours credit—The student uses rational and intuitive problem-finding procedures to identify a design project, presents a project proposal, performs research, and prepares a design program. The creative aspects of design are emphasized.

5346. DESIGN PROJECT II (2-3) 3 hours credit—This course is a continuation of mechanical engineering 5345 in which a project is carried to the working prototype. Cost and production are considered.

5191, 5291, 5391. ADVANCED STUDIES IN MECHANICAL ENGINEERING (Variable credit from 1 to 3 semester hours as arranged)—May be repeated for credit as topics change.

5192, 5292, 5392. ADVANCED TOPICS IN HEAT TRANSFER (Variable credit from 1 to 3 semester hours)—Various special topics in heat transfer will be covered. May be repeated for credit as topics change.

5398 or 5698. THESIS 3 or 6 hours credit—Prerequisite: graduate standing in mechanical engineering.

6301. NONLINEAR PROBLEMS IN ENGINEERING (3-0) 3 hours credit—This is a survey of nonlinear problems arising in mechanical engineering systems, and the methods of characterizing such typical nonlinearities as friction, backlash, and dead zone.

6302. DESIGN OF DIGITAL CONTROL CIRCUITS (3-0) 3 hours credit—The theory for synthesis and design of digital control systems with emphasis on fluid controlled switching circuits is covered in this course. Topics included are sequential machine



control, synthesis of asynchronous sequential circuits, hydraulic logic components, fluidics, and timing considerations in circuit design.

6303. INDUSTRIAL APPLICATIONS OF SYSTEMS THEORY IN ANALYSIS AND CONTROL (1-6) 3 hours credit—Advanced concepts pertaining to the modeling, analysis, and design of dynamic systems is covered in one hour of lecture per week. Throughout the semester, the students are involved in the solution of advanced design and control problems supplied by industry (SP).

6327. JOINING MATERIALS OF MANUFACTURE (3-0) 3 hours credit—Studies are made of surface bonding, welding metallurgy, effect of rate of energy input on properties, residual stress and distortion, economics and process capabilities.

6331. COMPUTER METHODS IN SYSTEMS ANALYSIS (3-0) 3 hours credit—This course provides background and experience in the use and developments of Fortran-coded digital computer programs for large-scale systems analysis and synthesis. Prerequisite: mechanical engineering 5307, 5303.

6332. ESTIMATION THEORY (3-0) 3 hours credit—Means of treating measurements to obtain a best estimate of the quantities measured are presented. The emphasis is on application to dynamic systems. Prerequisite: mechanical engineering 5303, 5307, 5334.

6333. APPLIED DIFFERENTIAL GAME THEORY (3-0) 3 hours credit—The fundamentals of differential game theory are introduced, and application in the area of systems optimization in the presence of uncertainties and two player zero-sum games are discussed. Prerequisite: mechanical engineering 5309.

6334. APPLICATION OF OPTIMIZATION TECHNIQUES (3-0) 3 hours credit—The application of dynamic programming, linear programming, and non-linear (with emphasis on geometric) programming to systems control problems is presented. Prerequisite: mechanical engineering 5309.

6336. FRICTION AND WEAR (3-0) 3 hours credit—Wear and other types of surface attrition are considered in this course with reference to surface nature and combinations, friction, absorbed gases, contaminants and surface heating.

6337. COMPUTER AIDED DESIGN (3-0) 3 hours credit—Studies are made of computer techniques to be used in the design process. Consideration is given to the mathematics and graphics of curved surfaces, curve fitting, curve smoothing, and the communication of the logical structure of problem solutions.

6338. DESIGN AND ITS ENVIRONMENT (3-0) 3 hours credit—The interactions of corporate and social elements and the designer are studied with their contributions to the comprehensive design.

6390. SUPERVISED TEACHING IN MECHANICAL ENGINEERING (3-0) 3 hours credit—This course involves teaching under close supervision, attending group meetings, and individual conferences, and submitting reports as required. May be repeated for credit. Prerequisite: graduate standing and appointment as a teaching associate.

6197-6997. RESEARCH IN MECHANICAL ENGINEERING (Variable credit 1 to 9 semester hours as arranged)—This course may be repeated for credit.

6699. DISSERTATION (6 semester hours)—Prerequisite: admission to candidacy for the Doctor of Philosophy degree.

ENGINEERING INTERDISCIPLINARY AREAS

OBJECTIVE

Although master's degrees are not offered in bioengineering and computer science, these areas provide valuable support courses for master's programs in other engineering and science areas. Somewhat stronger specialization in these areas is available at the doctoral level. The areas of bioengineering and computer science are described briefly below along with their current course offerings.

BIOENGINEERING

The program in bioengineering is jointly supported by The University of Texas at Arlington and The University of Texas Southwestern Medical School at Dallas. Some courses presently offered at the medical school include: Biomedical Instrumentation, Biomedical Physiology, and Anatomy for Bioengineers. Inquiries should be directed to Director, Bioengineering Program, School of Engineering, UT Arlington, Arlington, Texas 76010.

5101. SEMINAR IN BIOENGINEERING (1-0) 1 hour credit—University and guest lecturers speak on topics of current interest in the field of bioengineering. The course is offered on a pass-fail basis.

5191, 5291, 5391. SELECTED TOPICS IN BIOENGINEERING (Variable credit from 1 to 3 hours as arranged)—The material covered may vary from semester to semester. This course may be repeated for credit if different topics are covered for each registration. Prerequisite: permission of the instructor.

5192, 5292, 5392. DIRECTED RESEARCH IN BIOENGINEERING (Variable credit from 1 to 3 hours credit as arranged)—The student shall participate in a research project under the direction of a faculty supervisor. This course may be taken as a technical elective with the permission of the student's graduate advisor. Prerequisite: permission of the instructor.

5311. NEUROPHYSIOLOGICAL SYSTEMS ANALYSIS (3-0) 3 hours credit—The course applies systems theory to neurophysiology. Topics covered include: the neuromuscular system, pupillary control, eye tracking, temperature regulation and central nervous system function. Prerequisite: a course in college biology and a course in linear systems.

5312. BIOELECTRIC PHENOMENA (3-0) 3 hours credit—The course is designed to introduce the electrical behavior of nerve and muscle. Mathematical techniques are utilized to provide a quantitative basis for observed phenomena. Topics include physiology of nerve and muscle, electro-chemistry and electrodes, subthreshold membrane phenomena, membrane action potentials, and volume-conductor fields. Prerequisite: courses in college biology, calculus, physics, and chemistry.

5325. CARDIO-PULMONARY DYNAMICS (3-0) 3 hours credit—This course covers: physical properties of blood and blood vessels; blood velocity and vascular impedance; pulmonary ventilation, impedance, and transfer mechanisms; pathologies. Prerequisite: courses in college biology, physics, calculus and differential equations.



5335. **BIOMECHANICS** (3-0) 3 hours credit—This course is designed to provide the student with the objectives of biomechanics; basic mechanical properties of living tissues; biomechanical aspects of injury and prosthesis. Prerequisite: courses in college biology, mathematics through differential equations, statics, and dynamics.

COMPUTER SCIENCE

The computer science curriculum provides basic courses in programming applications to support other disciplines and courses in the areas of compiler theory, operating systems, formal languages, etc. The courses are administered through the Department of Industrial Engineering, but for the most part do not require an engineering background.

4301. **ANALYSIS AND COMPUTATION METHODS FOR ENGINEERS AND SCIENTISTS** (3-0) 3 hours credit — This course is designed to give the engineer or scientist the computer methods necessary for the solution of a wide variety of practical applications. These include simultaneous equation solutions applied to various engineering and scientific areas, integration methods, root finding, derivatives and differential equations, solutions of linear systems of differential equations, series approximations and error analysis. A number of the engineering applications discussed will be run on a high-speed digital computer in the computer laboratory. Credit will not be given for both computer science 4301 and mathematics 3345. Prerequisite: mathematics 3318 (Differential Equations) and either computer science 3201 (Introduction) or consent of instructor.

4302. **SURVEY OF ALGORITHMIC LANGUAGES** (3-0) 3 hours credit—A study of the various types of algorithmic languages and problem solutions utilizing them is included. Included are languages for scientific purposes (e.g. ALGOL), string processing (e.g. SNOBOL4), general purpose (e.g. PL/1), and others. Prerequisite: computer science 3201 (Fundamentals) or 3306 (Computer Programming and Applications) and maturity as demonstrated by one additional computer applications course.

4303. **SIMULATION AND OPTIMIZATION TECHNIQUES** (3-0) 3 hours credit—Extremal properties of multivariate functions with and without constraints, convex functions, linear programming. Computer simulation utilizing logical, numerical and Monte Carlo modeling. The generation, termination, and flow of entities through storage and processing facilities. Prerequisite: computer science 3201 (Fundamentals) or 3306 (Computer Programming and Applications) and a basic knowledge of probability.

4304. **COMPUTER AND PROGRAMMING SYSTEMS** (3-0) 3 hours credit — A study of input-output and storage systems, structures and transformations of data bases, and executive systems. Also included are the structures of program libraries, program intercommunication, batch processing executive systems, multiprogramming executive systems, interrupt systems, and on-line console time sharing systems. Prerequisite: computer science 4306 or 4425.

4305. **ALGORITHMIC LANGUAGES AND COMPILERS** (3-0) 3 hours credit—Formal description of algorithmic languages such as ALGOL and the techniques used in writing compilers for such

(e.g. Backus normal form). A study of syntax, semantics, ambiguities, procedures, iteration, and recursion in these languages. Will include the definition and writing of compilers for simple languages including some having a nonalgebraic base. Prerequisite: computer science 4302 and 4306 or 4425.

4306. INFORMATION STRUCTURES (3-0) 3 hours credit—Study of information representations and relationships between the forms of representation and processing techniques. The generation, development, and processing of structures such as lists and trees will be developed to illustrate inter-relationships of data structures. Prerequisite: computer science 3341 (Symbolic and Algorithmic Process).

4425. SYMBOLIC PROGRAMMING AND INFORMATION PROCESSING (4-0) 4 hours credit—This course is intended for students desiring to do graduate work in computer science but who have had only an introduction to computer programming. It will contain a study of the symbolic programming languages currently in use and their application to both numeric and non-numeric problems. It will also include a study of information representation and computer processing techniques. Prerequisite: computer science 3201 (Fundamentals) or 3306 (Computer Programming and Applications), or consent of the instructor.

5301. ADVANCED INFORMATION STRUCTURES (3-0) 3 hours credit—Linear lists, strings, arrays, and orthogonal lists. Representation of trees and graphs. Storage systems and structures, and storage allocation and collection. Multilinked structures. Symbol tables and searching techniques. Sorting (ordering) techniques. Formal specification of data structures. Prerequisite: computer science 4306 or 4425.

5302. COMPUTER GRAPHICS (3-0) 3 hours credit—This course studies the input/output devices and programming techniques suitable for the visual representation of data and images. Prerequisite: computer science 4306 or 4425.

5303. ADVANCED COMPUTER AND PROGRAMMING SYSTEMS (3-0) 3 hours credit—A further and more detailed study of input-output and storage systems structures and transformations of data bases, and executive systems. Also included are the structures of program libraries, program intercommunication, batch processing executive systems, addressing techniques, system accounting and micro-programming. Prerequisite: computer science 4304.

5304. COMPILER THEORY I (3-0) 3 hours credit—Review of program language structures, translation, loading, execution, and storage allocation. Compilation of simple expressions and statements. Organization of a compiler including compile-time and run-time symbol tables, lexical scan, syntax scan, object code generation, error diagnostics, and overall design. Introduction to formal language descriptions (e.g. Backus normal form, Polish notation, etc.) Prerequisite: computer science 4305.

5305. FORMAL LANGUAGES AND SYNTACTIC ANALYSIS (3-0) 3 hours credit—Definition of formal grammars: arithmetic expressions and precedence grammars, context free and finite-state grammars. Algorithms for syntactic analysis: recognizers, backtracking, operator precedence techniques. Semantics of grammatical constructs: reductive grammars, simple syntactical compilation. Prerequisite: computer science 4305.

5306. INFORMATION ORGANIZATION AND RETRIEVAL (3-0) 3 hours credit—Structure of semiformal languages and



models for the representation of structured information. Aspects of natural language processing on digital computers. The analysis of information content by statistical, syntactic, and logical methods. Search and matching techniques. Automatic retrieval systems. Evaluation of retrieval effectiveness. Production of secondary outputs. Prerequisite: computer science 4306 and computer science 4302 or concurrent.

5307. COMPUTER ORGANIZATION I (3-0) 3 hours credit—Basic digital circuits, Boolean algebra and combinational logic, data representation and transfer, and digital arithmetic. Digital storage and accessing, control functions, input-output facilities, system organization and reliability. Description and simulation techniques. Features needed for multi-programming multiprocessing and real-time systems. Prerequisite: computer science 4304.

5309. ADVANCED COMPUTATIONAL METHODS FOR ENGINEERS AND SCIENTISTS I (3-0) 3 hours credit—Selected topics from the theory and practice of using automatic digital computers for approximating arithmetic operations, approximating functions, solving systems of linear and non-linear equations, computing eigen-values and solving ordinary and partial differential equations. Prerequisite: computer science 3201 (Fundamentals) or equivalent and graduate standing in engineering or science.

5310. ADVANCED COMPUTATIONAL METHODS FOR ENGINEERS AND SCIENTISTS II (3-0) 3 hours credit—A continuation of computer science 5309. Topics in matrix operations, iterative procedures, quadrature, solution of differential equations, boundary value determination and simulation of physical processes will be studied in context of computer applications. Prerequisite: computer science 5309 or 4301 and consent of instructor.

5311. ADVANCED COMPUTER SYSTEMS I (3-0) 3 hours credit—This course goes into the structures of batch processing and time-sharing systems, their components, operating characteristics, user services and limitations. Implementation techniques for parallel processing of input-output and interrupt handling. Structure of multiprogramming systems on multiprocessor hardware configurations. Details on addressing techniques, core management, file system design and management, system accounting, and other user related services. System updating, documentation, and operation. Prerequisite: computer science 4304.

5312. DATA PROCESSING MANAGEMENT (3-0) 3 hours credit—This course presents a comprehensive study of problems associated with management of data processing and computer facilities. Particular emphasis is placed on problems of cost effectiveness, machine configuration, personnel, security, systems planning, and facilities requirements.

5313. LOGIC OF INFORMATION PROCESSING (3-0) 3 hours credit—This course includes principles and applications of digital computers to problems of data reduction, information retrieval, and large-scale commercial data processing problems.

5314. TIME-SHARING COMPUTER SYSTEMS (3-0) 3 hours credit—A comprehensive survey of time-sharing computational techniques with emphasis on software for time-shared computer operation. Prerequisite: computer science 4304.

5315. INTRODUCTION TO INFORMATION PROCESSES (3-0) 3 hours credit—An introductory survey of concepts and methods of modern information processing with emphasis on the

digital approach. Topics include discrete coding, analog to digital conversion, computer processing techniques, and illustrative applications.

5316. INFORMATION PROCESSING SYSTEMS (3-0) 3 hours credit—A study of data processing systems including serial processing, file maintenance, editing, random access processing, interrupt mode, documentation, system phase-over, tape, disk and document control.

5317. APPLICATION OF DIGITAL COMPUTERS TO ENGINEERING PROBLEMS (2-3) 3 hours credit—The analysis of engineering problems from the viewpoint of their expedient computation. Students will acquire a working knowledge of high speed digital computer through the laboratory sessions. Emphasis is placed on those problems which have become accessible by high speed computers. Prerequisite: computer science 4301 or 5309, or mathematics 3345.

5318. COMPUTER APPLICATIONS IN THE SOCIAL SCIENCES (3-0) 3 hours credit—This course is intended to provide the graduate student in the social and behavioral sciences with programming and decision-making techniques which might be needed to support their research. In addition to exercises in programming, there will be applications to statistical problems, authenticity of authorship, computer assisted instruction, and computer simulation of cognitive processes.

5319. COMPUTER GENERATED SOUND I (3-0) 3 hours credit—This course makes use of the concepts of digital programs and digital to analog conversion with associated equipment to generate sound. Emphasis will be placed on the languages, such as TEMPO, PLAY, MUSIC, etc. for the generation of music.

5320. COMPUTER GENERATION OF SOUND II (2-3) 3 hours credit—This course is concerned with various electronic devices suitable for converting digital signals produced by the computer into sound.

5321. COMPUTERIZED IMAGE MANIPULATION (3-0) 3 hours credit—This course is concerned with the representation of alphanumeric characters and graphic shapes on suitable output devices, such as the plotter or the cathode ray tube. The use of the light pen will also be considered.

5322. COMPUTER ANIMATED FILM FOR ART AND EDUCATION (3-0) 3 hours credit—A study of methods for using the computer and a cathode ray tube to generate graphic and animated figures. These methods will be useful for increasing teaching effectiveness by use of the computer.

5323. CONTINUOUS SYSTEM MODELING (3-0) 3 hours credit—This course includes a brief survey of languages suitable for digital representation of continuous models. Exercises and projects will be assigned for application to physical systems.

5325. DESIGN OF HYBRID COMPUTING SYSTEMS (3-0) 3 hours credit—An introduction to the design of analog/hybrid computing elements in hybrid linked systems. I/O structure of digital process for hybrid applications. Advanced hybrid concepts. Hybrid considerations for real time simulation.

5326. LIST PROCESSING AND SYMBOL MANIPULATION (3-0) 3 hours credit—A study of the various list and string manipulation languages is made. Applications are presented in a variety of areas. The design of a list-processing system is considered.



5327. MATHEMATICAL THEORY OF COMPUTATION (3-0) 3 hours credit—Semantics and syntax of programming languages, formal systems of proving equivalence of programs, computability and unsolvability, computer proof procedures, and related topics in mathematical logic.

5328. INFORMATION PROCESSING (3-0) 3 hours credit—A discussion of basic theoretical methods of information processing is presented. Trade-offs between digital and analog approaches for implementing the methods are emphasized. Topics include methods of signal representation, data conversion, decision making, filtering, digital error problems and machine interaction.

5330. THE COMPUTER AND NATURAL LANGUAGE (3-0) 3 hours credit—This course is for students of literature, linguistics, and computer science interested in using the computer as a research tool in processing natural language. The course consists of a survey of computer applications in processing natural language, an introduction to programming the computer to manipulate natural language, and exploration of appropriate programming languages and useful programming techniques. This course is also listed as English 5330 and Linguistics 5330. Credit will be granted for one of the courses only.

5331. CYBERNETICS (3-0) 3 hours credit—A survey of the methods and concepts of cybernetics. Prerequisite: college calculus, probability.

5339. REAL-TIME SIMULATION AND FUNCTION GENERATION (3-0) 3 hours credit—This course includes the study and application of methods and techniques of preparing computer software for simulation and function generation by combinations of digital and analog methods and equipment.

5392. SELECTED TOPICS IN ADVANCED COMPUTER SCIENCE (3-0) 3 hours credit—May be repeated for credit when the topics vary. Prerequisite: graduate standing and consent of instructor.

SOCIAL WORK

OBJECTIVES

The two-year program leading to the master's degree focuses on developing community leaders in the areas of direct social work practice and community social work practice. The program of instruction includes an intensive academic phase integrated with a practicum phase allowing the student to learn and apply theory concurrently. The curriculum includes:

1. An understanding of social welfare policy and the social welfare institutions established to translate policy into services.
2. The behavioral, social, economic and political sciences which rationalize practice and the administrative and managerial concepts and principles needed to administer programs.
3. Causes and prevention of social dysfunctioning.
4. The methods, techniques and tools needed to identify, reduce and prevent social problems.
5. Practice under faculty supervision.

Second Year Concentration — Prior to the second year, the student chooses one of the two core areas for concentration: (1) direct practice—service to individuals, families, and small groups; (2) community practice—community organization and planning or administration.

ADMISSION REQUIREMENTS

The requirements for admission to the Graduate School of Social Work are the same as those for general admission to graduate study at The University of Texas at Arlington. Intellectual maturity, emotional stability, and ability and interest in working with people are among the necessary personal qualifications. Letters of reference are required and a personal interview may be required.

DEGREE REQUIREMENTS

The Master of Science in Social Work degree requires the completion of 64 semester hours of class and field instruction including individual or group research. Research options include a thesis and a research practicum.

Human Behavior and the Social Environment

5301. HUMAN BEHAVIOR AND THE SOCIAL ENVIRONMENT I (3-0) 3 hours credit—This course will present an overview of the normal social functioning and behavior of the individual within the context of the family, group, community and other social systems. Special emphasis is placed on the inter-relatedness and impact of the physical, emotional, intellectual, cultural and social systems related to the stages of human development.

5302. HUMAN BEHAVIOR AND THE SOCIAL ENVIRONMENT II (3-0) 3 hours credit—A continuation of 5301 with particular emphasis on theories of, and research into, social



deviance and psychopathology. Prerequisite: 5301 or permission of the instructor.

6301. HUMAN BEHAVIOR AND THE SOCIAL ENVIRONMENT III (3-0) 3 hours credit—This course, intended for students who select the specialty of direct practice in their second year, is a study of personality theories. The focus is on the commonalities and critical differences between the theories and their status in terms of current empirical research into the area of personality dynamics. Prerequisite: 5302 or permission of the instructor.

6302. HUMAN BEHAVIOR AND THE SOCIAL ENVIRONMENT IV (3-0) 3 hours credit—This course is a wide-ranging seminar exploring the potential impact of some recent theoretical, conceptual and empirical developments in the behavioral sciences upon the practice of social work and the institution of social welfare. Prerequisite: permission of the instructor.

6303. HUMAN BEHAVIOR AND THE SOCIAL ENVIRONMENT V (3-0) 3 hours credit—This course provides an analysis of the influences, external and internal, on human behavior in formal organization, as well as the forms, individual and group, that behavior takes within organizations. Of special concern is the interaction between personality attributes and organizational imperatives. Prerequisite: permission of the instructor.

Social Welfare Policy and Services

5303. FOUNDATIONS OF SOCIAL WELFARE POLICY AND SERVICES (3-0) 3 hours credit—This course examines how social goals are met by social welfare institutions. Conceptual schemes are developed for analyzing the structure of social welfare institutions and evaluating social welfare sub-systems. Emphasis is placed on understanding the processes of social welfare policy formulation and implementation. The profession of social work is also examined in the context of the evolution and function of the contemporary American social welfare system.

6304. SOCIAL WELFARE POLICY AND SERVICES SEMINAR IN SUBSTANTIVE AREAS (3-0) 3 hours credit—This course examines significant policy issues and problems in specific substantive areas—for example, mental health and child welfare—through the development and testing of an analytic model. Among the issues considered are those of problem definition, client identification, manpower, and organization and delivery of services. Through analysis of these interrelated issues substantive knowledge will be developed. Prerequisite: 5303 and/or permission of the instructor.

6305. SOCIAL WELFARE POLICY AND SERVICES INTEGRATING SEMINAR (3-0) 3 hours credit—This seminar focuses on issues and problems of broad concern to the profession of social work. Members of the faculty may serve as consultants and resource persons to seminar members who are required to make analyses and presentations on issues that predict as well as apprehend the urgent concerns of the social work profession. Prerequisite: 5303 or permission of the instructor.

Direct Practice

5304. SOCIAL WORK PRACTICE I (3-0) 3 hours credit — Introduction to basic direct service methodologies of social work intervention at the individual, family, and group levels. Common elements of direct service methodology—criteria for problem

identification, goal determination, and selection of intervention techniques and treatment strategies are explored. Emphasis is placed on the knowledge and skill required in the management of the worker-client relationship to effect desired treatment outcomes. Laboratory demonstrations and case material from the student's on-going field course are utilized.

5305. SOCIAL WORK PRACTICE II (3-0) 3 hours credit — Further attention is given to change theories, intervention strategies and therapeutic techniques employed at the individual, family, and group levels. Emphasis is placed on developing criteria for selection among alternative approaches, intervention activities which are appropriate to the specific goal of intervention and the specific practice context. Course content will also focus on the utilization of small group theory, process and group formulation criteria. Prerequisite: 5304 or equivalent.

6306. SOCIAL WORK PRACTICE III (3-0) 3 hours credit — This seminar provides for an intensive study of social work theory stressing the development and use of the principles of diagnosis, relationship, structure, function and process. These principles are discussed and critically analyzed in terms of the student's own field practice experiences. Emphasis is given to form in helping client or family partialize and focus on the problem. Depth is stressed through focus on one method (casework) and one model. Prerequisite: 5305 or equivalent.

6307. SOCIO-BEHAVIORAL THEORY FOR DIRECT SOCIAL WORK PRACTICE (3-0) 3 hours credit—An introduction to the experimental bases and clinical applications of socio-behavioral approaches relevant to social work practice. Attention is given to different change methods such as reinforcement, extinction, shaping, modeling and aversive control. Application is made directly to the wide range of behaviors of concern to the social worker. Recent theoretical formulations and relevant research are considered. Prerequisite: 5305 or equivalent and permission of instructor.

6308. ADVANCED SEMINAR IN SOCIAL WORK PRACTICE IV (3-0) 3 hours credit—This seminar will focus on the integration of theoretical knowledge and practice principles in terms of their utilization for direct practice. Emphasis is placed on recent theoretical developments in the social and behavioral sciences as well as to current practice trends. Attention is given to an examination of substantive and methodological issues in current research as applied to interventions with individuals and family groups. Prerequisite: 6306, or 6307 or equivalent and permission of instructor.

6309. SUPERVISION AND CONSULTATION FOR DIRECT PRACTICE (3-0) 3 hours credit—An introduction to the philosophy, objectives, and methods of the supervisory and consultative processes. Application of relevant social and behavioral science concepts and social work theory to principles of administration, teaching, and learning. Administrative, supervisory, educative, and helping aspects of the social worker's leadership function with a range of social service personnel will be explored. Prerequisite: 5305 or equivalent and permission of instructor.

6310. SEMINAR IN TREATMENT MODALITIES (3-0) 3 hours credit—A critical examination of a broad spectrum of intervention methodologies employed by a variety of allied helping professions. Attention is given to problems of their efficacy, the status of empirical validation, and the adequacy of their



explanations of human behavior for given practice situations. Prerequisite: 5305 or equivalent and permission of instructor.

6311. SEMINAR IN DIRECT METHODS IN MARITAL AND FAMILY COUNSELING (3-0) 3 hours credit—Examination of various psychological, social and behavioral treatment approaches as they relate to the treatment of problems in marital and familial adjustment. Emphasis will be placed on developing criteria for assessing the sources and patterns of imbalance and conflict, the selection and ordering of treatment strategies, and intervention techniques consistent with determined goals. Case material from the student's field experience is utilized. Prerequisite: 5305 or equivalent and permission of instructor.

6312. DIRECT METHODS WITH GROUPS I (3-0) 3 hours credit—Social group work as a basic process of direct practice is examined. Emphasis is placed on the range of worker roles and activities in the use of groups for effecting individual change and in helping groups to achieve a variety of purposes. Several models of the helping process in small groups will be explored. Prerequisite: 5305 or equivalent and permission of the instructor.

6313. DIRECT METHODS WITH GROUPS II (3-0) 3 hours credit—Theoretical bases and various direct and indirect intervention techniques for effecting an individual's personal and social problems within and through the group are explored. Among the topics considered are: assessment of group structure and processes, leadership roles, determination of goals, analysis of interpersonal relationships within the group, and the development of evaluative outcome criteria. Prerequisite: 6312 or equivalent and permission of instructor.

Community Practice

5306. COMMUNITY PRACTICE I (3-0) 3 hours credit—An introductory survey course of community organization, social planning, administration, and management with emphasis on common areas of knowledge and practice skills. The development of analytical approaches to the understanding of community and organizational phenomena. Illustrations are given to aid in understanding theoretical concepts. Beginning development of rational analytical schemes to guide the practitioner in his choice of strategies and tactics.

5307. COMMUNITY PRACTICE II (3-0) 3 hours credit—Community social and related service systems and their interrelationships will be reviewed. The client systems of the administrator, community planner, and community organizer will be identified. Methodologies in problem identification and analysis will be reviewed. The respective roles of the community practitioner, related professional disciplines, and the citizen participant will be studied for their respective utility. Trends in planning will be reviewed and a general problem resolution model developed. Prerequisite: 5306 or permission from the instructor.

6314. ADMINISTRATION (3-0) 3 hours credit—Study of the principles and processes of administration; organization and administration in social welfare organization; role of the administrator; personnel administration. Theories of organizational behavior and their significance for the administrator will be studied.

6315. COMMUNITY PROBLEM SOLVING (3-0) 3 hours credit—This methods course will review and compare a series of community planning and community organization models in order to identify some of the major action strategies available to the

practitioner. In addition, special attention will be given to the role of the consultant as well as administrative, program, and planning consultation techniques, theories, and principles. Prerequisite: 5307 or permission from the instructor.

6316. ADVANCED ADMINISTRATION (3-0) 3 hours credit—A review of critical writings and research in administration with a view to identifying selected problems and methodologies in decision making, principles of organization and administration, community relations, and financing. Prerequisite: 6314 or permission of the instructor.

6317. ADVANCED PLANNING (3-0) 3 hours credit—A review of selected current and anticipated national and urban social problems analyzing current planning strategies, their efficacy and relevance. At the conclusion of the course, the student will be expected to develop his own planning practice model. Prerequisite: 6315 or permission of the instructor.

6318. MANAGEMENT (3-0) 3 hours credit—Study of the principles of management as applied to social welfare organizations and programs. Social theory knowledge applicable to management will be reviewed. Principles and problems of personnel administration, supervision and leadership, motivation, and communication within an organization will be reviewed.

6119. ADMINISTRATIVE LEADERSHIP IN SOCIAL PROGRAMS (1-0) 1 hour credit—This seminar aims to help the student integrate in the final semester the knowledge, skills and values acquired in other courses during the preceding three semesters around the concepts of (a) administrative leadership, (b) social systems, (c) role, (d) organizational behavior, (e) multi-causation of problems, and (f) interdisciplinary approach to problem solving. To the degree possible, the student's own experience during the previous three semesters will be utilized in bringing life and substance to the above concepts as they relate to administrative processes.

6120. RESEARCH ADMINISTRATIVE (1-0) 1 hour credit—A review of administrative methods and principles involved in developing and administering research programs. The culture of social work research and its social functions will be reviewed. A study of the role and function of the social work researcher.

6121. GROUP DYNAMICS IN COMMUNITY ORGANIZATION AND ADMINISTRATION (1-0) 1 hour credit—A methods course, focusing on the practice theories available to the professional. This includes an examination of the major types of task groups such as boards, committees, citizen organizations and staff groups to determine their major characteristics, functions and utility in achieving social welfare objectives. Criteria and methodologies involved in the creation and organization of such groups, organization for fulfillment of their task objectives, staff roles and requirements, will be examined. An overview of group, community and organizational dynamics which affect the functioning of such groups. Prerequisite: 5307 or permission from the instructor.

Research

5308. RESEARCH METHODOLOGY IN SOCIAL WORK (3-0) 3 hours credit—Introduction to social science methodology. Course content covers the various research strategies — exploratory, quantitative-descriptive, and experimental—which are applicable to the study of social problems. Data collection proce-



dures, sampling techniques, problems of measurement and principles of data analysis are investigated. Some attention is devoted to an investigation of techniques used in the evaluation of social programs and therapeutic approaches.

6322. STATISTICAL IDEAS IN SOCIAL WORK (3-0) 3 hours credit—Introduction to parametric and non-parametric statistical procedures which are used in social work research. The emphasis is upon statistical reasoning and the role of statistics in data analysis rather than upon the mathematical foundations of statistics. This course completes the technical preparation necessary for the research practicum. Prerequisite: 5308 or equivalent.

6395, 6695. RESEARCH PRACTICUM 3 or 6 hours credit—An individual or small group (2-3 students) research project in the student's major area of specialization with emphasis on applying research principles and procedures. A substantial research report is expected at the conclusion of the course. This research project may be conducted throughout the entire second year for six hours credit or may be completed during one semester—either the first or second semester—for three hours credit. Prerequisite: 5308 and 6322 or the equivalent.

6698. THESIS 6 hours credit — Prerequisite: permission of graduate advisor.

Field Instruction

5481. FIELD INSTRUCTION I (0-16) 4 hours credit.

5482. FIELD INSTRUCTION II (0-16) 4 hours credit.

6483. FIELD INSTRUCTION III (0-16) 4 hours credit.

6484. FIELD INSTRUCTION IV (0-16) 4 hours credit.

Field Instruction is a directed educational experience in social work practice with instruction offered by agency or campus-based faculty members. Offered concurrently with classroom instruction, the field courses offer an opportunity for a student to integrate and utilize classroom content in the context of practice.

6683. FIELD INSTRUCTION III (0-24) 6 hours credit.

6684. FIELD INSTRUCTION IV (0-24) 6 hours credit.

The addition of two credit hours to the field course requires one additional day (8 hours) to be spent in the course. The additional day will be at the same location and taught by the same instructor as the four credit hour required field course for which the student would register. The additional day will allow the student to pursue theoretical, conceptual, and experiential material in a special area of interest with the consent of the instructor. As prescribed by the instructor, the student will attain, through selected readings, conferences, didactic presentations and sense data, a breadth and depth of knowledge and practice in a special interest area above and beyond that which is covered by other academic or field courses.

Tutorials

6190, 6290, 6390. TUTORIAL 1, 2, or 3 hours credit—Arrangements may be made for a directed and supervised tutorial in a select area of special interest to the student. May be repeated for credit in varying areas with permission of the graduate advisor.

Special Seminars

6192, 6292, 6392. SELECTED TOPICS IN SOCIAL WELFARE
1, 2, or 3 hours credit—Topics in this course may be varied from semester to semester depending on the needs and interest of the students. This course may be repeated for credit. Prerequisite: permission of graduate advisor.



GRADUATE FACULTY

(Year in parentheses indicates year of initial employment. If more than one year in parentheses appears, these indicate return from leave or leaves. Asterisk before name indicates current leave of absence.)

- ACKER, BERTIE N., Assistant Professor of Foreign Languages (1965). B.A., Texas Woman's University, 1943; M.A., Southern Methodist University, 1957; Ph.D., University of Texas at Austin, 1971.
- ADAMS, DUANE A., Professor of Foreign Languages (1960). B.A., University of Nebraska, 1947; M.A., 1949; Ph.D., Louisiana State University, 1963.
- ALLBRITTON, JULIE N., Assistant Professor of Social Work (1970). B.A., Mississippi State College for Women, 1961; M.S.W., Louisiana State University, 1963.
- AMSLER, ROBERT W., Professor of History and Assistant Dean of Liberal Arts (1957). B.A., University of Texas at Austin, 1936; M.A., 1940; Ph.D., 1950.
- ANGUIZOLA, GUSTAVE, Assistant Professor of History (1966). B.A., Evansville University, 1947; M.A., Indiana University, 1948; M.S., Michigan State University, 1953; Ph.D., Indiana University, 1954.
- ARANGIO, ANTHONY J., Associate Professor of Social Work (1969). B.S., Louisiana State University, 1962; M.S.W., Tulane University, 1964; Ph.D., 1970.
- ARMSTRONG, ANDREW T., Assistant Professor of Chemistry (1968). B.S., North Texas State University, 1958; M.S., 1959; Ph.D., Louisiana State University, 1967.
- BAERWALDT, JAMES W., Assistant Professor and Acting Chairman of the Department of Psychology (1966). B.A., Wesleyan University, 1961; M.A., University of Michigan, 1965; Ph.D., 1968.
- BAILEY, DURL M., Assistant Professor of Civil Engineering (1966). B.S., University of Texas at Austin, 1958; M.S., 1962. Professional Engineer.
- BAKER, W. A., Professor of Chemistry and Dean of the Graduate School (1971). B.S., Texas A&I University, 1955; Ph.D., University of Texas at Austin, 1959.
- BARKER, CALVIN L. R., Professor of Mechanical Engineering (1960). B.S., University of Texas at Austin, 1953; M.S., California Institute of Technology, 1954; Ph.D., 1958. Professional Engineer.
- BEAUDRY, HARRY R., Assistant Professor of English (1966). A.B., Rice University, 1952; M.A., Boston University, 1956; Ph.D., Duke University, 1968.
- BELLION, EDWARD, Assistant Professor of Chemistry (1970). B.Sc., University of Leeds, 1965; Ph.D., 1968.
- BERNSTEIN, IRA H., Professor of Psychology (1964). B.A., University of Michigan, 1959; M.A., Vanderbilt University, 1961; Ph.D., 1963.
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- BISBEE, JAMES R., Assistant Professor of Social Work (1968). B.B.A., University of Texas at Austin, 1941; M.S.W., Tulane University, 1947.
- BLACK, TRUMAN D., Associate Professor of Physics (1965). B.S., University of Houston, 1959; M.A., Rice University, 1962; Ph.D., 1964.
- BLACKWELL, CHARLES C., JR., Professor of Mechanical Engineering (1966). B.A., Rice University, 1955; B.S., 1956; M.S., Southern Methodist University, 1960; Ph.D., University of Arizona, 1966. Professional Engineer.
- BLAIR, LEON B., Associate Professor of History (1967). B.A., Texas Tech University, 1940; M.A., Rice University, 1949; Ph.D., Texas Christian University, 1968.
- BLAKE, DANIEL M., Assistant Professor of Chemistry (1970). B.S., Colorado State University, 1965; Ph.D., Washington State University, 1969.
- BOCK, E. C., Associate Professor of History (1966). A.B., St. Gregory's College, 1945; M.A., Oklahoma University, 1964; Ph.D., 1966.
- BOLEN, JAMES C., Associate Professor of Mathematics (1960). B.A., Texas A & M University, 1954; M.S., 1956; Ph.D., Texas Christian University, 1968.
- BOLEY, ROBERT B., Associate Professor of Biology (1965). B.S., Sam Houston State College, 1949; M.S., Texas A & M University, 1960; Ph.D., Ohio State University, 1963.
- BOON, JOHN D., Professor of Geology (1942). B.S., Southern Methodist University, 1936.
- BOWEN, JAMES N., Associate Professor of Psychology (1963). B.A., Hardin-Simmons University, 1960; Ph.D., University of Texas at Austin, 1963.
- BRAGG, LOUIS H., Associate Professor of Biology (1960) (1964). B.S., North Texas State University, 1953; M.S., 1957; Ph.D., University of Texas at Austin, 1964.
- BURKART, BURKE, Assistant Professor of Geology (1970). B.S., University of Texas at Austin, 1954; M.A., 1960; Ph.D. Rice University, 1965.
- BURNS, JOHN S., Associate Professor of English (1964). B.A., New York University, 1951; M.A., Rice University, 1953; Ph.D., 1964.
- BUTLER, JAMES K., Associate Professor of Biology (1960). B.A., University of Texas at Austin, 1950; M.A., 1952; Ph.D., 1961.
- CAFFEY, JAMES E., Professor of Civil Engineering (1959) (1965). B.S., Texas A & M University, 1955; M.S., 1956; Ph.D., Colorado State University, 1965. Professional Engineer.
- CALLICUTT, JAMES W., Associate Professor of Social Work (1968). B.S., Memphis State College, 1951; MSSW, University of Tennessee, 1958; Ph.D., Brandeis University, 1969.
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- CANNON, DON L., Assistant Professor of Electrical Engineering (1970). B.S., Texas Technological University, 1961; M.S., Massachusetts Institute of Technology, 1963; Ph.D., University of Houston, 1970. Professional Engineer.
- CANTWELL, DONALD W., Assistant Professor of Business Administration (1959) (1967). B.B.A., Southern Methodist University, 1953; M.B.A., 1959; J.D., 1962; State Bar, 1962.
- CARNEY, MARNA K., Associate Professor of Economics (1967). B.S., Northwestern University, 1947; M.A., Southern Methodist University, 1965; Ph.D., 1968.
- CASEY, LANNY M., Assistant Professor of Chemistry (1970). B.S., Harding College, 1965; Ph.D., Louisiana State University, 1969.
- CASH, FLOYD L., Professor and Chairman of the Department of Electrical Engineering (1959). B.S., University of Oklahoma, 1946; M.S., University of Texas at Austin, 1951; Ph.D., 1955. Professional Engineer.
- CHEAVENS, FRANK, Professor Emeritus of Psychology (1957). B.A., Baylor University, 1927; M.A., University of Texas at Austin, 1946; Ph.D., 1957.
- CHEN, MO-SHING, Professor of Electrical Engineering (1962). B.S., National Taiwan University, 1954; M.S., University of Texas at Austin, 1958; Ph.D., 1962. Professional Engineer.
- CHESTER, EDWARD W., Associate Professor of History (1965). B.A., Morris Harvey College, 1956; M.A., University of Pittsburgh, 1958; Ph.D., 1961.
- CLARK, DAYLE M., Assistant Professor of Civil Engineering (1964). B.S., Texas Tech University, 1955; M.S., Southern Methodist University, 1967.
- COGDELL, THOMAS J., Assistant Professor of Chemistry (1966). B.A., Midwestern University, 1955; M.A., University of Texas at Austin, 1962; Ph.D., Harvard University, 1965.
- COOKE, JAMES H., Assistant Professor of Physics (1968). B.A., North Texas State University, 1962; Ph.D., University of North Carolina, 1967.
- CORLEY, HERBERT W., JR., Assistant Professor of Industrial Engineering (1971). B.S., Georgia Institute of Technology, 1966; M.S., 1968; Ph.D., University of Florida, 1971.
- CORNEHLS, JAMES V., Associate Professor of Urban Affairs (1970). B.A., University of the Americas, 1961; Ph.D., University of Texas at Austin, 1965.
- COURTNEY, HARLEY M., Associate Professor of Accounting (1970). B.B.A., Lamar University, 1955; M.B.A., Texas A&M University, 1961; Ph.D., University of Illinois, 1966; C.P.A., 1960.
- COX, VERNE, Associate Professor of Psychology (1970). B.A., University of Texas at Austin, 1960; Ph.D., University of Houston, 1964.
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- CRUMB, STEPHEN F., Professor of Electrical Engineering (1961). B.S., University of Texas at Austin, 1943; M.S., 1948; Ph.D., California Institute of Technology, 1955. Professional Engineer.
- CUMMINS, ROBERT C., Assistant Professor of Business Administration (1971). B.A., Occidental, 1965; M.S., Purdue University, 1968; Ph.D., 1970.
- DALEY, JOHN M., JR., Assistant Professor of Social Work (1971). B.S., Spring Hill College, 1960; M.S.W., St. Louis University, 1967; M.S., University of Pittsburgh, 1969; Ph.D., Tulane University, 1971.
- DALLEY, JOSEPH W., Professor of Aerospace Engineering and Engineering Mechanics (1960). B.S., University of Texas at Austin, 1947; M.S., 1951; Ph.D., 1959. Professional Engineer.
- DEBOE, DAVID C., Assistant Professor of History (1968). B.A., Macalester College, 1964; M.A., Tulane University, 1966; Ph.D., 1969.
- DIANA, LEONARD M., Professor of Physics (1965). B.S., Georgia Institute of Technology, 1948; Ph.D., University of Pittsburgh, 1953.
- DODGE, CHARLES F., Professor and Acting Chairman of the Department of Geology (1948) (1957) (1962). B.S., Southern Methodist University, 1949; M.S., 1952; Ph.D., University of New Mexico, 1967. Professional Geologist.
- *DOWDEY, JAMES E., Associate Professor of Physics (1962). B.S., University of Texas at Austin, 1951; M.A., 1956; Ph.D., 1958.
- DREYFUS, MAYBETH E., Assistant Professor of Social Work (1968). B.A., Texas Christian University, 1932; M.S.S.W., Columbia University, 1941.
- DRYDEN, ROBERT D., Assistant Professor of Industrial Engineering (1968). B.S., Oklahoma State University, 1967; M.S., 1968.
- DUEHN, WAYNE D., Associate Professor of Social Work (1970). B.A., North Central College, 1961; M.S.W., Loyola University, 1964; Ph.D., Washington University, 1970.
- DUWAJI, GHAZI, Associate Professor of Economics (1966). B.A., American University of Beirut, Lebanon, 1959; Ph.D., Duke University, 1966.
- DYER, DANNY D., Assistant Professor of Mathematics (1963). B.S., University of Texas at Arlington, 1961; M.S., Southern Methodist University, 1963; Ph.D., 1970.
- EDGAR, SANFORD M., Assistant Professor of Business Administration (1971). B.B.A., University of Texas at Austin, 1966; M.A., University of Oklahoma, 1969; Ph.D., 1971.
- EICHELBERGER, CLAYTON L., Professor of English (1956). B.A., University of Colorado, 1949; M.A., 1950; Ph.D., University of Texas at Austin, 1956.
- ELLER, R. ROY, Associate Professor of Biology (1962). B.S., Abilene Christian College, 1959; M.S., Texas Tech University, 1962; Ph.D., Rice University, 1968.
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- ELLIOTT, PATRICA C., Assistant Professor of Accounting (1969). B.B.A., Eastern New Mexico University, 1963; M.B.A., University of Denver, 1966.
- ELLIS, JASON A., Associate Professor of Physics (1963). B.S., South Dakota School of Mines and Technology, 1942; M.S., State University of Iowa, 1952; Ph.D., 1962.
- ESTES, EMORY D., Associate Professor and Acting Chairman of the Department of English (1956). B.A., East Texas Baptist College, 1949; M.A., North Texas State University, 1956; Ph.D., Texas Christian University, 1970.
- ESTES, RALPH W., Professor of Accounting (1966). B.S., University of Kentucky, 1959; M.B.A., 1963; C.P.A., 1961; D.B.A., Indiana University, 1967.
- EVERARD, NOEL J., Professor of Civil Engineering and Engineering Mechanics (1960). B.S., Louisiana State University, 1948; M.S., 1957; Ph.D., Texas A & M University, 1962. Professional Engineer.
- FAIRCHILD, JACK E., Professor of Aerospace Engineering (1964). B.S., University of Texas at Austin, 1953; M.S., University of Southern California, 1959; Ph.D., University of Oklahoma, 1964. Professional Engineer.
- FARMER, WAYNE, Assistant Professor of Social Work (1970). B.A., University of Texas at Austin, 1950; M.S.S.W., 1959.
- FERGUSON, RICHARD W., Assistant Professor of Business Administration (1970). B.B.A., University of Texas at Austin, 1959; M.B.A., 1960.
- FILES, CARL W., Professor and Chairman of Department of Aerospace and Mechanical Engineering (1959). B.S., Iowa State College, 1939; M.S. Texas A & M University, 1949. Professional Engineer.
- FITZER, JACK, Associate Professor of Electrical Engineering (1967). B.S., University of Missouri, 1951; M.S., Washington University, 1960; D.Sc., 1962.
- FORTENBERRY, GEORGE E., Associate Professor of English (1955). B.A., Texas Christian University, 1948; M.A., 1951; Ph.D., University of Arkansas, 1967.
- FOX, JOHN N., Assistant Professor of Industrial Engineering (1968). B.S., University of Oklahoma, 1955; M.S., 1962; Ph.D., University of California at Los Angeles, 1967. Professional Engineer.
- FRANCIS, ROBERT F., Associate Professor of Chemistry (1955). B.S., East Texas State University, 1954; M.S., 1955; Ph.D., Texas Christian University, 1967.
- *FRANK, LUANNE T., Assistant Professor of English (1969). B.A., University of North Carolina, 1955; M.A., Emory University, 1959, 1963; Ph.D., University of Michigan, 1970.
- FRANK, TED E., Assistant Professor of Foreign Languages (1970). B.A., University of Western Ontario, 1954; M.A., 1957; Ph.D., University of Michigan, 1970.
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- FRYE, BERNARD L., Assistant Professor of Biology (1962). B.S., Baylor University, 1960; M.S., 1961; Ph.D., University of Oklahoma, 1972.
- GAINES, J. H., Associate Professor of Aerospace Engineering and Engineering Mechanics (1966). B.S., University of Texas at Austin, 1957; M.S., 1959; Ph.D., 1966.
- GARNER, STANTON B., Professor of English (1970). B.S., United States Naval Academy, 1948; A.M., Brown University, 1960; Ph.D., 1963.
- GAUPP, PETER G., Associate Professor of Social Work (1968). A.B., Southwestern University, 1950; M.S.S.W., University of Texas at Austin, 1954; Ph.D., University of Pittsburgh, 1968.
- GEISEL, PAUL N., Associate Professor of Urban Affairs (1970). B.A., Willamette, 1956; M.A., Vanderbilt, 1958; Ph.D., 1962.
- GERLOFF, EDWIN A., Assistant Professor of Business Administration (1970). B.B.A., University of Texas at Arlington, 1964; M.B.A., North Texas State University, 1966; Ph.D., University of Texas at Austin, 1971.
- GIBSON, ANNE L., Associate Professor of Foreign Languages (1962). B.A., Southern Methodist University, 1959; M.A., 1961; Ph.D., University of Texas at Austin, 1969.
- GIRARDOT, PETER R., Professor of Chemistry and Dean of School of Science (1966). B.S., University of Detroit, 1944; M.S., University of Michigan, 1948; Ph.D., 1952.
- GLASER, JAMES R., Assistant Professor of Civil Engineering (1968). B.S., University of Texas at El Paso, 1964; M.S., University of Texas at Austin, 1966; Ph.D., 1969. Professional Engineer.
- GOLLADAY, GERTRUDE L., Associate Professor of English (1959) (1965). B.A., West Texas State College, 1946; M.A., University of Denver, 1952; Ph.D., Texas Christian University, 1967.
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- GREEN, GEORGE N., Assistant Professor of History (1966). B.A., University of Texas at Austin, 1961; M.A., Florida State University, 1962; Ph.D., 1966.
- GREEN, WM. PAUL, Associate Professor of Business Administration (1967). B.S., University of Colorado, 1963; M.B.A., 1964; Ph.D., University of North Carolina, 1968.
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- HAGINS, LILA B., Assistant Professor of Social Work (1968). B.A., Oklahoma University, 1938; M.S.W., University of Texas at Austin, 1960.
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- HALL, C. C., JR., Professor of Biology (1963). B.S., Southern Methodist University, 1949; M.S., 1950; Ph.D., University of Kansas, 1961.
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- HARVEY, JAMES R., Assistant Professor of Mathematics (1964). B.S., B.A., University of Texas at Austin, 1953; M.S., Texas Christian University, 1959; Ph.D., 1969.
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- HELLIER, THOMAS R., JR., Associate Professor of Biology (1960). B.A.; University of Florida, 1955; M.S., 1957; Ph.D., University of Texas at Austin, 1961.
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- HOLLAND, THOMAS E., Professor of Economics (1970). B.S., University of Tennessee, 1957; M.S., 1958; Ph.D., Duke University, 1963.
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- McAFEE, HUGH D., Professor of Chemistry (1946). B.S., University of Texas at Austin, 1929; M.S., 1931. Professional Engineer.
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- McDOWELL, CHARLES T., Associate Professor of Foreign Languages (1966). B.S., Texas A & M University, 1943; Ph.B., 1955; M.A., Columbia University, 1953.
- McNULTY, CHARLES L., JR., Professor of Geology (1946) (1957). B.S., Southern Methodist University, 1940; M.S., Syracuse University, 1948; Ph.D., University of Oklahoma, 1955.
- McNUTT, JOHN D., Assistant Professor of Physics (1967). B.S., University of Michigan, 1960; M.S., Wayne State University, 1962; Ph.D., 1966.
- MEACHAM, WILLIAM R., Professor and Chairman of Department of Biology (1950). B.S., Texas A & M University, 1948; M.S., North Texas State University, 1950; Ph.D., University of Texas at Austin, 1958.
- MEIER, FRANCE A., Professor and Chairman of Department of Industrial Engineering (1965). B.S., Texas Tech University, 1951; M.S., University of Houston, 1959; D.Sc., Washington University, 1966.
- MILLER, ROBERT P., Professor of Foreign Languages and Linguistics (1962). B.Mus., Michigan State College, 1933; M.A., Yale University, 1948; Ph.D., 1952.
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- MOFFETT, JAMES M., Assistant Professor of English (1965). B.S., Appalachian State University, 1954; M.A., University of Arkansas, 1956; Ph.D., 1968.
- MONOSTORY, DENES, Professor of Foreign Languages (1958) (1966). B.A., St. Olaf College, 1951; M.A., University of Texas at Austin, 1953; Ph.D., 1963.
- MOON, JHANG S., Associate Professor of Government (1968). B.A., Southern Methodist University, 1959; M.A., Tulane, 1961; Ph.D., 1963.
- MOORE, MARION E., Associate Professor of Mathematics (1966). B.S., West Texas State University, 1957; M.S., Texas Tech University, 1960; Ph.D., University of New Mexico, 1968.
- MORRIS, GERALD LAVOY, Associate Professor of Mathematics (1967). B.A., Baylor University, 1963; M.A., University of Texas at Austin, 1966; Ph.D., Texas Tech University, 1967.
- MULLENDORE, WALTER E., Associate Professor of Economics (1968). B.S., Oklahoma State University, 1961; M.S., 1963; Ph.D., Iowa State University, 1968.
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- MYKLESTAD, NILS O., Professor of Aerospace Engineering and Engineering Mechanics (1967). B.S., Royal Tech. College, Copenhagen, Denmark, 1932; Ph.D., Cornell University, 1940. Professional Engineer.
- MYRES, SANDRA L., Associate Professor of History (1963). B.A., Texas Tech University, 1957; M.A., 1960; Ph.D., Texas Christian University, 1967.
- NEDDERMAN, WENDELL H., Professor of Civil Engineering and Vice President for Academic Affairs (1959). B.S., Iowa State University, 1943; M.E., Texas A & M University, 1949; Ph.D., Iowa State University, 1951. Professional Engineer.
- NEILL, ROBERT LEE, Assistant Professor of Biology (1970). B.S., Kansas State Teacher's College, 1963; M.S., 1968; Ph.D., University of Oklahoma, 1970.
- NESTELL, MERLYND K., Assistant Professor of Mathematics (1969). B.A., Andrews University, 1957; M.A., University of Wisconsin, 1959; Ph.D., Oregon State University, 1966.
- NOGUEIRA-MARTINS, CARLOS, Assistant Professor of Foreign Languages (1968). Diploma, University of Lisbon, 1961; M.A., University of Colorado, 1965.
- O'NEAL, COTHBURN M., Professor of English (1938). B.A., Trinity University, 1927; M.A., University of Texas at Austin, 1934; Ph.D., 1940.
- O'CONNOR, ROBERT M., Assistant Professor of Social Work (1970). B.A., University of Texas at Austin, 1959; M.S.W., Our Lady of the Lake College, 1963.
- PATTERSON, JOHN D., Assistant Professor of Electrical Engineering (1968). B.S., University of Texas at Arlington, 1962; M.S., University of Texas at Austin, 1964; Ph.D., 1966.
- PERRYMAN, JOHN K., Associate Professor of Mathematics (1963). B.A., Union College, 1958; M.A., University of Texas at Austin, 1960; Ph.D., 1963.
- PHELPS, FLORENCE H., Assistant Professor of Social Work (1971). A.B., Howard University, 1925; M.S.W., Atlanta University, 1949; M.Ed., North Texas State University, 1958.
- PHILLIPS, JAMES D., JR., Associate Professor of Psychology (1962). B.A., University of Arizona, 1956; M.S., Florida State University, 1959; Ph.D., Louisiana State University, 1962.
- PHILP, KENNETH ROY, Assistant Professor of History (1968). B.A., Michigan State University, 1963; M.A., University of Michigan, 1964; Ph.D., Michigan State University, 1968.
- PIERCE, MELVIN L., Associate Professor of Industrial Engineering and Acting Director of the University Computer Center (1961). B.A., Bethany Nazarene College, 1952; M.S., Texas A & M University, 1954.
- PINNEY, WILLIAM, Assistant Professor of Business Administration (1969). B.S., University of Florida, 1964; M.B.A., 1965; Ph.D., 1967.
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- POLK, NOEL, Assistant Professor of English (1970). B.A., Mississippi College, 1965; M.A., 1966; Ph.D., University of South Carolina, 1970.
- POOR, ARTHUR R., Associate Professor of Civil Engineering (1970). B.S., University of Utah, 1950; M.S., Texas A&M University, 1960; Ph.D., University of Texas at Austin, 1965. Professional Engineer.
- POULTER, VIRGIL L., Associate Professor and Acting Chairman of Department of Foreign Languages and Linguistics (1961). B.A., Oklahoma State University, 1954; M.A., University of New Mexico, 1960.
- PYBURN, WILLIAM F., Professor of Biology (1956). B.A., University of Texas at Austin, 1951; M.A., 1953; Ph.D., 1956.
- RAO, K. R., Associate Professor of Electrical Engineering (1966). B.E., University of Madras, 1952; M.S., University of Florida, 1959; M.S., 1960; Ph.D., University of New Mexico, 1966.
- RAYBURN, LOUIS A., Professor and Chairman of the Department of Physics (1970). B.S., University of Kentucky, 1948; M.S., 1950; Ph.D., 1954.
- REHER, WILLIAM C., Professor of Economics (1965). B.S.C., St. Louis University, 1941; M.S.C., 1948; Ph.D., University of Michigan, 1957.
- RICHARDS, EDWARD B., Professor of Government (1968). B.A., University of Northern Iowa, 1948; M.A., University of Iowa, 1953; Ph.D., 1957.
- RICHARDSON, WILLIAM M., Associate Professor of English (1965). B.A., Southeast Missouri State College, 1949; M.A., Texas Christian University, 1960; Ph.D., 1969.
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- ROBINSON, DUNCAN W., Professor of English (1928). B.A., North Texas State University, 1928; M.A., Southern Methodist University, 1933.
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- RYAN, THOMAS A., Assistant Professor of English (1970). A.B., University of Notre Dame, 1966; A.M., Brown University, 1968; Ph.D., 1971.
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