WHO TO CONTACT AT THE UNIVERSITY OF ARIZONA

Arizona is on Mountain Standard Time all year.

Graduate College
Administration Building, 3rd Floor ........................................... (520) 621-3471
Admissions .......................................................... (520) 621-3132
Degree Certification .................................................. (520) 621-3609

Bookstores
ASUA Bookstore, west end of the Student Union, the UA Mall .... (520) 621-2426

Bursar's Office
Administration Building, Room 208 ........................................... (520) 621-3232

Center for Disability Related Resources
Second and Cherry Streets ........................................... (520) 621-3268

Financial Aid
Administration Building, Room 203 ........................................... (520) 621-1858

Libraries
Main Library, Cherry Avenue and the UA Mall ....................... (520) 621-6441
Science-Engineering Library, the UA Mall ......................... (520) 621-6384

Office of the Registrar
Residency Classification, Administration Building, Room 210 .......................... (520) 621-3636
Student Information, Administration Building, Room 210 .......................... (520) 621-3113

Residence Life (Housing)
A. L. Slonaker Building .................................................. (520) 621-6500

Student Health Services
Cherry Avenue and the UA Mall ........................................... (520) 621-6490

Student Union
On the UA Mall .................................................. (520) 621-7755

Summer Session Office
1955 East Sixth Street .................................................. (520) 624-UofA

Transcripts
Administration Building, Room 210 ........................................... (520) 621-3212

Veterans' Services
Administration Building, Room 210 ........................................... (520) 621-6455

Campus Community Service Center
Cherry Avenue and the UA Mall ........................................... (520) 621-5130
WELCOME TO
THE UNIVERSITY OF ARIZONA

The variety and depth of the courses and curricula depicted in this catalog are a tribute to the richness of our University's graduate program, and to the extraordinary wealth of opportunity that it represents for the individual student.

Our graduate program rests on the firm foundation of a distinguished faculty and a large and ever expanding research program. These are the factors which are essential to ensuring that students are exposed to current thinking and the most recent developments in their field.

The material in this catalog can be expected to answer many of the questions that a current or potential student is likely to have. However, if you need more information, please do not hesitate to ask for help either at the Graduate College or at the individual academic department.

Sincerely,

Manuel T. Pacheco
President
All colleges and departments establish certain academic requirements which must be met before a degree is granted. These requirements concern such things as curricula and courses, majors and minors, and campus residence. Advisors, directors, department heads, and deans are available to help the student understand and arrange to meet these requirements, but the student is responsible for fulfilling them. At the end of a student's course of study, if all requirements have not been satisfied, the degree will not be granted. For this reason it is important for each student to be acquainted with and remain currently informed about all regulations and to be responsible for completing requirements. Courses, programs, and requirements described in the catalog may be suspended, deleted, restricted, supplemented, or changed in any other manner at any time at the sole discretion of The University of Arizona and the Arizona Board of Regents. The catalog does not establish a contractual relationship, but it summarizes the total requirements which the student must presently meet before qualifying for a faculty recommendation to the Arizona Board of Regents to award a degree.

The determination of acceptability of credit for course work completed at another institution of higher learning, whether the other institution is accredited or not, is made solely at the discretion of this institution as guided by its academic policy bodies. Students are advised to check with the Graduate Degree Certification Office to determine the acceptability of credit from other institutions and its applicability toward a program of study at The University of Arizona.

Inquiries regarding admission to the Graduate College should be addressed to:
Graduate Admissions Office
Administration 322
The University of Arizona
Tucson, AZ 85721
(520) 621-3132

Please note:
Prospective graduate students may receive a complimentary copy of The University of Arizona General Catalog from the Graduate College Office. Copies may be purchased for $4.00 from the ASUA Bookstore.

The University of Arizona General Catalog may be purchased for $4.00 from the ASUA Bookstore.

Information regarding the times and locations courses are scheduled is found in the Schedule of Classes available free in the ASUA Bookstore. Schedules for fall and spring semesters are available in April and October, respectively. The Summer Session Schedule of Classes is available in February.

UAInfo—Catalog and Schedule of Classes
The University of Arizona General Catalog and the Schedule of Classes are also available through UAInfo, the campus online information service. Department and course descriptions are linked to the online schedule, which offers up-to-the-minute information on the status of course offerings, including additions, cancellations, room changes, and enrollment figures that are updated as seats are reserved. For information on accessing UAInfo, call the Center for Computing & Information Technology (CCIT) Help Desk at 621-HELP.

The address for all campus offices:
The University of Arizona
Tucson, AZ 85721

The University of Arizona Affirmative Action Statement
The University of Arizona is committed to both Equal Employment Opportunity and Affirmative Action and is determined to maintain those principles at all levels of the University for all persons who are employed with and who participate in University-affiliated activities. The University is committed to meeting the provisions of those federal and state laws and University policies which apply to employment and admittance to any University program. The University prohibits discrimination on the basis of age, color, disability, ethnicity, gender, national origin, religion, sexual orientation, or veteran's status and is also committed to maintaining an environment free from sexual harassment and retaliation.

Office of Affirmative Action
The University of Arizona
1609 E. Helen Street
Tucson, AZ 85721
(520) 621-3081

Credits
University Curriculum and Academic Articulation Office:
Stardust K. Johnson, Associate Director
Ken Nichols, Program Coordinator
William Fee, Articulation Specialist

Graduate College:
Patricia A. Bailes

AHSC Biomedical Communications:
Rita Ellsworth, Designer
Margaret Hartshorn, Photographer
# ACADEMIC CALENDAR

Note: For specific graduate degree completion deadlines, contact the Degree Certification Office, Administration Building, Room 316, 621-3459.

## First Semester 1995-96 1996-97

<table>
<thead>
<tr>
<th>Event</th>
<th>1995-96 Dates</th>
<th>1996-97 Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classes begin</td>
<td>Aug. 24 Th</td>
<td>Aug. 24 Th</td>
</tr>
<tr>
<td>Last day to register for credit, to add courses,</td>
<td>Aug. 31 Th</td>
<td>Aug. 29 Th</td>
</tr>
<tr>
<td>and to change from no credit to credit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labor Day - no classes</td>
<td>Sept. 4 M</td>
<td>Sept. 2 M</td>
</tr>
<tr>
<td>Last day to drop with deletion of course from</td>
<td>Sept. 20 W</td>
<td>Sept. 18 W</td>
</tr>
<tr>
<td>record</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Last day to drop courses and to change from</td>
<td>Nov. 1 W</td>
<td>Oct. 30 W</td>
</tr>
<tr>
<td>credit to no credit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Veterans' Day - no classes</td>
<td>Nov. 13 M</td>
<td>Nov. 11 M</td>
</tr>
<tr>
<td>Thanksgiving recess</td>
<td>Nov. 23-26, Th-Su</td>
<td>Nov. 28-Dec. 1, Th-Su</td>
</tr>
<tr>
<td>Class and laboratory sessions end</td>
<td>Dec. 11</td>
<td>Dec. 9 M</td>
</tr>
<tr>
<td>Semester examinations begin</td>
<td>Dec. 13 W</td>
<td>Dec. 11 W</td>
</tr>
<tr>
<td>Semester examinations end</td>
<td>Dec. 20 W</td>
<td>Dec. 18 W</td>
</tr>
<tr>
<td>Winter Commencement</td>
<td>Dec. 21 Th</td>
<td>Dec. 19 Th</td>
</tr>
</tbody>
</table>

## Second Semester 1995-96 1996-97

<table>
<thead>
<tr>
<th>Event</th>
<th>1995-96 Dates</th>
<th>1996-97 Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classes begin</td>
<td>Jan. 11 Th</td>
<td>Jan. 15 W</td>
</tr>
<tr>
<td>M. L. King Holiday - no classes</td>
<td>Jan. 15 M</td>
<td>Jan. 20 M</td>
</tr>
<tr>
<td>Last day to register for credit, to add courses,</td>
<td>Jan. 19 F</td>
<td>Jan. 23 Th</td>
</tr>
<tr>
<td>and to change from no credit to credit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Last day to drop with deletion of course from</td>
<td>Feb. 7 W</td>
<td>Feb. 11 Tu</td>
</tr>
<tr>
<td>record</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spring recess</td>
<td>Mar. 9-17 Sa-Su</td>
<td>Mar. 15-23 Sa-Su</td>
</tr>
<tr>
<td>Last day to drop courses and to change from</td>
<td>Mar. 27 W</td>
<td>Apr. 1 Tu</td>
</tr>
<tr>
<td>credit to no credit</td>
<td>May 1 W</td>
<td>May 7 W</td>
</tr>
<tr>
<td>Class and laboratory sessions end</td>
<td>May 3 F</td>
<td>May 9 F</td>
</tr>
<tr>
<td>Semester examinations begin</td>
<td>May 10 F</td>
<td>May 16 F</td>
</tr>
<tr>
<td>Semester examinations end</td>
<td>May 11 Sa</td>
<td>May 17 Sa</td>
</tr>
<tr>
<td>Spring Commencement</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Summer Sessions 1996 1997

<table>
<thead>
<tr>
<th>Event</th>
<th>1996 Dates</th>
<th>1997 Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preseason Classes begin</td>
<td>May 13 M</td>
<td>May 19 M</td>
</tr>
<tr>
<td>Memorial Day Holiday - no classes</td>
<td>May 27 M</td>
<td>May 26 M</td>
</tr>
<tr>
<td>Last day of classes and final examination day</td>
<td>June 1 Sa</td>
<td>June 7 Sa</td>
</tr>
<tr>
<td>First Summer Session Classes begin</td>
<td>June 3 M</td>
<td>June 9 M</td>
</tr>
<tr>
<td>Independence Day</td>
<td>July 4 Th</td>
<td>July 4 F</td>
</tr>
<tr>
<td>Last day of classes and final examination day</td>
<td>July 3 W</td>
<td>July 10 Th</td>
</tr>
<tr>
<td>Second Summer Session Classes begin</td>
<td>July 8 M</td>
<td>July 14 M</td>
</tr>
<tr>
<td>Last day of classes and final examination day</td>
<td>Aug. 7 W</td>
<td>Aug. 13 W</td>
</tr>
</tbody>
</table>
ABBREVIATION GUIDE

The abbreviations listed below are used throughout this catalog to refer to the disciplines indicated.

AAS ......................................... African American studies
ABE .... agriculture and biosystems engineering
ACCT ........................................ accounting
A ED ........................................... agricultural education
AGRI .......................................... agriculture
AINS ......................................... American Indian studies
A ME .. aerospace and mechanical engineering
AMES ....................................... anesthesiology
AN S ......................................... animal sciences
ANTH ......................................... anthropology
APPL ......................................... applied mathematics
AR ............................................. Arabic
ARCH ......................................... architecture
ARE ........................................... art education
AREC ......................................... agricultural and resource economics
ARCH ......................................... art history
AR L .......................................... arid lands resources science
ART ........................................... art
ASTR .......................................... astronomy
AT MO ......................................... atmospheric sciences
B AD ........................................... business administration
BIOC .......................................... biochemistry
BIF ........................................... biophysics
CBA .......................................... cell biology and anatomy
CBIO .......................................... cancer biology
CCLS ......................................... comparative cultural and literary studies
CHN .......................................... Chinese studies
CLAS ......................................... classics
COMM ....................................... communication
CR L .......................................... critical languages
C SC .......................................... computer science
DNC .......................................... dance
EAS .......................................... East Asian studies
ECE .......................................... electrical and computer engineering
ECOL ......................................... ecology and evolutionary biology
ECON ......................................... economics
ED A .......................................... educational administration
ED P .......................................... educational psychology
EDUC ......................................... education
E M ........................................... engineering mechanics
ENGL ......................................... English
ENGR ......................................... engineering
ENTO ......................................... entomology
EXSS ......................................... exercise and sport sciences
F A ........................................... fine arts
FCM .......................................... family and community medicine
FCR .......................................... family and consumer resources
FIN .......................................... finance
FREN ......................................... French
FS .............................................. family studies
GC ........................................... global change
G EN .......................................... geological engineering
GENE ......................................... genetics
GEOG ......................................... geography and regional development
GEOS ......................................... geosciences
GER .......................................... German studies
GERO ......................................... gerontological studies
GRK .......................................... Greek
H ED .......................................... higher education
HE E .......................................... home economics education
HIST ......................................... history
HLTH ......................................... health education
HRP .......................................... health-related professions
HUM .......................................... humanities
HWR .......................................... hydrology and water resources
ITAL .......................................... Italian
JOUR .......................................... journalism
JPN .......................................... Japanese studies
JU S .......................................... Judaic studies
L AR .......................................... landscape architecture
LA S .......................................... Latin American studies
LAT .......................................... Latin
LAW .......................................... law
LI S .......................................... library science
LING .......................................... linguistics
LRC .......................................... language, reading, and culture
MAP .......................................... management and policy
M AR .......................................... media arts
MAS .......................................... Mexican American studies
MATH ......................................... mathematics
MBIM ......................................... microbiology and immunology
MCB .......................................... molecular and cellular biology
MED .......................................... medicine (interdepartmental)
MEDI ......................................... medicine
MEDT ......................................... medical technology
MIC .......................................... microbiology
MIS .......................................... management information systems
MKTG ......................................... marketing
MN E .......................................... mining engineering
MNEC ......................................... mineral economics
MSE .......................................... materials science and engineering
MUS .......................................... music
MUSI ......................................... music (performance studies)
NEE .......................................... nuclear and energy engineering
NES .......................................... Near Eastern studies
NEUR ......................................... neurology
NRC .......................................... neuroscience
NURS ......................................... nursing
NS .......................................... nutritional sciences
NUSC ......................................... nutritional sciences
OBG .......................................... obstetrics and gynecology
OPH .......................................... ophthalmology
OPTI ......................................... optical sciences
OSH .......................................... occupational safety and health
PA .......................................... public administration and policy
PATH ......................................... pathology
PCOL ......................................... pharmacology
PED .......................................... pediatrics
PHIL ......................................... philosophy
PHLC ......................................... pharmacology (College of Medicine)
PHLS ......................................... pharmacy
PHYS ......................................... physics
PL NG ......................................... planning
PL P .......................................... plant pathology
PL S .......................................... plant sciences
POL .......................................... political science
PORT ......................................... Portuguese
PRS .......................................... Persian
PSIO .......................................... physiology
PSY .......................................... psychology
PSY I ......................................... psychiatry
PTYS ......................................... planetary sciences
RADI ......................................... radiology
RA ........................................... range management
RELI ......................................... religious studies
REM ......................................... remote sensing
RNR .......................................... renewable natural resources
RONC ......................................... radiation oncology
RSS .......................................... Russian and Soviet studies
RUSS ......................................... Russian and Slavic languages
SER .......................................... special education and rehabilitation
SIE .......................................... systems and industrial engineering
SLAT ......................................... second language acquisition and teaching
SOC .......................................... sociology
SP H .......................................... speech and hearing sciences
SPAN ....................................... Spanish
STAT ......................................... statistics
SURG ......................................... surgery
SW .......................................... soil and water science
T AR .......................................... theatre arts
TOX .......................................... toxicology
TTE .......................................... teaching and teacher education
V SC ......................................... veterinary science
WFSC ......................................... wildlife and fisheries science
WS .......................................... women's studies
WS M ......................................... watershed management
# TABLE OF CONTENTS

Who to Contact at The University of Arizona .. inside front cover .......................... ii
The University of Arizona Record ............................................................... ii
Academic Calendar .................................................................................. iii
Abbreviation Guide ................................................................................. iv

I. General Information
   The University - A Brief History .......................................................... 1
   The Organization of Academic
   Responsibilities of the University ......................................................... 1
   Academic Divisions ................................................................................ 1
   Graduate Programs at the University of Arizona ................................. 3
   Graduate Programs by College .............................................................. 4

II. Graduate College Admission/Policy Information
   The Mission of the Graduate College .................................................... 7
   The Nature of Graduate Work ............................................................... 7
   Admission ............................................................................................... 7
   Graduate Credit ...................................................................................... 9
   Examinations and Grades .................................................................. 10
   Scholarship Requirements .................................................................. 10
   Enrollment Policies .............................................................................. 12
   Graduate Study in Summer Session ...................................................... 13
   Extended University ............................................................................ 13
   Code of Academic Integrity; Synopsis ................................................ 13
   Accommodation of Religious Observance and Practice ..................... 14

III. Expenses, Fees, and Graduate Appointments
   Expenses and Fees General Policies ..................................................... 15
   General Fees Related to Registration .................................................. 15
   Special Course Fees ............................................................................ 16
   Refunds of Tuition and Fees ............................................................... 16
   Summary of Minimum Annual Estimated Expense ............................ 16
   Graduate Appointments, Scholarships, and Financial Aid .................. 16

IV. Student Housing and Services
   Housing ................................................................................................. 19
   Student Union Dining Service .............................................................. 19
   Student Services .................................................................................. 19

V. Requirements for Master's Degrees
   General Requirements ......................................................................... 23
   Master of Arts ..................................................................................... 24
   Master of Science .............................................................................. 24
   Master of Accounting ........................................................................ 24
   Master of Agricultural Education and Master of Home
   Economics Education ........................................................................... 24
   Master of Architecture ....................................................................... 24
   Master of Business Administration .................................................... 24
   Master of Education ............................................................................ 25
   Master of Fine Arts ............................................................................. 25
   Master of Landscape Architecture ...................................................... 26
   Master of Music ................................................................................... 26
   Master of Public Administration ........................................................ 27
   Master of Public Health ...................................................................... 27
   Master of Teaching ............................................................................. 27

VI. Requirements for Specialist Degrees
   Educational Specialist ................................................................. 29

VII. Requirements for Doctor's Degrees
   Doctor of Philosophy ........................................................................... 31
   Doctor of Education ........................................................................... 32
   Doctor of Musical Arts ................................................................. 33

VIII. Departments and Courses of Instruction
   Accounting (ACCT) ................................................................. 39
   Aerospace and Mechanical Engineering (AME) .............................. 39
   Agricultural and Biosystems Engineering (ABE) ............................. 41
   Agricultural and Research Economics (AREC) ............................ 42
   Agricultural Education (A ED) .......................................................... 43
   Agriculture (AGRI) ............................................................................ 43
   American Indian Studies (AINS) ....................................................... 44
   Animal Sciences (AN S) .................................................................... 44
   Anthropology (ANTH) ................................................................. 45
   Applied Mathematics (APPL) ........................................................ 48
   Architecture (ARCH) ................................................................. 49
   Arid Lands Resource Sciences (AR L) ............................................ 50
   Art (ART/ARE/ARH) .......................................................................... 51
   Astronomy (ASTR) .............................................................................. 53
   Atmospheric Sciences (ATMO) .......................................................... 54
   Biochemistry (BIOC) ......................................................................... 56
   Biomedical Engineering ................................................................. 57
   Biophysics (BIP) ................................................................................. 57
   Business Administration (B AD) ....................................................... 57
   Cancer Biology (CBIO) ...................................................................... 58
   Cell Biology and Anatomy (CBA) ..................................................... 59
   Chemical and Environmental Engineering (CH E) ....................... 60
   Chemistry (CHEM) ........................................................................... 61
   Civil Engineering and Engineering Mechanics (CE/EM) ............. 63
   Classics (CLAS/GRK/LAT) ............................................................ 65
   Cognitive Science .............................................................................. 66
   Communication (COMM) ............................................................... 66
   Comparative Cultural and Literary Studies (CCLS) .............. 67
   Computer Science (C SC) ............................................................ 68
   Dance (DNC) ..................................................................................... 69
   East Asian Studies (EAS) .............................................................. 69
   Ecology and Evolutionary Biology (ECOL) ..................................... 71
   Economics (ECON) ........................................................................... 73
   Education (EDUC) ............................................................................ 74
   Educational Administration and Higher Education (ED A/H ED) .... 75
   Educational Psychology (ED P) ....................................................... 76
   Electrical and Computer Engineering (ECE) ................................. 77
   Engineering and Mines (ENGR) ..................................................... 80
   English (ENGL) ................................................................................ 80
   Entomology (ENTO) ................................................................. 82
   Epidemiology (EPT) ................................................................. 83
   Family and Consumer Resources .................................................... 83
   (FCR/COUN/FS/HIE/ID/MCS) .................................................. 85
   Finance (FIN) ................................................................................... 85
   French and Italian (FREN/ITAL) ..................................................... 86
GENERAL INFORMATION

THE UNIVERSITY—
A BRIEF HISTORY

In 1885—nearly three decades before Arizona became a state—the thirteenth territorial legislature approved $25,000 for building The University of Arizona in Tucson. The first classes convened in 1891, when 32 students and six teachers met in the original building now known as Old Main.

The University has developed in accordance with the Act of Congress of July 2, 1862, known as the Morrill Act. This legislation created the land-grant colleges and enabled the institution to obtain federal funds for its original schools of agriculture and mines.

In its early days, there were more students in the preparatory department than in the University proper, and the number of University graduates was never more than ten a year. Then came a decade of rapid expansion. The territory became a state, high schools multiplied, and the preparatory department was closed. In 1915, the University was reorganized as three colleges—the College of Letters, Arts, and Sciences (later Liberal Arts); the College of Mines and Engineering; and the College of Agriculture. The Arizona Bureau of Mines was established the same year.

In 1922, the College of Education was organized, and in 1925 offerings in law, originally established in 1915, were organized under the College of Law. The School of Business and Public Administration, established within the College of Letters, Arts, and Sciences in 1934, was reorganized as a separate college in 1944. In 1934 the Department of Home Economics was enlarged to a school within the College of Agriculture. In 1934 the College of Fine Arts, including the School of Music, and the Graduate College were established. In 1940 the Board of Regents reorganized the College of Mines and Engineering into two separate colleges. In 1967 the School of Earth Sciences was organized within the College of Mines, and became the College of Earth Sciences in 1971. In 1947 the School of Pharmacy was organized within the College of Liberal Arts, and was given separate status as the College of Pharmacy in 1949. The Board of Regents in 1956 authorized the establishment of the School of Nursing as a division of the College of Liberal Arts, and in 1964 the school became the College of Nursing. The Department of Architecture in the College of Fine Arts, authorized in 1958, became the College of Architecture in 1964. The Board of Regents authorized the College of Medicine in 1961. In 1974 the School of Renewable Natural Resources was approved as a new unit of the College of Agriculture. The School of Health-Related Professions was authorized by the Board of Regents in 1977. In 1982 the College of Liberal Arts and the College of Fine Arts were reorganized into the College of Arts and Sciences, which includes the Faculty of Fine Arts, the Faculty of Humanities, the Faculty of Science, and the Faculty of Social and Behavioral Sciences. In 1984, the departments that constituted the former College of Earth Sciences were reorganized to become part of the College of Arts and Sciences and the College of Engineering, and the School of Home Economics was renamed the School of Family and Consumer Resources. In 1985, the College of Mines combined with the College of Engineering to become the College of Engineering and Mines.

The 40-acre campus of the 1890s, then some miles outside Tucson, has grown to 345 acres and 155 buildings. Its stated purpose remains: "to provide the inhabitants of this state with the means of acquiring a thorough knowledge of the various branches of literature, science, and the arts," and, insofar as possible, to provide a technical education adapted to the development of the resources peculiar to Arizona. The university is maintained by funds appropriated by the State of Arizona and the United States government, and by fees and collections including private grants from many sources.

THE ORGANIZATION
OF ACADEMIC
RESPONSIBILITIES
OF THE UNIVERSITY

The responsibility for administering the state's public universities resides with the Arizona Board of Regents. The President of the University is appointed by the Arizona Board of Regents and serves as the University's chief executive officer. The Senior Vice President for Academic Affairs and Provost is the University's chief academic officer and the Senior Vice President for Business Affairs is the University's chief fiscal and operations officer. Two vice presidents and five vice provosts report to the Senior Vice President for Academic Affairs and Provost. They are the Vice President for Research; the Vice President for Student Affairs; the Vice Provost for Academic Affairs; the Vice Provost, College of Agriculture; the Vice Provost, College of Engineering and Mines; the Vice Provost for Health Sciences; and the Vice Provost for Undergraduate Programs.

Eleven colleges comprise the academic divisions of the University. Colleges have principal responsibility for determining degree requirements, including the general education program required for each degree. The eleven colleges are the College of Agriculture, the College of Architecture, the College of Arts and Sciences, the College of Business and Public Administration, the College of Education, the College of Engineering and Mines, the College of Law, the College of Medicine, the College of Nursing, the College of Pharmacy, and the Graduate College. The College of Arts and Sciences is divided into Schools of Fine Arts, Humanities, and Social and Behavioral Sciences. Each college and each division within Arts and Sciences is administered by a dean who has responsibility for academic programs and policies.

Within colleges are schools, departments, divisions, or committees which have direct responsibility for course offerings and for determination of requirements for majors. The academic programs offered by the University through its various units are listed in the chart which follows in this section of the catalog. Course offerings are listed according to the offering department in the Departments and Courses of Instruction section of this catalog.

Graduate studies, in progress continuously since the academic year 1898-1899, were organized independently in 1934 with the founding of the Graduate College. Initially, direction was provided by a dean and a committee composed of faculty members from graduate-level disciplines. Administration of the Graduate College is now provided by the Dean of the Graduate College and the Graduate Council, whose membership is broadly representative of the academic areas in which graduate programs are pursued. In addition, a Committee of Graduate Study is primarily responsible for maintaining proper standards and developing graduate programs.

ACADEMIC DIVISIONS

More detailed information may be found under listings for the specific college or department.

GRADUATE COLLEGE—Committees: American Indian Studies; Applied Mathematics; Arid Lands Resource Sciences;
Biophysics; Cancer Biology; Cognitive Science; Comparative Cultural and Literary Studies; Epidemiology; Genetics; Gerontological Studies; Global Change; Insect Science; Latin American Studies; Neuroscience; Nutritional Sciences; Optical Sciences; Pharmacology and Toxicology; Physiological Sciences; Planning; Remote Sensing; Second Language Acquisition and Teaching.

COLLEGE OF AGRICULTURE—Schools: Family and Consumer Resources (with divisions in Family Studies; Retailing and Consumer Studies); Renewable Natural Resources (with programs in Landscape Architecture; Range Management; Watershed Management; Wildlife and Fisheries Science). Departments: Agricultural and Biosystems Engineering; Agricultural and Resource Economics; Agricultural Education; Animal Sciences; Entomology; Nutritional Sciences; Plant Pathology; Plant Sciences; Soil and Water Science; Undergraduate Program in Microbiology; Veterinary Science. University Departments: Biochemistry; Molecular and Cellular Biology.

COLLEGE OF ARCHITECTURE

COLLEGE OF ARTS AND SCIENCES—Schools: Music; Library Science. Departments: Anthropology; Art; Astronomy; Atmospheric Sciences; Chemistry; Classics; Communication; Computer Science; East Asian Studies, Ecology and Evolutionary Biology; English; French and Italian; Geography and Regional Development; Geosciences; German Studies; History; Journalism; Linguistics; Mathematics; Media Arts; Near Eastern Studies; Philosophy; Physics; Planetary Sciences; Political Science; Psychology; Russian and Slavic Languages; Sociology; Spanish and Portuguese; Speech and Hearing Sciences; Statistics; Theatre Arts, University Departments: Biochemistry; Microbiology and Immunology; Molecular and Cellular Biology. Committees: African American Studies; Critical Languages; Dance; Judaic Studies; Mexican American Studies; Religious Studies; Russian and Soviet Studies; Women's Studies. Program: Humanities.

COLLEGE OF BUSINESS AND PUBLIC ADMINISTRATION—Schools: Karl Eller Graduate School of Management; Public Administration and Policy. Departments: Accounting; Economics; Finance; Management and Policy; Management Information Systems; Marketing.

COLLEGE OF EDUCATION—Departments: Educational Administration and Higher Education; Educational Psychology; Language, Reading and Culture; Special Education and Rehabilitation; Teaching and Teacher Education.

COLLEGE OF ENGINEERING AND MINES—Departments: Aerospace and Mechanical Engineering; Chemical and Environmental Engineering; Civil Engineering and Engineering Mechanics; Electrical and Computer Engineering; Hydrology and Water Resources; Materials Science and Engineering; Mining and Geological Engineering; Nuclear and Energy Engineering; Systems and Industrial Engineering. Committee: Biomedical Engineering.

COLLEGE OF LAW

COLLEGE OF MEDICINE—Departments: Anesthesiology; Cell Biology and Anatomy; Family and Community Medicine; Medicine; Neurology; Obstetrics-Gynecology; Ophthalmology; Pathology; Pediatrics; Pharmacology; Physiology; Psychiatry; Public Health; Radiation Oncology; Radiology; Surgery. University Departments: Biochemistry; Microbiology and Immunology; Molecular and Cellular Biology.

COLLEGE OF NURSING

COLLEGE OF PHARMACY—Departments: Pharmaceutical Sciences; Pharmacology and Toxicology; Pharmacy Practice.

SCHOOL OF HEALTH-RELATED PROFESSIONS—Departments: Exercise and Sport Sciences. Divisions: Community and Environmental Health; Medical Technology.

GENERAL DEPARTMENTS—School of Military Science, Naval Science, and Military Aerospace Studies.

UNIVERSITY DEPARTMENTS—Biochemistry; Microbiology and Immunology; Molecular and Cellular Biology.

EXTENDED UNIVERSITY AND THE SUMMER SESSION

THE UNIVERSITY LIBRARIES
## GRADUATE PROGRAMS AT THE UNIVERSITY OF ARIZONA

<table>
<thead>
<tr>
<th>Major</th>
<th>MASTER'S</th>
<th>SPECIALIST</th>
<th>DOCTORAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounting</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Aerospace Engineering</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Agricultural &amp; Biosystems Engineering</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Agricultural and Resource Economics</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Agricultural Education</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>American Indian Studies</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Anatomy</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Animal Sciences</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Anthropology</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Anthropology and Linguistics</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Applied Mathematics</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Architecture</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Arid Lands Resource Sciences</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Art (studio)</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Art Education</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Art History</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Astronomy</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Atmospheric Sciences</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Bilingual / Bicultural Education</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Bilingual / Multicultural Education</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Biochemistry</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Biology (General)</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Biophysics</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Botany</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Business Administration</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Cancer Biology</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Chemical Engineering</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Chemistry</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Civil Engineering</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Classics</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Communication</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Comparative Cultural and Literary Studies</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Computer Science</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Creative Writing</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Dietetics</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>East Asian Studies</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Ecology and Evolutionary Biology</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Economics</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Educational Administration</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Educational Media</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Educational Psychology</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Electrical and Computer Engineering</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Elementary Education</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Engineering Mechanics</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>English</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>English as a Second Language</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Entomology</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Major</th>
<th>MASTER'S</th>
<th>SPECIALIST</th>
<th>DOCTORAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Engineering</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Epidemiology</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Exercise and Sport Sciences</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Family and Consumer Resources</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Finance</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Food Science</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Foundations of Education</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>French</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Genetics</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Geography</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Geological and Geophysical Engineering</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Geosciences</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>German</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Gerontology</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Health Education</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Higher Education</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>History</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Home Economics Education</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Hydrology</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Industrial Engineering</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Insect Science</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>International Trade Law</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Journalism</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Landscape Architecture</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Language, Reading and Culture</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Latin American Studies</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Law ¹</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Library Science</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Linguistics</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Management</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Management and Policy</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Management Information Systems</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Marketing</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Materials Science and Engineering</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Mathematics</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Media Arts</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Medicine ²</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Microbiology &amp; Immunology</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Mining Engineering</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Molecular and Cellular Biology</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(Music) Composition</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(Music) Conducting</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Music Education</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(Music) Performance</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Music Theory</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Musicology</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

¹ Juris Doctor
² Doctor of Medicine

<table>
<thead>
<tr>
<th>Major</th>
<th>MASTER'S</th>
<th>SPECIALIST</th>
<th>DOCTORAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near Eastern Studies</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Neuroscience</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Nuclear Engineering</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Nursing</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Nutritional Sciences</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Optical Sciences</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Pathobiology</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Pharmaceutical Sciences</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Pharmacology</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Pharmacology and Toxicology</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Philosophy</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Physics</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Physiological Sciences</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Planetary Sciences</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Planning</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Plant Pathology</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Plant Science</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Political Science</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Psychology</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Public Administration</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Public Health</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Range Management</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Reading</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Reliability and Quality Engineering</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Renewable Natural Resources Studies</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Rhetoric, Composition, and the Teaching of English</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Russian</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Second Language Acquisition and Teaching</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Secondary Education</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Sociology</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Soil and Water Science</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Spanish</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Special Education</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Special Education and Rehabilitation</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Speech and Hearing Sciences</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Statistics</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Systems and Industrial Engineering</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Systems Engineering</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Teaching and Teacher Education</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Theatre Arts</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Toxicology</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Water Resources Administration</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Watershed Management</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Wildlife &amp; Fisheries Science</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Women's Studies</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>College, Faculty, or School</td>
<td>Department/School/Committee</td>
<td>Major</td>
<td></td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-----------------------------</td>
<td>-------</td>
<td></td>
</tr>
<tr>
<td><strong>AGRICULTURE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Agricultural and Biosystems Engineering</td>
<td>Agricultural and Biosystems Engineering</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Agricultural and Resource Economics</td>
<td>Agricultural and Resource Economics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Agricultural Education</td>
<td>Agricultural Education</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Animal Sciences</td>
<td>Animal Sciences</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Entomology</td>
<td>Entomology</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Family and Consumer Resources</td>
<td>Family and Consumer Resources</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nutritional Sciences</td>
<td>Dietetics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plant Sciences</td>
<td>Plant Pathology</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Renewable Natural Resources</td>
<td>Landscape Architecture</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil and Water Science</td>
<td>Soil and Water Science</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Veterinary Science</td>
<td>Pathobiology</td>
<td></td>
</tr>
<tr>
<td><strong>ARCHITECTURE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Architecture</td>
<td>Architecture</td>
<td></td>
</tr>
<tr>
<td><strong>BUSINESS &amp; PUBLIC ADMINISTRATION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Accounting</td>
<td>Accounting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Business Administration</td>
<td>Business Administration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Economics</td>
<td>Economics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Finance</td>
<td>Finance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Management and Policy</td>
<td>Management and Policy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Management Information Systems</td>
<td>Management Information Systems</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Marketing</td>
<td>Marketing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Public Administration and Policy</td>
<td>Public Administration</td>
<td></td>
</tr>
<tr>
<td><strong>EDUCATION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Educational Admin. and Higher Education</td>
<td>Educational Administration</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Educational Psychology</td>
<td>Educational Psychology</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Language, Reading and Culture</td>
<td>Bilingual /Bicultural Education</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Language, Reading and Culture</td>
<td>Bilingual /Multicultural Education</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Special Education and Rehabilitation</td>
<td>Special Education</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teaching and Teacher Education</td>
<td>Educational Media</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teaching and Teacher Education</td>
<td>Elementary Education</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teaching and Teacher Education</td>
<td>Secondary Education</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teaching and Teacher Education</td>
<td>Teaching and Teacher Education</td>
<td></td>
</tr>
<tr>
<td><strong>ENGINEERING AND MINES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Aerospace and Mechanical Engineering</td>
<td>Aerospace Engineering</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chemical and Environmental Engineering</td>
<td>Chemical Engineering</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Civil Engineering and Engineering Mechanics</td>
<td>Civil Engineering</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Electrical and Computer Engineering</td>
<td>Electrical and Computer Engineering</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hydrology and Water Resources</td>
<td>Hydrology</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Materials Science and Engineering</td>
<td>Materials Science and Engineering</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mining and Geological Engineering</td>
<td>Geological and Geophysical Engineering</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nuclear and Energy Engineering</td>
<td>Nuclear Engineering</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Systems and Industrial Engineering</td>
<td>Industrial Engineering</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Systems and Industrial Engineering</td>
<td>Systems and Industrial Engineering</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Systems Engineering</td>
<td>Systems Engineering</td>
<td></td>
</tr>
<tr>
<td>FINE ARTS</td>
<td>HEALTH-RELATED PROFESSIONS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>---------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Art</td>
<td>Exercise and Sport Sciences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Art Education</td>
<td>Health Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Art History</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Media Arts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Media Arts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Music</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conducting</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Music Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Music Theory</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Musicology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Performance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theatre Arts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Theatre Arts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HUMANITIES</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Classics</td>
<td>Classics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>East Asian Studies</td>
<td>East Asian Studies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>English</td>
<td>Creative Writing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>English</td>
<td>English</td>
<td></td>
<td></td>
</tr>
<tr>
<td>English as a Second Language</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rhetoric, Composition, and the Teaching of English</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>French and Italian</td>
<td>French</td>
<td></td>
<td></td>
</tr>
<tr>
<td>German Studies</td>
<td>German</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Russian and Slavic Languages</td>
<td>Russian</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spanish and Portuguese</td>
<td>Spanish</td>
<td></td>
<td></td>
</tr>
<tr>
<td>INTERDISCIPLINARY PROGRAMS</td>
<td>American Indian Studies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interdisciplinary Programs</td>
<td>Applied Mathematics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arid Lands Resource Sciences</td>
<td>Arid Lands Resource Sciences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biophysics</td>
<td>Biophysics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cancer Biology</td>
<td>Cancer Biology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comparative Cultural and Literary Studies</td>
<td>Comparative Cultural and Literary Studies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Epidemiology</td>
<td>Epidemiology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Genetics</td>
<td>Genetics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gerontological Studies</td>
<td>Gerontological Studies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insect Science</td>
<td>Insect Science</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Latin American Studies</td>
<td>Latin American Studies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neuroscience</td>
<td>Neuroscience</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nutritional Sciences</td>
<td>Nutritional Sciences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pharmacology and Toxicology</td>
<td>Pharmacology and Toxicology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physiological Sciences</td>
<td>Physiological Sciences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planning</td>
<td>Planning</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Second Language Acquisition and Teaching</td>
<td>Second Language Acquisition and Teaching</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LAW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Law</td>
<td>International Trade Law</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEDICINE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public Health</td>
<td>Public Health</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NURSING</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nursing</td>
<td>Nursing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPTICAL SCIENCES</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optical Sciences</td>
<td>Optical Sciences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PHARMACY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pharmaceutical Sciences</td>
<td>Pharmaceutical Sciences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pharmacology and Toxicology</td>
<td>Pharmacology and Toxicology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>STATISTICS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cell Biology and Anatomy</td>
<td>Anatomy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cell Biology and Anatomy</td>
<td>Anatomy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Astronomy</td>
<td>Astronomy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atmospheric Sciences</td>
<td>Atmospheric Sciences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biochemistry</td>
<td>Biochemistry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemistry</td>
<td>Chemistry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer Science</td>
<td>Computer Science</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ecology and Evolutionary Biology</td>
<td>Ecology and Evolutionary Biology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Botany</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geosciences</td>
<td>Geosciences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics</td>
<td>Mathematics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microbiology and Immunology</td>
<td>Microbiology and Immunology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Molecular and Cellular Biology</td>
<td>Molecular and Cellular Biology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physics</td>
<td>Physics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planetary Sciences</td>
<td>Planetary Sciences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speech and Hearing Sciences</td>
<td>Speech and Hearing Sciences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statistics</td>
<td>Statistics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SOCIAL &amp; BEHAVIORAL SCIENCES</td>
<td>Anthropology</td>
<td>Anthropology and Linguistics</td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
<td>--------------</td>
<td>-----------------------------</td>
<td></td>
</tr>
<tr>
<td>Communication</td>
<td>Anthropology</td>
<td>Communication</td>
<td></td>
</tr>
<tr>
<td>Geography and Regional</td>
<td>Communications</td>
<td>Geography</td>
<td></td>
</tr>
<tr>
<td>Development</td>
<td>History</td>
<td>History</td>
<td></td>
</tr>
<tr>
<td>Journalism</td>
<td>Library Science</td>
<td>Linguistics</td>
<td></td>
</tr>
<tr>
<td>Linguistics</td>
<td>Near Eastern Studies</td>
<td>Near Eastern Studies</td>
<td></td>
</tr>
<tr>
<td>Philosophy</td>
<td>Political Science</td>
<td>Political Science</td>
<td></td>
</tr>
<tr>
<td>Psychology</td>
<td>Psychology</td>
<td>Sociology</td>
<td></td>
</tr>
<tr>
<td>Sociology</td>
<td>Women's Studies</td>
<td>Women's Studies</td>
<td></td>
</tr>
</tbody>
</table>
The University of Arizona is a Research I University and a land grant university; it belongs to the Association of American Universities; and it is ranked 18th by the National Science Foundation for its research in science and engineering. This combination makes it one of the nation’s leading universities. Graduate students total 7800 in 91 Ph.D. and 128 master’s programs. Numerous departments are ranked in the top ten nationally. The University of Arizona is especially known for its graduate interdisciplinary programs. Nineteen interdisciplinary programs offer programs at the graduate level; faculty who participate in these programs have appointments in thirteen colleges and seventy-four departments.

**THE MISSION OF THE GRADUATE COLLEGE**

The mission of the Graduate College is to foster the development of high quality graduate education programs which will attract outstanding faculty, graduate students, and resources to the University. Consequently, the Graduate College provides academic leadership for scientific and scholarly research programs and programs of artistic expression throughout the University. The Graduate College provides academic support to all graduate and professional degree programs and attempts to nurture the standard-setting programs at The University of Arizona that are gaining reputations of excellence. The Graduate College is responsible for providing support services to departments and students through the Graduate Admissions Office and the Degree Certification Office and for special programs for recruiting and retaining minority graduate students.

**THE NATURE OF GRADUATE WORK**

Building on a well-balanced undergraduate education, graduate students are expected to develop a thorough understanding of a specific academic discipline. The fundamental purpose of the Graduate College is to encourage each graduate student to demonstrate excellent standards of scholarship and to produce high quality, original research.

The status of graduate students is different from that of undergraduates. Satisfying degree requirements should not be the primary aim of graduate students. Graduate education provides an opportunity to increase knowledge, to broaden understanding, and to develop research capabilities. Consequently, the student’s academic achievements should reflect a personal commitment to the discipline and to scholarly standards.

**ADMISSION**

Admission to the Graduate College is open to qualified applicants who hold the bachelor’s degree from The University of Arizona or from a college or university which grants degrees recognized by The University of Arizona. Degrees that are recognized should be based on programs of study that meet or exceed the general education requirements for comparable majors and degrees at The University of Arizona. A degree cannot ordinarily be recognized if it is based on any of the following types of credits:

1. Credits awarded by postsecondary institutions in the United States that lack candidate status or accreditation by a regional accreditation association.
2. Credits awarded by postsecondary institutions outside the United States that lead to degrees considered not equivalent to the U.S. bachelor’s degree, or that lack recognition by the home country’s Ministry of Education.

3. Credits awarded by postsecondary institutions for life experience unless validated by the institution awarding the credits through the use of standardized or comprehensive examinations (such as CLEP).
4. Credits awarded by postsecondary institutions for courses taken at noncollegiate institutions (e.g. governmental agencies, corporations, industrial firms, etc.).
5. Credits awarded by postsecondary institutions for noncredit courses, workshops, and seminars offered by other postsecondary institutions as part of continuing education programs.

In general, degrees that are recognized should be based on a unit of credit comparable to that defined by the Arizona Board of Regents (26 May 1979) for institutions under its jurisdiction. A minimum of forty-five hours of work by each student is required for each unit of credit. An hour of work is the equivalent of fifty minutes of class time (often called a “contact hour”) or sixty minutes of independent study work. For lecture-discussion courses, this requirement equates to at least fifteen contact hours and a minimum of thirty hours of work outside of the classroom for each unit of credit. Even though the values of fifteen and thirty may vary for different modes of instruction, the minimum total of forty-five hours of work for each unit of credit is a constant. Each applicant with an undergraduate academic record containing “pass,” “satisfactory,” “credit,” or similar entries for courses which have a substantial bearing on the field of specialization must also submit (i) a written evaluation by the instructor of each such course, or a letter grade, and (ii) scores on the aptitude test of the Graduate Record Examination. Admission is granted only after approval of the applicant’s previous academic record by the Dean of the Graduate College and the head of the academic unit in which the greater portion of major academic work will be completed.

**Grade-Point Average**

Applicants who apply for admission to the Graduate College are evaluated on the individual merits of their academic achievements and individual scholarly potential to complete graduate level course work and curriculum requirements. Ordinarily, a minimum cumulative grade-point average of 3.00 based on a 4.00 scale, over the last sixty units of course work or a minimum cumulative grade-point average of 3.00 over a minimum of twelve hours of graduate course work is required for admission to the Graduate College. Applicants should consult the academic unit to which they are applying regarding that unit’s grade-point average expectations. Prospective students who do not meet this standard may enroll as nondegree students and complete twelve consecutive units of 500-level (or higher) course work with a grade-point average of at least 3.250 in order to establish eligibility for seeking admission to the graduate degree program of their choice.

**Graduate Record Examination (GRE)**

Normally, applicants must submit scores on the Graduate Record Examination in order to complete the admission process. Scores on the aptitude test of the Graduate Record Examination are used to supplement other evidence of preparation for graduate work. Such scores are only one component of the credentials used to make admission decisions, and they are evaluated in the context of the complete record of each applicant. No formal minimum scores on standardized examinations are required for admission to the
Graduate College. A number of departments, however, have specific requirements with regard to the Graduate Record Examination, the Graduate Management Admissions Test, or other examinations. Some may require applicants to take the advanced GRE in the appropriate discipline. Academic departments and departmental headnotes in the Departments and Courses of Instruction section of this catalog should be consulted for further information. It is important that the examination be taken as early as possible in the academic year. Applications for the examinations, which are administered locally as well as in other centers, should be sent, together with the examination fee, to Graduate Record Examinations, Educational Testing Service; Box 6000; Princeton, New Jersey 08541-6000. Applications are available at the Testing Office and at the Graduate College.

Regular Graduate Status

Students who meet the admission requirements outlined above may be admitted to Regular Graduate Status to undertake work leading to an advanced degree.

Admission with Deficiencies

An additional number of undergraduate courses may be required when previous work has not approximated the general requirements for the corresponding bachelor's degree at The University of Arizona or the special requirements for the field in which the candidate proposes to specialize. With departmental approval, a limited number of course deficiencies may be satisfied after admission to a graduate program; however, this work will not receive graduate credit.

Provisional Admission

Provisional admission indicates some reservation on the part of the Graduate College with regard to the applicant's qualifications to undertake graduate work leading to an advanced degree. This restriction does not, however, impair the student's opportunity to earn graduate credit in properly selected courses. If admitted provisionally, a student who then completes nine credit hours of graduate work with superior grades will be in good standing, subject to any additional requirements established by the major department or academic unit. Students admitted provisionally because they lack only GRE scores may request conversion to regular graduate status immediately upon the receipt of the scores in the Graduate College and will have the requirement to complete nine credit hours of graduate work waived. Students on Provisional Status who wish to be admitted to regular graduate status should obtain the "Provisional to Regular Graduate Status Request Form" from the Graduate College and follow the directions on the form. Only a student in Regular Graduate Status can be awarded a degree.

Graduate Nondegree Status

Individuals holding a bachelor's degree, or its equivalent, from a college or university which grants degrees recognized by The University of Arizona may attend graduate-level courses without being admitted to a graduate degree program. Such students may enroll in graduate-level course work as their qualifications and performance permit; however, no more than twelve units earned while in this status may later be requested to be applied toward an advanced degree awarded at the University.

Admission of International Students

Nonimmigrants should request graduate application forms from the Graduate Student Admissions Office and departmental requirements and materials from the major department. All international student applications, with required credentials, must reach the Graduate Student Admissions Office before February 1 for the summer and full terms and August 1 for the spring term. International applicants may apply for a deferment of their application processing fee until enrollment if they are from Hungary, Liberia, Poland, Tunisia, Zimbabwe or the republics of the Commonwealth of Independent States. All other international applicants must submit a $35.00 processing fee with their application. Applicants receiving a deferment are expected to pay the application fee in full to the Graduate College at the time of enrollment. Some graduates of foreign institutions may be admitted initially as International Special Students for a period of enrollment limited to two academic terms with the understanding that they may be required to undertake some work without graduate credit in order to make up deficiencies in preparation. In any event, no commitment can be made regarding the time required to complete a course of study.

International Special Status

Students admitted to this status are full-time students, taking a minimum of nine units of credit per semester. Those units may be in appropriate courses at either the undergraduate or graduate level. At the conclusion of the student's first semester in residence, the Graduate College and the academic unit to which the student seeks admission will evaluate the student's progress. If the academic unit recommends a change to Regular Graduate Status, the student can receive graduate credit for all graduate eligible work taken during the first semester in residence. If Regular Graduate Status is not recommended, a final evaluation of the student's progress will be conducted following the student's second semester in residence in International Special Status. Students admitted to Regular Graduate Status can receive graduate credit only for the graduate eligible units taken during the one semester immediately preceding the award of Regular Graduate Status. It is the responsibility of the student to initiate the paperwork requesting the change to Regular Graduate Status. Forms are available in the department or in the Graduate College.

Proficiency in English

International students must demonstrate proficiency in English as one of the conditions for admission. Submission of a minimum score of 550 on the Test of English as a Foreign Language (TOEFL) is required for those applicants whose native language is not English. The 550 score is a Graduate College requirement. Departments may choose to require a score higher than 550, but not lower.

Exempt from submitting TOEFL scores are applicants who have completed two years of full-time academic study or who have received a bachelor's degree or higher from institutions in the United States, English-speaking Canada, the United Kingdom, Australia, or New Zealand.

Students seeking assistantships, whose native language is not English or who do not have a degree from a U.S. institution, must submit a TOEFL score of 550 or higher prior to their appointment as a graduate assistant. Additionally, all graduate teaching assistants whose native language is other than English, and who are not citizens or permanent residents of the U.S., must take the Test of Spoken English (TSE) or the Speaking Proficiency English Assessment Kit (SPEAK) and achieve a score of 230 or higher.

TOEFL results are valid for two years from the test date. When requested by the applicant, an official score report will be sent to The University of Arizona from the Educational Testing Service. A student's application is not considered complete until satisfactory TOEFL scores are received.

For those prospective students who lack college-level English proficiency, the Center for English as a Second Language (CESL) offers full-time English language training on campus. The full semester or
summer term sessions carry no college credit, but satisfactory completion of CESL training meets the University's English proficiency requirement for admission. Further information can be requested from the Center for English as a Second Language, Room 104, CESL Building, University of Arizona, Tucson, AZ 85721.

Financial Resources for International Students

Students on nonimmigrant visas must certify that they possess adequate financial resources to support themselves while in residence at The University of Arizona. If sponsorship is through an organization or government agency, the sponsor must inform the Graduate Student Admissions Office, in advance, what the terms of support will be. Financial guarantees must be dated and addressed to The University of Arizona. If the University is to bill for tuition and fees, billing must be through an embassy or an agent in the United States. An official letter regarding billing information must be sent to the The University of Arizona Bursar's Office, P.O. Box 44390, Tucson, AZ 85733-4390. In addition, students on nonimmigrant visas are required by the University to have student accident and sickness insurance coverage for each term of enrollment. The cost of this insurance is included in the amount of financial guarantee required. Students may be exempted from the University of Arizona's insurance plan only when their government or sponsoring agency has submitted accident and sickness insurance plans acceptable to The University of Arizona. Additional information and costs of this coverage will be sent to those international students who are accepted for admission.

Application for Admission

Application for admission to the Graduate College must be made on forms furnished by the Graduate College. New applicants should submit one set of complete official transcripts/degree certificates of all undergraduate and graduate work with the Graduate College application. Each transcript must be in its original, sealed envelope. All applications and supporting documents should be sent to the Graduate Admissions Office, University of Arizona, Administration Building, Room 322, Tucson, Arizona 85721-0001. Credits which appear as transfer credits on any other transcript are not valid; applicants must submit an official transcript from the school where the credits were earned. Applications and required credentials for domestic applicants must be submitted to the Graduate Admissions Office before June 1 for fall term and October 1 for spring term. Applicants are urged to have all materials submitted well in advance of the above dates. Submission of the application and materials up to one year in advance is recommended. Applicants whose records are not in English are required to provide a certified translation of their records. Applicants should contact the department of their intended major to obtain departmental application materials and requirements.

Students who have been admitted to the Graduate College but who were not enrolled during the previous regular semester must reapply for admission. (See "Leave of Absence" for exceptions to this policy.) All material becomes the property of the Graduate College and will not be returned.

Candidacy for an Advanced Degree

Admission to graduate study does not imply admission to candidacy for an advanced degree and gives no right or claim to be so admitted. Such candidacy is determined after the student has demonstrated, by work done at The University of Arizona, the ability to do work of graduate character with originality and independence. Until admitted to candidacy, a student should not rely upon taking the final examination for a degree at any set time.

Students in master's or specialist programs apply for candidacy by submitting the Master's/Specialist Application to Candidacy, with appropriate signatures, to the Graduate College. Students in doctoral programs submit the Doctoral Application to Candidacy. Upon approval of the appropriate form by the Dean of the Graduate College, the student is admitted to candidacy.

GRADUATE CREDIT

Regular Graduate Credit Courses

Regular courses numbered at the 500, 600, 700, and 900 levels are intended for graduate students. (See the Departments and Courses of Instruction section for classification of regular courses by number.) With prior written permission of the Dean of the Graduate College, exceptionally well-qualified seniors may enroll in 500-level courses. Courses numbered at the 600, 700, and 900 levels are not open to undergraduates.

General Prerequisites for Graduate Credit in the Major

The undergraduate major, or its equivalent, in any field of study is prerequisite to graduate credit toward a major in that field. In some cases, a field of concentration in undergraduate work, different but suitably related to the graduate major, may be acceptable.

Deficiencies in undergraduate preparation must be satisfied by the completion of prescribed courses, for undergraduate credit.

Repeating Courses

Graduate students may not repeat for credit any course which is not marked [Rpt.] in the Graduate Catalog. For more detailed information, please see "Course Description Explanation" under Departments and Courses of Instruction elsewhere in this catalog.

Use of 400-Level Courses in Graduate Programs

A graduate student may, with the approval of his or her major and minor advisors and department heads, use up to six units of 400-level course work on the graduate degree program in areas outside of the major department or interdisciplinary program. However, these units will not receive graduate credit nor will the grades earned for the courses be included in the graduate grade-point average.

Graduate Credit for Seniors

A University of Arizona student of senior standing who is within fifteen units of completing all requirements for graduation may register for graduate work if recommended by the head of the department and approved by the Dean of the Graduate College. For such registration a petition for graduate credit in excess of senior requirements must be filed with the Dean at the time of registration. This petition must be endorsed by the professor in charge of the course and the student's advisor. The Dean will not approve a petition unless the senior has a grade-point average of 3.000 or higher on all work already completed at the University, is proceeding toward graduation as directly as possible, and does not propose a total load to exceed sixteen units. The maximum number of units of graduate credit that may be earned by a senior in any semester is equal to the difference between sixteen and the number necessary to complete requirements for graduation.

Transfer of Graduate Credit

The University of Arizona accepts graduate credit by transfer from other accredited institutions; however, the whole number of transferred units offered toward a master's degree may not exceed twenty percent of the minimum number of units required for the degree in question. Such transfer of credit may be ap-
plied toward an advanced degree only upon satisfactory completion of such additional courses as may be prescribed by the head of the corresponding department in the University.

In any case, transfer of credit toward an advanced degree will not be made unless approved by the head of the major department, unless the grade earned was A or B, and unless it was awarded graduate credit at the institution where the work was completed. Furthermore, transfer will be made of credit only; no account will be taken of the grades of transfer work in computing the student’s grade-point average. Such transfer is initiated by the submission of the Application to Candidacy.

Credit for extension work from other institutions will not be accepted.

A student who plans to complete the final semester of the graduate program at another institution and to transfer those units to the graduate degree at The University of Arizona should be aware that delays in obtaining official transcripts from the other institution may result in postponing completion of degree requirements by at least one semester.

Correspondence Courses
Correspondence courses will not be accepted for graduate credit.

EXAMINATIONS AND GRADES
All courses offered for credit shall include a final examination given at the regularly scheduled examination time, unless specific exceptions for certain courses have been granted prior approval by departmental action and have been reported to the appropriate academic dean.

Grading System
The grading system used by The University of Arizona follows:

- A - Excellent
- B - Good
- C - Average
- D - Poor
- E - Failure
- F - Failure (see "Pass/Fail Option")
- P - Passing (see "Special Grades," "Pass-Fail")
- S - Superior (see paragraph on "Special Grades")
- I - Incomplete
- K - Course in progress
- W - Approved withdrawal
- O - Audit
- CR - Credit

Withdrawal Grades
Prior to the end of the fourth week of classes, withdrawal from a course cancels the registration for the course. Between the end of the fourth week and the end of the tenth week, a grade of W will be awarded to students who are passing at the time of withdrawal and a grade of E will be awarded to students who are failing at the time of withdrawal. The grade of W shall not be awarded to graduate students after the last day of the tenth calendar week in which classes are held except for cause approved by the Graduate Council. The grade for a nonofficial withdrawal, without the filing of withdrawal forms, is restricted to E.

Special Grades
The grades S (superior) or P (passing) are used in place of grades A or B respectively for individual studies courses numbered 591, 593, 594, 599, 691, 693, 694, 699, 791, 793, 794, 799, 900, 908, 909, 910, 915, 920, and 925. The only grades available in courses numbered 599, 699, and 799 are S, P, C, D, E, I, and W. For courses numbered 595, 596, 695, 696, 795 and 796, the instructor may use these special grades or the regular letter grades as departmental policy or the instructor’s own policy dictates; but all registrants in a given instance are graded by the same system. Grades available for 900 are S, F, C, D, E, I, and W. The only grades available for 908, 909, 910, 915, 920, and 925 are S, P, E, K, and W. The only grade available for 930 is K. Special grades (S, P) are not used in the computation of the grade-point average.

Averaging of Grades
For the purpose of computing grade-point averages, grade points are assigned to each grade as follows: A, 4 points for each unit; B, 3 points; C, 2 points, D, 1 point; and E, 0 points. To calculate the grade-point average, the unit value for each course in which a student receives one of the above grades is multiplied by the number of grade points for that grade. The sum of these products is then divided by the sum of the units of A, B, C, D, and E. The grade-point average is based only on University credit.

Pass-Fail Option
This option is not available to graduate students except for: (a) admission deficiencies which the student has specific, prior, written approval to take on a P-F basis (only the department head or the departmental graduate advisor may give such approval, which must be on file in the Graduate College office before registration); (b) any undergraduate, nondeficiency course available for P-F grading; and (c) any course offered by the College of Law.

Removal of Incomplete
Graduate students have a maximum of one calendar year to remove a grade of I (incomplete). The calendar year begins at the end of the semester in which the student registered for the course which was graded I (incomplete). If not removed within one calendar year, a grade of I will be changed to an E on the student’s record and will be counted as an E in determining the grade-point average.

SCHOLARSHIP REQUIREMENTS
A high level of performance is expected of students enrolled in a graduate degree program. A student who does not appear to be making satisfactory progress in graduate work may be required to withdraw from the University. No student will be recommended for the award of an advanced degree unless he or she has achieved a grade-point average of 3.00 or higher (a) on all work taken for graduate credit and (b) on all work included specifically in the graduate study program. To meet condition (a), the grade-point average is computed on all University of Arizona course work for which the student has enrolled for graduate credit, whether or not it is offered in satisfaction of requirements for an advanced degree, except for courses in which grades of F or S have been awarded. To meet condition (b), the grade-point average is computed in a like manner but only on courses included in an approved graduate study program. Students who do not meet condition (b) may take additional graduate course work. Such additional work may be included with the major work in the computation of the grade-point average to meet condition (b), but only with the approval of the major department secured prior to taking the work in question.

Grade Appeal
A student who feels that a grade has been unfairly awarded may appeal. Before a student begins the appeal process, s/he should make a serious effort to resolve the problem by discussing the concerns with the course instructor, stating the reasons for questioning the grade.

The grade appeal process per se begins with the student going to the college dean’s office to receive direction and any requisite forms. The student must attest that s/he has informed the instructor that s/he intends to file a grade appeal. This
The student shall within one week thereafter appeal in writing to the dean of the college concerned. The dean shall convene a committee to review the case. The committee shall consist of five members, one selected from the faculty of the department of the instructor concerned, two from the faculty of another closely related department or college, and two students provided by the student council of the college concerned. If the college does not have a student council, the ASUA shall appoint the student members, selecting two full-time upper-division undergraduate students for a grade appeal by an undergraduate student or two full-time graduate students for a grade appeal by a graduate student. All student members must be in good academic standing.

Within the structure provided by the dean, the committee shall design its own rules of operation. The student and instructor shall represent themselves. The committee may, or may not, (a) meet separately with the student, the instructor and the department head, (b) request each party to submit a brief written summary statement of the issues, and/or (c) interview other persons who have relevant information. The committee shall consider all aspects of the case pertaining to the grade determination in rendering its recommendation. If feasible, the committee should meet with the student and the instructor together in an attempt to resolve the differences. At the conclusion of its work, the committee shall make a written report containing its recommendations and provide copies to the student concerned, the instructor, the department head, and the dean.

Within the structure provided by the dean, the committee shall design its own rules of operation. The student and instructor shall represent themselves. The committee may, or may not, (a) meet separately with the student, the instructor and the department head, (b) request each party to submit a brief written summary statement of the issues, and/or (c) interview other persons who have relevant information. The committee shall consider all aspects of the case pertaining to the grade determination in rendering its recommendation. If feasible, the committee should meet with the student and the instructor together in an attempt to resolve the differences. At the conclusion of its work, the committee shall make a written report containing its recommendations and provide copies to the student concerned, the instructor, the department head, and the dean.

The appointment, meeting, and recommendation of the committee and the final action of the dean shall be made within four weeks of the dean’s receipt of the student’s written appeal. Final action on the case shall be taken by the dean only after full consideration of the committee’s recommendation. The dean shall have the authority to change the grade and the registrar shall accept the dean’s judgment. The department head, the instructor, and the student shall be notified in writing of the outcome of the dean’s judgment.

The student may request written verification of receipt of his or her letters of appeal from instructor, department head and dean.

Summary of Grade Appeal Process

Step 1: Student informs instructor of his/her intent to file a grade appeal.

Step 2: Student obtains direction and any requisite forms from dean’s office.

Step 3: Student submits written statement to course instructor and instructor’s department.

Step 4: Instructor responds in writing to student’s statement.

Step 5: Student submits written statement and instructor’s written response to department head.

Step 6: Department head responds in writing to student and instructor.

Step 7: Student submits written statement, and written responses from the instructor and department head to college dean.

Step 8: College dean convenes committee that hears the grade appeal.

Step 9: Grade appeal committee provides copies of its recommendations to the student, instructor, department head, and college dean.

Step 10: College dean rules on the appeal and notifies the student, instructor, and department head in writing of his/her ruling.

Maximum Time Table for Grade Appeal

<table>
<thead>
<tr>
<th>Step</th>
<th>Time Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior to week 5</td>
<td>Steps 1, 2, and 3</td>
</tr>
<tr>
<td>Prior to week 7</td>
<td>Step 4</td>
</tr>
<tr>
<td>Prior to week 8</td>
<td>Step 5</td>
</tr>
<tr>
<td>Prior to week 10</td>
<td>Step 6</td>
</tr>
<tr>
<td>Prior to week 11</td>
<td>Step 7</td>
</tr>
<tr>
<td>Prior to week 15</td>
<td>Steps 8, 9, 10</td>
</tr>
</tbody>
</table>

Graduate Grievance Procedures

The grievance procedure for graduate students who feel that they have been treated unfairly by a member of the faculty is as follows:

The student should discuss the situation with his/her graduate advisor. If the problem is not resolved, the student should then consult the department head. If there is no resolution at this level, the student should proceed to the dean of the college in which the department is housed. If this discussion fails to achieve positive results, the student should then consult the Associate Dean of the Graduate College.

Unfair treatment of graduate students is an embarrassment to the college or department in which it occurs. Thus, these units will try to achieve a solution. However, if the student feels that airing a grievance may lead to further punishment by the department, s/he may contact the Graduate College directly.

Graduate Petitions

Students may petition the Graduate Council if extenuating circumstances, such as hospitalization, have prevented their compliance with University rules, regulations, or policies regarding aca-
demic affairs—for instance, the extension of an incomplete grade. Petition forms are available in the Graduate College. The completed form with all relevant facts, supporting evidence, and letter of justification from the student's advisor should be returned to the same office.

Graduate Examination Appeal Procedure

A candidate for the master's degree must pass a final examination, either oral or written, or both, administered by a committee of at least three faculty members. The candidate for a specialist degree must pass a qualifying examination before or during the first term of work in the program and a comprehensive examination, either oral or written, or both, covering all graduate work when all course work is completed or during the final semester of course work. Each prospective doctoral candidate must pass a qualifying examination in the proposed major field, and many departments also require a qualifying examination in the minor field. Before admission to candidacy, the student must pass a preliminary examination testing general fundamental knowledge of the major and minor fields, and consisting of written and oral portions. The final oral examination constitutes the defense of the dissertation.

Failure may occur at any of these required examinations. Occasionally, a student may dispute the action of an examining committee, and usually such cases are resolved by a prompt discussion between the student and the committee chairperson. A member of the Committee for Graduate Study will be present at the second final master's oral examination (following an initial failure) to ensure that all appropriate procedural rules are followed.

If a student believes a dispute has not been satisfactorily resolved after discussion with the examining committee chairperson, the student may appeal by requesting a formal meeting with the entire examining committee. If no resolution results from this meeting, the student may request in writing that the head, chairperson or director of the appropriate academic unit discuss the matter after the latter individual has made an investigation. If these discussions are not adequate to settle the matter to the complainant's satisfaction, the student may then confer with the Dean of the Graduate College or the Dean's delegated representative.

The Dean of the Graduate College will convene a committee to review the case. This committee will consist of at least five members, with at least two selected from the faculty of the major field, at least one selected from the faculty of the minor field (in cases of disputes concerning a preliminary examination or final doctoral examination) or from the faculty of a department other than that of the major field, at least one member of the Graduate Council or the Committee on Graduate Study, and a fifth member to be selected by the Graduate Dean.

The committee should design its own procedures and rules of operation. It may or may not: (a) request that the student and the examining committee submit a brief written summary statement of the issue; (b) meet separately with the student and the examining committee; and/or (c) interview other persons who may have relevant information. The committee may, at any stage of the inquiry, meet with the student and examining committee together. At the conclusion of the hearing, the committee will make a written report containing its recommendations and provide copies to the student, the members of the examining committee, the head/Chairperson/director of the major academic unit (and of the minor field, where appropriate), and the Dean of the Graduate College.

Final action should be taken by the Dean of the Graduate College after full consideration of the committee's recommendation. The dean will have the authority to direct that a new examination or re-examination be held and, in the case of qualifying examinations and master's oral examinations, to assign a member of the Committee on Graduate Study to attend this examination or re-examination.

The written request to appeal must initiate during the first regular semester after the semester or summer term in which the disputed examination was held. The student's first contact with the examining committee chairperson does not constitute initiating an appeal.

ENROLLMENT POLICIES

Full-Time Student Status

Full-time status for graduate students varies, depending upon assistantship and associateship duties and the constitution of the individual student's program.

FALL AND SPRING SEMESTERS—During the fall and spring semesters, full-time status consists of enrollment for: (a) Nine units of graduate credit, or (b) Six units of graduate credit plus an assistantship or associateship, or (c) Three or more units of 900-level enrollment.

SUMMER SESSIONS—During precession and first and second summer sessions, full-time status consists of enrollment for six graduate units or more in any combination of precession, first, or second summer sessions.

Any student whose financial aid agreement requires enrollment during summer sessions should contact the Office of Student Financial Aid to verify the specific requirements. Students in doubt about their standing should consult the Graduate College.

Maximum Enrollment

The maximum enrollment (including graduate, undergraduate, and audited courses) allowed per semester for students registered in the Graduate College is sixteen units.

Minimum Enrollment

Each student admitted to a graduate degree program who, during any academic term, is associated with the University in any capacity that makes use of University facilities or faculty time must register. During the fall and spring semesters, a minimum of three units of graduate credit will be required; during any summer term, graduate students need not register for graduate units unless they will make use of University facilities or faculty time. A graduate student who will make use of University facilities or faculty time during a summer session must register for a minimum of one unit of graduate credit. A graduate student who makes use of University facilities or faculty time during an intersession must register for the minimum required number of units during the preceding semester or summer session. The minimum course work registration requirement may be met by registering officially for any single course or a combination of courses for which the total number of units meets or exceeds the minimum number of units required for the term enrolled.

Supplementary Registration

Students who have previously enrolled for all the regular courses required for their degrees and who still must register should enroll for supplementary registration (course number 930). Supplementary registration may be used concurrently with other enrollments to meet these registration requirements.

Leave of Absence

Graduate students in degree programs may, with the approval of their graduate advisor and department head, be granted a leave of absence for up to one academic year. Students on approved leave of absence will not be required to apply for
readmission. Graduate students who are absent beyond the end of the approved leave of absence will be required to apply for readmission when they wish to return. The granting of a leave of absence does not extend the six-year time limitation for master’s students nor the ten-year time limitation for doctoral students. “Leave of Absence” request forms are available in the Graduate Degree Certification office.

**Thesis and Dissertation Work in Absentia**

Under conditions approved by the head of the major department or the major advisor, a portion of the student’s thesis or dissertation work may be done in absentia. Approval to do work in absentia must be sought prior to undertaking the work.

**Auditing of Courses by Graduate Students**

With the consent of the Dean of the Graduate College and the instructors concerned, students enrolled in the Graduate College may unofficially audit courses not included in their regular programs. It is not necessary to register for such courses, but an auditor’s permit must be obtained from the Dean. If courses are audited officially by registering as an auditor, the units are included in the student’s unit load and the fees are the same as a registration for credit. For the purpose of reporting full or part-time student status to outside agencies, however, only those courses taken for credit are counted. After the fourth week of classes, a change from credit to audit will be permitted only if the student is doing passing work in that course, and receives the approval of the course instructor and the Dean of the Graduate College.

**Posting of Degrees on the Official Transcript**

Arizona Board of Regents policy states, “The University should award degrees to candidates who have completed all necessary course and curriculum requirements and other University or Board of Regents requirements. Universities may award the degrees at the conclusion of the summer session, the first semester, or the academic year.” Since the award of degrees requires approval by the Faculty Senate and because degrees can be conferred officially only on the three designated graduation dates in August, December, and May, confirmation of degree completion may not be posted to the transcript until the official date of graduation. Certificates of Completion may be issued to those students who have completed all degree requirements but to whom the degree has not yet been awarded.

**GRADUATE STUDY IN SUMMER SESSION**

Graduate study is available during The University of Arizona summer session. In response to demand for graduate work during the summer, a number of departments of the University have provided for independent research in their special fields. Such courses are listed under their respective departments. Students who wish to pursue any of these courses must obtain the consent of the course instructors before registering.

Graduate credit earned at The University of Arizona Summer School at Guadalajara, Mexico, may be used directly in advanced degree programs where appropriate.

In certain departments provision is made for teachers in service and others who are unable to attend the University during the regular year to complete the requirements for the master’s degree by attendance at summer session only.

**Summer Expenses**

Registration fee per unit of credit for the 1994-95 academic year was $96.00. There is no additional nonresident tuition fee for out-of-state students during the Summer session. In addition to the per unit tuition fee, students are assessed a student fee of $5.50 per unit and an Arizona Financial Aid Trust fee of $4.00. Since fees are subject to change, students should consult the current Summer Session Schedule of Classes for fees in effect for any given year.

**EXTENDED UNIVERSITY**

In cooperation with University colleges and departments, Extended University provider opportunity for graduate study in several formats, including evening, weekend, and video-based classes.

The Graduate Gerontology Certificate Program is available through the Evening and Weekend Campus.

Graduate programs through VideoCampus include the Master of Library Science degree; the Master of Science degree with a major in electrical engineering, emphasis in communication devices, digital hardware, electronic circuits, electronic packaging, and general purpose; the Master of Science degree with a major in optical sciences available from The University of Arizona in cooperation with the National Technological University satellite network; and the Professional Certificate in Reliability and Quality Engineering requires 15 units of graduate-level coursework.

The Extended University Writing Works Center periodically offers “Public or Perish,” a practical workshop in scholarly publishing. For information, please call 624-UofA.

**CODE OF ACADEMIC INTEGRITY: SYNOPSIS**

Integrity is expected of every student in all academic work. The guiding principle of academic integrity is that a student’s submitted work must be the student’s own.

Students engaging in academic dishonesty diminish their education and bring discredit to the academic community. Students shall not violate the Code of Academic Integrity and shall avoid situations likely to compromise academic integrity. Students shall observe the provisions of the Code whether or not faculty members establish special rules of academic integrity for particular classes. Failure of faculty to prevent cheating does not excuse students from compliance with the Code.

Faculty members shall foster an expectation of academic integrity and are responsible for notifying students of special rules of academic integrity established for a particular class (e.g. collaboration on homework, appropriate use of sources, use of the same paper in more than one class, etc.) and making every reasonable effort to avoid situations conducive to infractions of the Code.

Conduct prohibited by the Code consists of all forms of academic dishonesty, including, but not limited to: cheating, fabrication, facilitating academic dishonesty, and plagiarism as set out and defined in the Code of Conduct; modifying any academic work for the purpose of obtaining additional credit after such work has been submitted to the supervising faculty member except that the supervising faculty member may approve such alterations; failure to observe rules of academic integrity established by a faculty member for a particular course; and attempting to commit an act prohibited by this Code. Any attempt to commit an act prohibited by these rules shall be subject to sanctions to the same extent as completed acts.

Students found guilty of violating the Code are subject to any one or a combination of the following sanctions: written warning, disciplinary probation, loss of credit for the work involved, reduction in
grade, failing grade assigned in the course, suspension, expulsion, or other sanctions imposed by a University Hearing Board.

Sanctions that may be imposed by a faculty member are a written warning, disciplinary probation, loss of credit for the work involved, reduction in grade, and a failing grade in the course. A faculty member may recommend suspension or expulsion to a University Hearing Board.

Students charged with a violation of the Code have the right to a fair consideration of the charges including the right to see the evidence, and to confidentiality in the course of that consideration to the extent allowed by law and fairness to other affected persons. Procedures under the Code shall be conducted privately except that a student charged with a violation of the Code shall have the right to be accompanied by an advisor in any proceeding under the Code and may cause a hearing by a University Hearing Board to be open to the public. Except in the course of authorized consideration of a charge, faculty shall not reveal the identity of students charged or otherwise involved in a violation.

For a more detailed outline of procedures, see the complete Code of Academic Integrity. Copies are available in the Dean of Students Office.

**ACCOMMODATION OF RELIGIOUS OBSERVANCE AND PRACTICE**

Administrators and faculty members are responsible for reasonable accommodation of individual religious practices. A refusal to accommodate is justified only when undue hardship would result from each alternative of reasonable accommodation.

Persons wishing clarification of the nature or proper application of this policy should consult the Office of the Dean of Students or the Office of the Director of Human Resources, as appropriate.
EXPENSES, FEES, GRADUATE APPOINTMENTS, SCHOLARSHIPS, AND FINANCIAL AID

EXPENSES AND FEES
GENERAL POLICIES

All fees are payable prior to the due date for any semester or term. Payment of fees entitles students to many services, including instruction in university courses, use of university libraries, use of laboratory and course equipment, use of the recreation center, etc. No reduction is made for students who may choose not to use some of these university services or facilities.

The University accepts Visa, MasterCard, Discover and checks for the amount due but cannot advance cash on checks. The University cannot extend credit or accept installment payments; therefore, all fees for the semester must be paid in full at the time of registration. Students with past-due debts to The University of Arizona are considered financially ineligible to register until outstanding debts are paid in full. The registration of a student whose check is returned to the bank is considered incomplete and a late fee will be assessed. Collection fees are also assessed if payment for returned checks is not received in twelve calendar days.

Fees for the 1996-97 academic year were not established at the time of the publication of this catalog. Fees cited in this catalog are those which were established for the 1995-96 academic year. The Arizona Board of Regents has the legal responsibility to establish fees and reserves the right to change all fees without notice. Current registration fees are published in the Schedule of Classes for each term. Also, current information on these and other fees may be obtained from the Bursar's Office.

GENERAL FEES RELATED TO REGISTRATION

REGISTRATION AND TUITION FEES— Registration and specified fees are paid by all students enrolled at The University of Arizona; in addition, non-resident students pay tuition in lieu of the state legislative funding provided to the university through taxes paid by the state's residents. Conditions determining residency are established by Arizona state law. For a summary of those conditions and the process for determining residency status, see the section of the University of Arizona General Catalog titled Residence (Domicile) Classification for Tuition Purposes, in the chapter titled Admission and Registration, or consult the Office of Domicile Classification.

THE ARIZONA FINANCIAL AID TRUST (AFAT)—The Arizona Legislature approved a program of student aid, the Arizona Financial Aid Trust, which became effective in the 1989-90 academic year. This program was enacted through the efforts of the student governments on state campuses, the Arizona Student Association, the Arizona Board of Regents and the State Legislature. The program enables currently enrolled students in Arizona universities to receive additional financial aid and provides for the creation of a long-term endowment to assist future generations of Arizona students. As a result of the authorizing legislation and action by the Arizona Board of Regents, an Arizona Financial Aid Trust fee is assessed to all students who register for any fall, spring and summer term and is nonrefundable once class begins.

RECREATION CENTER FEE—In 1985, students adopted a referendum assessing themselves a mandatory $25 per semester fee to construct the Recreation Center. All students registering for four or more units of credit are charged the recreation center fee.

LATE PAYMENT AND LATE REGISTRATION FEES—A student who fails to complete payment of all fees prior to the due date for any semester or term will be assessed a non-refundable late payment fee. Students who fail to register prior to the first day of class will be assessed an additional late registration fee.

SPECIAL COURSE FEES AND DEPOSITS—Special course fees and deposits are applicable only under certain specific conditions and must be approved by the Provost and/or the Arizona Board of Regents. Fees for off-campus field trips,

EXPENSES AND FEES PER SEMESTER FOR 1995-96 ACADEMIC YEAR

ARIZONA RESIDENTS:

<table>
<thead>
<tr>
<th>Number of Units</th>
<th>AFAT Fees</th>
<th>Recreation Center Fee</th>
<th>Registration</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$4</td>
<td>—</td>
<td>$99</td>
<td>$103</td>
</tr>
<tr>
<td>2</td>
<td>$4</td>
<td>—</td>
<td>$198</td>
<td>$202</td>
</tr>
<tr>
<td>3</td>
<td>$4</td>
<td>$25</td>
<td>$297</td>
<td>$301</td>
</tr>
<tr>
<td>4</td>
<td>$4</td>
<td>$25</td>
<td>$396</td>
<td>$425</td>
</tr>
<tr>
<td>5</td>
<td>$4</td>
<td>$25</td>
<td>$495</td>
<td>$524</td>
</tr>
<tr>
<td>6</td>
<td>$4</td>
<td>$25</td>
<td>$594</td>
<td>$623</td>
</tr>
<tr>
<td>7 or more</td>
<td>$8</td>
<td>$25</td>
<td>$942</td>
<td>$975</td>
</tr>
</tbody>
</table>

NONRESIDENTS:

<table>
<thead>
<tr>
<th>Number of Units</th>
<th>AFAT Fees</th>
<th>Recreation Center Fee</th>
<th>Tuition &amp; Registration</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$4</td>
<td>—</td>
<td>$330</td>
<td>$334</td>
</tr>
<tr>
<td>2</td>
<td>$4</td>
<td>—</td>
<td>$660</td>
<td>$664</td>
</tr>
<tr>
<td>3</td>
<td>$4</td>
<td>—</td>
<td>$990</td>
<td>$994</td>
</tr>
<tr>
<td>4</td>
<td>$4</td>
<td>$25</td>
<td>$1320</td>
<td>$1349</td>
</tr>
<tr>
<td>5</td>
<td>$4</td>
<td>$25</td>
<td>$1650</td>
<td>$1679</td>
</tr>
<tr>
<td>6</td>
<td>$4</td>
<td>$25</td>
<td>$1980</td>
<td>$2009</td>
</tr>
<tr>
<td>7</td>
<td>$8</td>
<td>$25</td>
<td>$2310</td>
<td>$2343</td>
</tr>
<tr>
<td>8</td>
<td>$8</td>
<td>$25</td>
<td>$2640</td>
<td>$2673</td>
</tr>
<tr>
<td>9</td>
<td>$8</td>
<td>$25</td>
<td>$2970</td>
<td>$3003</td>
</tr>
<tr>
<td>10</td>
<td>$8</td>
<td>$25</td>
<td>$3300</td>
<td>$3333</td>
</tr>
<tr>
<td>11</td>
<td>$8</td>
<td>$25</td>
<td>$3630</td>
<td>$3663</td>
</tr>
<tr>
<td>12 or more</td>
<td>$8</td>
<td>$25</td>
<td>$3956</td>
<td>$3989</td>
</tr>
</tbody>
</table>

1 Expenses and fees for 1996-97 were not available at the time the catalog was printed. All fees are subject to change.
### SPECIAL COURSE FEES

<table>
<thead>
<tr>
<th>Course</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANAT 612</td>
<td>$50</td>
</tr>
<tr>
<td>AN 561</td>
<td>$50</td>
</tr>
<tr>
<td>ANTH 518</td>
<td>$250</td>
</tr>
<tr>
<td>ANTH 642a</td>
<td>$250</td>
</tr>
<tr>
<td>ANTH 642b</td>
<td>$250</td>
</tr>
<tr>
<td>ARCH 501</td>
<td>$25</td>
</tr>
<tr>
<td>ARCH 502</td>
<td>$25</td>
</tr>
<tr>
<td>ARCH 900</td>
<td>$25</td>
</tr>
<tr>
<td>ARCH 909</td>
<td>$25</td>
</tr>
<tr>
<td>ART 505</td>
<td>$35</td>
</tr>
<tr>
<td>ART 506</td>
<td>$25</td>
</tr>
<tr>
<td>ART 545</td>
<td>$25</td>
</tr>
<tr>
<td>ART 546</td>
<td>$25</td>
</tr>
<tr>
<td>ART 550</td>
<td>$40</td>
</tr>
<tr>
<td>ART 551</td>
<td>$40</td>
</tr>
<tr>
<td>ART 553</td>
<td>$40</td>
</tr>
<tr>
<td>ART 555</td>
<td>$40</td>
</tr>
<tr>
<td>ART 565</td>
<td>$25</td>
</tr>
<tr>
<td>ART 566</td>
<td>$25</td>
</tr>
<tr>
<td>ART 567</td>
<td>$25</td>
</tr>
<tr>
<td>ART 569</td>
<td>$25</td>
</tr>
<tr>
<td>ART 571</td>
<td>$25</td>
</tr>
<tr>
<td>ART 572</td>
<td>$20</td>
</tr>
<tr>
<td>ART 573</td>
<td>$20</td>
</tr>
<tr>
<td>ART 580</td>
<td>$11</td>
</tr>
<tr>
<td>ART 583</td>
<td>$20</td>
</tr>
<tr>
<td>ART 587a</td>
<td>$50</td>
</tr>
<tr>
<td>ART 587b</td>
<td>$50</td>
</tr>
<tr>
<td>ART 587c</td>
<td>$40</td>
</tr>
<tr>
<td>ART 587d</td>
<td>$40</td>
</tr>
<tr>
<td>ART 587e</td>
<td>$40</td>
</tr>
<tr>
<td>ART 587f</td>
<td>$40</td>
</tr>
<tr>
<td>ART 587g</td>
<td>$40</td>
</tr>
<tr>
<td>ART 589</td>
<td>$50</td>
</tr>
<tr>
<td>ART 656</td>
<td>$40</td>
</tr>
<tr>
<td>ART 673</td>
<td>$50</td>
</tr>
<tr>
<td>ART 687</td>
<td>$40</td>
</tr>
<tr>
<td>BIOC 612</td>
<td>$50</td>
</tr>
<tr>
<td>ECOL 542</td>
<td>$250</td>
</tr>
<tr>
<td>ECOL 542 (optional travel fee)</td>
<td>$250</td>
</tr>
<tr>
<td>ENTO 612</td>
<td>$50</td>
</tr>
<tr>
<td>GEO 536/HWR 536</td>
<td>$25</td>
</tr>
<tr>
<td>HWR 514</td>
<td>$75</td>
</tr>
<tr>
<td>HWR 517L</td>
<td>$25</td>
</tr>
<tr>
<td>HWR 531L</td>
<td>$10</td>
</tr>
<tr>
<td>HWR 536/GEOS 536</td>
<td>$25</td>
</tr>
<tr>
<td>HWR 551</td>
<td>$25</td>
</tr>
<tr>
<td>MBIM 612</td>
<td>$50</td>
</tr>
<tr>
<td>MCB 612</td>
<td>$50</td>
</tr>
<tr>
<td>MUSI Performance Studies—1/2 hr wk</td>
<td>$40</td>
</tr>
<tr>
<td>MUSI Performance Studies</td>
<td></td>
</tr>
</tbody>
</table>

### MISCELLANEOUS EXPENSES:

<table>
<thead>
<tr>
<th>Item</th>
<th>Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application fees</td>
<td>$35.00</td>
</tr>
<tr>
<td>to graduate degree program</td>
<td></td>
</tr>
<tr>
<td>to graduate nondegree status</td>
<td>$10.00</td>
</tr>
<tr>
<td>for readmission</td>
<td>$10.00</td>
</tr>
<tr>
<td>Music fee for private lessons, per semester*</td>
<td>$25.00</td>
</tr>
<tr>
<td>1/2 hr. per week</td>
<td>$40.00</td>
</tr>
<tr>
<td>1 hr. per week</td>
<td>$60.00</td>
</tr>
<tr>
<td>See General Catalog for further details.</td>
<td></td>
</tr>
<tr>
<td>Late registration fee</td>
<td>$25.00</td>
</tr>
<tr>
<td>Foreign student language examination fee (any one examination)</td>
<td>$15.00</td>
</tr>
<tr>
<td>Application for degree candidacy fee</td>
<td>$15.00</td>
</tr>
<tr>
<td>Processing fee (thesis or dissertation)</td>
<td>$15.00</td>
</tr>
<tr>
<td>Thesis microfilm fee (optional)</td>
<td>$65.00</td>
</tr>
<tr>
<td>Dissertation microfilm fee</td>
<td>$65.00</td>
</tr>
<tr>
<td>Transcript fee</td>
<td>$4.00</td>
</tr>
<tr>
<td>(Immediate service is $6.00)</td>
<td></td>
</tr>
</tbody>
</table>

*Graduate assistants currently on appointment are exempt from music fees in the major field if the student is a music major.

### GRADUATE APPOINTMENTS, SCHOLARSHIPS, AND FINANCIAL AID

Financial assistance for graduate students is available from diverse sources, but the primary source of information and assistance is the Office of Student Financial Aid, 203 Administration Building. A catalog delineating the financial assistance available to students is published by that office and may be obtained by requesting a copy. Various types of financial aid are described below.

Students are also urged to explore various other possibilities at other locations such as the student's major department; the College of Education; the Advisor to Study Abroad; the Student Counseling Service; and the Social Science Reference Department of the Main Library. A brochure, "Graduate College Sources of Funding for Graduate Students," is available in the Graduate College.

### Assistantships and Associateships

Teaching and research assistantships are available in many University departments. Approximately 2,500 of these positions exist and many of them are for first-year graduate students. Salaries vary, but students may expect to receive an academic year salary in the range of $2,763 to $5,319 for services not exceeding ten hours a week, or $5,527 to $10,652 for half-time assistantships.

All communications regarding graduate assistantships and associateships should...
be addressed to the head of the department concerned.

Tuition and Fees
Graduate assistants and associates are exempt from the nonresident tuition charge and from music fees applicable to courses in their major fields. Registration fees are not waived.

Academic Requirement
Graduate assistants and associates must be enrolled in a graduate degree program and must maintain a University of Arizona graduate grade-point average of 3.00 or higher.

Minimum Enrollment for Graduate Assistants and Associates
Students employed as graduate assistants and associates are required to register for at least six units of graduate credit per semester as a condition of their appointments. Some colleges require their graduate assistants and associates to register for more than six units.

Maximum Enrollment for Graduate Assistants and Associates
The maximum number of units per semester which students employed as graduate assistants and associates may take is dependent upon the total hours of employment.

Scholarships, Fellowships, Traineeships, Grants, Awards
A limited number of scholarships and College Work Study awards are available to qualified graduate students. Interested students should request financial aid applications from the Office of Student Financial Aid. The priority deadline for applications is March 1.

A limited number of Graduate Tuition Scholarships, which waive out-of-state tuition, are available for academically qualified graduate students who meet minimum GPA requirements. Scholarship recipients must be recommended by their major departments and approved by the Graduate College.

Graduate Registration Scholarships, which waive the registration fee, are available in limited numbers for academically qualified graduate students. As with the Graduate Tuition Scholarships, recipients must be recommended by their major departments and approved by the Graduate College.

The Graduate College has Graduate Fellowships and Graduate Minority Fellowships for eligible students. Departments are required to apply for an allocation of these Fellowships. Departments receiving Fellowships can award them at their discretion. Students should contact their department chair for information.

The Graduate College welcomes applications from members of all ethnic groups and is especially interested in receiving materials from qualified applicants who are members of ethnic groups traditionally underrepresented in graduate programs—American Indians/Alaskan Natives, Asian/Pacific Islanders, African Americans and Hispanics.

Support offered by the Graduate College, specifically for minority students, includes: Graduate Minority Fellowships, Graduate Minority Tuition Waivers and Graduate Minority Registration Scholarships (see catalog under sources of financial assistance). These awards are made at the recommendation of the student's department.

The Graduate College also supports the American Indian Graduate Student Center. Cultural activities as well as academic and support services take place at the Center. These are coordinated by a full-time director.

The Graduate College administers several programs which are designed to provide academic, social and cultural support to minority graduate students and are funded by Arizona House Bill 2108. HB 2108 funds are targeted for Hispanic, African American, Asian/Pacific Islander and American Indian students. These programs include the Minority Graduate Student Research Fund, the Minority Graduate Student Travel Fund, the Minority Professional Development Network, and a tutoring program.

Awards such as NSF Graduate Fellowships and Ford Foundation Fellowships for Minority Students are made by the sponsoring agency to individual students. Applications are submitted by students to the sponsor, usually in early fall.

Loans
Loan programs in which graduate students may participate include, but are not limited to, Perkins Loans (formerly National Direct Student Loans), Nursing Student Loans (NSL), Pharmacy Student Loans, Medical Student Loans, Dougherty Foundation Student Loans, and Federal Family Education Loans.

Financial aid applications should be submitted to the Office of Student Financial Aid by the annual application deadline of the year the funds are required. The priority deadline for applications is usually March 1. Selection will be made on objective criteria with respect to the applicant's qualifications, and awards are limited by the availability of funds.

A separate application is required for the Federal Family Education Loan Program. An applicant must be admitted to a degree program before the application will be processed by the Office of Student Financial Aid. The total processing time at the University, bank and guaranty agency can take up to four months. Therefore, early application is advised.
Christopher City Apartments
The University of Arizona operates the Christopher City Apartments for students with families and single students, and University faculty and staff, an excellent alternative for year-round graduate students. The 360 apartments are conveniently located in northeast Tucson about a 15-minute drive from campus. Most apartments offer a breathtaking view of the nearby Santa Catalina Mountains.

The city bus system provides a direct line between campus and Christopher City that runs frequently. Bus passes are available by month or by semester at discounted rates. Recreational and educational sites are in nearby state parks. Grocery stores, postal services, a public park, a YMCA, and the elementary school are some of the services located within a one and one-half mile radius of the complex. Children attend schools in Tucson Unified School District.

Christopher City is a unique and diverse community of cultures that provides family support and a peaceful environment. The complex features a state-licensed cooperative preschool for children ages 2-5. An on-site staff is available to assist residents. Ample parking, 24-hour laundry facilities, and spacious grounds are enjoyed by all residents. The community center is the focus of activities for residents and includes meeting rooms, study rooms, a weight room, a lounge/game room, and a 70-foot pool and wading pool.

All apartments are single-story with a patio and garden area. Apartments include window coverage, electric appliances and garbage disposal, and carpeting. Furnished or unfurnished apartments are available. Monthly rental rates include the cost of air conditioning, heat, and water. For current rates on specific apartment types, please contact the Christopher City Apartments office. Pets are not permitted in the complex.

For an application or further information about Christopher City, contact: Christopher City Apartments, 3401 N. Columbus Blvd., Tucson, Arizona, 85712, (520) 327-5918. Fax: (520) 322-5881.

Housing Off the Campus
Listings of off-campus housing are available in the Center for Veterans and Off-Campus Students, Student Union 353. A renter’s guide for students is available. It contains information about Tucson, utilities, apartment listings, and legal resources.

Change of Address
It is the student’s responsibility to keep the University informed of all times of his or her current Tucson address. Change-of-address forms are available in the Office of Student Information, Registration and Records.

STUDENT UNION DINING SERVICE
The Student Union is the primary provider of dining services on the campus. Student Union food services are located at various campus facilities including the Park Student Center, the Business and Public Administration, the Electrical and Computer Engineering, the Student Recreation Center, and the Arizona Stadium. The range of services includes specialty snack bars, convenience stores, and table service restaurants. Campus vending locations are also offered. All food services on campus (including most vending machines) participate in the campus meal program ALL ABOARD.

ALL ABOARD is a debit card program. Average annual deposits are $900 - $1,200. Participation in the ALL ABOARD meal plan is voluntary. For additional information write: ALL ABOARD, Student Union - Rm. 208, The University of Arizona, Tucson, AZ 85721-0017.

STUDENT SERVICES
Counseling, testing, job and learning skill services are available to students through the Student Resource Center in Old Main; the Student Health Service; the Speech-Language and Hearing Clinics; the Center for Disability Related Resources; the International Student Center; the American Indian Graduate Center; and the Center for Veterans and Off-Campus Students. For full information concerning each of these, the student should consult the Dean of Students Office or the General Catalog.

Student Resource Center
The Student Resource Center, located in Old Main, houses three separate departments aimed at strengthening the students’ academic efforts.

The University Learning Center provides direct learning assistance to students enhancing their successful achievement as effective and independent learners. The University Learning Center is located in Old Chemistry, 217. See the general catalog for details on Tutoring Service, Testing Services for GRE, LSAT, PPST, and MCAT exams, and Minority Student Services.
be paid at the Bursar's Office. Visa and MasterCard are accepted. During regular school sessions, general medical care is provided; however, the Student Health Service is unable to provide all services during summer sessions, spring break and semester breaks. The Student Health Center is closed on weekends and university holidays.

Special clinics available at the Student Health Center include orthopedics, dermatology, allergy, immunization, sports medicine and minor surgery.

Chronic and pre-existing illnesses, as well as problems requiring complex therapeutic and rehabilitative care, may require outside consultation and referral to the local medical community. In such cases, the cost must be assumed by the student. Occasionally, an illness involving hazard to self or others may require temporary withdrawal from the University.

COUNSELING & PSYCHOLOGICAL SERVICES—The Counseling & Psychological Services section of the Student Health Service is open to all students who are eligible for care at the Student Health Service. CAPS offers short-term individual, couple, and group therapy, as well as skill-building workshops to promote positive, active mental health.

HEALTH PROMOTION & PREVENTIVE SERVICES—The Health Promotion & Preventive Services section of the Student Health Service is located in Old Main at the center of campus. Health educators and student peer educators are available for individual counseling and group presentations on sexuality, nutrition, fitness, alcohol and other drugs, and other health and wellness topics. Health Promotion also maintains a Wellness Center in the Student Recreation Center. Drop-in services include body composition, fitness and nutrition analysis, cholesterol screening and blood pressure checks. Stop by our office or the Student Health Center main lobby for a copy of the Calendar which lists Student Health Service support groups, skill-building workshops and classes.

INSURANCE—A supplemental health insurance plan for students is available to those regularly enrolled at the University who meet eligibility requirements. Since these requirements are subject to change, check with the Student Health Service to verify your eligibility. This insurance is not required for services at the Student Health Center. The insurance option is an HMO plan using the Student Health Service as the primary care provider for students. Another option is CampusCare, a plan which covers most charges (exclusive of prescriptions) within the Student Health Service.

MEDICAL RECORDS—The relationship between a Student Health Service clinician and a student is a personal one and professional confidence is carefully maintained. Release of information may be obtained only by specific written authorization from the student concerned.

Speech-Language and Hearing Clinics

These clinics function both as a service center for persons with communication difficulties and as a training site for graduate students under supervision in the Department of Speech and Hearing Sciences. Both clinics are committed to the provision of quality and state-of-the-art services. The program is accredited by the American Speech-Language-Hearing Association in both speech-language pathology and audiology.

The University clinics offer a full array of services to students, staff and faculty at The University of Arizona and to both children and adults in the community. The Speech-Language Clinic offers evaluation and remediation of articulation, language, voice, including abnormalities in quality, pitch, or loudness, and fluency (stuttering) disorders, as well as accent and dialect reduction. Individual and group therapy sessions are offered. Specialized instrumental testing is available. Flexible hours, including evenings, can be arranged.

Services in the Hearing Clinic include assessment of hearing; selection of hearing aids; training in use of amplification; counseling relative to alternate communication devices; as well as procurement of earmolds and maintenance of amplification systems.

For information regarding fees, consult the Speech-Language and Hearing Clinics. The clinics may be reached at 621-7070 for Hearing and 621-1826 for Speech.

Center for Disability Related Resources (CeDRR)

The mission of the center is to equalize educational opportunities for students and provide support services for faculty and staff with disabilities. The program of services and resources is designed to promote full inclusion and participation in the educational experience and campus life. Services of the center are available for students, faculty and staff who have physical, visual, hearing, learning (basic services) and hidden disabilities. Major programs and services provided by the center are academic accommodations, physical support services, a technology center (computer lab), Disability Resource Clearinghouse, adaptive athletics/recreation, counseling and advocacy, testing services, interpreting, advocacy and referral. The primary service center and administrative offices are located at the SW corner of 2nd Street and Cherry Avenue. Phone: (520) 621-3268 V/TDD

Center for International Students and Scholars

The Center for International Students and Scholars provides specialized services for international students and scholars at The University of Arizona. These services include personal counseling and advising; screening and referral to academic departments and support services on campus; orientation programs each semester for newly-arriving international students and scholars; assistance in complying with federal, state, and local laws and regulations affecting non-immigrant students and scholars; liaison and support to over 45 sponsoring agencies and governments in the United States and abroad; supporting numerous international student clubs and organizations; extracurricular field trips; community interaction through the International Friends organization; co-curricular educational programs on topical international issues; and periodic workshops and seminars on topics affecting the international student and scholar population. The Center for International Students and Scholars is located at 915 North Tyndall Avenue. The center may be reached by telephone at (520) 621-4627 or by fax at (520) 621-4069.

SPONSORED PROGRAM FEES—The Sponsored Programs section of the Center for International Students and Scholars assesses an administrative management fee for international students supported under contractual arrangements with sponsoring agencies and governments. The following fees are billed directly to the sponsor on a per student basis.

Fall semester                      $250.
Spring semester                     $250.
Summer term                        $100.

Specific information with regard to services provided may be obtained by contacting the Sponsored Programs section of the Center for International Students and Scholars.

American Indian Graduate Center

The American Indian Graduate Center is a support group for American Indian graduate students and provides students with the opportunity to participate in social, organizational, and community activities with other graduate students and with the American Indian community.
Academic counseling, publishing opportunities, advocacy, financial and academic support services and meeting space are also provided. Location: 1610 E. 7th Street; telephone: (520) 621-7989

Center for Off-Campus Students
This center provides advocacy and programs for traditional-age commuter students, undergraduates 25 years or older and veteran students. Services focus on promoting student success. Academic, social, cultural, and recreational programs are sponsored by students for students. The center, as a part of the Department of Student Programs, is a bridge linking off-campus students to the many on-campus student service resources. Location: Student Union 353.

Veteran Services
This office provides certification of enrollment for benefits to the DEPARTMENT OF VETERAN AFFAIRS. It also assists with the Veteran Workstudy Program and provides tutorial assistance. Located in Administration Bldg. 210.

Office of Child Care Initiatives
Child care for students who are also parents is a need that the University is seriously addressing. Students may count on assistance with locating and selecting a child care arrangement including referrals to centers and family child care providers. Because the cost of care is a serious issue for students on limited budgets, the Office of Child Care makes every attempt to know of financial assistance programs specific to child care, including centers that offer sliding fees and state funded subsidies. Information, resources, and referral contacts may be given over the phone at 621-5844; however, visitors are welcome in the office which is located in the Student Union, Room 300.
REQUIREMENTS FOR MASTER'S DEGREES

GENERAL REQUIREMENTS

Master’s degrees may be conferred for advanced work done by students who have received the bachelor’s degree from this institution or one of similar standing. The master’s degree implies advanced training gained through intensive study in a special field, supplemented, if advisable, by study in supporting subjects. The unit requirement varies somewhat among the various master’s degrees, but all work must be completed within a six-year period. All master’s degree programs must include a minimum of twelve units of work done on the University campus in Tucson. Except for a limited amount of transfer work from other approved institutions, the remaining credit requirements must be met by University credit, graduate-level courses, including (a) on-campus courses, (b) courses offered away from the main campus, and (c) approved thesis credit in absentia. For restrictions on the applicability of transfer credit to degree programs, see “Transfer of Graduate Credit” under Graduate College Admission and Policy Information elsewhere in this catalog. With the prior approval of the head of the department, thesis work, where applicable, may be done in absentia under the direct supervision and guidance of a member of the faculty.

Time Limitation

Graduate credit to be applicable with full value toward a master’s degree shall have been earned not more than six years prior to the completion of the requirements for the degree. Graduate courses taken more than six years and not more than ten years prior to completion of degree requirements will be counted for half credit toward the degree. Work more than ten years old is not accepted toward meeting degree requirements.

Major Professor

The head of the department in which the student’s major work lies shall designate as the major professor (advisor) some member of the department and, where applicable, as the thesis director either this same person or some other member of the department. To be acceptable, the student’s program of study and thesis (if required) must have the prior approval of the major professor and thesis director.

Foreign Language Option

At the option of the head of the department in which the major work is done, a reading knowledge of German, French, Russian, Spanish, or other language, may be required to complete the requirements for the master’s degree.

Master’s Application to Candidacy

Consult the Graduate College for deadline dates by which the Master’s/Specialist Application to Candidacy must be submitted to the Graduate College. This notice, approved by the major advisor and the department head on forms provided by the Graduate College, shall set forth the student’s program of study and other information required by the Graduate College. The program must conform to the requirements set forth in this catalog and those issued from time to time by the Graduate Council, including the general requirement that the units be offered in 500-level or above, University credit courses, and that at least one half of the required units be offered in courses in which regular grades (A, B, C) have been earned. Approval of this notice by the Dean of the Graduate College will constitute approval of advancement to candidacy for a master’s degree.

Final Examination

A candidate for the master’s degree must pass a final examination, oral or written or both, administered by a committee of at least three faculty members (including at least two from the major department) recommended by the major department for appointment by the Dean of the Graduate College. Deadlines for submission of final examination results may be obtained from the Degree Certification Office. Any candidate who fails the final examination may, upon recommendation of the major department and approval of the Graduate Council, be granted a second examination after a lapse of at least four months. The second examination is final.

Thesis

A thesis is required in many master’s programs. The appropriate departmental statement in this catalog will indicate thesis requirements for each degree. In cases in which a thesis is part of the degree program, a limited number of thesis units (910) must be earned for its preparation. Submission of the thesis for publication by University Microfilms Incorporated is optional. Students who choose not to have their theses published by UMI will not submit copies to the Graduate College, and the theses will not be kept in the University Library. A student who elects to submit his or her thesis to University Microfilms will, following the final examination, submit to the Graduate College two complete and signed copies of the thesis (approved and accepted by the major department), along with the Statement by Author and special abstract of 150 words or less. Deadlines for submission of the final thesis copies may be obtained from the Degree Certification Office. A third copy of the thesis may be required by the major department at its option. A manual describing the format of the thesis may be obtained from the Associated Students Bookstore. A thesis fee is paid to the University Cashier to cover the cost of processing by the Graduate College and microfilming by University Microfilms.

Publication of Thesis

Master’s theses are published by University Microfilms, Ann Arbor, Michigan. For the student who elects to submit his or her thesis for publication, upon certification by the student’s major professor, members of the committee for the final examination, and the Graduate College, a thesis copy and an abstract of 150 words or less are forwarded to University Microfilms. (This abstract is in addition to the two abstracts required for processing with the thesis and must be carefully prepared for microfilming according to specifications set forth in the thesis manual.) The manuscript is cataloged and microfilmed and the negative inspected and put in vault storage; the catalog information is sent to the Library of Congress for printing and distribution of cards for depository catalogs and libraries. The abstract is printed in Microfilm Abstracts and distributed to leading libraries in the United States and abroad, and to a selected list of journals and abstracting services. The copy is then returned to the University of Arizona Library.

Publication by microfilm does not preclude publication by other methods, and successful candidates are urged to submit thesis material for publication in a scholarly or professional journal. Suitable acknowledgment must always indicate the publication to be a thesis, or portion of a thesis, submitted in partial fulfillment of the requirements for a master’s degree at The University of Arizona.

Second Master’s Degree

Normally, students may earn only one master’s degree at The University of Arizona. Occasionally, a student is permitted to
enter a second master's degree program if the majors are sufficiently different to justify such an exception. No student will be permitted to undertake a third master's degree program at the University without the specific prior approval of the Graduate Council.

**MASTER OF ARTS**

The Master of Arts degree is offered for forty different fields of study. A minimum of thirty units of graduate work, including the thesis where one is appropriate, is required. Not less than fifteen units must be in a major field. By prior approval of the Graduate Council, two or more closely allied subjects may be combined to form a major. Special departmental requirements, if any, are listed under the appropriate department or committee in the Departments and Courses of Instruction section of this catalog.

**MASTER OF SCIENCE**

The Master of Science degree is offered for seventy different fields of study. A minimum of thirty units of graduate work, including the thesis where one is appropriate, is required. Not less than fifteen units must be in a major field. By prior approval of the Graduate Council, two or more closely allied subjects may be combined to form a major. Special departmental requirements, if any, are listed under the appropriate department or committee in the Departments and Courses of Instruction section of this catalog.

**MASTER OF ACCOUNTING**

The Master of Accounting degree program is a graduate professional program designed to provide advanced specialized training in accounting and related fields. Except as indicated below, the general regulations and requirements for the Master of Science degree apply.

A score at the 60th percentile or above on the Graduate Management Admissions Test and an academic average of "B" or better are required for admission consideration. Applicants must also have completed six units of statistics and twenty-four units of accounting including: accounting principles, six units; intermediate accounting, six units; cost accounting, three units; federal income tax, three units; advanced accounting, three units; and auditing, three units.

Of the thirty units required for the Master of Accounting degree, no fewer than fifteen must be in the field of accounting and at least sixteen must be in course work open only to graduate students.

The required courses consist of a fifteen-unit core: ACCT 510, 522, 535, 551 plus one from ACCT 526, 528, or 529. The balance of the thirty units is to be completed with electives. Each candidate must pass a written comprehensive examination.

**MASTER OF AGRICULTURAL EDUCATION AND MASTER OF HOME ECONOMICS EDUCATION**

The general regulations and requirements for the Master of Arts and Master of Science degrees apply to these degrees, with the following exceptions. Candidates must have a bachelor's degree and a minimum of one year's successful classroom or extension teaching or similar education experience. Evidence of acceptability of the candidate's experience record shall be based upon at least two letters to either the Chairperson of the Division of Family Studies or the department head in Agricultural Education from persons who have had administrative authority over the candidate's professional work experience. These letters should attest the candidate's professional competence. A minimum of thirty-two units of course work is required. The major or field of study shall include a minimum of twenty units in home economics education, family and consumer resources, and/or education; or, agriculture and agricultural education. All candidates shall complete a professional report of approved investigative work.

**MASTER OF ARCHITECTURE**

The College of Architecture offers a graduate program leading to the second professional degree, the Master of Architecture. The program is designed to accommodate graduates of accredited schools of architecture and is flexible in concept in order to meet the needs and interests of students who desire advanced, specialized training in architecture and related fields.

For admission consideration, applicants must have completed, with a grade average of B or higher, an undergraduate program of either four- or five-year duration that is substantially equivalent to the Bachelor of Architecture program at The University of Arizona. Students without this background will be required to first apply to the undergraduate Bachelor of Architecture program to complete undergraduate coursework. Graduate applicants must submit to the College of Architecture the following: (1) a statement of purpose for entering the graduate program, (2) a proposed program of graduate studies indicating their special interests in the field, (3) a biographical summary including a record of professional work experience, (4) a portfolio of creative work including design projects, and (5) letters from three academic and/or professional references. Students are encouraged to accumulate one year of professional work experience prior to undertaking graduate study.

This program requires a minimum of thirty-two graduate units including at least sixteen units of architecture. The graduate study program will be planned by the student in consultation with a committee consisting of the major professor and two additional faculty members. This program must include ARCH 596A and a thesis or master's report. The thesis and the report each consist of three parts: research, written report, and graphic presentation. Candidates must pass a final oral examination over the thesis/report and related matters.

**MASTER OF BUSINESS ADMINISTRATION**

The goal of The University of Arizona M.B.A. Program is to provide the foundation for a lifetime of development so that each student can maximize his or her potential for success. This is accomplished by providing a curriculum that combines the benefits of education based on sound business concepts with the relevance of confronting real business problems. The first year curriculum introduces a management decision-making environment in which students face risk, uncertainty, change, and competition in a controlled setting. Students learn problem solving, communications, team building, and decision-making skills so they can function effectively in such an environment.

The second year of the curriculum provides a special blend of theory and project courses in which newly acquired skills can be further developed through interactions with local and national business leaders. Upon the completion of the program, students are able to identify and formulate business problems, to specify and locate the information needed to solve them, and to develop and implement practical solutions.

Completion of previous course work in business is not required. Prerequisites, however, include undergraduate courses in finite mathematics and business calculus, which must be completed prior to enrolling in M.B.A. Program course work. Applicants should also have a working knowledge of basic word processing, spreadsheet, and database computer software packages.
Admission to the program is for the fall semester only. All application materials (including Graduate Management Admission Test (GMAT) scores, two letters of recommendation, one official copy of transcripts for each college or university attended, an educational/vocational resume, brief essays on several assigned topics, and the Eller School’s supplemental application form) must be submitted to the Graduate Admissions Office in the Karl Eller Graduate School of Management in McClelland Hall 210. Test of English as a Foreign Language (TOEFL) scores are required of all non-native speakers of English. Interviews are not required but are highly recommended.

The Eller School of Management offers both a two-year (four semesters), full-time program and a four-year (eight semesters and three summers), part-time program. The sixty-unit curriculum includes nine core courses (twenty-seven units), three communications components (three units), nine elective courses (twenty-seven units), and a capstone course (three units) which serves as the final examination for the program. The MBA Program reserves the right to change requirements for the degree.

Students who possess prior academic training equivalent to required comprehensive business core courses may elect to sit for waiver examinations which are scheduled at the beginning of the first and second semesters of the first year. Any student receiving a waiver for the content of a core course is required to substitute an elective to fulfill the unit requirement.

Full-time students enroll in course work in the following sequence:

**FALL I:**
- ACCT 550 (3), ECON 500 (3), MAP 502 (3)
- MKTG 500 (3), MKTG 552 (3), MAP 506 (1), MKTG 506 (1)

**SPRING I:**
- ACCT 569 (3), FIN 511 (3), MIS 567 (3)
- MIS/ACCT 570 (3), Elective (3), MIS 506 (1)

**SUMMER:**
- Internship

**FALL II:**
- Electives (15)

**SPRING II:**
- Electives (9), MAP 571 (3)

Enrollment in full-time (day) sections of all required core courses is restricted to students admitted to the full-time MBA Program.

Elective areas of emphasis include: accounting, corporate finance, design of data base systems, entrepreneurship, financial institutions, health care administration, information systems design, international business, legal studies, management of information, operations management, marketing management, marketing research, quality management, and reliability and quality engineering. Alternatives include the JD/MBA Program, which reduces the time to completion of both degree programs from five years to four years, and the MBA/Master of International Management (MIM - at Thunderbird) Program, which reduces the completion of both programs (if the student is proficient in a foreign language) from four years to 2.5 years. Detailed information regarding the joint degree programs may be obtained from the Eller School Office.

**MASTER OF FINE ARTS**

The Departments of Art, Theatre Arts, and English offer programs leading to the Master of Fine Arts degree with majors in art, theatre arts, and creative writing, respectively. Applicants must have completed appropriate undergraduate majors at this institution or one of similar standing. Deficiencies may be established if the applicant's undergraduate major differs significantly from the corresponding major at The University of Arizona. Theses are not required but the departments reserve the right to retain for departmental collections a selected work, or works, from those submitted in connection with students' work toward a degree. Final examinations are required. Applicants should contact the appropriate department for instructions about submitting examples of creative work directly to the department in support of an application. Special features and requirements of the three programs are described below.

**Major in Art**

Applicants must submit twenty slides of their work, slide list, three letters of reference (on recommended departmental forms), resume, autobiographical statement, official transcripts, and the yellow copy of the Graduate College Application form directly to the Department of Art. The white copy of the Graduate College Application form, domicile affidavit, official transcripts, and processing fee are to be sent directly to the Graduate College. No application will be considered until all the above information has been received by the department.

The unit requirement for this program is sixty units, of which twelve must be in art history, art criticism or related areas, thirty in studio area of concentration, and eighteen in related electives (as approved by major advisor). In lieu of a thesis, an original work, or group of such works, must be presented in public. Review of this work will accompany the final oral examination. The exhibit may be accompanied by a written document, but the document itself will not be considered a thesis. As evidence of completion of this work, a folio of slides or photographs of the exhibition must be submitted to the Art Department graduate committee upon completion of the final examination. The candidate may be required to prepare a one-person exhibit of the work or to participate in a group exhibit during the last semester in residence.

**Major in Creative Writing**

The unit requirement for this program is thirty-six units. Required are four graduate literature courses in the English
Department, including two literature seminars for writing students. The program also requires the writing of an original book-length work of fiction, poetry, or literary nonfiction. The rest of the program may be in writing courses, in literature, or in courses of other departments related to the student’s field of interest such as playwriting, film-writing, anthropology, history, or the literature of other languages. An examination on the craft of modern literature is given at the end of the student’s work. There is no foreign language requirement.

**Major in Theatre Arts**

The unit requirement for this program is sixty units. Concentrations are available in acting-directing, in design-technical production, or in dramatic writing. Applicants for the acting-directing option must submit a resume and at least three letters of recommendation and must arrange for an audition and interview. Applicants for design-technical production must submit renderings and slides or photographs of theatrical design or technical work directly to the department. Applicants for dramatic writing must submit at least two samples of original dramatic writing and letters of recommendation from at least three persons acquainted with the student as a writer.  

**Acting-Directing Option:** (a) Professional Actor Training Program. Program requirements are 503, 504, 549, 551, 552, 555, 575; ten units of 597f, 600, 605, 606; three units of 693; three units of 696b; three units of 909; one course in theatre history; one course in dramatic theory; three units of DNC 591; and two units of MUSI 580w. The final project is the preparation and presentation of an acting recital developed according to departmental guidelines. (b) Directing Emphasis. Program requirements are 531, 549, 551, 552, 556, 575; two units of 597, 600, 605, 606, 650, 655, 656, 663; three units of 696b; three units of 696d, 909; six additional units of theatre history, dramatic theory, or criticism; and one unit of TAR 691. In lieu of a thesis, each student must present a monograph on the direction of a play, presented and prepared according to departmental guidelines.

**Design-Technical Production Option:** Emphases are available in scenic design, lighting design, costume design, costume production, and technical production. Degree requirements are TAR 600; three units of 600-level theatre history; three units of 600-level dramatic theory or criticism; and at least forty units of graduate-level design, technical production, and/or theatre workshop courses. Specific course requirements are detailed in the Department of Theatre Arts' Guide to Graduate Degree Programs. In lieu of a thesis, an original design or production project must be accomplished during the University Theatre season. This will be accompanied by a written document including renderings, photographs, working drawings, and other information describing the produced creative design. This document will not be considered to be a thesis but must be presented to the advisory committee upon completion of the design project and the final oral examination.

**Dramatic Writing Option:** The departmental graduate core curriculum is required for this option. The following pattern of courses is required: twenty-one units of dramatic writing; twelve units of theatre production; fifteen units of dramatic history/theory/criticism; three units of TAR 600; one-six units of TAR 693; and three units of TAR 909. The student must serve an internship with a professional company for a period of six to sixteen weeks. In lieu of a thesis, each student must write an acceptable master's project play prepared and presented according to departmental guidelines.

**MASTER OF LANDSCAPE ARCHITECTURE**

This is a graduate professional degree program emphasizing landscape ecology and socio-cultural and behavioral factors as well as landscape aesthetics and artistic principles in a variety of design, planning, and management applications. Students have an opportunity to work within interdisciplinary studios which explore broad cross-sections of outdoor environment types and scales. The context in which design and planning studios operate simulates the breadth of the profession to include wilderness, rural, urban, and historic landscapes. Special attention is given to the ecology, culture, and history of the arid Southwest. All M.L.A. students will be expected to develop computer skills to the current level of use within the profession.

Landscape Resources offers the Master of Landscape Architecture as both First and Second (advanced) Professional Degrees. Applicants with undergraduate degrees from design or planning disciplines are encouraged to apply for the Second Professional Degree program. All others are encouraged to apply for the First Professional Degree program. While both programs involve the investigation of new thoughts and applications which advance the art and science of landscape architecture, the First Professional Degree program intends to prepare persons to enter the field of landscape architecture and to practice as professional landscape architects. The Second Professional Degree is designed to provide opportunities for individual research and advanced study in the following subjects: design, planning, management of natural resources.

Although the Master of Landscape Architecture Degree requires a minimum of thirty units of credit, students should expect to exceed the minimum and be in residence for two to three years of full-time study. The First Professional Degree program consists of a three-year curriculum including six to nine units of thesis. The Second Professional Degree provides opportunity for an advanced, individualized program of study to include a thesis of six to nine units.

Curriculum information, admission requirements, and application materials are available from the Graduate Coordinator, School of Renewable Resources.

**MASTER OF MUSIC**

The School of Music offers programs leading to the Master of Music degree with majors in performance, composition, musicology, music education, and music theory. The programs are designed for those students whose professional and artistic goals warrant study beyond the bachelor's degree and who show continued growth in the field of music they have chosen. Applicants must have completed appropriate undergraduate majors. Deficiencies may be established if the applicant's undergraduate preparation is inadequate for graduate study at The University of Arizona.

**Major in Performance**

Applicants are admitted through a screening process that requires audition by personal interview or tape recording. Concentrations are offered in vocal performance, instrumental performance, conducting, and accompanying. The program requires a minimum of thirty graduate units and culminates in the performance of a public recital (two recitals for accompanying majors).  

**Major in Composition**

Applicants submit a minimum of three reproduced manuscript scores (with tape recordings whenever possible) for evaluation by the composition faculty. If admitted, students must complete a minimum of thirty graduate units including twelve in advanced composition studies. An original composition is required as a thesis. A public recital of original compositions is required to complete the degree.

**Major in Musicology**

This major requires a minimum of thirty graduate units of which at least twelve must be in musicology. A thesis is required, as is a reading knowledge of French or German.
Master of Teaching

Applicants for master’s degree programs in music education must qualify for teacher certification prior to completion of the degree. The program requires a minimum of thirty graduate units, with no more than six units of credit in special workshops. The degree culminates in a major project which demonstrates individual accomplishment of a creative, pedagogical, musical, or scholarly nature.

Major in Music Theory

This major requires a minimum of thirty graduate units of which at least twelve must be in music theory. A thesis is required.

MASTER OF PUBLIC ADMINISTRATION

The M.P.A. degree program is designed to prepare men and women for positions of administrative leadership in public sector and nonprofit organizations, as well as private organizations dealing with the public sector. Graduates may expect to pursue management or policy making concerns in a wide variety of settings within organizations at local, state, national and international levels.

The M.P.A. degree is a two-year, fifty-four-unit program, divided into four segments of study. The first segment is a twenty-seven-unit public administration core taken by all students. The courses in this segment are:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA 501</td>
<td>Public Organization Theory</td>
</tr>
<tr>
<td>PA 503</td>
<td>Politics and the Policy Process</td>
</tr>
<tr>
<td>ECON 500</td>
<td>Managerial Economics</td>
</tr>
<tr>
<td>MKTG 552</td>
<td>Statistical Decision Making</td>
</tr>
<tr>
<td>PA 504</td>
<td>Public and Policy Economics</td>
</tr>
<tr>
<td>PA 505</td>
<td>Methods for Policy Analysis and Program Evaluation</td>
</tr>
<tr>
<td>MAP/PA 502</td>
<td>Organization Theory and Behavioral Relations</td>
</tr>
<tr>
<td>PA 507</td>
<td>Institutional Action</td>
</tr>
<tr>
<td>PA 508</td>
<td>Public and Nonprofit Financial Management</td>
</tr>
</tbody>
</table>

The second segment consists of nine units in either management or policy courses. The management stream offers additional training for students wishing to pursue managerial or administrative careers. The policy stream offers additional training for those interested in careers in policy and program analysis.

The third segment is a twelve-unit specialization in a substantive area of study. Specializations include health policy and administration, criminal justice policy and administration, public and nonprofit financial management, social policy, and natural resource policy.

Finally, a six-unit internship is required.

For admission consideration, applicants must submit a superior undergraduate record and an acceptable score on the Graduate Record Examination or the Graduate Management Admissions Test. Applicants must be competent in basic finite mathematics and calculus. Students with a mathematics deficiency must complete PA 400 before the first semester of graduate study.

MASTER OF PUBLIC HEALTH

The Master of Public Health is a professional interdisciplinary degree in public health. Students bring a wide variety of backgrounds to the program, ranging from bachelors degrees to masters and doctorates in related fields. The Master of Public Health degree program prepares graduates to solve public health problems as practitioners who can apply a breadth of understanding as well as their expertise and experience in one specific area of public health, and as researchers who can develop new approaches within the field of public health. The degree requires a minimum of thirty-three units including a minimum of three units of internship. Students must complete fifteen units of specified core courses and an appropriate number of units in one of ten concentrations. For additional information on degree requirements, see “Public Health” in the Departments and Courses of Instruction section of this catalog.

MASTER OF TEACHING

The graduate programs leading to the Master of Teaching degree are intended for persons currently engaged in teaching or in other appropriate programs of training and development. The two majors available are elementary education and secondary education. At the time the catalog was being edited, revisions to the Master of Teaching program in the College of Education were being considered. All current or prospective students should check with the College of Education or the Department of Teaching and Teacher Education for information regarding the status and requirements of all programs and degrees.
REQUIREMENTS FOR SPECIALIST DEGREES

EDUCATIONAL SPECIALIST

Upon acceptance by the Graduate College, candidates for the degree of Educational Specialist are admitted by the faculty of the College of Education. The degree is granted to those who comply with the General Regulations set forth in this catalog and who satisfactorily complete the program requirements as specified by the departments offering this degree.

Admission

All prospective students should check with the appropriate department in the College of Education for information regarding the admission requirements of all programs leading to the Educational Specialist degree.

Qualifying Examination

To demonstrate acceptability to undertake work leading to candidacy for the degree, each applicant must pass a qualifying examination before or during the first term of work on an Educational Specialist program. An applicant's acceptability for work toward the degree will be judged on the basis of this examination.

Time Limitations

Requirements for the Educational Specialist degree shall be completed within a period of six calendar years after satisfactory completion of the qualifying examination. Students who are able to demonstrate to the satisfaction of the qualifying examination committee that they have kept abreast of current developments in their areas of study may have prior course work taken for graduate credit while in a graduate degree program accepted at full value to the extent this course work is relevant to the Educational Specialist program being proposed. No more than twelve units taken as an unclassified or nondegree graduate student, however, may be applied toward requirements for the Educational Specialist degree. If in the judgment of the examining committee, the applicant does not demonstrate possession of knowledge and concepts that prior course work would tend to suggest, relevant course work over six years old may be reduced to half credit on the proposed program of studies and such course work over ten years old may be rejected.

Advisory Committee

After successfully passing the qualifying examination, the student may request that the head of the major department appoint an advisory committee of three members from the department. With the concurrence of the head of another department, one of the committee members may be from that department. The chairperson of the committee will be the student's advisor. The duties of the committee are: (1) to evaluate the student's proposed program of study; (2) to make recommendations regarding the program to the Dean of the Graduate College through the appropriate department head, and (3) to be available to the student for advice as needed.

Program of Study

A program of study, recommended by the department head, shall be designed, in cooperation with the Advisory Council, to meet the needs of the individual student as determined by previous academic work, experience, interests, and career objectives. Please see the appropriate department in the College of Education for information on program requirements.

Final Examination

When the student has completed all course work or is in the final semester of course work and has met the required standards of scholarship, he or she shall pass a comprehensive written examination covering the graduate work. An oral examination may also be required.

Professional Experience

Except for school psychology, candidates are required to furnish evidence of a minimum of two years of successful teaching or administrative experience as approved by the department concerned, before the degree will be awarded.


REQUIREMENTS FOR DOCTOR'S DEGREES

DOCTOR OF PHILOSOPHY

Departments which possess special advantages for original investigation accept prospective candidates for the degree of Doctor of Philosophy. This degree requires distinguished attainment in a recognized field of learning demonstrated in a dissertation which contributes to the general fund of knowledge. It is not granted merely as a certificate of faithful performance of a prescribed program of studies and research.

Residence and Credit Requirements

The equivalent of at least six semesters of essentially full-time graduate study is required. Graduate credit earned at other approved institutions, if accepted by the major department and the Graduate Council, may be counted toward the requirements for this degree.

To meet the minimum residence requirement, the student must spend two regular semesters of essentially full-time work in the major field in actual residence at The University of Arizona, and at least thirty units of graduate credit must be completed at this institution. Any semester during which a doctoral student in actual residence at The University of Arizona is registered for at least nine units of graduate course work or research will be counted toward meeting the residence requirement, provided that the student’s full time is devoted to his or her graduate work. (See next paragraph for the only exceptions to this general requirement.)

A student who proceeds directly, without a break in enrollment, from a master's degree to a doctoral degree in the same major, may be permitted to apply one or more semesters of full-time enrollment in the master’s program toward the residence requirement for the doctoral degree. If there is a change of major or a break in enrollment between the master’s degree and the doctoral degree, the residence requirement must be fulfilled again for the doctoral degree. Graduate assistants or graduate associates and students on appointment to any teaching or research position at the University can discharge the minimum residence requirement by four semesters during each of which they register for six or more units of work for graduate credit, provided their full time is devoted to the their graduate work and meeting the responsibilities of their appointments.

The dissertation requires the equivalent of at least two semesters of full-time work. Registration for a minimum of eighteen units of dissertation credit (920) is required during the conduct of the dissertation. With the prior approval of the student's advisor and the head of the academic unit, dissertation work may be done in absentia.

All requirements for the degree of Doctor of Philosophy, including work done for the master’s degree (if applicable), cannot exceed a period of ten years.

Major and Minor Subjects

The student shall choose a major subject and either one or two supporting minor subjects. Although the minor subject or subjects will usually be taken outside the major department, minors within the major department may be permitted with the approval of the department and the Graduate College. At least thirty-six units of work exclusive of the dissertation must be in the area of the major subject.

Qualifying Examination

For the purpose of demonstrating acceptability to undertake work leading to candidacy for the doctorate, each prospective candidate must pass a qualifying examination in the proposed major field. The examination is waived at the discretion of the department in a field in which the candidate has done major work toward a completed master’s degree at The University of Arizona. The examination should be taken during the first semester of residence and preferably during the first two weeks of residence. Many departments also require a qualifying examination in the minor field, but this may be waived at the option of the minor department.

Program of Study

A proposed program of study recommended by the department or departments concerned must conform to the requirements set forth in this catalog and those issued from time to time by the Graduate Council, including the general requirement that the required units be offered in 500-level or above, University credit courses, and that at least one half of the required units be offered in University graduate credit courses in which regular grades (A, B, C) have been earned. (For specific degree requirements, see the offering department in the Departments and Courses of Instruction section of this catalog.)

Foreign Language Requirement

Many departments have foreign language requirements for the Ph.D. degree. Doctoral students should ascertain from the department what the foreign language requirements are, if any, and how they may be satisfied.

Preliminary Examination

Before admission to candidacy for the degree, the student must pass a general examination in the chosen fields of study. This examination is intended to test the student's general fundamental knowledge of the fields of the major and minor subjects of study. It shall include written portions covering the major and minor fields and an oral portion which shall be conducted before a committee of the faculty appointed by the Dean of the Graduate College upon consultation with the major and minor department. The written and oral portions of the preliminary examination shall take place within two successive semesters, not including summer sessions. Deadlines for the submission of paperwork pertaining to the preliminary examination are available in the Degree Certification Office. The preliminary examination will be held when essentially all course work has been completed and in any case not later than three months prior to the date of the final oral examination. No student will be permitted a second attempt to pass the preliminary examination except upon recommendation of the examining committee, endorsed by the major department and approved by the Graduate Council. The second examination, if approved, may not take place until four months from the date of the first examination. The only visitors permitted at the preliminary examination are regular University faculty members.

Advancement to Candidacy

After satisfying any language requirements, passing the preliminary examination, and showing evidence of ability to do original research, the student will submit the Doctoral Application to Candidacy to the Graduate College. Upon acceptance of this form by the Graduate College, the student will be recommended to the Graduate Council for acceptance as a candidate for the doctorate. Deadlines for the submission of paperwork pertaining to the Doctoral Application to Candidacy are available in the Degree Certification Office.

Final Examination

When the required standards of scholarship have been met and research ability has been demonstrated, the candidate shall submit to an oral examination in defense of the dissertation, as
well as any general questioning which may develop therefrom related to the field of study. The exact time and place of this examination shall be scheduled with the Graduate College at least three weeks in advance and announced publicly at least one week in advance. The examination shall be open to the public. The committee shall be appointed by the Dean of the Graduate College in consultation with the major and minor departments.

Dissertation

Following the final examination, the Graduate College representative returns the Notice of Completion of Final Examination and Dissertation Requirements to the Degree Certification Office. The candidate submits two complete and signed copies of the dissertation, along with the approval pages and special abstract, to the Graduate College for delivery to the University Library. A processing fee must be paid to the University Cashier. The major department, at its option, may require an additional copy for the departmental files. A manual of instructions relating to the form of the dissertation may be obtained from the Associated Students’ Bookstore.

Publication of Dissertation

Ph.D. dissertations are published by University Microfilms, Ann Arbor, Michigan, and a fee is charged to cover this expense. Upon certification by the student’s major professor, members of the committee for the final examination, and the Graduate College, a dissertation copy and an abstract of 350 words or less are forwarded to University Microfilms. (This abstract is in addition to the two abstracts required for inclusion in the dissertation and must be carefully prepared for microfilming according to specifications set forth in the Dissertation Manual.) The manuscript is cataloged and microfilmed and the negative inspected and put in vault storage; the catalog information is sent to the Library of Congress for printing and distribution of cards for depository catalogs and libraries. The abstract is printed in Microfilm Abstracts and distributed to leading libraries in the United States and abroad, and to a selected list of journals and abstracting services. The copy is then returned to the University of Arizona Library.

Publication by microfilm does not preclude publication by other means, and successful candidates are urged to submit dissertation material for publication in a scholarly or professional journal. Suitable acknowledgment must always indicate the publication to be a dissertation, or portion of a dissertation, submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at The University of Arizona.

Other Examinations

Prior to the final examination and in addition to the preliminary examination and the regularly scheduled course examinations, the candidate may be required to take any other examinations, oral or written, deemed proper by the departments concerned.

DOCTOR OF EDUCATION

Through the Graduate College, the faculty of the College of Education accepts prospective candidates for the degree of Doctor of Education. The degree is granted only to those who demonstrate a high proficiency in education and who present an approved dissertation. (For the degree of Doctor of Philosophy, see above.)

All current and prospective students should check with the College of Education or the appropriate department for information regarding the status and requirements of all programs and degrees.

Residence and Credit Requirements

The equivalent of at least six semesters of essentially full-time graduate study, including work toward a master’s degree, is required. Graduate credit earned at other approved institutions, if accepted by the College of Education and the Graduate Council, may be counted toward the requirements for this degree.

To meet the minimum residence requirements, the student must spend at least two regular semesters of essentially full-time academic work in the program, beyond the master’s degree, in actual residence at The University of Arizona, and at least thirty-six units of graduate credit must be completed at this institution. Any semester during which a doctoral student in actual residence at The University of Arizona is registered for at least nine units of graduate coursework or research will be counted toward meeting the residence requirement, provided that the student’s full time is devoted to his or her graduate work. (See next paragraph for the only exceptions to this general requirement.)

A student who proceeds directly, without a break in enrollment, from a master’s degree to a doctoral degree in the same major, may be permitted to apply one or more semesters of full-time enrollment in the master’s program toward the residence requirement for the doctoral degree. If there is a change of major or a break in enrollment between the master’s degree and the doctoral degree, the residence requirement must be fulfilled again for the doctoral degree. Graduate assistants or graduate associates and students on appointment to any teaching or research position at the University can discharge the minimum residence requirement by four semesters during each of which they register for six or more units of work for graduate credit, provided their full time is devoted to their graduate work and meeting the responsibilities of their appointments.

The dissertation requires the equivalent of at least two semesters of full-time work. Registration for a minimum of eighteen units of dissertation credit (920) is required during the conduct of the dissertation, with a maximum of nine units during any regular semester. With the prior approval of the student’s advisor and the head of the academic unit, dissertation work may be done in absentia.

All requirements for the degree of Doctor of Education, including work done for the master’s degree (if applicable), cannot exceed a period of ten years.

Major and Minor Subjects

The student will major in educational administration; language, reading and culture; special education and rehabilitation; and teaching and teacher education. The student may minor either inside or outside the College of Education as approved by the advisors and department heads concerned and by the Graduate Council.

Qualifying Examination

To demonstrate acceptability to undertake work leading to candidacy for the doctorate, each applicant must pass a qualifying examination in the major field and in the proposed minor field. This examination must be taken in the first term of work beyond the master’s degree during which the student is in residence at The University of Arizona. The applicant’s acceptability for doctoral work will be judged on the basis of this examination. A qualifying examination in the minor field may be waived at the option of the department concerned.

Program of Study

A proposed program of study recommended by the department or departments concerned must conform to the requirements set forth in this catalog and those issued from time to time by the Graduate Council, including the general require-
ment that the units be offered in 500-level or above, University credit courses, and that at least one half of the required units be offered in University graduate credit courses in which regular grades (A, B, C) have been earned. (For specific degree requirements, see the offering department in the Departments and Courses of Instruction section of this catalog.)

Preliminary Examination
Before admission to candidacy for the degree, the student must pass a general examination in the chosen fields of study. This examination is intended to test the student's general fundamental knowledge of the fields of the major and minor subjects of study. It shall include written portions covering the major and minor fields and an oral portion which shall be conducted before a committee of the faculty appointed by the Dean of the Graduate College upon consultation with the major and minor academic units. The written and oral portions of the preliminary examination shall take place within two successive semesters, not including summer sessions. No later than three weeks prior to the proposed date of the examination, the Request to Schedule Preliminary Oral Examination must be filed with the Graduate College. The preliminary examination will be held when essentially all course work has been completed and in any case not later than three months prior to the date of the final oral examination. No student will be permitted a second attempt to pass the preliminary examination except upon recommendation of the examining committee, endorsed by the major department and approved by the Graduate Council. The second examination, if approved, may not take place until four months after the date of the first examination. The only visitors permitted at the preliminary examination are regular University faculty members.

Advancement to Candidacy
After passing the preliminary examination and giving evidence of ability to carry on professional studies at the highest level, the student will be recommended to the Graduate Council for acceptance as a candidate for the doctorate.

Final Examination
When the required standards of scholarship have been met and research ability has been demonstrated, the candidate shall submit to an oral examination in defense of the dissertation, as well as any general questioning related to his or her field of study which may develop therefrom. The exact time and place of this examination shall be scheduled with the Graduate College no later than three weeks in advance and announced publicly at least one week in advance. The examination shall be open to the public. The committee shall be appointed by the Dean of the Graduate College in consultation with the major and minor departments.

Dissertation
Following the examination, the Graduate College representative returns the Notice of Completion of Final Examination and Dissertation Requirements to the Degree Certification Office. The candidate submits two complete and signed copies of the dissertation, along with the approval pages and special abstract, to the Graduate College for delivery to the University Library. A processing fee must be paid to the University Cashier. The College of Education requires two additional copies of the dissertation, one for the College of Education files and one for the dissertation director. A manual of instructions relating to the form of the dissertation may be obtained from the Associated Students’ Bookstore.

Publication of Dissertation
Dissertations are published by University Microfilms Incorporated, Ann Arbor, Michigan, and a fee is charged to cover this expense. Upon certification by the student's major professor, members of the committee for the final examination, and the Graduate College, a copy and an abstract of no more than 350 words are forwarded to University Microfilms. (This abstract is in addition to the two abstracts required for inclusion in the dissertation and must be carefully prepared for microfilming according to specifications set forth in the Dissertation Manual.) The manuscript is microfilmed and the negative inspected and put in vault storage. The manuscript is cataloged and the catalog information sent to the Library of Congress for printing and distribution of cards to depository catalogs and libraries. The abstract is included in the forthcoming issue of Microfilm Abstrats, which is distributed to leading libraries here and abroad, and to a selected list of journals and abstracting services. The first copy is then returned to the University of Arizona Library.

Publication by microfilm does not preclude publication by other methods, and successful candidates are urged to submit dissertation material for publication in a scholarly or professional journal. Suitable acknowledgment must always indicate the publication to be a dissertation or portion of a dissertation, submitted in partial fulfillment of the requirements for the degree of Doctor of Education at The University of Arizona.

DOCTOR OF MUSICAL ARTS
The School of Music, through the Graduate College, accepts prospective candidates for the degree of Doctor of Musical Arts. The degree is granted in the fields of composition, conducting, and performance. It is not granted merely as a certificate of general performance of a prescribed program of studies but requires demonstration of distinguished attainment. Information about the Doctor of Philosophy degree with a major in music theory or music education will be found under "Music" in this catalog.

Preliminary admission to the program is recommended by appropriate School of Music faculty members and the Director of Graduate Studies in Music. Before a recommendation can be made, the applicant must file an application for admission to the Graduate College and must forward transcripts of all previous college work to the Dean of the Graduate College. Performers and conductors must submit a tape recording and/or have a personal audition with the area faculty concerned. Applicants for a major in composition must submit scores and tapes of their own works in performance.

Residence and Credit Requirements
The equivalent of at least six semesters of essentially full-time graduate study is required. Graduate credit earned at other approved institutions, if accepted by the School of Music and the Graduate Council, may be counted toward the requirements for this degree.

To meet the minimum residence requirement, the student must spend three semesters or the equivalent of essentially full-time academic work in the Doctor of Musical Arts program in actual residence at The University of Arizona, and at least thirty units of graduate credit must be completed at this institution. Any semester during which a student is registered for at least nine units of graduate course work or research will be counted toward meeting the residence requirement, provided that the student's full time is devoted to graduate work. (See next paragraph for the only exceptions to this general requirement.)

A student who proceeds directly, without a break in enrollment, from a master's degree to a doctoral degree in the same major, may be permitted to apply one or more semesters of full-time
enrollment in the master's program toward the residence requirement for the doctoral degree. If there is a change of major or a break in enrollment between the master's degree and the doctoral degree, the residence requirement must be fulfilled again for the doctoral degree. Graduate assistants or graduate associates and students on appointment to any teaching or research position at the University can discharge the minimum residence requirement by four semesters during each of which they register for six or more units of work for graduate credit, provided their full time is devoted to their graduate work and meeting the responsibilities of their appointments.

At the beginning of the first semester of enrollment, diagnostic examinations in music history and music theory must be taken if not already completed.

All requirements for the Doctor of Musical Arts degree, including work done for the master's degree (if applicable), cannot exceed a period of ten years.

**Major and Minor Subjects**

The student will major in conducting, composition, or performance, and choose a minor subject in another area of music or in a department other than music if approved in the candidate's program of study.

**Qualifying Examination**

For the purpose of demonstrating acceptability to undertake work leading to candidacy for the Doctor of Musical Arts degree, each applicant must pass a qualifying examination in the proposed major field and minor fields and in other related areas. The minor examination may be waived at the option of the department concerned. In order to make the most effective use of the results of the examination in establishing the student's course of study, the examinations should be taken during the first semester in residence. In addition, a personal interview, a review of the applicant's college record and musical achievement, and evidence of an ability to write in a clear and precise manner are required.

**Advisory Committee**

The Director of Graduate Studies in Music, upon the recommendation of the School of Music Graduate Committee, will appoint an advisory committee representing the major and minor fields of study for each candidate. The chairperson will be the student's major professor.

**Program of Study**

A proposed program of study recommended by the School of Music and any other department concerned must conform to the requirements set forth in this catalog and those issued from time to time by the Graduate Council, including the general requirement that the units be offered in 500-level or above, University credit courses, and that at least one half of the required units be offered in University graduate credit courses in which regular grades (A, B, C) have been earned. (For specific degree requirements, consult the paragraphs on the specific requirements for the majors in composition, conducting, and performance at the end of this section.)

**Preliminary Examination**

Before admission to candidacy for the degree, the student must pass a general examination in the chosen fields of study. This examination is intended to test the student's general fundamental knowledge of the fields of the major and minor subjects of study. It shall include written portions covering the major and minor fields and an oral portion which shall be conducted before a committee of the faculty appointed by the Dean of the Graduate College upon consultation with the major and minor departments. The written and oral portions of the preliminary examination shall take place within two successive semesters, not including summer sessions. No later than three weeks prior to the proposed date of the examination, the Request to Schedule Preliminary Oral Examination must be filed with the Graduate College. The preliminary examination will be held when essentially all course work has been completed and in any case not later than three months prior to the date of the final oral examination. No student will be permitted a second attempt to pass the preliminary examination except upon recommendation of the examining committee, endorsed by the major faculty and approved by the Graduate Council. The second examination, if approved, may not take place until four months from the date of the first examination. The only visitors permitted at the preliminary examination are regular University faculty members.

**Advancement to Candidacy**

After satisfying any written and oral portions of the preliminary examination and giving evidence of ability to carry on professional studies at the highest level, the student will submit the Doctoral Application to Candidacy to the Graduate College. Upon acceptance of this form by the Graduate College, the student will be recommended to the Graduate Council for acceptance as a candidate for the degree of Doctor of Musical Arts.

**Final Examination**

When the required standards of scholarship have been met, the candidate shall submit to an oral examination including any general questioning related to the field of study. The exact time and place of this examination shall be scheduled with the Graduate College at least three weeks in advance and announced publicly at least one week in advance. The examination shall be open to the public. The committee shall be appointed by the Dean of the Graduate College in consultation with the School of Music.

**Specific Requirements for the Major in Composition**

Approval of a major in composition will be based upon evidence of creative talent and a knowledge of craftsmanship in writing music.

In lieu of a dissertation, the candidate will compose a major work of approximately thirty minutes duration. Registration for a minimum of eighteen units of dissertation credit (920) is required during the preparation of the composition. Following the final examination, the Graduate College Representative returns the Notice of Completion of Final Examination and Dissertation Requirements to the Degree Certification Office. The candidate submits two complete and signed copies of the composition (approved and accepted by the School of Music and all members of the examining committee), together with approval pages and special abstract, for delivery to the University Library. The abstract addresses the formal, stylistic, and technical elements of the composition. The School of Music, at its option, may require an additional copy for its files. Regulations governing publication of the composition are the same as those governing publication of a Ph.D. dissertation. A processing fee must be paid to the University Cashier.

In addition to the composition of an extended work, a recital consisting of the candidate's compositions in several forms and a variety of media must be presented.

**Specific Requirements for the Major in Conducting**

Requirements are the same as for Performance majors (see below), except that conductors generally fulfill each recital.
requirement (except the lecture recital) through several performances with major university ensembles. Conductors work in a secondary conducting area for the second recital. Following the final examination, the Graduate College Representative returns the Notice of Completion of Final Examination and Dissertation Requirements to the Degree Certification Office. The candidate submits two complete and signed unbound copies of the lecture document (approved and accepted by the School of Music and all members of the examining committee) to the Graduate College for delivery to the University Library. A processing fee must be paid to the University Cashier.

Specific Requirements for the Major in Performance
In lieu of a dissertation, the candidate must present the following four recitals: (1) a qualifying recital during the first semester in residence (2) a program of vocal and/or instrumental chamber music, (3) a solo recital, and (4) a lecture-recital (must follow a successful preliminary examination). No more than one recital is permitted per semester. Registration for eighteen units of doctoral recital credit (925) is required during the preparation of the recitals, with a maximum of nine units during any regular semester.

The four recitals must include representative literature from all major periods. Each recital will be evaluated independently by the student's advisory committee and area faculty. Should the candidate's performance be judged unsatisfactory, an additional recital composed of different literature must be performed. In no case will a candidate be permitted to remain in the program should more than one recital be determined unsatisfactory.

The candidate will prepare and submit a formal document in connection with the lecture-recital. This document, based on some aspect of performance or performance practice, must show evidence of the candidate's ability to select and organize data pertinent to the study. The document should be an original contribution to the field of knowledge in the candidate's chosen subject area, and should demonstrate the candidate's ability to communicate effectively in writing. Following a successful final oral examination, the candidate will submit one bound copy of the Lecture Recital Document to the University Music Library for placement in its permanent collection. The candidate will submit two complete and signed unbound copies of the document (approved and accepted by the School of Music and all members of the examination committee) to the Graduate College for delivery to the University Library. A processing fee must be paid to the University Cashier.
36
DEPARTMENTS AND COURSES OF INSTRUCTION

COURSE LISTING INFORMATION

CURRICULAR CHANGE—Course listings in the following departmental sections are subject to change. Curriculum changes approved during the first year of the catalog's biennium are listed in the Supplement to the University of Arizona Catalog, published approximately one year after publication of the biennial catalog. A copy of this publication is available upon request from the University Curriculum Office.

CLASS SCHEDULES—To confirm or identify the semester of offering for any course, students should consult the Schedule of Classes for each term. Schedules for fall and spring classes are available in April and October, respectively. The Summer Session Schedule of Classes is available in February.

PREREQUISITES—Students must meet the course prerequisites or otherwise satisfy the instructor of their preparation to take the course. Prerequisites can be waived only at the discretion of the instructor or department involved.

CANCELLATION OF COURSES—The University reserves the right to cancel courses not elected by an adequate number of students.

COURSE NUMBERING CLASSIFICATION SYSTEM

The number by which a course is designated indicates the level of the course. Courses are numbered as follows:

- 500-599: Graduate courses.
- 600-699: Graduate courses. Not open to undergraduate students.
- 700-799: Graduate courses limited to doctoral students.
- 800-899: Courses limited to students working toward degrees offered by the College of Medicine or the College of Pharmacy. Not available for credit toward other degrees.

*Certain 400- and 500-level courses with the same number and title may be counted jointly. Students may receive credit for such courses only once, whether jointly counted or separately, unless designated [Rpt.] or unless special approval is granted by the student's major advisor.

Semester Courses (Single Numbers)
A course designated by a single number (as ECON 560) is one semester in length.

Year Courses (Double Numbers)
A course designated by a double number (as POL 610a-610b) is continued through two successive semesters, the work of the first semester being prerequisite to that of the second unless otherwise indicated in the statement of prerequisites.

HOW TO READ COURSE DESCRIPTIONS

Following is a standard course description with the individual symbols explained in the order in which they appear in the description.

Sample Course Listing:

506. Social Structure in Modern Societies (3) [Rpt.] I 1993-94
GRD Critical review of modern theory and research on social structure and social organization in modern societies. 2R, 3L. P, 6 units of sociology or CR. (Identical with HIST 506) Smith

Explanation:

506.—Course number.
Social Structure in Modern Societies—Course title.
(3)—Number of units.
[Rpt.] — May be repeated for credit. A restriction regarding the number of times a course may be repeated for credit (beyond the student's first enrollment) or the total number of units of credit permitted for a course may be designated. [Rpt.] indicates that the course may be repeated for credit once, for a total of two enrollments. [Rpt./2] indicates that the course may be repeated for credit twice, for a maximum of three enrollments in the course; [Rpt./6 units] means that the course may be repeated until the student has received a total of 6 units of credit. It is the student's responsibility to ensure that course content is not duplicated.

I—Semester in which the course is usually offered. I indicates fall semester; II, spring; S, summer. To ascertain course offerings for a particular semester, consult the Schedule of Classes.

1993-94—Year in which course is offered. If no year designation is given, the course is offered each year.

Critical review...societies—Course description.

2R, 3L—Class structure. R, L, S, and D indicate “recitation,” “laboratory,” “studio,” and “discussion.” 2R, 3L indicates that the class meets for two hours of recitation and three hours of laboratory per week (based upon 15 weeks). For courses consisting of recitation (lecture) periods only, the number of class hours per week is the same as the unit value and is not specified in the course listing.

In addition to the above abbreviations for class structure, the College of Engineering and Mines uses the abbreviations ED and ES to designate the number of units in the areas of “engineering design” and “engineering science.” Thus 1ED, 2ES signifies that the course meets the requirement for 1 unit of engineering design and 2 units of engineering science.

P—Prerequisites. Identifies courses or other experiences which must be completed prior to enrolling in the course listed.

CR—Concurrent registration. Identifies courses which must be taken during the same term as the course listed.

(Identical with HIST 506)—Crosslisting. Identifies other departments which give credit for the same course. The complete course listing is shown in the course list of the “home” department which has instructional responsibility for the course. An abbreviated listing appears in the course list of the “crosslisting” department. Exceptions are house-numbered courses, which do not have course descriptions.

Smith—Professor in charge.

Note: Some course descriptions do not contain all of the elements described above.

UNIVERSITY-WIDE “HOUSE-NUMBERED” COURSES

Most University of Arizona courses use a combination of lectures, discussions, and laboratories as their basic teaching format. University-wide “house-numbered” courses identify alternative teaching formats which emphasize student participation, typically in small group or individual settings. Small-group courses are identified by numbers ending in 95, 96, or 97. The area of study for such courses is indicated through a subscript and subtitle. Individual-studies courses are those with numbers ending in 91, 93, 94, 98, and 99, as well as all 900-level courses. Under their generic numbers and titles, and without subscripts, they are available for use by all departments at the course-number levels appropriate to the departments’ academic programs.
Small Group Courses
595, 695, 795. Colloquium (Credit varies) The exchange of scholarly information and/or secondary research, usually in a small group setting. Instruction often includes lectures by several different persons. Research projects may or may not be required of course registrants. 
Grades Available: A, B, C, D, E, I, S/P*, W.

596, 696, 796. Seminar (Credit varies) The development and exchange of scholarly information, usually in a small group setting. The scope of work shall consist of research by course registrants, with the exchange of the results of such research through discussion, reports, and/or papers. 
Grades Available: A, B, C, D, E, I, S/P*, W.

597, 697, 797. Workshop (Credit varies) The practical application of theoretical learning within a group setting and involving an exchange of ideas and practical methods, skills, and principles.
Grades Available: A, B, C, D, E, I, W.

*Special (i.e., S,P,C,D,E) or regular grades may be used as departmental policy dictates; however, in any single course offering, all registrants must be graded by the same system.

Individual Studies
591, 691, 791. Preceptorship (Credit varies) Specialized work on an individual basis, consisting of instruction and practice in actual service in a department, program, or discipline. Teaching formats may include seminars, in-depth studies, laboratory work, and patient study.
Grades Available: S/P, C, D, E, I, W.

593, 693, 793. Internship (Credit varies) Specialized work on an individual basis consisting of training and practice in actual service in a technical, business, or governmental establishment. 
Grades Available: S/P, C, D, E, I, W.

593. Legislative Internship (9) II Working experience at the Arizona State Legislature; responsibilities draw upon student's area of major expertise and include preparing written and oral reports, summarizing legislative proposals, and providing information to legislators and legislative committees. Participating programs include but are not limited to: architecture, economics, English, geography and regional development, history, hydrology, journalism, management, management information systems, marketing, political science, psychology, public administration, secondary education, sociology, statistics, and urban planning. Students in other programs are eligible and should consult the department head or, in the case of the College of Law, the dean, for appropriate arrangements.
Grades Available: A, B, C, D, E, I, W.

594, 694, 794. Practicum (Credit varies) The practical application, on an individual basis, of previously studied theory and the collection of data for future theoretical interpretation. 
Grades Available: S/P, C, D, E, I, W.

599, 699, 799.* Independent Study (Credit varies) Qualified students working on an individual basis with professors who have agreed to supervise such work. 
Grades Available: S/P, C, D, E, I, W.

900. Research (Credit varies) Individual research, not related to thesis or dissertation preparation, by graduate students. 
Grades Available: S/P, C, D, E, I, W.

908. Case Studies (Credit varies) Individual study of a particular case, or report thereof. 
Grades Available: S/P, E, K, W.

909. Master's Report (Credit varies) Individual study or special project or formal report thereof submitted in lieu of thesis for certain master's degrees. 
Grades Available: S/P, E, K, W.

910. Thesis (Credit varies) Research for the master's thesis (whether library research, laboratory or field observation or research, artistic creation, or thesis writing). Maximum total credit permitted varies with the major department. 
Grades Available: S/P, E, K, W.

915. Master's Recitals (Credit varies) For master's students in performance. 
Grades Available: S/P, E, K, W.

920. Dissertation (1 to 9) Research for the doctoral dissertation (whether library research, laboratory or field observation or research, artistic creation, or dissertation writing). 
Grades Available: S/P, E, K, W.

925. Doctoral Recitals (1 to 9) For doctoral students in music performance. 
Grades Available: S/P, E, K, W.

930. Supplementary Registration (1 to 9) For students who have completed all course requirements for their advanced degree programs. May be used concurrently with other enrollments to bring to total number of units to the required minimum. 
Grade Available: K.

*Graduate students doing independent work which cannot be classified as actual research will register for credit under course number 599, 699, or 799.
Faculty Lists
The listing of faculty which precedes the departmental course offerings identifies tenured and tenure-track faculty members appointed for the 1994-95 academic year, as well as emeritus faculty and academic professionals who are approved for directing graduate student research. A department designation in parentheses following a faculty member’s name identifies the department in which the primary appointment is held. These designations appear only in cases of multiple appointments. For identification of Regents’ Professors as well as the complete listing of tenured and tenure-track faculty, consult the last section of this catalog.

Courses
Permanent graduate-level courses offered by The University of Arizona are listed on the following pages by department or committee in alphabetical order. For a complete listing of courses offered, see The University of Arizona General Catalog.

Accounting (ACCT)
McClelland Hall, Room 301
(520) 621-2620; FAX: (520) 621-3742
Professors Dan S. Dhaliwal, head, William B. Barrett, William L. Felix, Jr., William S. Waller
Associate Professors Ashiq Ali, Jeffrey W. Schatzberg
Assistant Professors Leslie Eldenberg, Sanjay Kallapur, W. Dana Northcut, Galen R. Sevcik, Brian P. Shapiro, Mark A. Trombley, Cynthia C. Vines, Shiing-wu Wang
The department offers a program leading to the Master of Accounting degree with a major in accounting. The department also participates in programs leading to the Master of Business Administration (major in business administration), Master of Public Administration (major in public administration), and Doctor of Philosophy (major in management) degrees. For information concerning these degrees, see Requirements for Master’s Degrees/Master of Business Administration, Master of Public Administration and see also Business Administration and Management and Policy headnotes elsewhere in this catalog.

500a-500b. Intermediate Financial Accounting (3-3) I II Theory and methodology involved in contemporary accounting for assets, liabilities, stockholders’ equity, net income, and funds; analysis and interpretation of financial statements. Credit allowed for this course or 400a-400b, but not for both. P, 450. Open to MBA candidates only.

522.* Advanced Federal Taxation (3) I II Introduction to advanced topics: taxation of corporations and stockholders’ transactions in stocks; taxation of partnerships and fiduciaries; gift and estate taxation. Credit allowed for this course or 422, but not for both. P, 420/520.

525.* Issues in Accounting and Taxation (3) I Professional discussion of current issues such as estate and income tax, financial planning, IRS audits, bankruptcy, accounting developments, and accounting in business formation. Credit allowed for this course or 425, but not both. P, 420/520.


529.* International Corporate Taxation (3) I Concepts of U.S. taxation of international transactions, including rules for sourcing income and allocating deductions and such fundamental multistate concepts as nexus, unitary taxes, and apportionment. Credit allowed for this course or 429, but not for both. P, 422/522 or permission of instructor.

531.* Principles of Auditing (3) I II The opinion formulation process of the professional auditor; the auditor’s reports, professional standards, internal and operational auditing. Credit allowed for this course or 431, but not both. P, 400b/500b. Open to MBA candidates only.

533. Seminar in Auditing (3) I II Analysis and discussion of current topics in auditing. P, 431 or 531.

550. Financial Accounting (3) I II Principles and procedures underlying basic financial accounting processes and their application in the preparation and analysis of financial statements. Advanced degree credit available for nonmajors only. Open to MBA candidates only.

551.* Principles of Financial Planning and Control (3) I II Examination of the value of managerial accounting in organizational decision-making and control, addressing specific managerial accounting problems and their solution. P, 310 or 550. Credit for this or 410, but not for both.

552.* Principles of Federal Taxation (3) I II Principles of federal income taxation, with emphasis on how individuals are taxed; additional topics. Credit allowed for this course or 420, but not for both. P, 550. Open to MBA candidates only.


Aerospace and Mechanical Engineering (AME)
AME Building, Room 301
(520) 621-2235; FAX: (520) 621-8191
Associate Professors Ara Arabyan, Cholik Chan, Edward J. Kerschen, Erdogan Madenci, Alfonso Ortega
Assistant Professors Younggang Huang, Jeffrey W. Jacobs, Karl Ousterhout, K.R. Sridhar
The department offers programs leading to the Master of Science and Doctor of Philosophy degrees with a major in aerospace engineering or in mechanical engineering. Students in either major may select one of the following interdisciplinary options: biomedical engineering, energy systems engineering, materials engineering, or reliability engineering. For information concerning these options see Engineering elsewhere in this catalog.
A Bachelor of Science degree from an aerospace or a mechanical engineering curriculum of a recognized institution of higher education is required of applicants to the graduate program. In general, a grade average of "B" or better in previous academic work is expected. Graduates from other engineering, mathematics, and physical sciences curricula may be admitted provisionally. All applicants must submit scores from the Graduate Record Examination general test.

Master of Science: All students are required to complete 32 units of graduate work, including two units of 696. All students are required to complete 500a and 500b and core courses in one fundamental area. These are dynamics and control systems, fluid mechanics, solid mechanics, and thermal sciences. A student may elect to present a master's thesis (six units of 910), a master's report (three units of 909), or complete a course work option. No more than three units of independent study are allowed for the course work option. No independent study units are allowed for the thesis or report options. All students are expected to attend the weekly graduate seminar. A final examination is required. Specific departmental M.S. degree requirements and exam procedures are described in the departmental Graduate Program booklet.

Doctor of Philosophy: All students are required to complete a minimum of 54 units of graduate course work (including 30 units, other than 696, earned for the M.S. degree), 18 units of 920 dissertation, and 3 units of 696. Each student must pass the qualifying examination. After completing all or nearly all the required course work, the preliminary examination may be scheduled. The preliminary examination on the major field is taken after the student has passed the examination on the minor field. Minor fields may be chosen from other engineering, physical sciences, or mathematics departments. A final oral examination including thesis defense is required. Doctoral students are expected to attend the weekly graduate seminar. In order to obtain the last unit of 696, all degree candidates are required to present a departmental seminar on their research during the last year in residence. Specific departmental Ph.D. degree requirements and exam procedures are described in the departmental Graduate Program booklet.


520.* Aircraft Conceptual Design (3) I Student groups develop conceptual designs for aircraft with specified performance and figures of merit. Design issues include program organization, configuration, aerodynamics, weights, and performance. Design groups develop computer flight simulators to evaluate performance. P, 320, 321, 323.


522.* Aerospace Engineering Design (3) II Application of engineering fundamentals, including structural analysis, structural vibrations, aero-elasticity and finite element methods to aerospace vehicle design project. 3ED. P, 420 or CR, 324, 425.


524.* Introduction to Space Technologies (3) I The space environment: vacuum, microgravity, radiation(s), free molecule flow and drag on bodies. Resource utilization in deep space. Introduction to orbital mechanics. Space transportation, spacecraft thermal design, automation and robotics, communications, space power, space structures. P, 523, 324; CR, 425, 455.


528.* Space Mission Conceptual Design (3) II Introduction to space mission design and modern tools available to aid the designer. Includes brief case histories of some of the more successful space missions and design of a mission. 3ED. P, 474.

530. Advanced Thermodynamics (3) II Reversible and irreversible macroscopic thermodynamics; selected engineering applications. P, 230, 331a.

531.* Numerical Methods in Fluid Mechanics and Heat Transfer (3) I Development of numerical techniques for the solution of ordinary and partial differential equations that arise in heat transfer and fluid mechanics; classification of equations, methods of solutions, examples. 3ES; P, 302, 331a.

532. Convective Transport Phenomena (3) I Convective energy, mass and momentum transfer; internal and external flow; exact, approximate and numerical solutions; application to current problems. P, 432; CR, 500a, computer programming ability.


534. Radiative Heat Transfer (3) I 1995-96 Fundamentals of radiative heat transfer; radiative properties of materials; gray-body and spectral exchange between surfaces; participating media; radiation combined with conduction and convection. Intended for students with strong interests in heat transfer, combustion, and applications such as energy conversion systems, materials processing, and space technology. P, 432.

536a-536b. Fundamentals of Fluid Mechanics (3-3) 536a: I Fundamental equations of motions; surface tension; kinematics of vorticity; integral solutions; irrotational flows; simple viscous flows. P, 500a. 536b: II Small-disturbance inviscid theory; low Reynolds number flow; vorticity dynamics; boundary layers. P, 500b.

537. Fluid Mechanics of Viscous Flows (3) I 1995-96 Behavior of viscous fluids over a range of Reynolds numbers; Navier-Stokes equations; boundary layer equations; slow flow; compressible boundary layers. P, 536b.

538. Nature of Turbulent Shear Flow (3) I 1996-97 Physical phenomena in turbulent shear flows; experimental techniques; observations and physical consequences; prediction methods; recent advances. P, 500b, 536a-536b.


540.* Energy Utilization and Management (3) I (Identical with NEE 540)

541. Industrial Energy and Power Management (3) I (Identical with NEE 541)

542.* HVAC System Design (3) II (Identical with NEE 542)

545.* Solar Energy Engineering (3) I (Identical with NEE 545)

547.* Direct Energy Conversion (3) II (Identical with NEE 547)


553. Computational Multibody Dynamics (3) I Computational methods in multibody dynamics; Euler parameters; automatic generation and numerical methods in solving equations; kinematics, application in vehicle dynamics, spacecraft, and robotics. P, MATH 254, knowledge of kinematics, dynamics and numerical methods.


556.* Control of Manufacturing Processes (3) I Modeling and control of manufacturing processes; mathematical modeling of manu-
facturing processes including metal forming, turning, milling and welding; review of classical control methods; introduction to nonlinear control systems analysis and simulation; analysis, design and applications of digital control systems; robotics; hardware and software issues; computer simulations. 1.5ES. P, 250, 300, 412a, 455.


561. Finite Element Analysis in Structural Mechanics (3) II 1996-97 Advanced problems in structural analysis using the finite element method; analysis of complex systems; dynamics, composite structures and material systems; program development. P, 461.


563. Finite Element Analysis in Nonlinear Solid Mechanics (3) I 1996-97 Finite element methods, including material nonlinearity (elastic, plastic, viscoelastic); geometric nonlinearity (finite deformations), numerical solution methods, and nonlinear programs. P, 461.

564. Biomechanical Engineering (3) II 1996-97 One subject covered yearly from: biomechanical-solid mechanics (orthopedic, vascular, muscle, skin); feedback control (physiological systems); heat transfer, thermodynamics (temperature regulation, hyperthermia, instrumentation). 3ES. P, 302, 330, 331b, 410.


572. Reliability Engineering (3) I Time-to-failure, failure-rate, and reliability determination for early, useful and wear-out lives; equipment reliability prediction; spare parts provisioning; reliability growth; reliability allocation. CR, 474 or EE 330.


575. Reliability Testing (3) II Mean-time-between-failure and reliability confidence limits; sequential testing; sampling; accelerated, sudden-death, suspended-items, non-parametric, and Bayesian testing. P, 472.

576. Advanced Probabilistic Design (3) II Advanced methods for mechanical and structural reliability analysis; system reliability analysis, random loading models, applications to fatigue, fracture, buckling, creep, etc. P, 473.

577. Maintainability Engineering (3) II Extension of 572; complex systems reliability; maintainability engineering; reliability and availability of maintained systems; operational readiness; system effectiveness; maintainability demonstration. P, 472.

May be repeated with 400-level course.


632. Advanced Topics in Heat Transfer (3) II 1995-96 Topics will depend on instructor(s). Possible topics include linear and nonlinear convective stability, turbulent convective heat transfer, advanced analytical and numerical methods in heat transfer, boiling and condensation, multiphase flow, and heat transfer phenomena. P, 500a-500b, 532, 536a-536b.


955. Colloquium a. Research Conference (1) I II g. Graduate Seminar (1) I II [Rpt.]

Agricultural and Biosystems Engineering (ABE)

Shantz Building, Room 403
(520) 621-1607; FAX: (520) 621-3963

Professors Donald C. Slack, Head, Delmar (520) 621-1607; FAX: (520) 621-3963
Shantz Building, Room 403

Delmar (520) 621-1607; FAX: (520) 621-3963
Shantz Building, Room 403

Agricultural and Biosystems Engineering-Agricultural and Biosystems Engineering 41

Assistant Professors Christopher Choi, Joel Cuello, Peter Waller
Superintendent, Maricopa Agricultural Center, Robert Roth
Research Professor Theodor Strelkoff
Principal Research Specialist Jeffrey Stone
Assistant Specialist Edward Martin

The department offers graduate work leading to the Master of Science and Doctor of Philosophy degrees with a major in agricultural and biosystems engineering.

Opportunities for study and research in several areas of concentration exist, including the following: irrigation and water resources management and development; bioresources and biochemical engineering with emphasis on biotechnology developments; energy issues and alternatives; biosystems analysis and design; waste management and water quality control; soil, water, plant relationships; micropollution, environmental control, and materials handling in agribiosystems production; and applications of sensors; control systems; computer applications, including digital imaging, computer vision, artificial intelligence, and multispectral analysis; robotics; and emerging technologies in these areas.

Students with adequate undergraduate preparation in engineering will be considered for admission to a degree program.

A thesis is normally required of students in the Master of Science program, but the requirement may be waived for a student who is the senior author of a manuscript published or accepted for publication in a refereed professional journal.


506. Applied Hydraulics (3) I Fundamentals of hydraulics applicable to the irrigation of agricultural lands, including fluid properties, hydrostatics, irrigation flow characteristics, open channel and pipeline applications, and measurement of flowing water. Not for ABE majors. P, MATH 118, 123 or 125a, PHYS 102a. Yitayew

508. Environmental Simulation (3) II Introduction to the usage of mathematical tools and techniques to analyze physical, chemical, and biological components of the environment. P, MATH 123 or 124a. Rasmussen


515. Agri-biosystems Process Engineering (3) II 1995-96 Application of the principles of
heat transfer, thermodynamics, psychrometrics, and fluid flow to the development and solution of simulation of 1) soil temperature and moisture distribution; 2) radiation balances of plants and ventilated greenhouses, and 3) photosynthesis and transpiration. 2R, 3L. P, A ME 230. Jordan

516. Simulation of Biological Systems (3) S Fundamental differential equations of plant systems are solved using analog computer methodology. Analysis of soil temperature and moisture, mulched systems, plant growth, and greenhouses. Environments are simulated using dynamic digital programs, CSMP and ACSL. Parameters of radiation, heat, and moisture transfer, CO2 and unique soil properties are utilized to provide realistic simulation of cyclic conditions. P, knowledge of computer programming.

523. Agricultural Systems Analysis and Design (3) II 1996-97 Application of systems analysis to environmental and biologically related problems; computer modeling and use of operations research methods. P, STAT 361. Larson


555. Irrigation Engineering (3) II Introduction to soil and water relationships, irrigation systems, irrigation water supply, and irrigation management; basic designs. P, C E 321 or A ME 331a. (Identical with C E 555) Yitayew


557. Irrigation Engineering Laboratory (1) II Data acquisition and analysis pertinent to the design and evaluation of irrigation systems. 3L. Field trip. CR 455. Walker

558. Drainage of Irrigated Lands (3) 1995-96 II Origin and nature of drainage problems in arid lands; drainage theories, investigations, and design for irrigated agriculture. Field trip. P, C E 321 or A ME 331a. (Identical with C E 558) Walker


563. Energy from Biomass (3) II Biomass energy sources; collection and processing methods; thermal anaerobic digestion and fermentation conversion processes, energetic, economic, and environmental issues. P, A ME 230. (Identical with NEE 563) Larson


566. Pressurized Irrigation Systems (3) II 1996-97 Analysis of design and operating criteria for sprinkler and trickle or drip irrigation systems, hydraulics of sprinklers and emitters, hydraulics of pipe systems. P, 456. Yitayew

696. Seminar
   a. Agricultural and Biosystems Engineering (1) [Rpt./8] I II Slack

Agricultural and Resource Economics (AREC)

Economics Building, Room 208 (520) 621-6241; FAX: (520) 621-6250

Professors Bruce R. Beattie, Head, Robert C. Angus (Emeritus), Bartley P. Cardon (Emeritus), Dennis C. Cory, Robert S. Finch (Emeritus), Roger W. Fox, Jeremy S. Hillman (Emeritus), Robert D. Innes, Maurice M. Kelso (Emeritus), Robert O. Kuehl, Jeffrey T. LaFrance, William B. Lord, William E. Martin (Emeritus), Eric A. Monke, Richard T. Newcomb, Lester D. Taylor, Paul N. Wilson

Associate Professors Bonnie C. Colby, Roger A. Dahlgran, Gary D. Thompson Assistant Professor Satheesh V. Aradhyula Adjunct Professor Harry Ayer Research Scientist Edwin H. Carpenter Assistant Research Scientist Mark W. Langworthy Specialist Russell L. Gum Assistant Specialists Julie Leones, Russell Tronstad

The department offers a program leading to the Master of Science degree with a major in agricultural and resource economics. A broad spectrum of agricultural economics subject matter is presented by the department, with special emphasis given to the economics of natural resources. In cooperation with the Department of Economics, work is also offered leading to the Doctor of Philosophy with a major in economics with emphases in international agricultural economic development and natural resource economics.

Students in the Master of Science degree program have a choice between thesis and nonthesis programs. Students completing a thesis are required to complete a minimum of 30 semester units which may include up to six units of credit for thesis research. Students completing the nonthesis option must complete 33 semester units.

504. Production Economics (3) I Theory of the firm and industry; single and multiple products; risk and uncertainty. P, MATH 123, ECON 242 or 361. (Identical with ECON 504) Aradhyula

512. Economic Policy in Developing Countries (3) II The role of policies in economic growth and development. The impact of commodity factor market and macroeconomic policies on economic incentives. (Identical with AR L 512 and ECON 512) Monke


514. Cost-Benefit Analysis (3) II Theoretical bases and empirical techniques, with emphasis on LDCs. Consumer-producer surplus; social and private costs; macroeconomic distortions; non-market goods; uses in policy analysis. (Identical with ECON 514) Monke

515. Operations Research in Applied Economics (3) II Application of linear, nonlinear, and multiple objective programming, decision theory, and simulation to problems of agricultural production, marketing, policy, and natural resource use. P, ECON 123. (Identical with ECON 515) Thompson

516. Agricultural Development (3) [Rpt./11] I Microeconomic analysis of agriculture in developing economies, focusing on factors affecting production decisions of small farmers, including adoption of new technologies. Interrelationships between agricultural activities and household consumption patterns also will be discussed. P, ECON 300 or 361. (Identical with ECON 516) Langworthy

540. Design and Analysis of Experiments (3) II Statistical principles of research design for experimental and observational studies; introduction to the linear statistical model for analysis of data from research studies, including techniques for complete block and incomplete block designs; factorial experiments; covariates and polynomial response functions. P, STAT 509. Kuehl

549. Applied Econometric Analysis (3) II (Identical with ECON 549) Dahlgran

550. Agricultural Finance (3) I Applying business and economic theory to problems confronting agribusiness firms in the acquisition, allocation, control, and transfer of capital resources. P, ECON 300 or 361 and 3 units of accounting. Wilson

571. Problems in Regional Development (3) I II (Identical with GEOG 571)

575. Economics of Natural Resource Policy (3) II Theory and application of economic concepts needed to evaluate resource laws and policies; including welfare economics, externalities, public goods, and valuation methodologies. Case studies focus on the American West and include federal and state environmental, water, land, and wildlife policies. P, ECON 300 or 361. (Identical with AR L 575, ECON 575 and RNR 575) Colby

577. Advanced Topics in the Economics of Environmental Regulation (3) II Advanced economic theory of environmental policy. Topics include regulation of air and water pollution under imperfect competition, imperfect information, costly enforcement, uncertainty, and the use of alternative regulatory instruments. P. ECON 361, MATH 123. (Identical with ECON 577, HWR 577, and WS M 577) Innis

580. Mathematics for Economists (2) I Intensive course in essential mathematics for entering graduate students in the M.S. and Ph.D. programs in economics and agricultural and resource economics. Topics covered include matrix algebra, functions, limits, differentiation, comparative statics, and constrained and unconstrained optimization. (Identical with ECON 580) LaFrance

May be convened with 400-level course.

676. Economic Dynamics and Natural Resources (3) I I 1995-96 Course covers three topic areas: the mathematical structure of dynamic optimization problems; the economics of exhaustible resource use; and the economics of renewable resource use. The methods part of the course treats both discrete and continuous time as well as deterministic and uncertain environments. Relationships between the methods of Lagrange, dynamic programming, optimal control, the calculus of variations, and the Hamilton-Jacobi approach are covered. The sections on natural resource use apply these tools to the classical economic problems of natural resource allocation and exploitation. P. graduate student standing with one year of graduate microeconomics theory. (Identical with ECON 676) LaFrance

696. Seminar g. Interstate Conflict Resolution (3) [Rpt.] II (Identical with SIE 696g)

Agricultural Education (A ED)
Forbes Building, Room 224
(520) 621-1523; FAX: (520) 621-9889
Professors Roger T. Huber, Head, Clinton O. Jacobs (Emeritus), Floyd G. McCormick (Emeritus), Kenneth S. Olson, Phillip R. Zurbrick (Emeritus)
Associate Professors David E. Cox, Glen M. Miller, Assistant Professor John F. Elliott

The department offers programs leading to the Master of Science and the Master of Agricultural Education degrees with a major in agricultural education.

Degrees

Master of Science: The program requires the completion of at least twenty units in agriculture and agricultural education. Supporting course work shall be in plant sciences, animal sciences, entomology, soil and water sciences, environmental sciences, agricultural and resource economics, renewable natural resources, agricultural and biosystems engineering, educational administration, higher education, teaching and teacher education, or in other disciplines appropriate to teaching, extension, or similar educational work. Thirty units, including a thesis (for which a maximum of six units may be earned), must be completed.

Master of Agricultural Education: For information concerning this degree see Requirements for Masters' Degrees/Master of Agricultural Education elsewhere in this catalog.

505.* Environmental Topics in Agricultural Education (2) I A synthesis of environmental concerns within a "systems" approach of understanding their relationship in agriculture.

522.* Communicating Knowledge in Agriculture (3) I Principles and processes of knowledge diffusion and methods of transferring appropriate technology to user/clientele groups. Communicating effectively within organizations. (Identical with AGTM 522)

539.* Non-Formal Education (3) I Characteristic and scope of non-formal education. Principles and application of non-formal education methods to diffuse knowledge in extension, adult, and continuing education settings. (Identical with HE E 539)

640. International Extension Education (3) II 1995-96 Critical evaluation of case histories of international extension education models, and integration of successful components into composite models based on cultural, political, and educational situations typically encountered in developing countries.


585.* Teaching Psychomotor Skills in Laboratory Sciences (2) II Methods and procedures in teaching psychomotor operational skills; conducting demonstrations; providing for student and teacher safety; sequencing skills activities; providing and organizing facilities, including micro-teaching demonstrations. 1R, 3L.

585. Teaching Psychomotor Skills in Laboratory Sciences (4) I Methods and procedures in teaching psychomotor operational skills; conducting demonstrations; providing for student and teacher safety; sequencing skills activities; providing and organizing facilities, including micro-teaching demonstrations. 1R, 3L.

597. Workshop a. Utilizing Occupational Experience Program (1) [Rpt./3] I II b. Developing Youth Leadership (1) [Rpt./3] I II c. Administration, Management, and Supervision of Non-Formal Education (1) [Rpt./3] I I (Identical with HE E 597d) d. Continuing Education in Agriculture (1) [Rpt./3] I II e. Program Planning and Evaluation (1-3) [Rpt./3] I II f. Computer Application in Agricultural and Non-Formal Education (1) [Rpt./3] I I (Identical with HE E 597g) g. Environmental Education Issues in Agriculture (1) [Rpt./3] I I (Identical with HE E 597h) h. Developments in Non-Formal Education (1) [Rpt./3] I I (Identical with HE E 597i) *May be convened with 400-level course.

601. Advanced Agricultural Education Methods (3) [Rpt./3] I II Problems in organizing and conducting programs of instruction in vocational and extension education. P. 8 units of a ED or education.

615. Investigations and Studies in Agricultural Education (3) I Study and analysis of research literature, methods, techniques and procedures for conducting investigations; selecting a problem and developing plans for a study.

641. Research Project Design and Implementation (3) II Principles and practices of selecting, developing and analyzing research instruments; analyzing and interpreting both quantitative and qualitative data research in agricultural and extension education including the use of the computer. P. 615.

621. Program Planning and Evaluation (3) II Developing and evaluating programs in agricultural teaching and extension; situation analysis, objectives, policies, content, procedures, and evaluative criteria. P. 6 units of agricultural education.

638. Teaching College Level Agriculture (2) I Analysis and preparation for improving effectiveness of teaching college level agriculture, including instructional objectives and strategies; content organization; and evaluation of learning experiences.

Agriculture
Forbes Building, Room 201 (520) 621-3612

Within the College of Agriculture, programs are offered leading to the Master of Science (M.S.), Master of Agricultural Education (M.Ag.Ed.), Master of Home Economics Education (M.H.E.E.), Master of Landscape Architecture (M.L.Arch.), and Doctor of Philosophy (Ph.D.) degrees as indicated in the following list of departments and majors:

Agricultural and Resource Economics
agricultural and resource economics ............................................. M.S.

Agricultural Education
agricultural education ................................................................. M.S. / M.Ag.Ed.

Agricultural and Biosystems Engineering
agricultural and biosystems engineering ........................................ M.S. / Ph.D.

Animal Sciences
animal sciences ................................................................. M.S. / Ph.D.

Entomology
entomology ................................................................. M.S. / Ph.D.

Family and Consumer Resources
family and consumer resources .............................................. M.S. / M.Ed. / Ph.D.

Home Economics
home economics education .................................................. M.S. / M.H.E.E.

Nutrition and Food Science
dietetics ................................................................. M.S.

food science ................................................................. M.S.

nutritional sciences ................................................................. M.S. / Ph.D.

Plant Pathology
plant pathology ................................................................. M.S. / Ph.D.

Plant Sciences
Plant Science ................................................................. M.S. / Ph.D.

Renewable Natural Resources
landscape architecture .................................................. M.L.Arch.

range management ................................................................. M.S. / Ph.D.
In special cases, an undergraduate field of concentration different from but related to the intended graduate major may be admissible.

Students with a special interest in genetics are referred to Genetics elsewhere in this catalog. For further information concerning any of the programs listed above, see the appropriate departmental headnotes and also see Requirements for Graduate Degrees elsewhere in this catalog.

The Agricultural Experiment Station offers the graduate student in agriculture an opportunity to participate in current research programs. The student may be assigned to a staff member of the Agricultural Experiment Station, under whose direction the research necessary to the writing of an acceptable thesis or dissertation is conducted. Residence credit may be earned for certain graduate courses offered at University facilities away from the Tucson campus.

American Indian Studies (AINS)
Harvill, Room 430
(520) 621-7108; FAX: (520) 621-7952

Graduate Interdisciplinary Program in American Indian Studies
Committee:
Professors Joseph (Jay) H. Stauss (Family and Consumer Resources), Director, Barbara A. Babcock (English), James W. Clarke (Political Science), Lawrence J. Evers (English), N. Scott Momaday (English), J. Jefferson Reid (Anthropology), Robert Williams, Jr. (Law)
Associate Professors Thomas M. Holm, Jennie R. Joe (Family and Community Medicine), Tsianina Lomawaima, Alice S. Paul (Teaching and Teacher Education), Ofelia Zepeda (Linguistics)
Assistant Professors Willem DeReuse (Anthropology), Teresa L. McCarty, Michelle Taigue, Octaviana Trujillo David E. Wilkins (Political Science), Mary Willie (Linguistics)
Assistant Research Social Scientist Mary Jo Fox

The American Indian Studies graduate interdisciplinary program offers opportunities for advanced study in the following concentrations: American Indian law and policy; American Indian societies and culture; American Indian languages and literatures.

Graduates of the program have assumed leadership roles with tribes, federal, or other governmental agencies, pursued a Ph.D. or J.D., or followed their own itinerary or scholarly pursuits.

Master of Arts (with a major in American Indian studies): 30 units, plus a 6 unit thesis. AINS 596F Seminar (1) is required each semester a student is enrolled. Each student completes 12 units in a field of concentration approved by the Committee. The student works closely with three faculty advisors to develop a challenging individual program. In addition to the thesis, a final master's examination is required.

The American Indian Studies Program also offers a non-thesis option. Contact the director or graduate coordinator for option requirements.

The American Indian Studies Program also offers a minor for Ph.D. students in related study areas. Contact the director or graduate coordinator for Ph.D. minor requirements.

Applicants must submit three letters of recommendation, two writing samples, and the personal and academic data called for on the American Indian Studies application form.

Applicants are also invited to submit vitae, published articles, or other materials relevant to admission.

502a-502b. Dynamics of Indian Societies (3-3) Philosophies, institutions, and characteristics of tribal life in North America. 502a: American Indian lifestyles prior to European contact. 502b: Impact of European immigration on tribal groups of North America. (Identical with ANTH 502a-502b)

513.* Ethnology of the Southwest (3) II (Identical with ANTH 513)
516.* Contemporary Indian America (3) (Identical with ANTH 516)
523.* Anthropology of Rural Mexico (3) (Identical with ENGL 545a-545b)
524.* Studies in Southwest Literature (3) II (Identical with ENGL 545a-545b)
530.* The Anthropology of Visual Art (3) II (Identical with ANTH 530)
545a-545b.* Structure of a Non-Western Language (3-3) [Rpt./2] (Identical with LING 545a-545b)
549a-549b.* Folklore (3-3) (Identical with ENGL 549a-549b)
577.* American Indian Literature (3) (Identical with ENGL 577)
578.* American Indians and the Supreme Court (3) (Identical with POL 578)
582.* Hopi Language in Culture (3) II (Identical with ANTH 582)
584a-584b. Development of Federal Indian Policy (3-3) (Identical with POL 584a-584b)
587a-587b.* Race and Public Policy (3-3) [Rpt./2] (Identical with POL 587a-587b)
589.* Areal Survey of Native North American Languages (3) [Rpt./4] (Identical with ANTH 589)
590.* Indian Religions and Spirituality (3) (Identical with ANTH 590)

Animal Sciences (AN S)
Shantz Building, Room 205
(520) 621-7623; FAX: (520) 621-9435


Associate Professors Sue K. DeNise, Vincent Guerrero, William A. Schurg, Mark E. Wise

Assistant Professor Parker Antin

Dairy Extension Specialist Dennis V. Armstrong

Livestock Assistant Extension Specialist Robert M. Kattig

The department offers programs leading to the Master of Science and Doctor of Philosophy degrees with a major in animal sciences. Areas of study include nutrition of beef and dairy cattle, reproduction and breeding, genetics, muscle growth, development and function, meat science, and effects of heat on animal performance.

Departmental faculty also participate in interdisciplinary graduate committees on genetics, nutritional sciences, and physiological sciences in offering the Ph.D. degree.

Applicants are expected to submit a detailed statement of professional goals, three letters of recommendation from persons who are in a position to predict the applicant's potential as a graduate student, and scores from the Graduate Record Exam (GRE). In addition to the regular portion of the examination (quantitative, analytical, and verbal), advanced examinations in either biology or chemistry are recommended but not required.
Degrees

Master of Science: Admission to the M.S. program depends on completion of a bachelor’s degree with a major in animal, biological, chemical, or physical sciences. Undergraduate preparation must include 3 units of college-level algebra (MATH 117R/S or equivalent; calculus recommended); one year each of general biology and organic chemistry (laboratories in each recommended); and one upper-division course in animal behavior, animal biotechnology, animal growth, animal physiology, animal nutrition, meat science and muscle biology, animal production/management, or meat/dairy products. In addition, depending on the selected area of study, at least one course from the following will be required: anatomy, physiology, advanced animal breeding and genetics, advanced cellular and molecular biology, animal endocrinology and physiology, analytical chemistry, biochemistry, calculus, organic chemistry laboratories, physics, or statistics. Students transferring to The University of Arizona with graduate credits from other universities can petition to apply those graduate credits to the major in this program; however, only graded courses are acceptable.

A minimum of 30 graduate units are required for the degree. At least one-half of the required units must be in courses in which regular grades (A, B, C) have been earned. Students must complete three units of statistics, three units of biochemistry, three units of physiology, and two units of seminar (AN S 596). Additional requirements for completion of the degree will be determined by the major professor and graduate advisory committee.

Doctor of Philosophy: Students are usually admitted to the Ph.D. program after completing the master’s degree. Either a B.S. degree or B.A. with a Master’s degree with a major in animal, biological, chemical, or physical sciences is recommended. The M.S. requirement may be waived for unusually well qualified candidates.

Courses required for admission include: one semester (3 units) each of biochemistry, general physiology, and statistical methods; one year (8 units) each of organic chemistry with laboratory. An applicant may have a limited number of deficiencies which must be completed in the first year of study. Students with M.S. degrees from other universities are encouraged to apply; students transferring to The University of Arizona with graduate credits from other universities can petition to apply those graduate credits to the major in this program, but only graded courses are acceptable.

At least 36 units of graduate credit exclusive of dissertation credits are required for the major. Students must meet the minimum requirements established for the master’s degree with a major in animal sciences. Additional required graduate credit units are three units of statistical design; three units of biochemistry; two units of animal growth, endocrinology, or physiology; and two units of seminar (AN S 596). At least 9 units of graduate courses, depending upon the requirements of the minor department, are required for the minor. A minimum of 18 units of dissertation is required. A maximum of 10 units of individual studies (599, 699, 900) plus seminar credits will be allowed toward the Ph.D. requirements. Additional requirements for completion of the degree will be determined by the major professor and student’s graduate advisory committee, but must include a minimum of 6 units from at least two of the following: AN S 501, 513, 585, 609, 622, 635, 636, 637, 684, 687.

501. Animal Growth and Development (II) 1996-97 Growth and development of domestic animals with emphasis on skeletal muscle, bone, and adipose tissue growth from the cellular level to the whole animal. P, BIOC 460 or 462a.

513. Quantitative Genetics (I) 1996-97 Theory of quantitative genetics including idealized populations, forces that change gene frequency, breeding systems, and estimation of genetic parameters in a population. P, 6 units of genetics. (Identical with GENE 513)

520. Pathways and Signals in Cells (II) (Identical with BIOC 520)

535. Biotechnology in Animal Sciences (III) 1996-97 Survey of current recombinant DNA technology and principles. Topics include: vectors and hosts, enzymes used in molecular cloning, DNA sequencing, site-directed mutagenesis, expression systems and polymerase chain reaction. P, BIOC 460 or 462a.


556.* Developmental Biology (II) 1996-97 Analyzes principles of development using vertebrate and invertebrate model systems. P, MCB 181. (Identical with CBA 556 and MCB 556)

585. Domestic Animal Endocrinology (III) 1996-97 Endocrine regulation of growth, metabolism and reproduction of domestic farm animals. P, 3 units of biochemistry.

596. Seminar
a. Animal Sciences (I) [Rpt./3 units] I II

*May be convened with 400-level course.

609. Nutritional Biochemistry Techniques (II) (Identical with N SC 609)

612. Biological Electron Microscopy (I) (Identical with MCB 612)

615. Chemistry and Metabolism of Lipids (II) 1995-96 (Identical with N SC 615)

622. Mineral Metabolism (II) 1995-96 (Identical with N SC 622)

635. Ruminant Nutrition (I) Recent findings in ruminant nutrition; the physiochemical processes of digestion and absorption; importance and metabolism of rumen microflora; normal metabolism and abnormal metabolic disorders; modes of action of feed stimulants. P, 330, 336; CHEM 241a, 243a.


665. Analysis and Purification of Proteins (I) 1995-96 Principles and procedures for analyzing, purifying, and characterizing proteins and amino acids from cells or from cDNA expression systems. P, BIOC 462a preferred, BIOC 460 acceptable. (Identical with BIOC 665 and N SC 665)


687. Environmental Physiology of Domestic Animals (III) 1995-96 Physiological, behavioral and anatomical responses of domestic animals to their environment with emphasis on adaptive mechanisms. P, 413, 415R, 430, 3 units of general physiology/anatomy.

696. Seminar
a. Animal Sciences (I) [Rpt./3 units] I II

Anthropology (ANTH)

Anthropology Building, Room 210 (520) 621-2585; FAX: (520) 621-2088


Associate Professors Thomas K. Park, Richard A. Thompson, Brackette F. Williams

Assistant Professors Ana Alonso, Willem de Reuse, David J. Killick, Stephen L. Kuhn, Barbara J. Mills, Daniel Nugent, Mary C. Stiner
The department offers programs leading to the Master of Arts and Doctor of Philosophy degrees with a major in anthropology. Concentrations are available in archaeology, biological anthropology, cultural anthropology, or linguistic anthropology. In addition to official transcripts, each applicant is required to submit scores on the aptitude test of the Graduate Record Examination taken within the last five years, a detailed statement of professional goals, and two letters of recommendation from instructors who are in a position to predict the applicant's potential as a graduate student.

**Degrees**

**Master of Arts:** A master's thesis or master's report is required. A minimum of 12 units in anthropology core courses and 18 units in supporting work must be completed. Supporting courses may be chosen from within the department or from American Indian studies, anatomy, arid lands, comparative cultural and literary studies, ecology and evolutionary biology, epidemiology, genetics, geosciences, linguistics, secondary education, southwestern studies, or women's studies. Specific course requirements for programs in applied anthropology, culture, science and technology, forensic anthropology, and medical anthropology are listed in literature available from departmental advisors.

**Doctor of Philosophy:** The major consists of 36 or more units of course work plus the dissertation. The minor may be taken within the department, in which case it consists of 15 or more units. Minors in other graduate programs at the University also are available; students should consult with the appropriate program advisor. Special requirements include reading knowledge of a foreign language and a working knowledge of modern statistical methods.

**Related research opportunities:** The Bureau of Applied Research in Anthropology (BARA), a division of the Department of Anthropology, is a unit dedicated to research and instruction in the area of applied anthropology. It carries out a wide-ranging agenda of applied research related to culture change, urban and rural living, gender, agricultural development, technological innovation, policy analysis, learning and education, cultural preservation, and environmental change. Extensive archaeological, ethnological, and osteological collections are available in the Arizona State Museum; internship opportunities in museology also are available. Field training in archaeological techniques is offered on both the graduate and undergraduate levels at the University of Arizona Archaeological Field School, which is operated jointly by the department and the Arizona State Museum. A specialization in culture and technology is offered in cooperation with the Program in Culture, Science, and Technology. The Laboratories of Tree-Ring Research, Isotope Geochemistry, and Paleoenvironmental Studies, provide opportunities for climatic and chronological studies of special interest to advanced students in archaeology. Programs in public health, nutritional sciences, and genetics as well as the Laboratory of Molecular Systematics and Evolution provide research opportunities for advanced students in biological anthropology. A joint program in linguistic anthropology and linguistics leading to the Ph.D. is offered in collaboration with the Department of Linguistics.

**The minor in anthropology:** Students majoring in other doctoral programs at The University of Arizona who elect a minor in anthropology must complete 15 hours of course work. Students who contemplate such a minor should consult at an early date with the graduate advisor in anthropology to develop a plan of study.

**502a-502b. Dynamics of Indian Societies (3-3)** (Identical with AINS 502a-502b)

**503. Anthropology of Conflict Resolution (3)** Decision making, conflict, and violence from a cross-cultural perspective, aiming to build both understanding of conflict processes and skills for managing and resolving them.

**506. Gender and Social Identity (3)** An analysis of the social and cultural construction of gender across cultures. Emphasis will be on preindustrial societies, using data to test theories of gender.

**509. Economic Anthropology (3)** Analysis of production, exchange, distribution, consumption, property, economic surplus, inheritance, and types of economic structure. P, 200, or 12 units of economics. (Identical with LA S 509)

**510. Ceramic Ethnoarchaeology (3)** Using ethnoarchaeological and ethnographic case studies from diverse geographical areas, the course examines relationships between ceramics and a range of matters traditionally of interest to archaeologists.

**511. Anthropology of Religion (3)** Comparative approaches to the study of religion; systems of ritual and symbolization in the primitive world; shamanism and possession; religious movements; religion in the modern world.

**512. Peasants and Peasant Societies (3)** Comparison of approaches to analyzing the peasantry. Special concern with peasant political mobilization and consciousness.

**513. Ethnology of the Southwest (3)** Cultural history and economic, social, and religious institutions of the living people of the Southwest. P, 200. (Identical with AINS 513)

**514. Late Quaternary Geology (3)** (Identical with GEO5 514)

**515. Cultural Ecology of Agrarian Societies in the Middle East (3)** Emphasis is on land tenure, Islamic law, irrigation and agricultural development in the central Middle East, Nile valley, North Africa, and the Sahel from the Middle Ages to the present.

**516. Contemporary Indian America (3)** The historical development and contemporary significance of the life of the Native American of the United States. (Identical with AINS 516)

**517. Cultures of Ancient Mexico (3)** Archaeological and ethnohistoric survey of the civilizations of ancient Mexico from earliest times to the period of the Spanish Conquest. Field trips. (Identical with LA S 517)

**519. Psychological Anthropology (3)** Cultural emphasis and experiences as basic shaping forces in personal development and emotion. Topics include psychoanalysis and anthropology, gender and sexuality, childhood, grief and mourning, dreaming, psychopathology. P, 102, 200.

**520. Contemporary American Culture (3)** Diverse perspectives on American values as expressed in organization of kinship, space, bureaucracy, media, social classes, ethnic groups, religious sects and movements.


**522a-522c. Pre-Hispanic Art (3-3)** (Identical with AR H 522a-522c)

**523. Anthropology of Rural Mexico (3)** Historical and cultural background, and contemporary economic, political and social organization of indigenous and non-indigenous groups in rural Mexico. Primarily concerned with the people of the countryside and the Mexican revolution.

**524. Theoretical Population Genetics (3)** (Identical with ECOL 524)

**525. Language Variation (3)** (Identical with LING 525)

**527a. The Prehistory of East Asia (3)** The origins and subsequent development of prehistoric cultures in Japan, Korea, Mongolia, Siberia and Southeast Asia. Broad concepts such as cultural change and environmental adaptation are stressed in order to draw parallels among these geographically and culturally diverse regions. P, 101. (Identical with EAS 527a)

**527b. The Archaeology of Pre-Han China (3)** The origin and florescence of Chinese culture and civilization from an archaeological perspective. An in-depth survey of Chinese prehistory and early history from the early Pleistocene to the third century BC. 527a is not a prerequisite for 527b. P, 101; consult department before enrolling. (Identical with CHN 527b)

**528. Near East Pastoral Nomads and Arid Lands Hunter-Gatherers (3)** A rigorous introduction to pastoral nomads and hunter-gatherers with a focus on arid lands.

**530. The Anthropology of Visual Art (3)** An introduction to the anthropology of visual art and the interdisciplinary methodology and techniques of studying art and aesthetics cross-culturally as sociocultural phenomena. P, 200. (Identical with AINS 530)

**532. Peoples of the Pacific (3)** I II Populations and cultures of Polynesia, Micronesia, and Melanesia; variability of these "natural laboratories" settings in an ecological framework.
583. Quaternary Palynology (4) II (Identical with GEOS 581)

582.* Hopi Language in Culture (3) II A conversational introduction to Third Mesa dialect of Hopi, with emphasis on cultural context and covering essentials of Hopi language structure. (Identical with AINS 582)

583. Sociolinguistics (3) I 1996-97 Contributions of the ethnography of communication, language variation studies, and conversation/discourse analysis to the interdisciplinary development of sociolinguistics. (Identical with LING 583)

585.* Social Organization of India and Pakistan (3) I (Identical with NES 585)

588. Healing Systems in the Southwest (3) I II (Identical with NURS 588)

589.* Areal Survey of Native North American Languages (3) I The field of native North American linguistics; areal and genetic classifications; how the study of particular languages provides insights into theories of linguistic anthropology and general linguistics. P, ANT 114T or LING 101. (Identical with AINS 589 and LING 589)

590.* Women in Middle Eastern Society (3) I Middle Eastern society viewed from the perspective of women. Examines the extent to which formal definitions of women's nature and roles coincide with women's self-images and activities. (Identical with NES 590)

595. Colloquium

a. Latin American Studies Special Topics (3) [Rpt./1] (Identical with LA S 595d)

596. Seminar

a. Paleonthropology and Paleolithic Archaeology of Africa (3) II P, introductory and upper-division courses in archaeology and biological anthropology.

c. Dynamics of Human Subsistence (3) II

e. Pre-Columbian Art (3) [Rpt./4] I (Identical with AR H 596e)

*f. Ceramic Analysis (3) I II

h. *Experimental Archaeology (3) I

j. Issues in African Art History (3) [Rpt./12 units] I II (Identical with AR H 596j)

k. Risk and Society (3) [Rpt./6 units] I (Identical with GEOG 596k)

q. Near Eastern Archaeology (3) [Rpt.] I II (Identical with NES 596q)

r. Quaternary Geochronology (1-4) I II (Identical with GEOS 596r)

597. Workshop

a. Biological and Forensic Anthropology I (2) [Rpt.] I Consult department before enrolling.

b. Biological and Forensic Anthropology II (2) [Rpt.] II Consult department before enrolling.

c. *Densochronology (2) 3L (Identical with GEOS 597c)

*May be convened with 400-level course.

600. Survey of Cultural Anthropology (3) I Intensive introduction, overview, and synthesis of cultural anthropology.

605. Professional Ethics and Skills (3) II Treatment of a series of ethical issues that can arise in acquisition and dissemination of anthropological data; design and implementation of research through the construction of fundable research proposals; professional self-presentation. Course materials will represent the four sub-disciplines of anthropology.

606. Women's Health in the United States (3) II An examination of social, cultural and political-economic factors affecting women's health in historical and contemporary contexts in the U.S. Focus on anthropological and feminist perspectives. (Identical with W S 606)

607. Anthropological Research Methods and Design (3) I Survey of research designs, data collection methods, and data analysis used in ethnographic field research by sociocultural and medical anthropologists. Focus on practical skill acquisition.

608. History of Anthropological Theory (3) I Survey of the foundations of contemporary theory in the field of cultural anthropology.

613. Policy Making and Organizational Culture (3) II Examines the development, goals, techniques and practices of anthropology as a policy science.

620. Linguistic Field Techniques (3) 1995-96 Practice in asking linguistically informed and ethnographically sensitive questions in face-to-face interaction with a linguistic consultant; techniques of language data analysis and description.

631. Anthropology and Development (3) II The role of anthropology in interdisciplinary projects involving economic development and planned change on the national and international levels. (Identical with AR L 631 and LAS 631)

636. Foundations of Archaeological Interpretation (3) I Surveys the history of archaeological interpretation. Central concepts in archaeological method and theory are presented.

637. Archaeological Methodology (3) II Surveys the fundamental principles, methods, and techniques of archaeological analysis and inference from a multidisciplinary perspective.

642a-642b. Advanced Field Course in Archaeology (3-3) S Archaeological methods, theory, and field techniques. 642a: Three-week field excavation and survey. Fee. 642b: Three-week laboratory processing and analysis. Fee. Registration restricted. Contact department for application, which must be returned by April 1.

645. Early Civilizations (3) [Rpt./2] I II Comparative analysis of early civilizations from both the Old World and the New World, with emphasis on regularities in cultural development. P, 454, 457, OR 456a or 456b.

665. Survey of Biological Anthropology (3) II Modern biological anthropology including evolutionary theory, genetics, primate anatomy, human growth, adaptability, and demography.


674. The Impact of Modernization on the Third World (3) II Intensive study of specific theories and varieties of culture change. P, 6 units in cultural anthropology or consent of instructor.

675a-675b. Anthropology and International Health (3-3) 1994-95 675a: An intensive overview of the field of international health and anthropologists' contributions to it. Responses to biotechnology, primary health care and child survival, diseases and development; health care utilization patterns; world systems and multinational pharmaceutical industry; health care bureaucracies; interaction between traditional medicine and public health. 675b: Health transitions and the household production of health with emphasis on anthropological investigations of health within a broader development context. P, 536a.

679. Language and Ethnography (3) II 1996-97 Training in the use of ethnographic method in linguistic and cultural research where naturally occurring speech is data. Analysis of data from observation, tape recording and videotaping.

680. Survey of Linguistic Anthropology (3) II Major theoretical and methodological issues in linguistic analysis. Language as a cultural code, biological foundations, universals and typology, language and social reality, textual analysis.

695. Colloquium

a. Forensic Anthropology (2) [Rpt./6 units] II 2R, 1L. P or CR, 468 and 597b.

696. Seminar

a. Archaeology (1-3) [Rpt./3] I II

b. Cultural Anthropology (1-3) [Rpt./3] I II (Identical with AR L 696b and NES 696b)

c. Linguistic Anthropology (1-3) [Rpt./3] I II

d. Biological Anthropology (1-3) [Rpt./3] I II

g. Nutrition in a Biocultural Context (3) I (Identical with FCM 696g) Open to graduate and medical students only.

Applied Mathematics (APPL)

Mathematics Building, Room 414
(520) 621-4664; FAX: (520) 621-8322

Graduate Interdisciplinary Program in Applied Mathematics

Committee:

Professors Michael Tabor, Head (Applied Mathematics), David W. Arnett (Physics), Thomas F. Balsa (Aerospace and Mechanical Engineering), Harrison H. Barrett (Optical Sciences), Jim M. Cushing (Mathematics), William J. Dallas (Radiology), William G. Paris (Mathematics), Hermann Fasel (Aerospace and Mechanical Engineering), Hermann Flaschka (Mathematics), W. Martin Greenlee (Mathematics), William B. Hubbard (Lunar and Planetary Sciences), Bobby R. Hunt (Electrical and Computer Engineering), C. David Levermore (Mathematics), David O. Lomen (Mathematics), Pierre Meystre (Optical Sciences Center), Richard E. Michod (Ecology and Evolutionary Biology), Jerome V. Moloney (Mathematics), Donald E. Myers (Mathematics), Marcel F. Neuts (Systems and Industrial Engineering), Alan C. Newell (Mathematics), Adrian N. Patrasciou (Physics), William M. Schafer (Ecology and Evolutionary
addition, the program has a substantial body of affiliate members who are involved in research with a strong applied mathematics component and who are potential research advisors. The combined network of members and affiliate members creates an unusually broad base of interdisciplinary research opportunities in applied mathematics.

Arabic
(See Near Eastern Studies)

Architecture (ARCH)
Architecture Building, Room 104
(520) 621-6751; FAX: (520) 621-8700


The College of Architecture offers a program leading to the second professional degree, Master of Architecture. For information concerning this degree program, see Requirements for Master's Degrees/Master of Architecture elsewhere in this catalog.

501.* Emphasis Areas in Architecture (6) I
Nine studios emphasizing one of the following: desert architecture, interior architecture, design competition, design/build, technology and form, practice, and large-scale projects. Offerings are determined by faculty availability and all topics may not be offered each year. Other topics may be introduced. Fee. P. 270, 302.

502.* Topics in Architectural Design (6) Studio work emphasizing design of large buildings or building complexes in one of the following: building design, urban design, campus design, design competitions, computer-aided design. Offerings are limited by faculty availability and all topics may not be offered each year. Other topics may be introduced. Fee. P. 401.

503.* Solar Utilization in the Built Environment (3) I Survey of solar energy utilization principles, methods, and case studies focused upon building and site planning design.

504.* Architecture and Planning in Mexico (3) I Study of architectural development in Mexico during the prehispanic, Spanish colonial, and contemporary periods, with emphasis on design ideas from each period. (Identical with LA S 504)

512.* Publication Graphics (3) I Designing compositions of text and graphics, and preparing them for publication. Class produces annual Archalendar and other publications. P. 222, 301.

513.* Architecture and the Arid Region (2) I Studies of the relationship between architecture and the climatic characteristics of arid regions with emphasis on passive cooling techniques. P. 302.

514.* History of American Architecture (3) I Developments in American architecture from the colonial to the early modern period. P. 334 or permission of instructor. Open to non-majors.

522.* Urban Communication (3) [Rpt. /6 units] II Study of design communication in urban settings including perception, way finding, and systems of signage. Class project of a specific urban area required. P. 222, 301.

524.* Modern Architecture (3) II Study of recent architectural developments throughout the world, focusing on the personalities, theories, and issues influencing built form since 1945. P. 334.

532.* Video and Media in Design Communication (3) [Rpt. /1 II Introduction to video and other media in architectural design communication with emphasis on photographic reproduction, graphic design, desktop publishing, slide photography, slide presentations, and video production. Personal presentations based upon communication psychology and theory.

533.* Lightweight Construction Techniques (3) II Survey of lightweight construction techniques, including pneumatics, tensile membranes, three-dimensional cable nets, grid shells, and flexible stiff plates.

534.* History of the American House (3) I Survey of American domestic buildings from European settlement to the present, including social, political, and economic forces affecting architectural change. P. 334 or permission of instructor. Open to non-majors. (Identical with AR H 534)

551.* Emphasis Areas in Architecture (6) I

552.* Urban Planning (3) I Preliminary exploration of large format photography with Polaroid film.

553.* Site Planning (3) II Studies relating to design determinants for development of outdoor space. Lectures and exercises dealing with individual design criticism including topography, hydrology, climate, and vegetation. Final project summarizing and applying all criteria to a realistic development project is required. P. 302.

554.* Summer Study Tours (6) Summer study tour of the Mediterranean focusing on architecture. Includes Greece and the Greek islands. Seminars and graphic and written projects and assignments. Emphasis on field investigation.

555.* Spanish Architecture and the Mediterranean (3) I Study emphasizing one of the following: desert architecture, community design, historic preservation, design communication,
computer-aided design, entrepreneurial design, architectural programming and evaluation. Offerings are limited by faculty availability, and all topics may not be offered each year. Other topics may be introduced. P, 334, 335, 336, 402, 428.

559.* Ethics and Practice (3) I Standards and values of architectural services and professional project and practice management. P, 270, 402.

560. Introduction to Architecture Graduate Computing (3) I Study and use of computing applied to the architecture graduate program including architectural graphics, desktop publishing, CAD, and computer presentations. Previous experience required with word processing, spreadsheets, and the DOS and Macintosh operating systems. P, graduate admission.

562.* Readings and Research in Design Communication (3) I Reading and discussion of design communication theory and research. Generating, developing, and defending a research proposal in design communication. P, 402.


564.* Women in American Architecture (3) I Women as users, patrons, and architects of American buildings with emphasis on understanding the relationship between gender and architecture in the history of the United States. P, permission of instructor. Open to non-majors. (Identical with AR H 564 and W S 564)

566.* The Art and Architecture of Le Corbusier (3) I Introduction to the art and architecture of Le Corbusier (1887-1965), emphasizing his urban plans, building designs, and plastic art. P, 334. (Identical with AR H 566)

570.* Computer Graphics in Architecture (3) I Introduction to the theory, techniques, and applications of computer-aided design. Focusing on modeling buildings using 3D CAD strategies and techniques on DOS and Macintosh platforms. Lectures on technical topics, with intensive experience on computers. P, 202 and 270.

573.* Introduction to the Conservation of Cultural Resources (3) I An overview of the Historic Preservation movement in America, including discussion of concepts, rationale for and methods of resource utilization, implementation of plans, legislation, etc. Field trips.

574.* Field Methods in Environmental Psychology (3) I (Identical with PSYC 574)

580.* Computer Presentations in Architecture (3) I Introduction to the theory, techniques, and applications of computer-based presentations. Focusing on generating realistic architectural images and fly-throughs that are assembled in a finished multimedia presentation. In-class experience on computers. P, 470.


584.* Planning the Built Environment (2) I A lecture survey dealing with the origins and implications of the physical manifestations of communal ordering systems. An analytic vocabulary is developed with which current and historic settlement patterns are visually compared to discover spatial attributes as a dimension of human experience. P, 302, 334. (Identical with PLNG 584)

587.* Space: A Social-Cultural View (3) [Rpt./1] I Human, socio-cultural use of space, including processes of symbolic expression. Investigation of the role of space through ethnographic readings describing both ritual and architectural examples. Consult department before enrolling.

596. Seminar
a. Readings in Architectural Theory (2-4) [Rpt./1] I Open to non-majors.

b. Research Methods in Design Communication (3) I P, graduate admission.

c. Interdisciplinary Environment-Behavior-Design (3) [Identical with PSYC 596u] I

597. Workshop
a. Architecture (3-8) [Rpt./1] I Open to non-majors. (Identical with PLNG 597a)

b. Special Projects in Architecture (1-3) [Rpt./6 units] I Open to non-majors. (Identical with L AR 597i and PLNG 597i)

*May be convened with 400-level course.

598. Seminar

b. Financing Public Services (3) I (Identical with PLNG 696b)

Arid Lands Resource Sciences (AR L)

845 N. Park Avenue, Room 102
(520) 621-1955; FAX: (520) 621-3816

Graduate Interdisciplinary Program in Arid Lands Resource Sciences

Committee:

Professors Joseph J. Hoffman (Arid Lands), Chair, Paul G. Bartels (Plant Sciences), Robert B. Bechtel (Psychology), Michael E. Bonine (Near Eastern Studies), Herbert E. Carter (Emeritus), Dennis C. Cory (Agricultural and Resource Economics), Stanley N. Davis (Emeritus), Peter F. Filoubiot (Renewable Natural Resources), Kenneth E. Foster (Arid Lands), Roger W. Fox (Agricultural and Resource Economics), Lay J. Gibson (Geography and Regional Development), C. Vance Haynes (Anthropology and Geosciences), Joseph J. Hoffmann (Arid Lands), Charles F. Hutchinson (Arid Lands), Helen M. Ingram (Political Science), Fred S. Matter (Architecture), Eric A. Monke (Agricultural and Resource Economics), James W. O’Leary (Plant Sciences), Stanley J. Olsen (Anthropology), Richard W. Reeves (Geography and Regional Development), Michael B. Schiffer (Anthropology), Donald C. Slack (Agricultural and Biosystems Engineering), Barbara N. Timmermann, (Arid Lands), Thomas Weaver (Anthropology)

Associate Professors D. Robert Altschul (Geography and Regional Development), Bonnie G. Colby (Agricultural and Resource Economics), Owen K. Davis (Geosciences), Michael J. Donoghue (Ecology and Evolutionary Biology), Lisa J. Graumlich (Laboratory of Tree-Ring Research), Katherine K. Hirschboeck (Laboratory of Tree-Ring Research), Stuart E. Marsh (Geography and Regional Development), Steven P. McLaughlin (Arid Lands), John W. Olsen (Anthropology), Thomas W. Scott (Laboratory of Tree-Ring Research), Thomas L. Thompson (Soil and Water Science)

The Program on Arid Lands Resource Sciences offers a program of graduate study leading to the Doctor of Philosophy degree with a major in arid lands resource sciences. The program is interdisciplinary and provides an academic environment in which to examine the ecological, economic, and social factors which influence the sustainable use of arid and semi-arid lands. It is structured around four general areas of study, or tracks.

Developmental studies focus on determining strategies for resource development and management that can be sustained locally without external support. Tools upon which the track draws come from many disciplines including agricultural economics, agronomy, applied anthropology, applied ecology, range science, soil science, and watershed management.

Economic botany studies focus on the development of specialty and industrial cash crops with low water use for sustainable agriculture in arid and semi-arid lands.

Ethnological studies focus on the interaction between humans and their physical and biological environment. The ethnological track draws heavily on several disciplines or traditions within disciplines, including anthropology (ethnology, archaeology, ethnobotany), geography (human ecology), ecology (botany), and plant sciences (economic botany).
Physical studies focus on the interaction of two or more of the physical elements of the environment. Climate is usually one of those elements. The physical studies track draws on the allied earth sciences, including atmospheric sciences, geosciences, hydrology, watershed management, and those parts of engineering, economics, and architecture that are concerned with large and enduring transformations of the arid landscape.

Application materials are available from the department. All applicants must provide the following directly to the department: General Graduate Record Examination scores, three letters of recommendation, a list of publications and special papers, curriculum vitae, personal resume, proposed study program, and a brief statement of long range professional plans. Interested students should request additional information from the program chairman. Doctoral students with majors in other fields may use arid lands resource sciences as a minor field.

512. Economic Policy in Developing Countries (3) II (Identical with AREC 512)

521. Physical Climatology (3) II (Identical with ATMO 521)

523. Hydrology (3) I (Identical with C E 523)

530. The Climate System (3) I (Identical with GEOG 530)

535. Water Management in Dryland Ecosystems (3) I 1996-97 (Identical with WS M 535)

541. Economic Botany of Arid Lands (3) I II (Identical with PL S 541)

550. Geomorphology (4) I (Identical with GEOS 550)

564. The Arid and Semi-arid Lands (3) I (Identical with GEOG 564)

565. Physical Aspects of Arid Lands (3) II (Identical with GEOG 565)

575. Economics of Natural Resource Policy (3) I (Identical with AREC 575)

590. Remote Sensing for the Study of the Planet Earth (3) II 1995-96 (Identical with REM 590)

595. Colloquium
a. Current Research (1) [Rpt./8 units] I II

596. Seminar
a. Physical and Biological Characteristics of Arid Lands (3) I
b. Use and Management of Arid Lands (3) II
b. Cultural and Institutions of Arid Lands (3) I
d. Current Topics in Arid Land Research (3) II

597. Economics of Natural Resource Policy (3) I (Identical with AREC 575)

599. Remote Sensing for the Study of the Planet Earth (3) II 1995-96 (Identical with REM 590)

605. Graduate Figure Drawing (3) [Rpt./5] I II Special problems in drawing, using the classroom model and outside sources as references for personal expression. 6S. Fee.

509. Graduate Drawing Critique (3) [Rpt./5] I II Individual exploration in drawing media and visual concepts. Classroom and individual critiques.

522. * Performance: Live/Photo/Video (3) An overview of diverse approaches within performance art in an interdisciplinary context. Combines live performance with video and photography. 6S.

523. New Genre Concept Development (3) [Rpt./1] Studio course to assist students with defining intentions, refining project ideas, and clarifying the content of their artmaking. Open to students working in any medium.

541. Advanced Photography (3) [Rpt./1] II Current trends, philosophies, and experimentation in still photography. 2R, 2S. Fee. P. 341, acceptance of portfolio.
546.* Experimental Color Photography (3) [Rpt./1] I Nontraditional approaches to color photography including the use of black-and-white and color negatives, manipulation of the negative, dyes and paints added to the print. Development of personal vision encouraged. 6S. Fee. P, 24,11,341a, 341b or 341c, 346, acceptance by portfolio.

547. Mixed Media Book (3) [Rpt./1] I II Investigation of the book as a format for presenting visual material; the process of making simple books. Contemporary bookmakers will be presented. 2R, 2S. Field trips. P, 12 units of upper-division studio art courses.

548.* Video for Artists (3) I II Seniors and graduate students utilize small format video camera and editing to extend/amplify concepts that have developed in their artistic inquiry. 2R, 2S. Field trips. P, admission by portfolio.

549.* Advanced Artists' Video (3) [Rpt./1] I II Students will produce individual video projects with an experimental, self-expression orientation. There is also an option to combine video with performance or to incorporate it within an installation context. P, ART 349 or M AR 314, portfolio review.

550. Graduate Relief Printmaking (3) I II Relief printmaking with emphasis on individual research, personal direction, and professional standards. 6S. Fee.

551. Graduate Intaglio (3) I II Intaglio printmaking with emphasis on individual research, personal direction, and professional standards. 6S. Fee.

552. Graduate Lithography (3) I II Lithography with emphasis on individual research, personal aesthetic, and professional standards. 6S. Fee.

553. Graduate Alternative Methods in Printmaking (3) I II Nontraditional approaches to printmaking with emphasis on individual research, personal direction and professional standards. 6S. Fee.

554. Graduate Graphic Design Problems (3) [Rpt./1] I II Two- and three-dimensional design considerations with emphasis on conceptualization and presentation. 6S. Field trips. Fee. P, acceptance of portfolio.

555.* Editorial Illustration (3) [Rpt./1] I II Problems in editorial and book illustration. 6S. Fee. P, 9 units of illustration courses, approval of portfolio.

556. Graduate Illustration (3) [Rpt./1] I II Exploration of any optical material or phenomenon as a possible solution to illustration problems. 6S. Fee. P, 466, acceptance of portfolio.

557.* Portfolio Preparation (3) [Rpt./1] I II Final approach to completion of portfolio. Student's portfolio is critiqued in areas of order, style, and degree of presentation to bring it to a professional level. 6S. Fee. P, 9 units of graphic design courses, approval of portfolio.

558.* Advanced Jewelry and Metallsmithing I (3) [Rpt./4] I II Advanced study of the various materials and methods in the construction of jewelry and metalwork. 6S. Fee. P, 9 units of metalwork.

559. Advanced Jewelry and Metallsmithing II (3) [Rpt./1] I II Advanced problems in design and execution of jewelry and metalworking projects. Preparation of professional credentials including portfolio, photographing, rendering, exhibitions, and resumes. Fee. P, 471.

560.* Advanced Ceramics (3) [Rpt./5] I II Individual studio research and instruction, with emphasis on personal creative development. 1R, 4S. Fee. P, 373, acceptance of portfolio.

561.* Advanced Fibers (3) [Rpt./5] I II Individual interpretations of concept into finished fiber works.

562. Graduate Two-Dimensional Fiber Techniques (3) I II Advanced fiber technique course for graduate students who wish to further develop their strengths in special technical areas. Stresses two-dimensional work. 6S. P, consult department before enrolling.

563. Graduate Three-Dimensional Fiber Technique (3) I II Advanced fiber technique course for graduate students who wish to further develop their strengths in special technical areas. Stresses three-dimensional work. 6S. P, consult department before enrolling.

564. Graduate Printmaking (3) [Rpt./5] I II Graduate study in painting with an emphasis on the development of a personal imagery and body of work. 6S.

565.* Combining Media (3) [Rpt.] I II Individual and group projects, including collages, constructions, image sequences, and elements from other art forms (sound, language, movement, etc.).

566. Graduate Watercolor Painting (3) [Rpt./5] I II High level experimentation in personal expression with watercolor and related media. Demonstration and critique.

567. Sculpture/Casting Materials (3) [Rpt./3] I II An in-depth exploration of the techniques and concepts of casting. Advanced process of mold making as applied to individual directions. 6S. Fee.

568. Sculpture Materials/Metal and Wood Fabrication (3) [Rpt./3] I II An in-depth exploration of advanced processes and concepts of sculpture through metal and wood fabrication. 6S. Fee.

569. Sculpture Materials/Carving (3) [Rpt./3] I II Advanced processes of subtractive thinking through direct carving versus specific imagery. 6S. Fee.

570. Sculpture Materials/Glass Casting and Slumping (3) [Rpt./3] I II Advanced research and studio work in materials and processes of glass casting and slumping. 6S. Fee.

571. Sculpture Materials/Experimental and Combined Media (3) [Rpt./3] I II In-depth advanced-level exploration of concepts, processes and personal direction through combining media and experimental sculpture processes. 6S. Fee.

572. Sculpture Materials/Site Specific Concepts (3) [Rpt./3] I II The development and research of specific sites and the ramifications of sculptural placements within these sites. Students will develop plans and models that reflect individual concepts. 6S. Fee.

573. Sculpture/Kinetic Materials (3) [Rpt./3] I II An in-depth exploration of the techniques and concepts of kinetic sculpture as applied to individual dimensions. 6S. Fee.

574. Workshop (3) [Rpt/9 units] I II Professional Practices in Art (1-3) I II P, 12 units of studio or art history.

575.* Professional Experiences in Art (1-3) [Rpt./9 units] I II S P, 12 units of studio or art history.

576. Painting Concepts (3) [Rpt./2] I II Preparation of one's painting concepts and the concepts of others, citing parallel influences, research, related ideas and implications for highly concentrated student and faculty discussion.

577. Studio Photography Critique (3) [Rpt./5] I II Investigation of practical methods of critique and their influence on an artist's developing body of work. Limited to art majors with photography concentration.

578. Graduate Printmaking (3) [Rpt./18 units] I II Printmaking with emphasis on aesthetics, conceptualization, technical competency, artistic literacy, and personal direction. 6S. Fee. P, consult department before enrolling.

579. Graduate Jewelry and Metalsmithing (1-6) [Rpt./6] I II Graduate study in all phases of jewelry and metalwork. 3-185.

580. Graduate Studio in Ceramics (3-10) [Rpt./6] I II S Studio research and instruction with emphasis on personal creative development. 6 to 205. Field trips. P, 303.

581. Graduate Fibre Studies (6-10) [Rpt./6] I II Graduate experimentation in all aspects of fiber work, with emphasis on the development of a personal style within the medium. 12 to 20S.

582. Graduate Studio (3-10) [Rpt./6] I II P, 12 units of graduate credit in art.

583. Graduate Problems in Sculpture (3) [Rpt./4] I II Emphasis on aesthetics, conceptualization, technical competency, artistic literacy, and personal direction. 6S. Fee. P, consult department before enrolling.

Art Education (ARE)

584.* Art for Exceptional Learners (3) Adaptation of structured art curricula to exceptional learner populations. P, previous course work in art and/or special education.

585. Introduction to Research in Art Education (3) I II Development of competency in application of language, methods, and diverse research procedures used in the visual arts and education as demonstrated by a scholarly written research report.

586.* The Teaching of Art (3) I II Exploration of art education curricula and instructional methodology in the elementary school. P, EDUC 350, TTE 300; CR, 3381 and 400.


588.* Cross-Cultural Issues in Art Education (3) Multicultural and cross-cultural issues within visual arts education (e.g., in studio art, art criticism, art history, and aesthetics).

589. Art Therapy Techniques (3) I I I explores the use of art related projective assessments and art therapy treatment issues and techniques used with adolescents.

590. Art in Art (3) Recent theories in the fields of curriculm and art concentration. Review and evaluation of extant art curricula and development...
skills for presentation, monitoring and evaluation of instruction. P, 338L.

596. Seminar

h.* Current Issues in Art Education Theory and Practice (3) [Rpt./12 units] I II

*May be convened with 400-level course.

630. History and Philosophy in Art Education (3) [Rpt./79 units with consent of instructor] Critical analysis of objectives, current theories, and texts that are shaped by the visual arts, history, philosophy, aesthetics and the behavioral sciences.

633. Issues and Recent Research in Art Education (3) [Rpt./79 units with consent of instructor] The identification of problems in art education at various curricular levels; examination of related research with possible implications for practice.

Art History (ARH)

511. Methods of Art History (3) I Major intellectual approaches to the visual arts developed within the past 150 years. Field trips. Open to majors only.

512a-512b-512c-512d.* Medieval Art (3-3-3-3) The history of art and architecture in Western Europe and Byzantium between ca. 300 and ca. 1300. 512a: Early Christian and Byzantine Art. 512b: Early Medieval Art. 512c: Romanesque Art. 512d: Gothic Art. May be taken in any order. P, 6 units of history or art history.

513b-513c.* Renaissance Art in Italy (3-3) Painting, sculpture and architecture in Italy. 513b: 15th century. 513c: 16th century. 513b is not prerequisite to 513c.

514a-514b.* Northern Renaissance Art (3-3) 514a: Development of German, French and Netherlandish painting during the late 14th through the 15th centuries. 514b: 16th century art production in Germany, France and the Netherlands. P, 6 units of history of art or art history.

514a is not prerequisite to 514b.

517a-517b.* 19th-Century European Art (3-3) Painting and sculpture. 517a: From the French Revolution to about 1850. 517b: From about 1850 through Impressionism. P, 6 units of history of art or art history.

518a-518b.* 20th-Century Art (3-3) Painting and sculpture in Europe. 518a: 1888 to World War I. 518b: Between the World Wars. P, 6 units of history of art or art history. 518a is not prerequisite to 518b.

522a-522c.* Pre-Hispanic Art (3-3) 522a: Art of the high cultures of Mesoamerica, with the focus on architecture, sculpture, painting and crafts prior to European contact. 522c: Social history of art in prehispanic Mesoamerica from the preclassic to the classic period. 522a is not prerequisite to 522c. (Identical with ANTH 522a-522b and LA S 522a-522c)

523a-523b.* The Art of Mexico (3-3) I II 523a: The art of Colonial Mexico from the early 16th century to the late 18th century. The effects of the Spanish conquest on native traditions; public, private and sacred patronage; the effects of the Bourbon reforms. Painting, sculpture, architecture, graphic and minor arts. 523b: The art of Modern Mexico from the late 18th century to the early 20th century. The Independence Period, the National Period, and the Revolutionary Period. Painting, sculpture, architecture, graphic and minor arts. 523a is not prerequisite to 523b.

524a-524b.* History of Photography (3-3) 524a: From its invention to 1895; Impact of photography on the art and culture of the 19th century. 524b: As an art medium from 1895 to 1965. P, 6 units of art history. 524a is not prerequisite to 524b.

529a-529b-529c-529d.* American Art (3-3-3-3) Art in the United States. 529a: Colonial art. 529b: 19th century art. 529c: From 1900 through 1940. 529d: Twentieth century American art from the 1930s to recent times. May be taken in any order. P, 6 units of history of art or history.

531.* Studio Introduction to Contemporary Art (3) Introduction to contemporary art, theory, criticism, and cultural politics circa 1945 to the present. Emphasis on movements and themes. Lecture with discussion.

534.* History of the American House (3) I (Identical with ARCH 534)

535.* History of Prints (3) The technique and functions of the printmaking media from their inception in the 15th century to the 19th century. P, 117 or 118.


552.* Etruscan Art and Archaeology (3) (Identical with CLAS 552)

554.* Greek and Roman Sculpture (3) (Identical with CLAS 554)

556.* Greek and Roman Painting (3) (Identical with CLAS 556)

557.* Greek Architecture (3) (Identical with CLAS 557)

561.* Greek Pottery 1200-400 B.C. (3) (Identical with CLAS 561)

564.* Women in American Architecture (3) I (Identical with ARCH 564)

566.* The Art and Architecture of Le Corbusier (3) I II (Identical with ARCH 566)

581.* Contemporary Theory and Criticism (3) [Rpt./2] I II Discussion of the theory and criticism of contemporary art since 1950 based on assigned readings and slide presentations.

584.* Roman Art and Architecture (3) (Identical with CLAS 584)

596. Seminar

a. Ancient Art and Archaeology (3) [Rpt./30 units] (Identical with CLAS 596a)

b. Problems in Renaissance-Baroque (3) [Rpt./2] I II

c. Studies in Medieval Art (3) [Rpt./2] I II

d. Pre-Columbian Art (3) [Rpt./4] I Consult instructor before enrolling. (Identical with ANTH 596e)

e. History of Photography (3) [Rpt./4] I II P, 424a or 424b.

f. Colonial and 19th-Century American Art (3) [Rpt./3] I II Consult department before enrolling.

993 N. Cherry Avenue, Room N204
(520) 621-2288; FAX: (520) 621-1532

Professors Peter A. Strittmatter, Head, J. Roger Angel, W. David Arnett (Physics), Willy Benz, John Black, Adam Burrows (Physics), Thomas Gehrels (LPL), William F. Hoffmann, J. R. Jokipii (LPL), Robert C. Kennicutt, Jr., James W. Liebert, Frank J. Low, Fulvio Melia (Physics), George H. Rieke, Marcia Rieke, Elizabeth Roemer, Gary Schmidt, Thomas L. Swihart (Emeritus), Rodger I. Thompson, William G. Tiff, Raymond E. White, Neville J. Woolf

Astronomers Craig B. Foltz, Donald McCarthy

Associate Professors John Bieging, William J. Cocke, Christopher Impey, Andrzej G. Pacholczyk

Associate Astronomers Edward Olszewski, Erik Young

Assistant Professors Jill Bechtold, Philip A. Pinto, Hans-Walter Rix, Christopher Walker

Project Director, Steward Observatory, John Hill

Director, Submillimeter Telescope Observatory, Robert Martin

Associate Astronomers E. Keith Hubbel, Mark V. Sykes

Adjunct Astronomer Richard Green

Adjunct Associate Astronomer William R. Stoeger

Project Scientist Hubert Martin

Associate Research Scientist Michael Lesser

The department offers programs leading to the Master of Science and Doctor of Philosophy degrees with a major in astronomy. Specializations are available within the department in theoretical or observational astrophysics and in astro-
nominal instrumentation. In addition, the Department of Planetary Sciences offers a concentration in solar system astronomy and the Committee on Optical Sciences, through the Optical Sciences Center, offers advanced degrees and research in its own field of specialization. For further information see Optical Sciences and Planetary Sciences elsewhere in this catalog.

The graduate program emphasizes doctoral studies, but admission as a Master's Degree candidate may be granted under special circumstances.

In view of the heavy demand for admission to the graduate program, applicants are required to submit scores from the Graduate Record Examination (Aptitude and Advanced Test in Physics). All applications must be supported by letters of recommendation. Undergraduate majors in physics, mathematics, or astronomy are preferred, but exceptions may be made for applicants with other majors in special circumstances.

For the Master of Science degree, a written document, but not a formal thesis, is required. A final oral or written examination is required.

Successful completion of the eight "core" graduate courses (515, 518, 522, 535, 540, 541, 545 and 582), three graduate physics courses and two elective graduate science courses is necessary for completing the Ph.D. program. Students may substitute equivalent graduate courses from other institutions.

Doctoral students from other departments who elect to minor in astronomy must complete 12 acceptable graduate units in astronomy.

The facilities of the Steward Observatory, which is associated with the Department of Astronomy, are available for student research. The 90-inch, 36-inch, and 20-inch reflecting telescopes are located at the Kitt Peak Observing Station, 48 miles southwest of Tucson and within the grounds of the Kitt Peak National Observatory. A dormitory and office building provide facilities for overnight and extended observing periods. The Steward Observatory, in collaboration with the Smithsonian Astrophysical Observatory, is upgrading the Multiple Mirror Telescope to a single 6.5 meter diameter primary mirror, which will be the fifth largest telescope in the world. In a collaboration with the Carnegie Institution of Washington, the Observatory is constructing a second 6.5 meter telescope to be located in Chile. Together with several other partners, the Observatory is building the Large Binocular Telescope (LBT) on Mt. Graham, Arizona. This telescope will consist of two 8.4 meter diameter mirrors on a common mount, with the light gathering power of a single 11.9 meter telescope. The LBT will be the second largest telescope (after the European VLT) in the world. All telescopes have a wide range of modern photometric, spectroscopic, and photographic equipment, as well as TV acquisition and guidance systems and provision for computer-controlled telescope operation and data acquisition. The Observatory has completed on Mt. Graham a 10-meter telescope for work at mm and sub-mm wavelengths in collaboration with the Max Planck Institute for Radio Astronomy in Bonn, West Germany. The campus buildings provide lecture rooms, research laboratories, staff and student offices, and technical facilities.

Instrumental equipment at the observing stations located in the Catalina Mountains includes a 61-inch reflecting telescope used for a variety of investigations, including high-resolution photography of the moon and planets; a 60-inch reflector, a 40-inch reflector, and a 28-inch reflector, all used principally for photometric studies, including investigations in the infrared; an 18/27/48-inch Schmidt telescope for wide-field infrared photography, and several smaller instruments. A 21-inch telescope for planetary photography is located on Tumamoc Hill in Tucson. Staff members of the Lunar and Planetary Laboratory also may participate in supervision of doctoral dissertations.

The principal areas of research at the Steward Observatory include galactic and extragalactic investigations, both observational and theoretical; mm wave and sub-mm wave astronomy; infrared astrophysics; spectrophotometric research on solar and multiple stars; astronomical instrumentation, theoretical investigations of stellar atmospheres and interiors, the interstellar medium, star formation, and magnetohydrodynamics and general relativity applied to astrophysical problems.

502. Astronomical Instrumentation Project (3) I 1995-96 Design, construction, and testing of an astronomical instrument chosen by each student under the guidance and supervision of the instructor. Regular class sessions are devoted to discussing techniques and reporting progress and problems. (Identical with PHYS 503)

503.* Physics of the Solar System (3) II 1995-96 Differentiation of physical conditions from spectral data. Ionized, atomic and molecular clouds, interstellar dust and magnetic fields. Ionization equilibrium, heating and cooling, supernova shocks, dust and protostellar evolution. (Identical with PHYS 503)

515. Interstellar Medium and Star Formation (3) I 1995-97 Derivation of physical conditions from spectral data. Ionized, atomic and molecular clouds, interstellar dust and magnetic fields. Ionization equilibrium, heating and cooling, supernova shocks, dust and protostellar evolution. (Identical with PHYS 503)

518. * Modern Astronomical Instrumentation and Techniques (3) I 1995-96 Radiant energy; signals and noise; detectors and techniques for imaging, photometry, polarimetry and spectroscopy. Examples from stellar and planetary astronomy in the x-ray, optical, infrared and radio. (Identical with PTYS 518)

522. Atomic and Molecular Astrophysics (3) I 1996-97 Interpretation of astronomical spectra: basic aspects of atomic and molecular spectra and processes that enable one to infer physical conditions in astronomical environments from analysis of their electromagnetic spectra. Familiarity with basic quantum mechanics is assumed.

523. Statistical Mechanical Problems in the Space Sciences (3) I 1996-97 (Identical with PTYS 523)

535. Stellar Structure (3) II 1995-96 Equations of stellar structure, virial theorem, energy transport, equations of state, opacities, nuclear reactions, stellar models, evolution of low and high mass stars, observational tests, rotation, and magnetic fields, binary evolution.

540. Structure and Dynamics of Galaxies (3) I 1996-97 Observational properties of galaxies; structure, kinematics, star and gas content. Structure of our own galaxy. Dynamics of stellar systems: equilibrium, instabilities, internally and externally driven evolution.

541. Extragalactic Astronomy and Cosmology (3) II 1996-97 The structure, origin and evolution of the physical universe from theory and observations of systems outside our own galaxy. Relativistic cosmology; galaxy evolution and clustering; active galaxies and quasars; the microwave background; galaxy formation; the hot big bang; and physics of the early universe. P, 540.

545. Stellar Astrophysics (3) I 1995-96 Radiative transfer, gray atmosphere, opacity, line formation, non-LTE, curves of growth, stellar hydrodynamics, planetary and other nonstellar applications. (Identical with PHYS 545)

553. Solar System Dynamics (3) I 1995-96 (Identical with PTYS 553)


556. Electrodynamicsof Conducting Fluids and Plasmas (3) I 1996-97 (Identical with PTYS 556)

575. General Relativity and Cosmology (3) I 1996-97 General relativity with application to celestial mechanics, stellar structure, gravitational radiation, black holes, gravitational lensing and cosmology.

582. High Energy Astrophysics (3) II 1995-96 Radiation mechanisms, synchrotron radiation, charged particle acceleration, pulsars, black holes, accretion disks, X-ray binaries, gamma-ray sources, radio galaxies, active galactic nuclei. (Identical with PHYS 582 and PTYS 582)

589. Topics in Theoretical Astrophysics (3) [Rpt.] I (Identical with PHYS 589)

*May be convened with 400-level course.

Atmospheric Sciences (ATMO)

Physics-Atmospheric Sciences

Building, Room 542
(520) 621-6831; FAX: (520) 621-6833

Professors E. Philip Krider, Head, George A. Dawson (Emeritus), Robert E. Dickinson,
The Department of Atmospheric Sciences offers programs leading to the Master of Science and Doctor of Philosophy degrees. Research is conducted through the Institute of Atmospheric Physics in areas such as climate and global change, mesoscale meteorology, atmospheric dynamics, radiative transfer, remote sensing, atmospheric aerosols, atmospheric chemistry, cloud and precipitation physics, lightning and atmospheric electricity.

An undergraduate major or minor in atmospheric sciences or meteorology is not required for admission, but some knowledge of the field is desirable. Applicants with undergraduate majors in physics, chemistry, mathematics or engineering are particularly encouraged to apply.

Degrees

All candidates for an advanced degree in atmospheric sciences will be expected to demonstrate proficiency in statistics and computer programming.

Master of Science: 30 units of graduate work, including 541a-541b, 551a-551b, and at least two other graduate-level atmospheric sciences courses, are required. All candidates must submit a thesis or manuscript which has been judged by the student's committee to be acceptable for publication in an appropriate scientific journal and present the results in a formal seminar or at a scientific meeting.

Doctor of Philosophy: The Doctor of Philosophy with a major in atmospheric sciences is primarily a research degree. The candidate must complete at least 36 units of graduate course credit in the major field, 18 units of dissertation credit, and fulfill the minor requirement. All Ph.D. students must pass a written and oral preliminary examination and complete and defend a dissertation based on original research.

Students in either the M.S. or Ph.D. program who have received a letter grade of C or lower in one or more of 541a-541b, 551a-551b, or the transferred equivalents thereof, are required to take a written examination covering the content of the course or courses in question.

All Ph.D. candidates in atmospheric sciences are required to complete a minor program. Requirements for the minor vary within the university and the student should consult the particular department in which they plan to minor for specific requirements.
methods for solving the relevant equations; applications to problems in radiative transfer; theoretical basis for remote sensing from the ground and from space; solutions to the "inverse" problem. P, MATH 254. (Identical with OPT 566a-566b)

**Biochemistry (BIOC)**

Biological Sciences West Building
Room 357
520) 621-5770; FAX: (520) 621-9288

Professors Michael A. Wells, Head, Hans J. Bohnert (Molecular and Cellular Biology, Plant Sciences), Don P. Bourque (Molecular and Cellular Biology), Danny L. Brower (Molecular and Cellular Biology), Michael F. Brown (Chemistry), Herbert E. Carter (Emeritus), Michael A. Cusano,ich, Rene Feyereisen (Entomology), Les S. Forster (Emeritus), Eugene W. Gerner (Radiation Oncology), Darrel E. Goll (Animal Sciences), William J. Grimes, Richard B. Hallick, David J. Hartshorne (Animal Sciences), Mark R. Haussler, John G. Hildebrand (Molecular and Cellular Biology; Division of Neurobiology/AR L), Victor J. Hruby (Chemistry), Richard G. Jensen, Henry Koffler (Microbiology and Immunology; Molecular and Cellular Biology), John H. Law, Jr., W. Little, David W. Mowen (Molecular and Cellular Biology), David F. O'Brien (Chemistry), Jose M.C. Ribeiro (Entomology), John A. Rupley, Eugene G. Sander, Marc E. Tischler, Gordon Tolin, F. Ann Walker (Chemistry), Henry I. Yamamura (Pharmacology; AR L)

Associate Professors Louise M. Canfield, Carol L. Dieckmann, Robert J. Gillies, Jennifer D. Hall (Molecular and Cellular Biology), Martinez J. Hewlett (Molecular and Cellular Biology), Neil E. MacKenzie (Pharmaceutical Sciences), Roger L. Miesfeld, Elizabeth Vierling Assistant Professors Mark S. Dodson, William R. Montfort, David B. Morton (Neurobiology), Martha L. Narro, Roy R. Parker (Molecular and Cellular Biology)

Teaching and research in biochemistry are carried out in several locations in the University and involve the efforts of the above-listed faculty members. There are individual faculty members constitute the University Department of Biochemistry, which is responsible for instruction in biochemistry in the Colleges of Agriculture, Arts and Sciences, and Medicine.

The Department of Biochemistry offers the Master of Science and Doctor of Philosophy degrees. Except in unusual circumstances, however, the department will only admit graduate students whose stated objective is the Doctor of Philosophy degree. The department also offers undergraduate instruction in programs of the Colleges of Agriculture, Arts and Sciences, and Medicine, and undergraduate Bachelor of Science and Bachelor of Arts degrees in biochemistry.

Research areas in which graduate studies may be pursued cover most modern aspects of biochemistry including electron and X-ray crystallography; electron tomography; protein structure and function; bioenergetics; plant molecular biology and biochemistry; gene regulation and expression; genetic engineering; membrane and cell surface biochemistry; muscle biochemistry and cell motility; hormone biochemistry, insect biochemistry; and protein, lipid and nucleic acid metabolism.

501. Medical Biochemistry (7) II P, formal admission to the Ph.D./M.D. program, and permission of the course instructor

502. Professionalizing Presentation Skills (1) I II Methods for students in any discipline to augment their proficiency in the preparation, delivery and self-evaluation of presentations. (Identical with ENGL 502, NURS 502)

505. Eukaryotic DNA Replication (3) [Rpt./1] I 1996-97 (Identical with BIOC 505)

510. Plant Molecular Biology (3) II 1996-97 (Identical with PL S 510)

* 511. *Molecular Biology* (3) II (Identical with MCB 511)

516. *Computer Analysis of Sequences* (3) II (Identical with MCB 516)

520. Pathways and Signals in Cells (3) II Objectives are to outline various mechanisms of intracellular signaling. This includes the chemical and structural bases for the action of second messengers, e.g., calcium and cyclic nucleotides. P, BIOC 460, 462a or equivalent; open to undergraduates with permission. (Identical with MCB 520, AN S 520)

533. Teaching Biology Labs (2) II Preparation and teaching of lab and field exercises for high school biology. Includes brief high school teaching experiences. Designed for prospective high school biology teachers. 1R, 3L. Field trip. Open to prospective biology teachers only. P, 462a-462b or consult department before enrolling. (Identical with MCB 533)

555. Molecular Mechanisms of Development (3) II (Identical with MCB 555)

561. Introduction to Biochemical Literature (1) I II Discussion of the biochemical literature aimed at helping the student evaluate and report the published literature. Primarily for first-year graduate students planning a career in biochemistry and desiring to prepare themselves for continued study. CR, 462a-462b. (Identical with CHEM 561)

565. Enzymes (3) I Advanced consideration of enzyme structure and function. P, 462a, CHEM 480b. (Identical with CHEM 565)

566. Nucleic Acids (4) I Chemistry, structure, and function of nucleic acids; replication, transcription, translation, gene organization, regulation of gene expression and organelle nucleic acids. Both prokaryotic and eukaryotic systems will be considered. P, BIOC 411/511, MCB 411/511, or an equivalent introductory molecular biology course, or permission of the instructor. (Identical with GENE 568, INSC 568 and MCB 568)

569. Topics in Gene Regulation (2) II 1995-96 Behavior of gene regulatory systems in prokaryotes and eukaryotes. Knowledge of mechanisms is assumed and discussed when needed, but emphasis is on regulatory circuitry. Most lectures will be student presentations. P, 568 or permission of instructor. (Identical with MCB 569)

572. Biological Regulation (4) I Advanced treatment of the biomedical aspects of biological regulation in eukaryotic cells. Topics to be discussed include regulation of cellular metabolism, growth and cell division in both plant and animal cells. P, 462a-462b or consult department before enrolling. (Identical with MCB 572)

574. Advances in Mammalian Genetics (2) [Rpt./1] I 1995-96 Student participation in the presentation and discussion of current literature covering recent advances in the molecular analysis of mammalian genetic loci. P, undergraduate courses in genetics and molecular biology. (Identical with GENE 574 and MCB 574)

577. Biological Structure II (3) II 1995-96 Advanced study of macromolecular structure; theory, methods, and results of x-ray crystallography and NMR. P, 585, or permission of instructor.

583. Biological Structure I (4) II Introduction to the current understanding and methods used for study of the structure, thermodynamics, and dynamics of proteins, nucleic acids, and membranes. P, CR, 462a-462b, CHEM 480a-480b. (Identical with CHEM 583)

588. Intracellular Messengers (2) I (Identical with NRSC 586)

589. Principles of Cellular and Molecular Neurobiology (4) I (Identical with NRSC 588)

595. Colloquium a. Oncogenes and Signal Transduction (1) [Rpt./2] I Open to graduate students in biological discipline, exceptionally qualified undergraduates. (Identical with CHEM 595a)

597. Workshop a. Recombinant DNA Techniques (2) S Designed especially for teachers. 1R, 3L. (Identical with MCB 597a)

*May be convened with 400-level course.

612. Biological Electron Microscopy (4) I (Identical with MCB 612)

621. Molecular, Plant, Microbe Interactions (3) I 1995-96 (Identical with PL P 621)

623a-623b. *Biological Update* (2-2) S Focuses on recent advances in understanding of basic biology and new applications. Open to middle and high school biology teachers only. 623a is not a prerequisite to 623b. (Identical with ECOL 623a-623b and MCB 623a-623b)

633. Secondary Biological Lab Curricula (3) S Contemporary secondary science curriculum
materials and teaching approaches. Course taught jointly by science and education faculty. The use of laboratories in teaching is discussed in the broad context of the national recommendations for science education. Open to middle and high school biology teachers only. 2R, 3L. P 18 units of biological sciences.

643. Biology Lesson Development (3) S Translates learned laboratory or field research into experiments suitable for middle/high school classrooms. Faculty advises on experimental design, lab techniques and testing the experiments. 2R, 3L. P 2 units of 900 level research. Open to middle and high school biology teachers only.

665. Analysis & Purification of Proteins (3) II 1995-96 (Identical with AN S 665)

681. Introduction to Biochemical Research (1-5) [Rpt./1] I II Supervised research experiences in the labs of individual faculty members. 3 or 6L Open only to first-year majors. CR 561.

691. Preceptorship
a. Workshop Development and Presentation (1-3) [Rpt./3 units] P, 643.

696. Seminar
a. Biochemistry I (1-3) I [Rpt./9 units]
b. Biochemistry II (1-3) II [Rpt./9 units]

800. Research (1-16) Yr.

801. Medical Biochemistry (7) II Comprehensive treatment of general biochemistry with clinical applications, oriented toward human biology. Includes protein and nucleotide chemistry and metabolism, enzymology, lipid and carbohydrate metabolism, metabolic regulations, biochemical nutrition, biochemical endocrinology and related topics. Includes clinical case studies, clinical discussions, tutorials and computer-assisted instruction.

891. Preceptorship
a. Biochemistry (3-12) [Rpt./12 units]

Biological Sciences

Graduate work and research in the biological sciences are carried out in a number of different locations at The University of Arizona. For information concerning degree programs see the following highlights elsewhere in this catalog:

Anatomy
Animal Sciences
Biochemistry
Biophysics
Cancer Biology
Ecology and Evolutionary Biology
Entomology
General Biology
Genetics
Microbiology and Immunology
Molecular and Cellular Biology
Neuroscience
Nutritional Sciences
Pharmacology and Toxicology
Physiological Sciences
Plant Pathology
Plant Sciences
Toxicology

In addition, a number of other departments offer graduate work, a component of which is related importantly to the biological sciences. Among these are:

Engineering (Biomedical option)
Exercise and Sport Sciences
Nursing
Nutrition and Food Science
Pharmaceutical Sciences
Pharmacy Practice
Speech and Hearing Sciences

Biomedical Engineering

1326 E. Mabel Street
(520) 626-4707; FAX: (520) 621-8076

Committee on Biomedical Engineering

Professors Stuart K. Williams, Chairperson (Surgery/Physiology), William J. Dallas (Radiology), Glen G. Gerhard (Electrical and Computer Engineering), Neil H. Mendelson (Molecular and Cellular Biology), Timothy W. Secomb (Physiology), Bruce R. Simon (Aerospace and Mechanical Engineering), Michael Tabor (Applied Mathematics), John G. Williams (Nuclear and Energy Engineering)
Associate Professors Jeffrey B. Goldberg (Systems and Industrial Engineering), Ralph Martinez (Electrical and Computer Engineering/Radiology), Robin N. Strickland (Electrical and Computer Engineering), Olivia R. Sheng (Management Information Systems)

Biomedical engineering can be defined as a multidiscipline in which physical scientists and engineers interact with life scientists and physicians to solve problems ranging from basic biomedical engineering research to applications in clinics and health care delivery systems. The University Committee on Biomedical Engineering coordinates options available to students in the College of Engineering and Mines and in other colleges.

Graduate students working toward the Master of Science or Doctor of Philosophy in an engineering department may select courses and research topics in biomedical engineering as part of their minor programs. No biomedical engineering degrees are offered.

Courses available in biomedical engineering are offered in several departments in the Colleges of Agriculture, Business and Public Administration, Engineering and Mines (for engineering minor programs), and Medicine, and in the Science and Social and Behavioral Sciences. Areas of emphasis include: biological imaging; biomaterials; biomedical instrumentation; cardiovascular and respiratory mechanics and transport; medical informatics and decision support systems; modeling and simulation of health delivery systems; biological systems, and molecular and cellular systems; musculoskeletal biomechanics, robotics and prosthetics; and neural systems.

For additional information contact Dr. Ralph Martinez (Electrical and Computer Engineering/Radiology), Dr. Timothy Secomb (Physiology), Dr. Bruce Simon (Aerospace and Mechanical Engineering), or Dr. Stuart Williams (Surgery/Physiology).

Biophysics (BIP)

Graduate Interdisciplinary Program in Biophysics

At the time of publication of this catalog, the Graduate Interdisciplinary Program in Biophysics was under review. For current information, contact R. Gruener, 621-8368.

578a-578b. Introduction to Biophysics (3-3) Introduction to the structure and chemistry of macromolecules, followed by a survey of the principal areas of biophysics: molecular biophysics, membrane and cellular biophysics, and systems biophysics. P, PHYS 332, CHEM 490a-490b.

681. Introduction to Biophysical Research (1-2) [Rpt./3 units] I II Supervised research experiences in the labs of individual faculty members. 3-6L Open only to first-year majors.

696. Seminar
a. Biophysics I (1-2) [Rpt./8 units] I Open to majors only.
b. Biophysics II (1-2) [Rpt./8 units] II Open to majors only.

Business Administration (B AD)

McClelland Hall
Accounting (520) 621-2620
Finance (520) 621-7554
Management Information Systems (520) 621-2748
Management and Policy (520) 621-1035
Marketing (520) 621-3519
Karl Eller Graduate School of Management (520) 621-2169

Committee on Business Administration

Professors Lee Roy Beach (Management and Policy), Price V. Fishback (Economics), Melanie R. Wallendorf (Marketing)
Associate Professors Sudha Ram (Management Information Systems), Michael S. Weisbach (Finance)
Assistant Professors Chris C. Demchak (Public Administration and Policy), Mark A. Trombley (Accounting)

The committee offers programs leading to the Master of Business Administration degree with a major in business administration and specialized concentrations in functional areas, specialized masters' degrees in functional areas and a Doctor of Philosophy degree with a major in
management and specialized concentrations in functional areas.

These degree programs are designed to educate students in modern scientific research methods as applied to general and specialized management problems and to prepare students for careers in education, management and government.

All prospective students should check with the academic department of their specialization with respect to matters of program focus and requirements.

Degrees
Master of Business Administration and specialized masters' degrees in functional areas: See Requirements for Masters' Degrees/Master of Business Administration elsewhere in this catalog.

Doctor of Philosophy: The degree program is interdisciplinary and draws heavily on the fields of humanities, economics, and the behavioral sciences, as well as knowledge of specific functional areas of management.

Candidates must have a bachelor's degree and proficiency in mathematics at the level of MATH 125a-125b. Individual functional areas will vary to allow for differing backgrounds and to accommodate different special interests. The program requires a concentration in one of the functional areas available in the college: accounting, finance, management information systems, management and policy, and marketing. Minor fields are selected to complement the major area of emphasis. Courses are chosen with the approval of the major and minor advisors to provide a strong theoretical and methodological background for research in the candidate's chosen discipline.

Cancer Biology (CBIO)
Arizona Health Sciences Center
Room 914
(520) 626-7479; FAX: (520) 626-4480

Graduate Interdisciplinary Program in Cancer Biology

Committee:
Professors G. Tim Bowden, Chair (Radiation Oncology), David S. Alberts (Internal Medicine), Harris Bernstein (Microbiology and Immunology), Danny L. Brower (Molecular and Cellular Biology), William S. Dalton (Internal Medicine), Eugene W. Gerner (Radiation Oncology), William J. Grimes (Biochemistry), Evan M. Hersh (Internal Medicine), Junetsu Ito (Microbiology and Immunology), John W. Little (Biochemistry), Neil Mendelson (Molecular and Cellular Biology), David W. Mount (Molecular and Cellular Biology), Raymond B. Nagle (Pathology), Garth Powis (Cancer Center), Sydney E. Salmon (Internal Medicine), I. Glenn Sipes (Pathology and Toxicology), Robert A. Taetle (Internal Medicine), Samuel Ward (Molecular and Cellular Biology), Ronald Weinstein (Pathology) Associate Professors Emmanuel Akporaye (Microbiology and Immunology), Louise M. Canfield (Biochemistry), Anne E. Cress (Radiation Oncology), Carol Dieckmann (Biochemistry), Harinder S. Garewal (Medicine), Helen Gensler ( Radiation Oncology), Robert Gillies (Biochemistry), Jennifer D. Hall (Molecular and Cellular Biology), Kit S. Lam (Internal Medicine), Daniel C. Liebler (Pharmacology and Toxicology), Alan F. List (Medicine), Charlene McQueen (Pharmacology and Toxicology), Roger L. Miesfeld (Biochemistry), Charles W. Taylor (Internal Medicine), Assistant Professors Alison E. Adams (Molecular and Cellular Biology), Lynne Manseau (Molecular and Cellular Biology), Jesse D. Martinez (Radiation Oncology), Kathy McGovern (Radiation Oncology), Roy R. Parker (Molecular and Cellular Biology), Scott Selleck (Molecular and Cellular Biology), Ted Weinert (Molecular and Cellular Biology)

Scientists from various departments comprise the interdepartmental Program in Cancer Biology which offers programs leading to the Master of Science and Doctor of Philosophy degrees with a major in cancer biology. The curriculum of the cancer biology graduate program is designed to introduce students to the body of knowledge that has been derived from experiments on the production, properties, and therapy of cancer and to assure that the students have the necessary background in one or more areas of related fundamental science to enable them to do original research.

For admission to the program students should have a B.S. or B.A. degree or an M.S. degree usually with a major in biochemistry or chemistry, molecular biology, genetics, cell biology, toxicology or a closely related area and with a cumulative grade-point average of at least 3.00 (B). The background of the students should include basic courses in these areas as well as several advanced courses from chemistry, microbiology and immunology, molecular and cellular biology, biochemistry, genetics, pharmacology and toxicology. Prior research experience is highly desirable and may be recognized in certain instances as evidence of competence in that area. All applicants must take the Graduate Record Examination, including the advanced test in chemistry or biology.

The deadline for receipt of application forms for fall admission is April 1 and for spring admission, November 1.

All students are required to complete 13 units of core courses specified by the program and which include: 3 units of Cancer Biology (555), 3 units of Environmental Carcinogenesis (551), 3 units of Cancer Genetics and Cytogenetics (589), 2 units of Cancer Cell Biology (595d), and 2 units of Cancer Biology Seminar (596h).

505. Eukaryotic DNA Replication (3) I (see PHP 590).
506. DNA Replication (3) I 1996-97 Physical and chemical aspects of DNA replication in mammalian will be described in conjunction with discussions of recent journal articles on selected topics. Includes the regulation of S phase within the eukaryotic cell cycle; nuclear organization during DNA synthesis; DNA replication enzymes; viral, cellular and engineered models of DNA replication; the initiation of DNA replication; DNA replication origins and the reconstitution of DNA replication complex. P, BIOC 462b. (Identical with BIOC 505, MBIM 505, and MCB 505) Cress

550. Drug Disposition and Metabolism (2) II (identical with PHCL 550).

551. Molecular Mechanisms of Carcinogenesis (3) I 1996-97 Physical and chemical carcinogenesis. Special emphasis will be upon molecular aspects of the interaction of the carcinogenic agents with mammalian cells and the subsequent mutagenic and metabolic consequences of such interactions. The topic of oncogene activation and tumor suppressor gene inactivation induced by carcinogens during multistage carcinogenesis will also be emphasized. The molecular biology techniques used in the study of carcinogenesis will also be covered. P, consult program before enrolling. (Identical with MBIM 551 and RONC 551) Bowden

555. Cancer Biology (3) II 1996-97 Fundamental biological aspects of neoplastic growth at the organ, cellular, and molecular levels; emphasis on the etiology, behavior, and therapy of neoplasms. (Identical with CBA 555, MEDI 555, MBIM 555 and RONC 555)

562. Tumor Immunology (3) I 1996-97 (identical with MBIM 562)


595. Colloquium
a. Oncogenes and Signal Transduction (1) I [Rpt. /2] Open to graduate students in biological discipline, exceptionally qualified undergraduates (Identical with BIOC 595a).

b. Special Topics in Cell Biology (2) II [Rpt. /6] II 1996-97 (Identical with CBA 595, MCB 595d, MBIM 595d, and RONC 595d) Gerner

596. Seminar
h. Cancer Biology Series (1) I (identical with RONC 596h)
597. Workshop
   a. Mechanisms of Cancer Prevention (3) II
   1995-96 P, graduate status in biological sciences
   (Identical with CBIO 597a, N SC 597a, RONC 597a)

602a. Biotoxiology (3) (Identical with TOX 602a)

681. Introduction to Cancer Biology Research
   (2) I II Supervised research experience in the
   laboratories of individual faculty members.
   851.* Molecular Mechanisms of Carcinogenesis
   (3) II 1995-96 For a description of course
topics, see 581. (Identical with MCB 851 and
RONC 851).
   855.* Cancer Biology (3) II 1996-97 Fundamental
   biological aspects of neoplastic growth at
   the organ, cellular, and molecular levels;
   emphasis on the etiology, behavior, and ther-
   apy of neoplasms. (Identical with RONC 855).
   889.* Cancer Genetics and Cytogenetics (3) I
   1995-96 See 589 for description.
   896. Seminar
   a. Cancer Biology Series (1) I (Identical with
   RONC 896h)
*Available on both 500 and 800 levels.

Cell Biology and Anatomy (CBA)
Arizona Health Sciences Center,
Room 4205
(520) 626-6084; FAX: (520) 626-2097

Professors Robert S. McCuskey, Head,
Jay B. Angevine, Jr., Joseph T. Bagnara
(Emiritus), Bryant Benson, Robert W.
Gore (Physiology), Mac H. Hadley,
Mary I. Johnson (Pediatrics), Philip H.
Kritzsch (Emiritus), Raymond B. Nagle
(Pathology), John Nolte, Donald P.
Speer (Surgery), Nicholas J. Straussfeld
(Arizona Research Laboratories,
Neurobiology)

Associate Professors Gail D. Burd
(Molecular and Cellular Biology), C. Ward
Kischer (Emiritus), R. Clark Lantz,
Christopher A. Leadem, Albert V.
LeBouton, Mary E. Morbeck
(Anthropology), Raymond Runyan,
Paul A. St. John, Leslie P. Tolbert
(Arizona Research Laboratories,
Neurobiology)

Assistant Professors Parker Antin (Ani-
mal Sciences), Herman Gordon,
Nathaniel McMullen, Naomi Rance
(Pathology), Mary Rykowski, Jean M.
Wilson

Research areas of faculty include cell biology,
developmental biology, endocrinology,
molecular biology, neurobiology,
reproductive biology, systems biology,
and biological anthropology. The Depart-
ment of Cell Biology and Anatomy offers
a program of study leading to the Doctor
of Philosophy degree. The Master of
Science degree is offered only in rare
instances in which students are unable to
continue in the doctoral program. Appli-
cants for admission normally should have completed course work in organic
and inorganic chemistry, physics, biology,
math through calculus, and biochemistry.
Additional courses in advanced biol-
ogy, advanced chemistry, genetics, mo-
lecular biology, and statistics are recom-
ended. In addition, applicants must
submit scores from the aptitude test of the
Graduate Record Exam (GRE); sub-
mission of the score on one of the ad-
anced tests is optional. Application
requirements also include 3 letters of rec-
ommendation from former science instruc-
tors and a statement of career goals.

The program of study is very flexible
with only one required lecture course
(CBA 577), two laboratory rotations, and
a research presentation every year. Each
student selects a personalized program of
additional course work and study with
guidance and approval from the stu-
dent's dissertation advisor and members
of the dissertation committee. Students
are required to take a total of 36 units, 18
of which must be obtained from graded
(A, B, C, etc.) courses. Students are re-
quired to teach one semester as part of
their training. Students also must select a
minor field and fulfill the requirements of
that department for the minor. Doctoral
students majoring in other disciplines
may select cell biology and anatomy as a
minor field of study. The minor program
must consist of 9 units in cell biology and
anatomy, 5 of which must be obtained from
graded (A, B, C, etc.) courses, and
approval from a cell biology and anat-
omy minor advisor who serves on the
dissertation committee.

502. Principles of Neuroanatomy (4) II
Cellular elements and recognized subsystems of the
mammalian nervous system, with emphasis on
main principles of neuroanatomical
organization and their functional
importance. Open to premedicals. P, 8 units of
biological lab. science; 401; PSYC 302, PSIO 400
desirable. Consult instructor before enrolling.
(Identical with EXSS 502, PSY 502, and SP H 502)

515.* Human Reproductive Biology (3) I
Structure and function of the human repro-
ductive system with emphasis on physiologi-
ical mechanisms which regulate fertilization,
pregnancy, birth, puberty, reproductive control
and reproductive senescence. P, one semester
of biology.

550. Topics in Pigment Cell Biology (2) I
Selected topics on the development function and
control of normal and abnormal pigment
cells in various pigmentation phenomena. (Iden-
tical with MCB 550)

555. Cancer Biology (3) II 1996-97
(Identical with MBIM 555)

556.* Developmental Biology (3) I
Analyzes principles of development using vertebrate
and invertebrate model systems. P, MCB 181.
(Identical with ANAT 556)

557. Experiments in Developmental Biology
(4) II Analyzes the principles of development.
2R, 6L. P, 556, CHEM 241b. (Identical with
MCB 557)

558. Advanced Subjects in Endocrinology (2)
[Repeat] Selected topics in vertebrate and inver-
tebrate endocrinology. P, 467R. (Identical with
MCB 558)

567R.* Endocrinology (3) II Neuronal and
endocrine integration in the regulation of mam-
alian physiological functions. (Identical with
MCB 567R)

571. Human Embryology (4) II Normal and
abnormal development of the human with
functional aspects stressed. Includes matura-
tion of germ cells to fertilization to birth. Lect-
ure, discussion and demonstration format. P,
MCB 181, 182; EXSS 201, 202 or MCB 456 or
457, or consult with department. (Identical with
ECOL 571 and MCB 571)

575. Special Topics in Biological Imaging
(2) I 1995-96 Designed for graduate students in
the biological and biomedical sciences to pro-
vise an understanding of biological imaging
principles. Lecture and laboratory demonstra-
tions/exercises. Student participation in
discussion will be expected. (Identical with
MCB 575 and PSIO 575)

577. Principles of Cell Biology (4) II Inten-
sive, graduate-level introduction to principles
and mechanisms of cell biology, including cur-
rent research strategies in the field. P, consult
course coordinator before enrolling. (Identical with
MCB 577)

582. Topics in Neural Development (2) I
1995-96 (Identical with NRSC 582)

583. Topics in Neural Plasticity (2) II 1996-97
(Identical with MCB 583)

584. Cellular Neurobiology (2) II 1996-97
Readings and discussions of primary literature
on the cell biology of the synapse. P, permis-
sion of instructor and prior course in neurobi-
ology or cell biology. (Identical with MCB 584
and NRSC 584) Tolbert-St John

588. Principles of Cellular and Molecular
Neurobiology (4) I (Identical with NRSC 588)

589. Principles of Systems Neurobiology (4)
II (Identical with NRSC 589)

595. Colloquium
   a. Journal Club (1) I II [Rpt. /14]. Consult
   instructor before registering.
   b. Special Topics in Cell Biology (2) [Rpt. /6
   units] II 1996-97 (Identical with CBIO
595d)

596. Seminar
   a. Concepts in Cellular Differentiation (2)
   I 1995-96 P, ANAT 577 or equivalent.
   (Identical with MCB 596c)

*May be convened with 400-level course.

601. Human Gross Anatomy (8) I Compre-
hensive survey of the development and gross
structure of the human body. Permission
required to enroll; consult instructor before
registering.

602. Histology and Cell Biology (5)
I Essentials of microscopic human anatomy and
cell biology. Permission required to enroll; consult
instructor before registering.

603. Microscopic Structure (1-3) I II Selected
concepts of structural organization at light and
electron microscopic levels of the anatomy and
development of the cells, tissues, and organs

604. Gross Human Anatomy (2-6) I II Compre-
hensive study of the development and
Chemical and Environmental Engineering (CHE)

Harshbarger Building, Room 120
(520) 621-6044; FAX: (520) 621-6048

Professors Thomas W. Peterson, Head; Milan Bier (Emeritus), Joseph F. Gross (Emeritus), Richard M. Edwards (Emeritus), Alan D. Randolph (Emeritus), Thomas R. Rehm, Farhang Shadmehr, Raymond A. Sierka, Jost O. L. Wendt, Donald H. White (Emeritus)

Associate Professors Robert Arnold, William P. Cosart, Bruce E. Logan, Jennifer Sinclair

Assistant Professors James Baygents, James Farrell, Roberto Z. Guzman, Kimberly L. Ogden

Visiting Professor David Wolf

The department offers programs leading to the Master of Science and the Doctor of Philosophy degrees with majors in chemical engineering and environmental engineering. The graduate program in chemical engineering is designed to provide advanced work in a core of transport phenomena, thermodynamics, reaction engineering, and materials engineering. The details concerning these options see Engineering elsewhere in this catalog.

Degrees

Master of Science with a major in chemical engineering: 30 units, including (a) 3 units from 505, 506, and 530, (b) at least nine additional units of course work in chemical engineering or allied fields, (c) 2 units 900, (d) 8-unit thesis and (e) 2 units seminar (696a). A non-thesis option consisting of 33 units of course work and 2 units of 696a is available with special permission.

Master of Science with a major in environmental engineering: 30 units, including (a) 18 units from the following courses: CHEE 574, 577, 673, 675, 676 and HWR 517; (b) 8 units from related areas, with advisor concurrence; (c) 3-unit thesis (required) and (d) 1 unit seminar (696a).

Doctor of Philosophy with a major in chemical engineering: In addition to the requirements for the Master of Science degree, advanced work in mathematics, chemistry, physics or other engineering fields is required. No foreign language is required.

Doctor of Philosophy with a major in environmental engineering: A total of 78 units, including 30 units from the M.S. degree, 30 units of additional coursework from CHEE or other approved courses, a minor (typically 12 units) and 18 units of dissertation research.


503. Advanced Chemical Engineering Transport Phenomena (3) I Momentum, energy and mass transport in continua, solution of multidimensional laminar flow problems, turbulence, boundary layer theory. P. 305.

506. Advanced Chemical Engineering Thermodynamics (3) I Advanced applications of First and Second Laws, nonideal gases and liquids and their mixtures, principles of chemical equilibrium, and molecular theory. P. 526.


520.* Chemical Reaction Engineering (3) I Application of thermodynamic and kinetic fundamentals to the analysis and design of chemical reactors. P. 201, 326.

521.* Topics in Real-Time Computing (3) I Introduction to microcomputer- and minicomputer-based real-time computing for data acquisition and process control. Includes study of various languages and operating systems. 2R, 3L.


532. Solid-Fluid Reactions (3) I Characterization of solid structural properties; principles of heterogeneous reactions involving a fluid and a reacting solid. P. 326 and 420, or MSE 450R and 412. (Identical with MSE 532)

535.* Corrosion and Degradation (3) II (Identical with MSE 535)

541. Industrial Energy and Power Management (3) II (Identical with EEE 541)

551.* Chemical and Physical Fundamentals of Air Pollution (3) II Study of the kinetics, transport phenomena and phase equilibria of urban air pollution problems. P. 305, 420.

554.* Law for Engineers/Scientists (3) I Topics covered in this course include patents, trademarks, copyrights, product liability contracts, business entities, employment relations, and other legal matters important to engineers and scientists. (Identical with ENGR 554)

560.* Aerosol Science and Engineering (3) I 1995-96 Physics, chemistry, mechanics, and optics of atmospheric aerosol particles. Topics include formation, dynamics, nucleation and growth, coagulation, scattering and absorption of radiation, deposition and aerosol technology. (Identical with ATM 560 and ECE 560)

573. Biodegradation of Hazardous Organic Compounds (2-3) II Chemical and microbiological considerations which affect the thermodynamics and kinetics of transformations of hazardous organic compounds in treatment facilities and in natural settings. For 2R, 3L, P. 577, or consult with department. (Identical with C E 573)

574. Environmental Transport Processes (3) I Engineering concerns in toxic and hazardous waste management with focus on aspects of chemical transport between air, water and soil systems, and microbial degradation processes in natural and engineered environment. (Identical with C E 574)

577. The Physiological Bases of Microbial Treatment Processes (3) II Principles of bacterial physiology including morphology, metabolism and genetics. Applications of importance
Chemistry (CHEM)

Old Chemistry Building, Room 221
(520) 621-6354; FAX: (520) 621-8407


Assistant Professors Jacquelyn Gervay, S. Scott Saavedra

The department offers programs leading to the Master of Arts, Master of Science, Master of Education, and Doctor of Philosophy degrees with a major in chemistry. Concentrations are available in analytical, biochemical, inorganic, organic and polymer, and physical chemistry; and can include chemical physics, materials science, optical sciences, and several other interdisciplinary fields.

Prospective students should write to the Recruitment Office in the Department of Chemistry. The minor is available, and the guidelines for the graduate students. Research support is also required of each student. A dissertation is required. All students must pass a final oral examination.

Master of Science: A thesis based upon original research is required. At least one year teaching experience is generally required. All students must pass a final oral examination.

Master of Education: See Master of Education elsewhere in this catalog.

Doctor of Philosophy: The Doctor of Philosophy with a major in chemistry is primarily a research degree. The number and selection of courses is tailored to the individual student's needs and interests according to the guidelines available from the Office of Academic Affairs in the Department of Chemistry. The minor work may be satisfied within the Department of Chemistry. Since teaching experience strengthens an individual's grasp of principles, a year of teaching is generally required of each student. A dissertation based upon original laboratory research is required. All students must pass a preliminary examination and a final oral examination.

501. Intermediate Analytical Chemistry (3) I Survey of principles of modern analytical chemistry; intended as concise review of modern chemical analysis. P, 424, 480b or consent of instructor.


503. Intermediate Physical Chemistry (3) I General survey of physical chemistry, including thermodynamics, structure, kinetics and electrochemistry. P, 480b.

504.* Inorganic Chemistry (3) I Fundamentals of inorganic chemistry. P, 480a or CR.

507. Radiochemistry and Radiation Detection (3) I (Identical with CE 507)

510a-510b. Advanced Inorganic Chemistry (3-6) Survey at the advanced level of the chemistry of the elements. P, 410.

512.* Inorganic Preparations (2 to 4) I Modern inorganic syntheses, including instruction in the use of high pressure, temperature, and vacuum techniques and in the manipulation of unstable compounds. 6 to 12L.

517. Structural Chemistry (2) II Introduction to the determination of structures of complex molecules by X-ray crystallography; the evaluation of structural information; current topics in structural chemistry. 2R.

517L. Structural Chemistry Laboratory (1) I Laboratory designed to accompany 517. Students work in the lab, solve structures and report their findings in papers. 3L. CR, 517.

518. Computational Chemistry (2) I State-of-the-art computational methods in chemical research, including approximate and ab initio electronic structure methods, molecular mechanical and modeling graphics. P, consent of department.

518L. Computational Chemistry Laboratory (1-2) Laboratory designed to accompany 518. Students work in the computer lab and report their findings in papers. 3 or 6L. P, consent of department. CR, 518.

to waste treatment and environmental quality. P, 370, or consult with department. (Identical with CE 577)

578.* Introduction to Hazardous Wastes (3) II Management, planning, legal and engineering aspects of liquid and solid hazardous waste treatment and disposal. P, 370 or consult department before enrolling. (Identical with CE 576)


581. Bioreactor Engineering (3) I Introduction to biotechnology; chemistry of microorganisms; design of bioreactors to include cellular and enzyme reactors of all types; transport phenomena and control of bioreactors; instrumentation and measurement in bioreactors.

583. Remote Sensing Instrumentation and Techniques (3) II (Identical with ECE 583)


*May be convened with 400 -level course.


645. Advanced Solar Engineering (3) II (Identical with NEE 645)


673. Advances in Water and Waste Reclamation and Reuse (2) I Theory, application, and evaluation of currently developing techniques in water and waste reclamation and reuse. P, 675. (Identical with CE 673)

675. Wastewater Treatment (3) I II Theoretical and applied principles of aerobic and anaerobic wastewater treatment systems. P, 370. (Identical with CE 675)

676. Advanced Water Treatment System Design (3) II Design and operation of water treatment plants; physicochemical treatment processes for potable water production. (Identical with CE 676)

696. Seminar
a. Chemical Engineering (1) [Rpt./6] I II
b. Combustion (1) [Rpt./6] I II
c. Kinetics (1) [Rpt./6] I II
d. Pollution Control (1) [Rpt./6] I IIf. Fluid Mechanics (1) [Rpt./6] I II
g. Biomedical (1) [Rpt./6] I II
h. New Developments (1) [Rpt./6] I II
i. Environmental Engineering (1) [Rpt./6] I II

Chemical and Environmental Engineering—Chemistry 61
520. Advanced Topics in Analytical Chemistry (2-3) [Rpt. 6 units] Special topics in modern analytical chemistry. Recent offerings have included principles of bioanalytical chemistry and mass spectrometry. Students enrolled for 3 units are required to complete an additional research project including a written paper and an oral presentation. P, 424 or consent of instructor.

521a-521b. Advanced Analytical Chemistry (3-3) II 521a: Principles of electronics, principles of signal processing hardware and software, instrumental principles of atomic and molecular spectroscopy, statistical treatment of data, chemometrics. P, 325, 424, 480b. 521b: Advanced fundamentals of equilibrium chemistry, principles of analytical separations including chromatography, principles of electroanalysis including ion selective electrodes and chemical sensors. P, 325, 424, 480b.

522. Electroanalytical Methods (2-3) Principles of electrochemistry and electroanalysis, including topics on electrochemical equilibrium and kinetics, potentiometry, voltammetry, amperometry, coulometry, chronopotentiometry, and modern cyclic and pulse methods. Students enrolled for 3 units are required to complete an additional research project including a written paper and an oral presentation. P, 424 or consent of instructor.

523. Application of Equilibrium Principles in Analysis (2-3) [Rpt. 6 units] Advanced topics in equilibrium chemistry including mathematical description of equilibria in aqueous and nonaqueous media, metal chelate chemistry. Students enrolled for 3 units are required to complete an additional research project including a written paper and an oral presentation. P, 521b or consent of instructor.

526a. Analytical Atomic Spectroscopy (2-3) Principles of atomic absorption and emission spectroscopies, and X-ray methods for chemical analysis. Students enrolled for 3 units are required to complete an additional research project including a written paper and an oral presentation. P, 424 or consent of instructor.

526b. Analytical Molecular Spectroscopy (2-3) Principles of molecular absorption, emission scattering spectroscopies for chemical analysis. Students enrolled for 3 units are required to complete an additional research project including a written paper and an oral presentation. P, 424 or consent of instructor.

527. Analytical Separations (2-3) I Fundamentals of separation processes including single and multistage, analytical chromatographic methods. Students enrolled for 3 units are required to complete an additional research project including a written paper and an oral presentation. P, 424 or consent of instructor.


529. Methods of Surface and Materials Analysis (2-3) I Fundamentals of electron, atomic and molecular spectroscopies for surface and materials analysis. Students enrolled for 3 credits are required to complete an additional research project complete with paper and oral presentation. P, 424 or consent of instructor.
Civil Engineering and Engineering Mechanics (C E/E M)

Civil Engineering Building, Room 206
((520) 621-2266; FAX: (520) 621-2550

Professors Dinshaw N. Contractor, Head, Donald A. DaDeppo, Chandrakant S. Desai, Martha W. Gilliland, Achintya Halder, David J. Hall (Emeritus), Simon Ince (Hydrology and Water Resources), Rudolf A. Jimenez, James D. Kriegh (Emeritus), Tribikram Kundu, Emmett M. Laursen (Emeritus), Allan J. Malvick, Haaren A. Miklofsky (Emeritus), Richmond C. Neff (Emeritus), Philip B. Newlin (Emeritus), Ralph M. Richard (Emeritus), Ernest T. Smerdon

Associate Professors Donald J. Baumgartner, Muniram Budhu, Mohammad R. Elshani, George N. Frantziskonis, Donald B. Hayes (Emeritus), Panos D. Kiousis, Kevin E. Lansey, Margaret S. Petersen (Emerita), Hamida Saadatmanesh, Robert H. Wortman

Assistant Professors Sonia H. Armaleh, William M. Isenhower

The department offers programs leading to the Master of Science and the Doctor of Philosophy degrees with majors in civil engineering and engineering mechanics. Work is directed toward research and professional development in such areas as engineering mechanics, engineering materials, regional development and urban planning, highway engineering, hydraulics and fluid mechanics, environmental engineering, geomechanics, geotechnical engineering, water resources, structural engineering, and transportation. Certain interdisciplinary options are available by combining various areas of the program. For further information concerning these options see Engineering elsewhere in this catalog.

Degrees

Master of Science: A thesis or engineering report is required. At the option of the department, the degree may be awarded to candidates for the Doctor of Philosophy degree who have passed the preliminary examination, provided they write a thesis or engineering report.

Doctor of Philosophy: A minor field may be selected from architecture, chemistry, environmental engineering, geology, mathematics, mechanical engineering, materials science and engineering, mining engineering, nuclear engineering, physics, or systems engineering, or from within the Department of Civil Engineering and Engineering Mechanics. Still other fields are available as minors with the approval of the head of the department.

Civil Engineering (C E)


503. Subsurface Fluid Dynamics (3) I (Identical with HWR 503)

504. Numerical Methods in Subsurface Hydrology (4) II (Identical with HWR 504)


511. Computer-Aided Geometric Design (3) (Identical with AME 511)

517.* Mechanics of Materials II (3) Three dimensional analysis of stress and strain, Castigliano's theorems, curved beams, asymmetric bending, shear center, torsion of thin-walled sections, beams on elastic foundation, nonlinear material behavior, membrane stresses in shells. P, 217.

523.* Hydrology (3) I Discussion and analysis of major topics of the hydrologic cycle and their interrelationship, such as rainfall, infiltration, evaporation, run-off, and flow. Statistical and probabilistic methods in water supply and flood hydrology. P, 321. (Identical with HWR 523 and AR L 523)

524.* Hydraulic Engineering Design (3) II Application of principles of hydraulic analysis to the design of hydraulic systems. Applications will vary and include hydropower systems, stilling basins, open channel distribution and collection systems, pipe networks and pumping systems, drainage problems and other topics. P, 322.


526. Water Quality Management (3) II (Identical with HWR 526)

527.* Computer Applications in Hydraulics (3) I Computer modeling of surface water hydrology, flood plain hydraulics and water distribution systems. Theoretical basis, application and design studies. (Identical with HWR 527)

528.* Introduction to Coastal Engineering (3) II Hydrodynamics of the coastal zone; coastal sediment processes and their interaction with structures; diffusion in coastal waters and marine outfall design; coastal zone management. P, 321.

532.* Advanced Structural Design in Steel (3) I Advanced problems in the analysis and design of steel structures including bending, beam-columns, plate girders, composite construction, multi-story buildings; static and dynamic lateral and vertical loads; connections; computer applications. P, 336.

533. Plastic Analysis and Design (3) II 1995-96 Material and member behavior to full plastification; redistribution of forces; plastic design of continuous beams and frames; influence of axial and shear forces; deflections and rotations; alternating plasticity; shakedown analysis. P, 432 or consult department before enrolling.


536. Prestressed Concrete Structures (3) I 1995-96 Behavior, analysis, and design of statically determinate and indeterminate prestressed concrete structures. P, 337.

537.* Advanced Structural Design in Concrete (3) I 1996-97 Advanced problems in the analysis and design of concrete structures, design of slender columns and one- and two-way slabs; lateral and vertical load analysis of bridges and multistory buildings; introduction to design for torsion and seismic forces; use of structural computer programs. P, 337.

540.* Foundation Engineering (3) II Settlement and bearing capacity of shallow and deep foundations; beam on elastic foundation; design of footings and pile foundations; foundations on metastable soils; the use of computer codes for foundation problems. P, 340.

541.* Earth Structures in Geotechnical Engineering (3) I Stability analysis for earth slopes, including planar, circular piecewise-linear, and composite-surface methods: analyses for static and steady-flow conditions; earth pressure theories and calculations for generalized conditions; design of rigid and flexible retaining structures; design of braced and tie-back shallow structures; design of reinforced earth walls; computer-aided analysis and design. P, 340.

544. Special Topics in Geomechanics (3) I 1995-96 Introduction to geoenvironmental engineering; physiochemical and microstructural behavior of geomaterials, effects of pollutants, design of waste disposal systems; advanced laboratory testing, geotextiles, space geomechanics, etc. P, 340 or consent of instructor.

547. Seepage and Earth Dams (3) I 1996-97 Principles of flow in porous media; analytical and approximate solutions of confined and unconfined flow; seepage, erosion, piping and filter design; earth and rock fill dam construction and design; stability analyses. P, 340.
548. Numerical Methods in Geotechnical Engineering (3) I 1995-96, II 1996-97 Brief statements and applications of numerical methods based on closed-form solutions, finite difference, finite element and boundary element methods for problems involving soil structure interaction such as piles, retaining walls, group piles, underground works; seepage; and consolidation. P, 340, 402 or 502.

552. Engineering Surveys (3) I Solar and Polaris observations; mineral, public, and private land surveys; route surveying, curves, and earthwork; triangulation, photogrammetry, and modern engineering surveys. P, 251.

555. Irrigation Engineering (3) II (Identical with ABE 555) P, C E 321 or A ME 331a

558. Drainage of Irrigated Lands (3) II 1995-96 (Identical with ABE 558)

562. Bituminous Materials (3) II Manufacture and evaluation tests for the control of bituminous materials used in highway construction and maintenance. P, 340, or consult department before enrolling.


564. Airport Planning and Design (3) II Location, analysis and design of airports and airport facilities, including aircraft characteristics, site selection, configuration, capacity, access and terminals. Field trips. P, 360.

565. Project Planning and Modeling (3) II Use of systems analysis in contemporary planning, including consideration of social, environmental and physical constraints; study of general and special purpose manual and computer-based simulation and gaming as an engineering and planning tool. P, senior standing in civil engineering or consult with department. (Identical with PLNG 565)

568. Urban Transportation Planning (3) II Transportation planning in relation to urban development; techniques and procedures for developing long-range regional plans. P, 360 or consult department before enrolling. (Identical with PLNG 568)

573. Biodegradation of Hazardous Organic Compounds (2-3) II (Identical with CHEE 573)

574. Environmental Transport Processes (3) I (Identical with CHEE 574)

577. The Physiological Bases of Microbial Treatment Processes (3) II (Identical with CHEE 577)

578. Introduction to Hazardous Wastes (3) II (Identical with CHEE 578)

586. Fundamentals of Industrial Hygiene (3) I (Identical with OSh 586)

587. Advanced Industrial Hygiene and Safety (3) II (Identical with OSh 587)


597. Workshop w. Advanced Cadastral Survey (1-4) II (Identical with RNR 597w)

*May be convened with 400-level course.

621. Sediment Transportation (2) I 1995-96, II 1996-97 Erosion, transportation and deposition of sediments by flowing water; sediment properties and their measurement; bed load and suspended load movement; river behavior and control. P, 321.


623. Flow through Hydraulic Structures (3) I 1995-96 Subcritical and supercritical flow through culverts, bridges, spillways, stilling basins, transitions, bends; hydrologic effects on inflow; pumps and turbines. P, 322.

624. Planning and Design of Multipurpose Water Resources Projects (3) I 1995-96 Design of water resources system for surface water supply, flood control, hydropower and navigation, either as single purpose or as multipurpose projects; brief review of environmental, economic and legal aspects. Field trips. P, 321, 423 or 523.

632. Infrastructure Rehabilitation (3) (11996-97 Status of infrastructure and causes of deterioration of constructed facilities. Strengthening of bridges and buildings. Application of advanced modern materials such as fiber composites in the design of new structures and rehabilitation of existing structures. P, 331, 336, 337.

633. Reinforced Concrete Members (3) I 1995-96, II 1996-97 Inelastic behavior of beams and columns; short- and long-term beam deflections; combined bending, shear, and torsion in beams; behavior under load reversals; analysis and design of beam to column connections and shear walls. P, 437 or departmental approval.


640. Advanced Soil Mechanics (3) I Site investigation and in situ testing; shear strength of sands and clays; interpretation of laboratory test results; consolidation theory; one-dimensional infinitesimal and finite strain; slope stability. P, 340.


645. Geoenvironmental Engineering (3) I 1995-96, II 1996-97 Interaction of environment and geotechnology; physicochemical properties and mechanisms of pollutant transport, effects on soil and foundation behavior and ground water, analytical and numerical modeling, design of geotechnical structures and waste contaminant systems. P, 340, 544 or consent of instructor.


661. Structural Design of Flexible Pavements (3) I Analysis of loads, stresses, material characteristics, and environmental factors for the theoretical and practical design, construction and maintenance of pavements. P, 340, 361.

664. Transportation Economics (3) I 1995-96 Economic analysis of transport projects, including rural and urban roadways, control systems, and mass transit; discussion of environmental and financial factors. P, 463 or 563.


666. Highway Geometric Design (3) II Study of geometric elements of streets and highways, with emphasis on analysis and design for safety. P, 463 or 563.


673. Advances in Water and Waste Reclamation and Reuse (2) I (Identical with CHEE 673)

675. Wastewater Treatment (3) II (Identical with CHEE 675)

676. Advanced Water Treatment System Design (3) II (Identical with CHEE 676)

Engineering Mechanics (E M)

Credit for these courses is offered in both civil engineering and engineering mechanics.

502. Introduction to Finite Element Methods (3) III (Identical with C E 502)


508. Fracture Mechanics (3) I 1995-97 Modes of fracture; crack propagation; Griffith energy balance; crack tip plasticity; J-integral; fatigue cracks; analytical and numerical techniques;
constitutive models for damaged materials. P, C E 505, or consult with department.

511. Advanced Finite Element Analysis (3) II 1995-96 Approximation functions, Lagrangian and Hermite interpolation, isoparametric elements and numerical integration; mixed, hybrid and boundary element methods, nonlinear analysis, nonlinear problems in solids under static and dynamic loads, time integration schemes, fluid and heat flow coupled problems and mass transport. P, C E 402, or consult department before enrolling. (Identical with A ME 511)

596. Seminar
   a. Research Topics (1) [Rpt. /II] (Identical with C E 596a)

603. Elasticity Theory and Application (3) I General three-dimensional equations of elasticity; problems in plane stress, plane strain, extension, torsion; energy, residual and other solution methods; applications to rings, beams, plates, torsion and other problems. P, C E 217, 302.

604. Plasticity Theory and Application (3) II Yield conditions and flow rules for perfectly plastic and strain hardening materials; application to various elastoplastic problems such as bars, cylinders and plates; effect of volume change behavior, isotropic and anisotropic hardening plasticity with expanding/contracting yield surfaces. P, C E 417 or E M 603, or consult department before enrolling.


635. Matrix Methods in Structural Mechanics (3) I 1996-97 General concepts and principles of the force and displacement methods; the finite element method, with application to bar, beam, plate, and shell structures; organization and development of computer programs; linear and nonlinear systems. P, C E 331 or A ME 461.


Assistant Professors Janet Jakobsen, Frank E. Romer, Cynthia White

The Department of Classics offers the degree of Master of Arts with a major in classics with concentrations in philology (Greek/Latin) and classical archaeology. Degree requirements include 33 units of graduate-level course work, accompanied by the passing of qualifying examinations, including demonstrations of research proficiency in French or German, and the completion and defense of a thesis.

For the concentration in classical archaeology, prior completion of CLAS 340a-340b is a prerequisite. The classical archaeology concentration also requires 12 units of 500-level CLAS courses, including 6 units of CLAS 596 and the completion of one 500-level course in either ancient Greek or Latin, and of one 400-level course in the other language with a grade of B or higher. A maximum of 15 units of elective credit may be earned in a related field, which may be outside the department. The program of study should be planned in consultation with the graduate advisor for classical archaeology.

Graduate courses in the Department of Classics are open to all graduate students with the permission of the instructor.

Classical Art and Archaeology (CLAS)

543a-543b. * Archaeology of Neolithic and Bronze Age Greece (3-3) History, art and culture of prehistoric Greece through the study of archaeological excavations. 543a: Paleolithic through the end of the Middle Bronze Age. 543b: The Minoan and Mycenaean cultures of the Late Bronze Age. 543a is not prerequisite to 543b. (Identical with ANTH 543a-543b).

552. * Etruscan Art and Architecture (3) Surveys the art and architecture of the Etruscans between the 7th and the 1st centuries B.C. P, 340b or consent of instructor. (Identical with ARH 552).

555. * Research Methods in Classical Archaeology (3) [Rpt./I] Analysis of various methods of research in classical archaeology emphasizing the critical use of source material, the development of independent thought and the production of the finished, written product. P, 340a or 340b.

556. * Greek and Roman Painting (3) Greek vase painting from the Dipylon vases of the geometric period in Athens to the Orientalizing animal styles of Corinth and the black and red figured Attic style. Also, survey of ancient Roman painting and mosaics. P, 340a-340b. (Identical with ARH 556).


558. * Greek and Roman Provincial Archaeology (3) Survey of classical archaeology in ancient Tunisia, Cyprus, Portugal and Turkey. P, 340a or 340b.

561. * Greek Pottery 1200-400 B.C. (3) The development of Greek pottery from the collapse of the Mycenaean empire to the close of the classical period. Special attention to shapes, decoration, function, and artistic and technical skills. (Identical with ANTH 561 and ARH 561).

563. * Classical Field Archaeology (6) [Rpt./I] Field training and lecture program for students beginning in archaeology; includes trench supervision, stratigraphy, loci theory, and oral and written reports on field techniques. Offered on several archaeological sites in the Mediterranean area. P, consult department before enrolling.

564. Topics in Ancient Mediterranean Archaeology (3) [Rpt./I] Research papers and oral presentations on different aspects of Greek and Roman archaeology; preparation in writing scholarly articles for refereed journals. P, 340a or 340b.

574. * Archeometry: Scientific Methods in Art and Archaeology (3) II 1993-94 (Identical with ANTH 574)

581. * Archaic Greek Sanctuaries (3) Archaeology of the sanctuary sites from the Archaic Period in Greece, both those which became panhellenic and those associated with individual states. Relationships between the polis and the local sanctuary. (Identical with ANTH 581)

584. * Roman Art and Architecture (3) The origin and development of Italian art and architecture from Etruscan beginnings through the Republic to the late Empire. P, ARH 117, 118, or 6 units of ancient history. (Identical with ARH 584)

587. Testing and Evaluation in Foreign/Second Language Programs (3) (Identical with GER 587)

596. Seminar
   a. Ancient Art and Archaeology (3) [Rpt./30 units] (Identical with ARH 596a)

*May be converted with 400-level course.

Classical Literature and Civilization (CLAS)

510a-510b. Classical Philology (3) Introduction to the various disciplines of classical scholarship: philology, textual criticism, paleography, papyrology, archaeology.

570. * Greek Philosophy (3) [Rpt./I] (Identical with PHIL 570)

572a. * Ancient Philosophy (3) [Rpt.] (Identical with PHIL 572a)


Greek (GRK)

502.* Greek Reading Course (3) [Rpt.] Readings in major Greek authors including Homer, Plato, and the historians and dramatists. P, 3 units of 400-level Greek.
512.* Readings in Greek Philosophy (3) [Rpt./1] Extensive readings in Greek in one of the following areas of Greek philosophy: the pre-Socratic, Plato's ethics and epistemology, Aristotle's Nicomachean Ethics. P, 3 units of 400-level Greek. (Identical with PHIL 512)
521.* Greek Lyric Poetry (3) [Rpt./1] Study in Greek of the early Greek Lyric writers from Archilochus to Bacchylides, including Pindar. P, 3 units of 400-level Greek.
522.* Readings in Greek Drama (3) [Rpt./1] Close reading in Greek of either (1) tragedy—one play each by Aeschylus, Sophocles and Euripides, or (2) comedy—two plays of Aristophanes, one of Menander. P, 3 units of 400-level Greek.
524.* Homer (3) [Rpt./1] Close reading of selections from the Iliad and Odyssey in Greek and an introduction to the critical secondary literature.
530.* Readings in the Greek Historians (3) [Rpt.] Selections from Herodotus and Thucydides with an introduction to the critical literature. Readings in Greek. P, 3 units of 400-level Greek.
531.* Greek Orators (3) [Rpt.] Readings in Greek from Lysias, Isocrates and Demosthenes as sources for ancient rhetoric, politics, and private life. P, 3 units of 400-level Greek.
532.* Literature of Archaic Greece (3) [Rpt.] Readings in Greek from Hesiod and the early lyric poets. The agricultural perspective and the anti-heroic ideal. P, 3 units of 400-level Greek.
596. Seminar a. Topics in Ancient Greek Literature (3) [Rpt./30 units]

*May be converted with 400-level course.

Latin (LAT)

501.* Latin Reading Course (3) [Rpt./1] Readings in one of the following: epic, lyric, drama, history, oratory, satire, epistles, novel, philosophical, technical or medieval literature. P, 3 units of 400-level Latin.
503.* Late Antique Literature (3) [Rpt./1] II S Selections from genres and/or authors, both Christian and non-Christian, from the late antique period. P, 3 units of 400-level Latin.
513.* Augustan Literature (3) [Rpt./1] Readings from a major writer or writers of the Augustan Age. P, 3 units of 400-level Latin.
514.* Medieval Latin (3) Survey of Latin literature during the thousand years between the end of the classical period and the beginning of the Renaissance. Readings in Latin. P, 3 units of 400-level Latin.
515.* Latin Love Elegy (3) [Rpt./1] Reading in the Latin texts of Ovid, Tibullus and Propertius. P, 3 units of 400-level Latin.
525.* Cicero (3) [Rpt./1] The life of Cicero illustrated by means of close reading of selected works in Latin (pro Caecilius, selections from the Philippi Times, the Verrine Orations) as well as selections from his letters. P, 3 units of 400-level Latin.
526.* Roman Historians (3) [Rpt.] Readings in Latin from the Roman historians and biographers. Selections from Livy, Caesar, Tacitus, or Suetonius. May be repeated without duplication of readings. P, 3 units of 400-level Latin.
528.* Silver Age Latin (3) [Rpt.] Readings from Latin writers of the early Empire. Readings will be in Latin. P, 3 units of 400-level Latin.
596. Seminar a. Topics in Latin Literature (3) [Rpt./30 units]

*May be converted with 400-level course.

Cognitive Science

Psychology Building, Room 312
(520) 621-2065; FAX: (520) 621-9306
Graduate Interdisciplinary Program in Cognitive Science

Committee:
Professors Merrill F. Garrett, Chair (Linguistics), Carol A. Barnes (Psychology), Kathryn A. Bayles (Speech and Hearing Sciences), Robert C. Cummins (Philosophy), Richard A. Demers (Linguistics), Kenneth L. Forster (Psychology), Alvin I. Goldman (Philosophy), R. Michael Harnish (Philosophy), Thomas J. Hixon (Speech and Hearing Sciences), Audrey L. Holland (Speech and Hearing Sciences), William H. Itelson (Psychology), Alfred Kaszniak (Psychology), D. Terence Langendoen (Linguistics), Adrienne J. Lehrer (Linguistics), John C. Maloney (Philosophy), Bruce McNaughton (Psychology), Lynn Nadel (Psychology), John Pollock (Psychology), Alan B. Rubens (Psychology), Susan M. Steele (Linguistics)
Associate Professors Diana B. Archangelu (Linguistics), Felice L. Bedross (Psychology), Michael Hammond (Linguistics), Laura A. McCloskey (Psychology), Richard T. Oehrle (Linguistics), Mary A. Peterson (Psychology), Linda Swisher (Speech and Hearing Sciences), Joseph Tolliver (Psychology)
Assistant Professors John J. Allen (Psychology), Andrew Barss (Linguistics), Paul Bloom (Psychology), Elizabeth Glinsky (Psychology), Kerry P. Green (Psychology), Chad J. Marsolek (Psychology), Janet L. Nicol (Linguistics), Cecil Mckee (Linguistics), Cyma Van Petten (Psychology), Yingyong Qi (Speech and Hearing Sciences), Margaret K. Wynn (Psychology)

The program offers a minor in cognitive science for the Doctor of Philosophy degree. Inquiries should be directed to the chairperson of the Committee on Cognitive Science at the campus address given above.

Communication (COMM)

Speech Building, Room 209
(520) 621-1366; FAX: (520) 621-5504
Professors William D. Crano, Head, Juudie K. Burgour, Michael Burgour (Family and Community Medicine), Henry L. Ewbank, Klonda Lynn (Emeritus)
Associate Professors David B. Buller, Sally A. Jackson, Curtis S. Jacobs, Henry C. Kenski (Political Science), Robert W. Sankey, David A. Williams

The department offers advanced study of human communication from a social science perspective, with content concentrations in (a) interpersonal interaction and relationship management, (b) social influence (including mass media and political communication), and (c) message processing. The department also offers extensive preparation in scientific research methods.

Graduates may enter a variety of academic, private sector, or public positions.

The department offers the Master of Arts and Doctor of Philosophy Degrees with a major in communication.

In addition to the materials required by the Graduate College, applicants for admission must submit a completed departmental application form, three letters of recommendation (preferably from academic sources), Graduate Record Examination scores that are no more than five years old, and a sample of scholarly writing (preferably thesis chapters or a thesis proposal for doctoral program applicants).

Master's students may select a thesis or nonthesis option and a disciplinary or interdisciplinary track.

The thesis option: 31 units including 4 thesis units. May include up to 12 units taken outside the department (the interdisciplinary track) as long as these units form a coherent concentration and are
approved by the guidance committee. All students are required to complete 610, 620, 660, and an additional graduate-level research methods course. Up to three units of independent study may be counted toward the minimum number of units. Students planning to enter a doctoral program are strongly urged to select the thesis option.

The nonthesis option: 36 units. May include the interdisciplinary track (described above). All students are required to complete 610, 620, 660, and an additional graduate-level research methods course. Up to three units of independent study may be counted toward the minimum number of units. Students interested in applied programs or positions in industry and government are urged to select this option, which provides excellent flexibility in tailoring the program to the student's needs.

Doctoral students must complete the following requirements, as well as declare areas of concentration.

Major: 36 units (9 of which may be transferred in from the master's degree). With guidance committee approval, some of these units may be taken from other departments offering courses with communication-related content. As part of these units, all students are required to complete 610, 620, 660, and 670. These satisfy the qualifying examination requirement.

Minor: All students must select one or more minors, the requirements of which are determined by the minor department.

Scholarly research tool: All students must complete a minimum of six additional hours of research methods course work, preferably related to the type of research they plan to conduct for their dissertation.

Dissertation: 18 units.

For doctoral students, a maximum of six units of independent study may be counted toward the major and minor minimum number of units. Additional requirements for both programs are that all courses counted toward degree minimums must be passed with a grade of B or better (or P or better for S/P Special Grades).

503. *Theories of Small Group Communication (3) I II Theory and research on social control and deviance in groups from the perspective of communication behavior.

509. *Theories of Mass Communication (3) II An in-depth analysis of theories of the social effects of various mass media sources on society.

510. *Struggle for the Presidency (3) I Examination of the campaign strategies and tactics of those seeking the nation's most powerful office from 1960 to the present. (Identical with POL 510)

511. *Communication and Conflict Management (3) I II Consideration of theory and research pertaining to the handling of conflict across diverse contexts.

514. *Verbal Communication (3) I II Theory and research on verbal messages. Topics include patterns of conversational interaction, processes of message construction and interpretation, functions and contexts of messages. P, 300.

515. *Nonverbal Communication (3) I II Theory and research on nonverbal communication codes (kinesics, touch, voice, appearance, use of space, time and artifacts) and social functions (impression formation and management, relational communication, emotional expressions, regulation of interaction, social influence).

517. *Relational Communication (3) I II The relational communication process and messages people use to define interpersonal relationships, including dominance-submissiveness, affective, involvement and similarity. P, 104.

520. *Communication and the Legal Process (3) I Presents a number of accomplishments and challenges in the social scientific study of law, with special emphasis on the effects of communication and social structure on the legal processes. (Identical with SOC 520)

521. *Political Campaign Communication (3) I Investigation and analysis of communication principles and practices in contemporary campaigns for elective office.

522. *Presidential Leadership and Communication (3) I II Examination of presidential leadership and communication strategies of the modern presidents from Kennedy to the present.

523. *Topics in Rhetorical Theory and Criticism (3) [Rpt./1] Intensive reading and analysis of the works of major rhetorical theorists. Each semester will focus on a specific era or perspective.

524. *Media and Politics in America (3) I Survey of field; media in political campaigns; media coverage of leaders, issues, and institutions; leadership theories and influence media.

525. *Scientific Argument in Public Discourse (3) I Advanced argumentation theory focused on examination of scientific argument in public decision-making. Topics include general theory of fallacies and special fallacies related to scientific reasoning.

528. *Communication Research Methods (3) I II Theories of communication and their research backgrounds; research methodology in communication behavior studies.


562. *Communication and Human Relationships (3) I II An advanced course enabling students to inventory, evaluate, and develop interpersonal communication skills in the interpersonal, group, and organizational dimensions of their lives. *May be conveyed with 400-level course.

576. Field and Observational Methods (3) I II (Identical with SOC 576)

589. Scholarly Communication (3) I II (Identical with LI S 589)

610. Communication Theory I (3) I An overview of theoretical perspectives on the role of verbal and nonverbal communication in the process of generating and understanding development of interpersonal relationships.

620. Communication Theory II (3) II An overview of historical and theoretical perspectives on communication strategies used in social influence attempts from interpersonal to mass media contexts. (Identical with PHL 620)

621. Theory Construction in Communication (3) I Theoretical and meta-theoretical positions in the discipline of communication with an emphasis on approaches to analyzing and developing original theories.

660. Research Methodologies I (4) I An introduction to research methods and designs used in contemporary communication research.

670. Research Methodologies II (4) II Advanced study of methods and statistical analysis in contemporary communication research.

671. Research Methodologies III (3) I Five issues in measurement and sampling in laboratory and field research in communication. P, 670.

696. Seminar

a. Nonverbal Communication (3) [Rpt./3] II
b. Rhetorical Theory and Criticism (3) [Rpt./3] II
c. Social Influence (3) [Rpt./3] II
d. Mass Media (3) [Rpt./3] II
f. Linguistic Investigations and Applications (3) [Rpt./3] II (Identical with LING 696f)
g. Message Analysis (3) [Rpt./3]
h. Organizational Communication (3) [Rpt./3] II
i. Interpersonal Communication (3) [Rpt./3] II
j. Information Processing and Management (3) [Rpt./3] II
k. Research Methods (3) [Rpt./3] II

Comparative Cultural and Literary Studies (CCLS)

1239 North Highland Avenue, Building 431a
(520) 626-8693; FAX: (520) 626-8694

Graduate Interdisciplinary Program in Comparative Cultural and Literary Studies

Committee:
Professors Barbara A. Babcock, Director (English), Jane H. Hill (Anthropology), Jerrold E. Hogle (English), Herbert N. Schneider (English), Melanie R. Wallendorf (Marketing)
Associate Professors Kamakshi P. Murty (German), Lileen R. Meehan (Media Arts), Marvin Waterstone (Geography and Regional Development)
Assistant Professors Elizabeth G. Harrison (East Asian Studies), Michelle A. Tagge (American Indian Studies)

Comparative cultural and literary studies explore similarities and differences within and among national cultures and literatures, as well as in the work of individuals, using a variety of methods from...
the humanities and social sciences. Such interdisciplinary studies focus on the production, circulation, and interpretation of meaning and value in all cultural activity.

The program offers the M.A. and Ph.D. degrees with a major in comparative cultural and literary studies. Students pursue a core of theoretical courses and study at least two primary discourses. Courses are taught by faculty from a variety of cooperating departments and programs. A list of affiliated faculty is available from the program office. Courses may be, but are not limited to, literary discourses in the original language. Examples of nonliterary discourses include anthropology, culture and technology, cultural geography, media arts, art history and science, among others. Ph.D. students may minor in a third discourse, which may be another literature or another discipline/program of study in the human sciences. The master’s degree is considered primarily as leading to the Ph.D. degree. CCLS also offers a 12-15 unit minor for doctoral students in other programs and departments.

Admission to the program is based on the following kinds of evidence: (1) excellent undergraduate performance in language, literature, and/or another form of discourse (preferably majors and minors) as indicated by a transcript; (2) three letters of recommendation from persons familiar with the student’s performance in these areas; (3) an example of the student’s writing on a literary or cultural topic. For students applying for the doctoral program, this must be an article-length and article-quality piece that will serve as a qualifying exam.

In addition, students may wish to submit GRE aptitude and/or subject test scores. Foreign students must submit TOEFL scores.

**Master of Arts: Degree requirements include at least 30 units: 18 units in graduate-level courses in at least two discourses; no more than 9 units may be taken in any one discourse; 3 units of 503; 3 units of 549a or 549b; 3 units of 550; 3 units of independent study in preparation for the master’s examination, a final examination (consisting of an article-length, article-quality paper presented to faculty and students) evaluated by the executive committee, augmented by at least one specialist in the area of the paper.**

**Doctor of Philosophy:** Degree candidates are required to take at least 42 units for the major, 18 units of dissertation and a minor. Course requirements include: 3 units of 503; 3 units of 549a or 549b; 6 units of 550; 3 units of 696 and an additional 3 units of 694 or 696. Course work is aimed at preparing for a preliminary exam in the student’s chosen discourses and theoretical specialization.

---

**Computer Science (CSC)**

Gould-Simpson Building, Room 721

(520) 621-6613; FAX: (520) 621-4246

Professors Gregory R. Andrews, Ralph E. Griswold, Udi Manber, Eugene W. Myers, Jr., Richard D. Schlichting

Associate Professors Saumya K. Debray, Peter J. Downey, Larry L. Peterson, Richard T. Snodgrass

Assistant Professors Mary L. Bailey, John H. Hartman, Todd A. Proebsting

The Department of Computer Science offers programs leading to the Master of Science and the Doctor of Philosophy degrees with a major in computer science. The department’s programs prepare graduate students for positions in the design and development of computer systems and applications in business and industry and for scientific positions in industrial or academic computing research. Areas of research interest include the use of the department currently include programming languages, operating systems, distributed processing, theory, analysis of algorithms, databases, computer networks, and computer graphics.

Applicants for admission should hold an undergraduate degree in computer science or a related field. In addition to the application materials submitted to the Graduate College, applicants must submit to the department the scores from both the general and subject test of the Graduate Record Examination. The department requires that two letters of recommendation be submitted.

A brochure describing admissions requirements and degree programs in detail is available from the department.

**Master of Science:** 30 units of graduate credit are required, including one course in each of the core areas: systems (552, 576), operating languages (520, 553), and theory (545, 573); four specialization courses; and at least one advanced topics course. A thesis is not required, but with departmental approval a student may elect to submit one.

**Doctor of Philosophy:** Doctoral students must complete 36 units of graduate credit in the major including the M.S. core, 520, 545, and 576, and at least two advanced topics. Course work in a related minor field is required. There is no foreign language requirement.

Doctoral candidates majoring in other disciplines may minor in computer science by completing a sequence of courses and examinations set by the department.

---

**502. Mathematical Logic (3) I 1995-96 (Identical with MATH 502)**

**520. Principles of Programming Languages (3) I Important programming language concepts, including types, control and data abstraction, denotational semantics, declarative and object-oriented languages, implementation issues. P. 453.**

**521a-521b. Systems Modeling and Simulation (3-3) (Identical with MIS 521a-521b)**

**522. Principles of Concurrent Programming (3) II Fundamental concepts of concurrent programming; synchronization mechanisms based on shared variables and message passing; systematic development of correct programs; paradigms for parallel and distributed programming. P. 342, 344, 372.**

**525. Principles of Computer Networking (3) II Theory and practice of computer networks, emphasizing the principles underlying the design of network software and the role of the communications system in distributed computing. Topics include routing, flow and congestion control, multicast, data representation, and RPC. P. 452.**

**530. Case Studies in Software Design (3) I II Techniques and tools for program design and implementation, especially of large programs. Specification, abstraction, verification, maintenance, performance tuning. Includes substantial programming. P. 237 or ECE 271b: 342.**

**533. Computer Graphics (3) I Theory and practice of computer graphics: 2D and 3D transformations, clipping and viewing, hierarchical modeling, computer graphics hardware, raster graphics, input models, interaction techniques and applications. P. 344, 430.**

**536. Computational Linguistics (3) I (Identical with LING 538)**

**541a-541b. Computer-Aided Information Systems Analysis and Design (3-3) (Identical with MIS 541a-541b)**

**543. Theory of Graphs and Networks (3) I (Identical with MATH 543)**

**545. Design and Analysis of Algorithms (3) I Time, space complexity; recurrences; algorithm design techniques; lower bounds; graph, matrix, set algorithms; sorting; fast Fourier transform; arithmetic complexity; intractable problems. P. 445, 473, MATH 362.**

**549. Continuous-System Modeling (3) I (Identical with ECE 549)**

**550. String and List Processing (3) I Data representation, pattern matching, programming techniques; applications. P. 344, 372, 430.**
552. Advanced Operating Systems (3) I Operating system design, implementation, and modeling; deadlock and memory management models; protection mechanisms; operating systems for parallel and distributed systems. P, 452.


571a. Digital Systems Design (3) (Identical with ECE 571a) I (Identical with ECE 572)

573. Theory of Computation (3) II Chomsky hierarchy, undecidability; general recursive functions; recursion theory; computational complexity theory; NP-complete and provably intractable problems. P, 473. (Identical with MATH 573)

574a-574b.* Computer-Aided Logic Design (3-3) I II (Identical with ECE 574a-574b)

575a-575b.* Numerical Analysis (3-3) (Identical with MATH 575a-575b)


578. Computational Methods of Algebra (3) II (Identical with MATH 578)

579.* Game Theory and Mathematical Programming (3) II 1995-96 (Identical with MATH 579)

595. Colloquium


597. Workshop a. Concert Production and Choreography (1-4) [Rpt./9 units] I II 4-8S. P, 445.

Creative Writing
(See English)

Dance (DNC)
Gittings Building, Room 8
(520) 621-4698; FAX: (520) 621-6981

Committee on Dance
Professors Jory Hancock, Chair, John M. Wilson
Associate Professors Nina Janik, Melissa Lowe
Assistant Professors Amy Ernst, Suzanne Knosp, Michael L. Williams

The Committee on Dance offers a dance concentration within the theatre arts major leading to the Master of Arts or Master of Fine Arts degree. Interested students should consult the Committee on Dance.

501.* Advanced Floor Barre (1) [Rpt./4 units] I II Develops deep strength, flexibility and alignment specific to all forms of dance. Building on the concepts presented in 201, this course is geared to the more advanced student, presenting exercises that are more rigorous and complex in nature. 2S. P, 201.

539a-539b.* Advanced Pointe Technique (1-1) [Rpt./4 units] I II 539a: Barre work; continuing development of strength, speed, and stamina. Introduction of advanced barre combinations. Center work; allegro en pointe, also adagio, pirouettes and consecutive turns. 539b: Continuation of 539a with increasing difficulty and complexity in the enchainments. 2S. P, audition. Love

540a-540b.* Ballet Technique III (2-3) [Rpt./3]
By audition only. Hancock/Love

541a-541b.* Modern Dance Technique III (2-2) [Rpt./3] I II 541a: Barre work; continuing development of strength, speed, and stamina. Introduction of advanced barre combinations. Center work; allegro en pointe, also adagio, pirouettes and consecutive turns. 541b: Continuation of 541a with increasing difficulty and complexity in the enchainments. 2S. P, audition. Love

544a-544b.* Jazz Dance Technique III (2) Continued development of jazz dance technique emphasizing stylistic diversity and technical proficiency including contemporary, lyrical, funky and classical jazz styles. Williams


East Asian Studies (EAS/CHN/JPN)
Franklin Building, Room 404 (520) 621-5452; FAX: (520) 621-1149

Professors Brian E. McNichot, Head, Gail L. Bernstein (History), Marie Chan, Anoop Chandola, Robert M. Gimello, John W. Olsen (Anthropology), Earl H. Pritchard (Emeritus), William R. Schultz (Emeritus), Jing-shen Tao, Allen S. Whiting (Political Science)

Associate Professors Charles H. Hedtke (Emeritus), Ronald C. Miao, Barbara N. Sands (Economics), Chia-lin Pao-Tao

Assistant Professors J. Philip Gabriel, Donald J. Harper, Elizabeth G. Harrisson, Kimberly A. Jones, Donald Kiri-hara (Media Arts), Feng-hsi Liu, James Millward (History)

The Department of East Asian Studies offers programs leading to the Master of Arts and Doctor of Philosophy with majors in East Asian studies. Graduate training in East Asian studies affords students important opportunities for careers in teaching, international business, international law, government and diplomatic service, and journalism.

Graduate programs on the master's level are available with concentrations based either in traditional academic disciplines or in specially constructed general study areas related to East Asia. The doctoral programs are rigorously based in traditional academic disciplines. Master's students must complete a minimum
of 30 graduate units and a thesis, or 33 units and a departmental paper. Disciplinary concentrations, often in preparation for further Ph.D.-level study, are currently offered in a number of fields in Chinese history, linguistics, literature, and religion and thought, and in Japanese literature as well as linguistics and language pedagogy. A general master's study program may include a variety of courses in the Department of East Asian Studies and other departments in both Chinese and Japanese areas. To ensure programmatic integrity, the general program must be devised in consultation with appropriate faculty. The general program is often suitable for preprofessional training. Doctoral study must be focused on Chinese history, linguistics, literature, religion and thought or on Japanese language pedagogy, linguistics, literature or religion; minor fields are usually selected from other supporting disciplines. Subjects in East Asian studies may serve as fields of study for students earning Ph.D. degrees in other departments. Contact the department for specific requirements for each degree program.

Admission requires adequate preparation, although admission with some deficiencies is possible. The department bases admission into the master's and doctoral programs upon the grade-point average, the applicant's statement of purpose, two letters of recommendation, and GRE scores. Foreign students must achieve a minimum score of 550 on the TOEFL. Applicant objectives must also correspond to the department's programmatic capabilities. Contact the graduate secretary in the Department of East Asian Studies for further details.

Courses related to East Asia in addition to the courses listed below may be taught in the Departments of Anthropology, Economics, History, Media Arts and Political Science.

**East Asian Studies (EAS)**

527a.* The Prehistory of East Asia (3) I (Identical with ANTH 527a)

545.* Hindu Mysticism (3) II Introduction to the major concepts and practices of Hindu mysticism, including yoga techniques, rites, symbols, and myths. (Identical with RELI 545)

551.* The United States and East Asia: 1840 to the Present (3) II (Identical with HIST 551)

552.* Hindu Literature (3) I Introduces major literary works with ancient Sanskrit genres. Selections from the Vedas, epics, Puranas and other classics in English translation.

564.* International Relations of East Asia (3) II (Identical with POL 564)

587. Testing and Evaluation in Foreign/Second Language Programs (3) (Identical with GER 587)

587a-587b.* History of East Asian Buddhism (3-3) Buddhism in China, Korea and Japan with emphasis on the relationship between East Asian Buddhist thought and practice and the various historical contexts in which they emerged.

589.* Women in East Asia (3) I (Identical with HIST 589)

596. Seminar
a. Topics in East Asian Buddhism (P), reading knowledge of Chinese and/or Japanese; EAS 487a-487b/587a-587b or the equivalent.

*bSpecial Topics in Asian Studies (3) [Rpt./4]

*May be conformed with 400-level course.

695. Colloquium
a. Advanced Studies in Asian History (3) [Rpt./3] II (Identical with HIST 695g)

**Chinese Studies (CHN)**


519.* Linguistic Structure of Modern Chinese (3) I Linguistic study of the phonological, morphological, and syntactic systems of modern Chinese, with particular attention to linguistic analysis. (Identical with LING 519)

520.* Linguistic Structure of Modern Chinese (3) II Linguistic study of the phonological, morphological, and syntactic systems of modern Chinese, with particular attention to linguistic analysis. P, 419/519. (Identical with LING 520)

521.* Resources and Methods in Sinology (3) II Introduction to and exercises in the use of standard sinological reference and research resources. P, 422/522.


527b.* The Archaeology of Pre-Han China (3) II (Identical with ANTH 527b)

529.* Chinese-American Literature 1960-Present (3) II (Identical with RELI 529)

530. Law in Traditional China (3) I Survey of law in traditional China, including examination of dispute resolution processes, the development of written law codes, formal judicial procedures, the theory and practice of punishment, crime and criminals, and the social role of legal process as reflected in civil law disputes (over such issues as marriage, divorce, property exchanges and inheritance).

540.* Chinese Calligraphy (2) [Rpt.] I Theory, practice, and aesthetics of Chinese brush writing, with emphasis on individual training and development.

541. Chinese Historical Linguistics (3) I Historical survey of the development of the Chinese language, with particular attention to linguistic changes in phonology, morphology, and syntax. P, 402 and a course in general linguistics.


547. Readings in Classical Chinese Prose (3) [Rpt./2] I Readings in selected texts from literary, philosophical, and historical traditions; includes selections from the Five Classics and the great prose masters of the Han-Qing. Variable content. P, 422/522.


556.* Modern Chinese Foreign Relations (3) II (Identical with POL 560)

568.* Women in China (3) I Analysis of the role of women in Chinese society with equal emphasis on traditional and modern periods.


576.* Modern China (3) (Identical with HIST 576)

582.* Social History of China (3) Formation of ancient Chinese society; organization of families and clans; social stratification, mobility, conflict, and control in traditional China; and transformation from traditional to modern society. (Identical with HIST 582)

583.* Confucianism: The Classical Period (3) (Identical with RELI 583)

584.* Confucianism: The Neo-Confucian Tradition (3) (Identical with RELI 584)

595. Colloquium
a. Readings in Chinese History (3) [Rpt./12 units]

597. Law in Traditional China (3) I Survey of law in traditional China, including examination of dispute resolution processes, the development of written law codes, formal judicial procedures, the theory and practice of punishment, crime and criminals, and the social role of legal process as reflected in civil law disputes (over such issues as marriage, divorce, property exchanges and inheritance).

**Japanese Studies (JPN)**

502.* Gender and Language in Japan (3) II Introduction to general issues of gender and language use, specific gender-related differences in the Japanese language, and gender
**World War Two.**

447b: Postwar and Contemporary Survey of modern Japanese literature with instructor.

595. Colloquium

574a-574b-574c.*

II Survey of modern Japanese literature with instructor. Meiji, 1600 -1900. P, 416/516 or consent of instructor.

574a.* Ancient Japanese Literature (3) [Rpt. /3] II

546b: Tokugawa and medieval, to 1600. 546b: Ancient Japanese Literature (3) [Rpt. /3] II

546a-546b.* Classical Japanese Literature (3) [Rpt. /3] II

546a.* Topics in Japanese Linguistics (3) [Rpt. /3] II

546b.* Advanced Japanese Linguistics (3) II (Identical with LING 511)

546c.* Advanced Japanese Linguistics (3) II


521.* Advanced Readings in Japanese (3) [Rpt.] I Reading and discussion in Japanese of a variety of advanced-level materials, including newspaper articles, short articles, and poetry. P, 416/516 or instructor’s permission.


547a-547b.* Modern Japanese Literature (3-3) II Survey of modern Japanese literature with readings in English translation. 547a: Meiji to World War Two. 547b: Postwar and Contemporary Literature. P, 416/516 or consent of instructor.

547a-547b-547c.* History of Japan (3-3-3) (Identical with HIST 574a-574b-574c)

595. Colloquium

a. Masters Colloquium (1) I

b.*Japan (3) [Rpt./2] I II

596. Seminar

a.*Japanese Literature (3) [Rpt./3] I II

c.*Topics in Japanese Linguistics (3) [Rpt./2] II P, 411 or 511 (Identical with LING 596c)

696. Seminar

r. Japanese History (3) [Rpt.] I II (Identical with HIST 696r)

*May be convened with 400-level course.

---

**Ecology and Evolutionary Biology (ECOL)**

Biological Sciences West Building Room 310

(520) 621-1588; FAX: (520) 621-9190


Associate Professors Russell Davies (Emeritus), Robert S. Mellor, Nancy A. Moran, Irene M. Pepperberg, Robert H. Robichaux, Stephen M. Russell (Emeritus), David J. A. Vleck, J. Bruce Walsh, Oscar G. Ward

Assistant Professors Leticia Aviles, Judith L. Bronstein, Lucinda Mccade, Wayne P. Maddison, Daniel R. Papaj

Assistant Research Scientist Michael F. Hammer

The department offers programs leading to the Master of Science and the Doctor of Philosophy degrees with majors in ecology and evolutionary biology and in botany. Concentrations are available in plant ecology, systematics, and evolution; evolutionary theory; ecological and molecular genetics; environmental physiolog; marine biology; animal behavior; vertebrate biology and systematics; evolutionary morphology; and theoretical and mathematical biology. The department maintains excellent collections of fishes, amphibians, reptiles, birds, and mammals. An extensive herbarium is shared with the College of Agriculture. Field work is facilitated by a Marine Biology Station at Puerto Peñasco, Sonora, Mexico, and by the availability of the Coronado Ranch in the Chiricahua Mountains; the Southwest Research Station, Portal, Arizona; the Research Ranch, Elgin, Arizona; and the Desert Laboratory on Tumamoc Hill, Tucson, Arizona.

Applicants are required to furnish the department with completed departmental application forms, copies of scores on the Aptitude and Advanced (any discipline) tests of the Graduate Record Examination (GRE), copies of transcripts of all college work, copies of GRE scores (in addition to those required by the Graduate College), and three letters of recommendation from persons qualified to evaluate the applicant’s scholarly potential. Applications should be submitted by January 15; admission is normally approved only for students beginning their graduate studies with the fall semester. Applicants are encouraged to seek external financial support from institutions such as the National Science Foundation and the Danforth Foundation. The department will make every effort to offer financial aid in the form of teaching or research assistantships.

Course work, while necessary, is no substitute for scholarship. Accordingly, particular emphasis is placed on the student’s ability to formulate and pursue original research problems. One course, Research in Ecology and Evolution (610a-610b), is required of all new graduate students. The remainder of the program is designed to meet the individual needs of each student.

In addition to the courses listed below, the department offers courses in quantitative genetics, phylogenetic systematics, evolutionary morphology, plant physiological ecology, biological rhythms, and approaches to problem solving in biology. 500a-500b. Advanced Topics in Ecology and Evolutionary Biology (4-3) 500a: Introduction to graduate study in ecology and evolutionary biology, via discussion of ongoing faculty research interests. P, 435. 500b: Introduction to field research methods in ecology. 3R, 3L. Field trips. (Identical with INSC 500a-500b)


503L.* Parasitology Laboratory (1) I (Identical with VSC 503L)

503R.* Biology of Animal Parasites (3) I (Identical with VSC 503R)

505.* Aquatic Entomology (3) II 1996-97 (Identical with ENTO 505)


511.* Insect Behavior (3) II 1995-96 (Identical with ENTO 511)

512.* Plants Useful to Man (2) S Lecture-demonstration course for teachers and others wishing information on the uses of plants: foods and food plants, medicinal plants, plants and industry, plants in textiles and other manufacturers.

514.* Plants of the Desert (2) S Designed for teachers and others wishing to become familiar with common native and cultivated plants; identification, ecology, and uses.

515L.* Insect Biology Laboratory (1) I (Identical with ENTO 515L)

515R.* Insect Biology (3) I (Identical with ENTO 515R)

---

East Asian Studies—Ecology and Evolutionary Biology 71
516. Computer Analysis of Sequences (3) II (Identical with MCB 516)

520. Evolutionary Quantitative Genetics (4) II Rigorous coverage of the inheritance and evolution of quantitative characters. Theory, estimation and design issues, and experimental results given equal coverage. P. Calculus.

521. Philosophy of the Biological Sciences (3) 1995-96 (Identical with PHIL 521)

523. Cytogenetics (3) II Investigation into the structure and function of chromosomes and their role in heredity and evolution. 2R, 3L, P, 320. (Identical with GENE 523)

524. Theoretical Population Genetics (3) I Mathematical theory of modern population genetics developed from first principles, with emphasis on evolutionary implications and the historical development of ideas. P. 320, MATH 223. (Identical with ANTH 524, GENE 524 and INSC 524)

525. Speciation (2) [Rpt.] II Mechanisms of evolution in the formation of races and species of animals and plants. P. 320. (Identical with GENE 525)

533. Human Genetics (3) I (Identical with GENE 533)

534. Population Interactions (4) [Rpt.] II 1996-97 Empirical and theoretical treatment of competition, exploitation, and mutualism within and between species, with emphasis on application of modern dynamics to ecological problems. Computer lab. 3R, 3L, P, 302, two semesters of calculus.

535. Evolution II (4) I A thorough coverage of the empirical and theoretical foundations of modern evolutionary thought. The fossil record and associated conceptual issues are explored in detail. The heart of the course is the theoretical (mathematical), experimental, and analytical logic necessary to understand processes of evolutionary change at molecular, biological, population, life history, species, and phylogenetic levels. The course is most appropriate for undergraduate and graduate students intending to pursue advanced study and research involving evolutionary questions in biology. P. 320, MATH 125a, P or CR 125b. (Identical with GENE 535).

538. Biogeography (3) II The role of historical events and ecological processes in determining the past and present geographic distribution of plants and animals. P. 182 or GEOS 225. (Identical with GEOS 538)

539. Animal-Human Communication (3) II Survey of animal-human communication studies. Critical discussions of papers describing the rational design and success of projects involving nonhuman primates, marine mammals, and a parrot, supplemented by films and videos. Background material on animal-animal communication and animal intelligence. Emphasis on what can be learned about human and nonhuman capacities from studying how animals acquire and use human communication systems. P. 487 or equivalent or instructor's permission. (Identical with PSYC 539)

540. Oceanography (2) I 1996-97 Introduction to the physical, chemical, geologic, and biological dimensions of the oceans, with emphasis on their importance as biological environments.

541. Limnology (4) I (Identical with WFSC 541)

542. Marine Ecology (6) SA field introduction to basic concepts in marine ecology with emphasis on the behavior and ecology of invertebrates and fishes and the factors affecting the diversity and community structure of marine communities. The entire course is conducted at selected sites in the Gulf of California. Optimal travel fee. Consult instructor before enrolling.

543. Insect Ecology (3) I 1996-97 (Identical with ENTO 544)

544. Concepts in Genetic Analysis (3) I (Identical with MCB 545)

550. Mathematical Population Dynamics (4) II 1995-96 Ecological population dynamics, demography and human epidemiology. Emphasis on mathematical models and techniques for data analysis with particular reference to dynamical systems and chaos. 3R, 3L, P, full calculus sequence, upper-level ecology course (547) or ordinary differential equations (MATH 254) (Identical with MATH 550)

555. Professional Skills (2) II (Identical with ENTO 555)

559. Comparative Vertebrate Histology (4) II (Identical with VSC 559)

560. Current Advances in Plant Physiology (3) I (Identical with PL S 560)

565. Phylogenetic Biology (3) I 1996-97 Concepts in phylogenetic biology, focusing on the phylogenetic (evolutionary) tree of species. The form of the tree, character evolution, speciation, and gene trees. P. 320, 435, 467 or other course in evolution, or permission of instructor. (Identical with ENTO 565 and GEOS 565)

566. Physiology Laboratory (3) II Emphasis on data acquisition, analysis and interpretation. Laboratory techniques and investigation of physiological mechanisms. 2R, 4L, P. Either 437, 468; VSC 400a-400b; or PSIO 480. (Identical with MB 566, PSIO 566, TOX 566, VSC 566)

568. Comparative Physiology (3) II The responses of physiological systems to the environment: energy exchanges, respiration, thermal and osmotic regulation, locomotion, behavioral regulation, and integration of responses. P. 181R, 182. (Identical with PSIO 568 and V SC 568)

570. Plant Diversity and Evolution (4) I Survey of the plant kingdom, with emphasis on comparative structure and evolution of major plant divisions. 2R, 6L. Field trips. P. 4 units of biological or plant sciences.

571. Human Embryology (4) I (Identical with ANAT 571)

572. Systematic Botany (4) II Evolutionary relationships of orders and families of spermatophytes; systems of classification; collection and identification of local flora. 2R, 6L.

575. Freshwater Algae (4) II 1995-96 Systematics, ecology, and evolution of planktonic and benthic species; field techniques and lab. culture. 2R, 6L. Field trips. P. 4 units of biology or plant sciences. (Identical with WFSC 575)

576b. Analysis of Biological Diversification (3-2) 576b. Patterns of biological diversity and the history of diversification and extinction. Phylogenetic analysis will be introduced to address issues in ecology, paleobiology, development and genetics. One Saturday field trip. P. 181 and 182 and either an evolution or paleobiology course or permission of instructor. 576b: Explores approaches to studying biological diversification, integrating phylogenetic biology, ecology, population genetics, developmental biology and molecular biology. P. 335 or permission of instructor. (Identical with GEOS 576a-576b and MCB 576a-576b)

578. Global Change (3) II (Identical with GEOS 578)

579. Art of Scientific Discovery (3) [Rpt.] II Techniques of posing questions and solving puzzles encountered in scientific research, with emphasis on life sciences and mathematics. P. consult department before enrolling.


582. Ichthyology (4) I 1995-96 Ecology, evolution and systematics of fishes, with field and laboratory emphasis on Gulf of California and Arizona fisheries. 2R, 6L. Weekend field trips. P. 182. (Identical with WFSC 582)

583. Herpetology (4) II Systematics, ecology, and evolution of the amphibians and reptiles. 2R, 6L or field work. P. 304. (Identical with WFSC 583)

584. Ornithology (4) II Natural history of birds and its bearing upon the problems of animal behavior, distribution, and evolution. 2R, 2L. Field trips. P. one basic biology course. (Identical with WFSC 584)

585. Mammalogy (4) II Systematics, ecology, and evolution of mammals. 3R, 4L or field work. P. 304. (Identical with WFSC 585)


587. Animal Behavior (3) I Concepts and principles of the mechanism, development, function and evolution of behavior, with emphasis on its adaptiveness. P. 8 units of biology.

587L. Animal Behavior Laboratory (1) III Exposure to current topics in behavior and process of behavioral research through video presentations, demonstrations of live animals and readings.


589. Selected Studies of Birds (2) [Rpt.] I Recent advances in ornithology. 1R, 3L or field trip. P. 304. (Identical with WFSC 589)

590. Seminar

591. Population Biology (1) [Rpt. /6 units] II Field trips. P. junior or senior ecology majors.


593. Macroevolution (2) [Rpt. /6 units] I (Identical with GEOS 593)


*May be converted with 400-level course.
Economics (CON)
McClelland Hall, Room 401
(520) 621-6224; FAX: (520) 621-8450


Associate Professors John Z. Drabicki, Donald G. Heckerman, Kenneth F. Kroner, James C. McBrearty, Barbara N. Sands, Gerald J. Swanson

Assistant Professors Bruno Broseta, Devajoty Ghose, Shawn E. Kantor, Diego Moreno, James D. Ratliff, Leslie S. Stratton, John C. Wooders

The department offers programs leading to the Master of Arts and Doctor of Philosophies with a major in economics. The department also offers supporting work for the Master of Public Administration degree, the Master of Business Administration degree and Doctor of Philosophy degree with a major in management. For information concerning these degrees see Requirements for Master's Degrees/Master of Public Administration and Master of Business Administration as well as the Business Administration headnotes elsewhere in this catalog.

Applicants must have completed an undergraduate major or minor in economics and must submit scores on the aptitude test of the Graduate Record Examination.

Degrees

Master of Arts: All students must complete the core program consisting of 501a, 502a, 508, 519, 520 and 522a, a nine-unit field of specialization, and a thesis. (A minimum of thirty total units is required.) The field of specialization may be in economics or a related area and must be approved by an advisor. The student will be given a comprehensive exam over the core program and field.

Doctor of Philosophy: All students must complete the core program consisting of 501a-501b-501c, 502a-502b, 506, 508, 519, 520, 522a-522b, eighteen units of 696-697 economics seminar and workshop courses, and a dissertation. A minimum of 66 hours is required.

500. Managerial Economics (3) I Microeconomic theory and applications. P, MIS 400 or MATH 119 or 123. Advanced degree credit available for nonmajors only. Open only to students admitted to a BBA graduate program.


504. Production Economics (3) I (Identical with AREC 504)


507. Studies in Microeconomics (3) II Studies in microeconomics, such as the economics of imperfect information and uncertainty, externalities and public goods, and imperfect competition. P, 361, MATH 125b.

508. Applied Economic Analysis (3) II Uses economic history to show how research methods in economics are used to analyze data collected through empirical observation. P, 501a, 520.


511. Microeconomic Theory and Behavior (3) II Microeconomic theory with an emphasis on the use of experimental laboratory and field methods for testing the behavioral implications of the theory. P, 521.

512. Economic Policy in Developing Countries (3) II (Identical with AREC 512)

513. Consumer Economics and Price Analysis (3) II (Identical with AREC 513)

514. Cost-Benefit Analysis (3) II (Identical with AREC 514)

515. Operations Research in Applied Economics (3) II (Identical with AREC 515)

516. Agricultural Development (3) [Rpt./1] I (Identical with AREC 516)

518. Introduction to Econometrics (3) II Statistical methods in estimating and testing economic models; single and simultaneous equation estimation, identification, forecasting, and problems caused by violating classical regression model assumptions. Advanced degree credit available for nonmajors only. P, 339 or 376 or MKTG 552.

519. Mathematical Economics (3) I Introduction to the theory and methods of mathematical economics and its applications. Designed primarily for entering graduate students majoring in economics. P, CR, 520; consult with department before enrolling.

520. Theory of Quantitative Methods in Economics (3) I Introduction to the basic concepts of statistics and their application to the analysis of economic data. Designed primarily for entering graduate students majoring in economics. P, CR, 519; consult with department before enrolling.

521. * Introduction to Mathematical Economics (3) II Comparative statics, stability, classical optimization, the Kuhn-Tucker theory, calculus of variations, linear algebra, and game theory, and the application of these techniques in economic analysis. P, six upper-division units in economics; MATH 125b.


524. * International Historical Development (3) I The process of international economic development with special emphasis on the historical economic development of Europe, China, or Japan. Advanced degree credit available for nonmajors only. P, 300 or 361 or 500.

525. * Topics in the Economic History of the United States (3) II Examines the economic history and development of the United States, including roles of legal and cultural institutions, changes in output mix, government regulations, income distribution, monetary policy, and international economic policies. Advanced degree credit available for nonmajors only. P, 300 or 500.

526. Health Economics (3) I (Identical with PA 526)

530. Macroeconomic Aspects of Finance (3) II The effects of changing economic conditions upon a firm's operation, including capital decisions as well as production decisions. P, 500.


536. Innovation and Economic Growth (3) I (Identical with MKTG 536)


542. * International Macroeconomics (3) I S Analysis of exchange rates, balance of payments, and macroeconomic/financial interde-
pendencies among nations. Advanced credit available for nonmajors only. P, 330, 332 or 510.

543.* International Trade Theory (3) II General equilibrium analysis of product and input markets of international trade, tariffs, commercial policy, and aspects of each. Advanced degree credit available for nonmajors only. P, 360 or 500.


553.* Business and Economic Forecasting (3) II Forecasting techniques used in business and government; assembly, interpretation and use of economic data; analysis of business conditions; examination of related environmental factors; construction of actual sales or revenue forecasts. P, 361 or 500 or MKTG 552.

560.* Industrial Organization (3) II Struc-
ture, conduct, and performance of American industries; governmental institutions and policies affecting business. Advanced degree credit available for nonmajors only. P, 300 or 361 or 500; 399 or 376 or MKTG 552.

561.* Economics of Regulated Industries (3) II Economic analysis of the regulated sector of the American economy, including communications, transportation and energy industries; impact of existing and alternative public policies. Advanced degree credit available for nonmajors only. P, 300 or 361 or 500.

562. Theory and Institutions in Industrial Organization (3) II Major issues in the field of industrial organization. Theoretical issues presented with complementary material dealing with specific American industries. P, 500.

568. Environmental Scanning and Business Strategy (3) I (Identical with MKTG 568)

575. Economics of Natural Resource Policy (3) II (Identical with AREC 575)

576. Advanced Natural Resource Economics (3) I (Identical with AREC 576)

577. Advanced Topics in the Economics of Environmental Regulation (3) I (Identical with AREC 577)

580. Mathematics for Economists (2) I (Identical with MATH 580)

584.* Economics of Fuels and Energy (3) II Analysis of demand/supply, pricing, competitive behavior, transportation, interfuel competition, electrical and nuclear power. Advanced degree credit available for nonmajors only. P, 300, 361, 500, 501a or AREC 504.

585.* Economics of Non-Fuel Minerals Industries (3) II Analysis of national and international minerals markets; reserves/deposits, production technologies, market structure and pricing, recycling, and international trade. Advanced degree credit available for nonmajors only. P, 300, 361, 500, 501a or AREC 504.

586.* Economics of Minerals, Residuals, Effluents, and the Environment (3) II Economic aspects and process analysis of minerals production, control and measurement of effluents and residuals for environmental compliance, case studies of production mitigation, competitiveness, and technology. P, 500, 501a or AREC 504.

589.* Public Choice (3) II The study of voting theory, government expenditures, government structures, behavior of voters and bureaucracy. P, 361 or consent of instructor. (Identical with POL 589)

597. Workshop
b. Computational Methods in Laboratory Economics (1-3) [Rpt./3 units] I II P, MATH 125a-125b; consult department before enrolling.
c. Economic Issues for Teachers (3) S Consult instructor before enrolling.
d. Summer Institute on the American Economy (3) S Consult instructor before enrolling.
e. Economics Education Workshop (2) S Consult instructor before enrolling.
f. Economic Development for Educators (2) S Open to nonmajors only. Consult department before enrolling.

*May be convened with 400-level course.

676. Economic Dynamics and Natural Resource Law (3) I 1995-96 Graduate student standing with one year of graduate microeconomic theory. (Identical with AREC 676)

696. Seminar
a. Experimental Economics I (3) [Rpt./3] II
b. Experimental Economics II (3) [Rpt./3] I
c. Applied Experimental Analysis I (3) [Rpt./3] II
d. Applied Economic Analysis I (3) [Rpt./3] II

e. Econometric Modeling I (3) [Rpt./3] II
f. Econometric Modeling II (3) [Rpt./3] I

697. Workshop
d. Labor Economics (3) [Rpt./4] II P, 696g, 696h.


700. *Advanced Microeconomic Theory (3) [Rpt./4] II P, 696r, 696s.


Education (EDUC)

Education Building, Room 201
(520) 621-1462

Majors and degrees offered by the academic departments within the College of Education are as follows:

Department of Educational Administration
eductional administration . Ed.S./Ed.D.
higher education . M.A./Ph.D.

Department of Educational Psychology
psychology . M.A./Ed.S./Ph.D.

Department of Language,
Reading and Culture
bilingual/bicultural education . M.Ed.
bilingual/multicultural education . M.A.
language, reading and culture . . M.A./Ed.S./Ed.D./Ph.D.

Department of Special Education and Rehabilitation
special education . M.Ed.
special education and rehabilitation . M.A./Ed.S./Ed.D./Ph.D.

Department of Teaching and Teacher Education
educational media . M.Ed./Ed.S.
early childhood education . M.T.
secondary education . M.T.
teaching and teacher education . . M.ED./M.A./Ed.D./Ph.D.
environmental education strand is available . . . M.A.

For further information, see individual department listings.

Education (EDUC)

The College of Education offers certain courses that are not directly affiliated with any of the academic departments in the college. In many cases, these courses are college-wide requirements for degree programs.

500. Disciplined Inquiry in Education (3) I Introductions to research methods in education: analysis of research; writing of research reviews; applying research results in educational settings.

501. Foundations of Education (3) I Schools and social institutions; political and social influences on education; nature of the educational profession; reform and implementation in education.

502. Variations in Learners (3) I Social and cultural context of differences among learners, both among and within groups; causes and factors relating to variations in learners; implications for educational placement, curricular planning and program development.
Educational Administration and Higher Education (ED A/H ED)

Education Building, Room 321
(520) 621-7951; FAX: (520) 621-9271

Professors Larry L. Leslie, Program Head (Higher Education), Donald C. Clark, Program Head (Educational Administration), Waldo K. Anderson (Emeritus), Henry E. Butler, Jr. (Emeritus), Robert G. Grant (Emeritus), Fred Harcleroad (Emeritus), Lawrence O. Nelson (Emeritus), F. Robert Paulsen (Emeritus), Macario Saldate, IV, T. Frank Saunders (Emeritus), Sheila Slaughter, Marsden B. Stokes (Emeritus), Dudley B. Woodard, Jr. Associate Professors Gary Rhoades, John S. Levin Assistant Research Scientist Kenneth G. Brown

The department offers programs leading to the Master of Arts and Doctor of Philosophy degrees with a major in higher education and the Doctor of Education degree with a major in educational administration. At the time of catalog production, the Doctor of Education with a major in educational administration was under revision. The Education Specialist degree with a major in educational administration and the Master of Arts and Doctor of Philosophy with a major in foundations of education were under review at the time of the catalog production. Consult the department head for current information.

Concentrations are available within graduate majors offered in the department. The major in higher education is offered through the Center for the Study of Higher Education, with concentrations in academic administration, student personnel services administration, finance and business affairs administration, community college administration, curriculum and instruction, higher education policy making, and institutional research and planning.

The department also offers certification in educational administration. Students seeking institutional recommendation for Arizona administrative certification should major in educational administration. In the Center for the Study of Higher Education, master's degree programs may be designed to meet the requirements for the Arizona Community College Teaching Certificate (Type A1a) or for entry-level administrative service in institutions of higher education.

An undergraduate grade-point average of at least 3.00 is required for admission to full standing in a graduate degree program. However, applicants with undergraduate grade-point averages of 2.50 to 2.99 may be admitted on a provisional basis. Standardized test scores also are required (e.g., GRE, Millers Analogies). Beyond these minimal requirements, applicants must also meet the specific requirements for all majors offered in the department. The meeting of standards does not guarantee admission.

Educational Administration (ED A)

597. Workshop
a. Trends in Educational Leadership (3) [Rpt. /12 units] I I S.
b. School Evaluation/Accreditation: Problems and Procedures (3) I I S.

*May be convened with 400-level course.

660. Leadership and the Educational Environment (3) I I S Introduction to educational leadership; overview of administration within school contexts and larger societal environment; organizational and leadership theories.

661. Administration of Bilingual Education Programs (3) I S Dynamics of the administration of educational programs for the bilingual learner including socio-political realities, mandated federal and state funded educational programs, and effective community participation.

662. Educational Law: Policy and Practice (3) I S Evolution of modern educational law and the effects of law on educational policy formation and administrative practice.

663. Computer Applications in School Administration (3) I Techniques for using computers to make school administration more efficient; using computers to enhance the management of information. P. 660 or CR.

664. Personnel Administration in Education (3) I Composition of school staffs and the functions of various personnel; patterns and practices in school personnel management; issues, trends, and prospects in personnel management. P. 660.

665. Supervision of the Instructional Program (3) I S Purposes of instructional supervision; organization, techniques and skills for supervisory competency. P. 660.

666. Managing Curriculum Change (3) I I Techniques for administrators to use in analyzing the quality of the curriculum in schools as well as the appropriateness of instructional techniques used to support the curriculum. P. 660 or CR.

671. School Finance (3) I Historical background of the financing of education in the United States; economics and principles; sources and distribution of funds for education; budgeting, accounting, and reporting. P. 660, 661 or CR.

672. School Business Management (3) I I The general management of school business; administration and accounting of school funds; administration of equipment and supplies; other business operations. P. 660 or CR.
675. Theory and Behavior in School Organizations (3) I II Perspectives on the nature of the individual in the school organization; nature of schools as organizations; development of individual-organizational relationships. P, 660.

681. The Principalship (3) I II Functions and activities of building-level administrators, with emphasis on instruction, staff development, student services evaluation, and operational services. P, 693a and 15 units of educational administration, CR 693b.

682. The Superintendency (3) I II S Functions and responsibilities of the chief school executive and central office staff, with emphasis on external and internal system relationships in policy formation and decision-making. P, 693a, 693b or CR.

693. Internship a. Educational Leadership (2-3) [Rpt./4 units] II I II P, 660, 661, 662 or CR.
   b. Advanced Educational Leadership (3-4) [Rpt./8 units] I II P, 693a and 15 units of educational administration. CR, 681 or 682.

695. Colloquium a. Issues in Educational Leadership (1-3) [Rpt./12 units] II
   b. Seminar a. Issues in Educational Leadership (1-3) [Rpt./12 units] II
   c. Seminar b. Topics in Educational Leadership (1-3) [Rpt./12 units] II
   d. Workshop a. Problems in Educational Leadership (1-3) [Rpt./12 units] II

Higher Education (H ED)

561. The Community College (3) I The scope, objectives, and educational functions of the community college, patterns of community college programs.

560. Higher Education in the United States (3) I The scope of higher education in the United States; historical development and philosophic bases, public policy issues at the state and federal level; types of institutions and their purposes; characteristics of faculty, students and curricula.

568. The College Student (3) I History and characteristics of the college student; interactions with campus environmental influences; developmental and normative trends in major research findings.

569. Organization and Administration in Higher Education (3) I Organizational theory, structures, systems, and administrative procedures in varied higher education institutions; patterns of governance and policy development.

577. Student Personnel Services in Higher Education (3) I Student personnel services, philosophy, history, administrative procedures, representative programs, current trends.

572. Teaching in Higher Education (3) I II Planning, organizing, presenting and evaluating learning experiences for mature students.

641. Institutional Research and Planning (3) I Development of institutional research programs for short-term and long-term planning; input and output measures.

650. Higher Education Finance (3) I Historical patterns of financing private and public higher education; current sources and types of financial support; alternative methods of financing; social benefits and consumer theories.

651. Higher Education Business Management (3) I II Budget planning and execution; systems of resource allocation; personnel management; physical plant planning and construction; information systems and use in management.

693. Internship
   c. Higher Education (1-3) [Rpt./12 units] II
   d. Colloquium
   c. Issues in Higher Education (1-3) [Rpt./12 units] II
   e. Seminar
   c. Topics in Higher Education (1-3) [Rpt./12 units] II

Educational Psychology (ED P)

Educational Building, Room 602
(520) 621-7825; FAX: (520) 621-2909


Associate Professors Harley D. Christiansen, Emeritus, Joseph D. Gullo Emeritus, Mary McCalin, Valerie F. Reyna

Assistant Professor M. Virginia Gonzalez

The Department of Educational Psychology offers programs leading to the M.A., Ed.S., and Ph.D. degrees. Concentrations on the doctoral level include: school psychology; teaching, learning and development—early childhood through adulthood; measurement and methodology; and instructional design and technology. The Ed.S. degree is available only in school psychology and instructional design and technologies concentrations.

500. Life Span Development (3) I Dynamics of development, social integration and roles across the life span. Special emphasis on cognitive, emotional, and personality development with concentration on the antecedent events to adult life experiences. (Identical with FS 500)

501. Advanced Child Development (3) I II Aspects of growth and development which influence behavior of the school-age child; emphasis on current research findings. P, 301.

502. Early Adolescent Development (3) I II Major cognitive, psychosocial, physical and anthropological developmental theory of early adolescence (ages 10-14 years old). Also, the implications of theory into practice regarding early adolescents and schooling.

503. Advanced Adolescent Development (3) I II Major developmental issues within the adolescent years, emphasis on the importance and design of adolescent research. (Identical with FS 503)

510. Learning Theory in Education (3) I II Major theories of learning and motivation; emphasis on relationships between theory and practice in the schools.

511. Computer Applications in Education (3) I Essentials of computer operations; presentations software; software evaluations; telecommunications; computer-based diagnosis; application to instruction.

517. Classroom Application of Behavior Modification Techniques (3) I Application of behavior principles and techniques to promote learning and social development of school-related behavior. 2R, 3L, P, 510 or CR.

523. * Socio-Cultural Context of Human Development (3) I II (Identical with FS 523)

530. School Psychology (3) I Roles of the school psychologist; implementing programs in the public schools; legal and ethical issues in school psychology. 2R, 3L.

541. Statistical Methods in Education (3) I II Descriptive, correlational, and inferential procedures for presenting and analyzing school and research data. For students in all fields. 3R, 1L.

550. Design of Questionnaires and Scales (3) I II Emphasis on theoretical and methodological issues related to the development of survey and rating scales, sampling procedures, and response bias.

558. Educational Tests and Measurements (3) I Theoretical and practical application of psychometric techniques to test construction, analysis, and interpretation of test results. P, 541.

559. Testing of Minorities (3) I II Theoretical, social, and practical issues in the use of norm-referenced tests with individuals from minority cultures.

*May be convened with 400-level course.

600. Theories of Human Development (3) I History and analysis of psychological theories of human development and a comprehensive overview of major theoretical systems. P, 500 or 501.

613. Psychological Theory in Educational Practice (3) I II Major theories of psychological thought; strategies for utilizing such theories in educationally relevant research. P, 510.

615A-615B. Cognitive Development (3-3) I II Cognitive theory and research as they bear upon developmental and educational processes. P, 500 or 501.


636. Behavioral Consultation in Educational Settings (3) I II Principles and techniques of
694. Practicum
b. School Psychology (1-3) [Rpt./12 units] III
695. Colloquium
b. Issues in Educational Psychology (1-3) [Rpt./12 units] II
696. Seminar
b. Issues in Educational Psychology (1-3) [Rpt./12 units] III

Electrical and Computer Engineering (ECE)

ECE Building, Room 230
(520) 621-2434; FAX: (520) 621-8076

Professors Kenneth F. Galloway, Head, John R. Brews, Robert N. Carlile (Emeritus), Thomas C. Cetas (Radiation Oncology), Donald G. Dudley (Emeritus), Walter H. Evans (Emeritus), Walter J. Fahey (Emeritus), Jack D. Gaskill (Optical Sciences), Glen C. Gerhard, Douglas J. Hamilton (Emeritus), Charles R. Hausenbauer (Emeritus), Robert A. Hessemeyer, Jr. (Emeritus), Fredrick J. Hill, Stuart A. Hoening (Emeritus), Lawrence P. Huelsmans (Emeritus), Bobby R. Hunt, Roger C. Jones (Emeritus), William J. Kerwin (Emeritus), Granino A. Korn (Emeritus), H. Angus Macleod (Optical Sciences), Roy H. Mattson (Emeritus), Pitu B. Michan-dani (Systems and Industrial Engineering), Kenneth C. Mylrea, Olgierd A. Palusinski, John L. Prince, John A. Reagon, Harry E. Stewart (Emeritus), Maurus K. Sundaresan, Miklos Szilagyi, James R. Wait (Emeritus), John V. Wait, James C. Wyant (Optical Sciences), Bernard Zeigler


Assistant Professors Jo Dale Carothers, Pamela A. Delaney, Steven L. Dvorak, Ming-Kang Liu, Michael Marefat, Mark A. Neifeld, Jeffrey J. Rodriguez, Indra Wijdaja, Arthur F. Witulski

The department offers programs leading to the Master of Science and the Doctor of Philosophy degrees with a major in electrical engineering. These programs prepare students for careers in research and development in such areas as communications, computers, control, electromagnetics, microelectronics, optics, and signal processing.

The Master of Science degree requires a minimum of 30 units. There are thesis and nonthesis options. The thesis option requires at least 15 units in the major field (no more than 9 of these may be jointly convended 400/500-level courses), 6 units in the minor field, and 6 units of thesis. The nonthesis option requires at least 21 units in the major field (no more than 9 of these may be jointly convended 400/500-level courses), and 6 units in the minor field. Candidates must pass a final oral examination. A nonmajors program is available for qualified students who do not hold B.S. in Electrical Engineering or B.S. in Computer Engineering degrees.

The Ph.D. program must contain a minimum of 54 units of course work (including the Master of Science degree) and 18 units of dissertation study. A minimum of 18 units in the major field and 6 to 12 units in the minor field must be completed at The University of Arizona. To satisfy the residence requirement, the student must spend a minimum of two regular semesters of full-time study on campus. Students must pass a qualifying examination, which is taken during the first semester of residence beyond the master's degree, and are admitted to candidacy after passing a written and oral preliminary examination near the end of the study program. The final examination is a defense of the dissertation. There is no foreign language requirement.

Minors for the Ph.D.: 12 units of classes in a minor subject are required for the Ph.D. The minor subject is usually in an area complementary to a student's ECE studies, such as physics, mathematics or computer science. It also is possible to minor within the department. Split minors also are allowable. The minor subject is determined by consultation between the student and a faculty advisor.

The student should be aware that the preliminary examination will have written and oral components in the minor area, that examiners from the minor area will be present at the preliminary oral exam, and professors from the minor have the option to attend and participate in the dissertation defense.

When a minor class is a dual numbered course, the Ph.D. student must enroll in the graduate section of the class for it to count towards the Ph.D. minor. Courses taken as minor courses during a Master's program may be counted toward the Ph.D. minor as long as the courses are 500 level or above. Applicants are required to submit Graduate Record Examination (GRE) General Test scores and a statement of purpose directly to the department. All students whose native language is not English must submit TOEFL scores directly to the Graduate College. Applications to the Ph.D. program must also contain three letters of recommendation from M.S. professors.
Additional details concerning requirements for the master's or doctoral program may be obtained on request from the department graduate studies office (520) 621-6195.

501. Linear Systems Theory (3) I Mathematical descriptions of linear systems, state-variable models, analysis methods-stability, controllability and observability, state feedback techniques, design of feedback controllers and observers.


503. Random Processes for Engineering Applications (3) I II Probability, random variables, stochastic processes, correlation functions and spectra with applications to communications, control, and computers. P, 320.


524. Active RC Filters (3) II Modern techniques for realizing active RC filters using passive elements and operational amplifiers gain blocks; determination of sensitivity; effects of gain-bandwidth.

525.* Image Science and Engineering (3) I II Properties of optical images and image forming systems; acquisition and manipulation of digital images; two-dimensional Fourier representation; image quality criteria; introduction to image processing. P, 340.

527. Holography (3) II 1994-95 (Identical with OPTI 527)


530.* Optical Communication Systems (3) I Physics of optical communication components and applications to communication systems. Topics include fiber attenuation and dispersion, laser modulation, photo detection and noise, receiver design, bit error rate calculations, and coherent communications. P, SIE 230, ECE 352, 381; CR, 431.

531. Image Processing Laboratory for Remote Sensing (3) I Techniques and applications of digital image processing in remote sensing, multispectral image enhancement and analysis, classification, feature extraction for cartography, rule-based systems for mapping from imagery. 3R, 1L. (Identical with OPTI 531)

532. Computer Vision (3) II Digital image analysis, including feature extraction, boundary detection, segmentation, region analysis, mathematical morphology, stereophotogrammetry, and optical flow. P, 340. (Identical with OPTI 532)


534. Advanced Topics in Electronic Materials (3) [Rpt/2] 1996-97 (Identical with MSE 534)

535.* Noise in Communications Systems (3) I Principles of communication in the presence of noise; discussion of basic statistical techniques, noise sources, SNR, and error rates. Credit is allowed for this course or for 538 but not both. P, 431, SIE 305.

536.* Introduction to Coding Techniques (3) I Error-correcting codes used in modern digital communications systems, with emphasis on hardware implementations and performance on real channels. P, 274 and SIE 305.

537. Digital Transmission and Telephony (3) Spectrum control, synchronization, and multiplexing in digital transmission systems. Topics include line coding, scrambling, spread spectrum, time-division multiplexing, frequency division multiplexing, timing recovery, frame synchronization, modulation, and echo cancellation. P, SIE 305 and ECE 431.

538. Digital Communications Systems (3) II Digital modulation techniques for the Gaussian white noise channel, emphasizing optimal demodulation methods analysis of error rates, and signal design over finite bandwidth channels. Credit is allowed for this course or for 535 but not both. P, 503.

539. Algebraic Coding Theory (3) II 1995-96 (Identical with MATH 539)


542.* Digital Control Systems (3) II Modeling, analysis, and design of digital control systems; A/D and D/A conversions, Z-transforms, time and frequency domain representations, stability, microprocessor-based designs. P, 441.


545. Decentralized Control and Large-Scale Systems (3) I Introduction to large-scale systems, design techniques, and modeling and control reduction, structural properties, decentralization of control and information, hierarchical and multi-level controllers. P, 501.

546.* Photovoltaic Systems Engineering (3) I (Identical with NEE 546)

547.* Direct Energy Conversion (3) II (Identical with NEE 547)


549.* Continuous-System Modeling (3) I Techniques for modeling systems described by differential equations and difference equations. Physical modeling, mass and energy balances, analysis, bond graph, system dynamics, qualitative modeling, intuitive reasoning, neural networks. 1ES, 2ED. P, CR, 500 (Identical with CSC 549)


552. Solid State Devices (3) II Basic semiconductor physics and materials, PN junctions, metal semiconductor junctions/contacts, BJTs and MOSFETs, device operation, terminal behavior and frequency response, device models. P, 352, 451.


554. Electronic Packaging Principles (3) I II Introduction to problems encountered at all levels of packaging thermal, mechanical, electrical, reliability, materials and systems integration. Future trends in packaging. (Identical with ECE 554 and MSE 554)

555. VLSI Chip Engineering (3) I Layout methods and tools for MOSFET and bipolar ICS, statistical circuit design techniques, circuit models for SPICE simulation, ESD and latchup protection, exercises and term project in design of a chip, including SPICE simulation on mainframe computer and chip layout using modern CAD system on work station. P, 458.

556.* Optoelectronics (3) I Properties and applications of optoelectronic devices and systems. Topics include radiation sources, detector and detector circuits, fiber optics, and electro-optical components. P, 352, 381.

557.* Integrated Circuit Laboratory (3) Experiments in diffusion, oxidation, processing, etc. Fabrication of an integrated circuit. P, 458, 540, or equivalent (Identical with MSE 457)

558. Vacuum System Engineering (3) II 1995-96 Rarefied gas dynamics, pumping and gauging systems as they apply to microelectronic device and thin-film fabrication. Materials and techniques for ultraclean and ultrahigh vacuum processing. P, 557b or consult department before enrolling.
559.* Optical Fundamentals for Electrical Engineers (3) I Introduction to diffraction and 2D Fourier optics, geometrical optics, paraxial systems, third order aberrations, Gaussian beam propagation, optical resonators, polarization, temporal and spatial coherence, optical materials and nonlinear effects, electrooptic modulators. Applications to holography, optical data storage, optical processing, neural nets, associative memory optical interconnects. P, 352, 381, CR, 482.

560.* Aerosol Science and Engineering (3) I 1995-96 (Identical with CHEE 560)


563. Engineering Application of Graph Theory (3) I Topics will emphasize engineering applications of graph theory. Terminology, algorithms, and complexity analysis will be included. Application areas will include, but are not limited to, communication networks, VLSI, and network interconnection networks. P, 347.

565.* Microelectronics Packaging Materials (3) II (Identical with MEE 565)


568. Computer Architecture and Organization (3) I Overview of uniprocessor architectures, introduction to parallel processing, pipelining, vector processing, multi-processing, multiprocessor and multicomputer systems, cache memory design for parallel computers, cache design, communication networks for parallel processing, algorithms for parallel processing. P, 369.


571a. Digital Systems Design (3) 571a: Computer organization and architecture; control unit design, microprogramming, input-output. (Identical with C SC 571a)

572.* Continuous-System Simulation (3) II Techniques for simulating systems described by differential equations and difference equations. Numerical integration, parameter estimation, random number generation, simulation software, simulation hardware. 2ES, 1ED, P, CR, 340 (Identical with C SC 572)

573.* Software Engineering Concepts (3) II In-depth consideration of each of the phases of the software project life code. Object-oriented design and programming. Includes a large-scale software development project involving groups of students. 2R, 3L. P, 571.

574a-574d.* Computer-Aided Logic Design (3-3) I II 574a: Tabular minimization of single and multiple output Boolean functions, NMOS and CMOS realizations, synthesis of sequential circuits, RTL description, laboratory exercises. P, 574b: Standard cell layout, gate and switch level simulation, level mode sequential circuits. VLSI testing, CAD tools, laboratory projects. (Identical with C SC 574a-574d)


576. Knowledge-Based System Design (3) II Provides a framework for systematic design of systems: for constructing computer-aided environments to support engineering design activities. Characterization of design methodologies; introduction to knowledge-based design; system design and simulation modeling, knowledge-based model of design, representing designs and design knowledge, design model synthesis, concepts for design evaluation, learning and creativity in design systems. A large-scale term project is central to the course. P, 479, 473.


579.* Principles of Artificial Intelligence (3) I Provides an introduction to problems and techniques of artificial intelligence (AI). Problem solving; basic problem solving methods and techniques; search and game strategies, knowledge representation using predicate logic; structured representations of knowledge; semantic nets, entity structure, frames and scripts; planning; learning, expert systems; implementing AI systems. 1.5ES, 1.5ED. P, 571, 473.

581a-581b. Electromagnetic Field Theory (3-3) 581a: II Time-harmonic fields; fundamental theorems and concepts; rectangular and circular waveguides and resonators; aperture in ground planes, cylinders, and wedges; scattering by cylinders and wedges. P, 502 or MATH 422b; 482 or PHYS 415b. 581b: I Spherical geometries: interface problems; perturbation techniques; integral equations; asymptotic techniques; introduction to transient fields.

583. Remote Sensing Instrumentation and Techniques (3) II Development of instrumentation, measurement and signal processing techniques required for electromagnetic remote sensing applications with emphasis on atmospheric remote sensing. P, 482. (Identical with ATM 583)

584. Advanced Antenna Theory and Design (3) II 1994-95 Electromagnetic radiation and diffraction; dipoles, slots, open wave guides, and horns; apertures, reflectors, and arrays; mechanical and electronic scanning; applications to practical radar and communications problems. P, 581a

585.* Radio Waves and Telemetry (3) II Principles and properties of electromagnetic propagation through the atmosphere and space including terrain effects. Applications to telemetry, with emphasis on microwave and satellite transmission, frame and packet construction, data synchronization, link characterization and systems considerations. 1.5ES, 1.5ED. P, 581, 431.

587.* Fiber Optics Laboratory (3) II (Identical with OPTI 587)

589. Atmospheric Electricity (3) II 1995-96 (Identical with ATM 589)

*May be convened with 400-level course.

561. Neural Networks (3) I Theory and application of parallel distributed computation via elementary processing elements; PE models and neural analogies; statistical classification, supervised/unsupervised; neural net models; perceptrons, associative memories; training algorithms.

563. Information Theory (3) II 1994-95 Definition of a measure of information and study of its properties; introduction to channel capacity and error-free communications over noisy channels; rate distortion theory; error detecting and correcting codes. P, 503. (Identical with MATH 636)


565.* Advanced Analytical Circuits (3) II Advanced topics in bipolar and CMOS analog integrated circuits including both switching and nonswitching applications. Voltage references, DAC and ADC systems, instrumentation amplifiers, sample-hold circuits, switched-mode power supply regulators. P, 550.

562. Advanced Solid-State Devices (3) I Analysis and design of devices including BJTs, MOSFETS, MESFETS, MODFETS, microwave devices, and photonic devices. P, 552.


569. Advanced Topics in Microelectronics and Solid State Devices (3) [Rpt./9 units] Specialized topics, as announced, such as submicron MOSFETS, radiation effects on devices, yield analysis, advanced semiconductor processing technologies, and contamination control. P, consult department before enrolling.
678. Integrated Telecommunication Networks (3) I Analysis and design of integrated voice, data, and image networks for integrated telecommunications applications. Protocols for LANs, ISDNs, WANs, MANs and interoperable networks. ISO-based network software design for applications. P. 566, 673.

679. Advanced Artificial Intelligence (3) II Expert system design, reasoning under uncertainty, advanced planning methods in AI, case based reasoning, machine learning, logical foundations of intelligent systems. P. 579.


690. Seminar
b. Advanced Topics in Electrical Engineering (3) I [Rpt./9 units] P, consult instructor before enrolling.

Engineering and Mines (ENGR)

Harbarger Building, Room 134
(520) 621-6032; FAX (520) 621-9995

Within the colleges of Engineering and Mines, and Agriculture, programs are offered leading to the Master of Science (M.S.) and the Doctor of Philosophy (Ph.D.) degrees as indicated in the following list of departments and majors:

Aerospace and Mechanical Engineering
- aerospace engineering M.S./Ph.D.
- mechanical engineering M.S./Ph.D.

Agricultural and Biosystems Engineering
- agricultural and biosystems engineering M.S./Ph.D.

Chemical and Environmental Engineering
- chemical engineering M.S./Ph.D.
- environmental engineering M.S./Ph.D.

Civil Engineering and Engineering Mechanics
- civil engineering M.S./Ph.D.
- engineering mechanics M.S./Ph.D.

Electrical and Computer Engineering
- electrical engineering M.S./Ph.D.

Hydrology and Water Resources
- hydrology M.S./Ph.D.
- administration M.S./Ph.D.

Materials Science and Engineering
- materials science and engineering M.S./Ph.D.

Mining and Geological Engineering
- mining engineering M.S./Ph.D.
- geologic engineering M.S./Ph.D.
- geophysical engineering M.S./Ph.D.

Nuclear and Energy Engineering
- nuclear engineering M.S./Ph.D.

Systems and Industrial Engineering
- systems engineering M.S.
- industrial engineering M.S.
- reliability and quality engineering M.S.

Qualifying students working toward an advanced degree in various engineering programs may select certain options which are interdisciplinary or interdepartmental in nature. The programs in which these options are available and descriptions of the option follow:

Biomedical Engineering: This option is available in the departments of Aerospace and Mechanical Engineering, Chemical and Environmental Engineering, Electrical and Computer Engineering, Nuclear and Energy Engineering, and Systems and Industrial Engineering. Biomedical engineering is a multidiscipline in which physical scientists and engineers interact with life scientists and physicians to solve problems ranging from basic investigations to applications in clinics and related health service facilities. The work is coordinated by the Committee on Biomedical Engineering.

Energy Systems Engineering: This option is available in the departments of Aerospace and Mechanical Engineering, Chemical and Environmental Engineering, Civil Engineering and Engineering Mechanics, Electrical and Computer Engineering, and Nuclear and Energy Engineering. The program is designed to encourage engineering study and research efforts directed toward society's energy needs. The scope of interest includes energy sources (fossil, geothermal, hydro, nuclear, and solar); systems to convert and transfer energy and power; efficient energy utilization; and environmental controls. Applied research and industrial interaction are stressed. The program is coordinated by a committee representing the departments in which the option is available.

501. Planning for Discovery: Problem Selection and Proposal Preparation (3) II (Identical with MEE 501)

502. Research Proposal Preparation (3) I (Identical with MEE 502)

554. Law for Engineers/Scientists (3) II (Identical with CHEE 554)

*May be convened with 400-level course.

Engineering Mechanics

(See Civil Engineering and Engineering Mechanics)
Record Examination and a short sample of their scholarly or critical writing. Applicants must also arrange to have the department receive three letters of recommendation. These materials should be addressed to the Director of Graduate Study of the Department of English. Thirty units are required for the M.A. degree; in the literature program, at least 27 units (nine courses) must be in regularly scheduled literature classes, unless otherwise approved by the program director. Students in both programs must also pass an M.A. examination.

**Master of Arts** (major in English as a second language): Applicants should have an overall grade-point average of 3.50 in a relevant undergraduate major. Scores from the Graduate Record Examination must be submitted along with evidence of significant teaching experience and completion of two years of study of a foreign language or equivalent proficiency. International students must provide TOEFL scores of at least 550.

**Master of Fine Arts:** For information concerning this degree see Requirements for Master's Degrees/Master of Fine Arts elsewhere in this catalog.

**Doctor of Philosophy:** The admission requirements for this degree program are the same as those set forth for the Master of Arts with a major in English, above. In literature, students who have earned the Master of Arts degree from the literature program must complete at least 15 units of 500-level course work beyond the requirements for the M.A., for a total of 45 units. At least 33 units (11 courses) of the 45 must be in regularly scheduled literature classes, unless otherwise approved by the program director. Literature students who have earned the M.A. degree elsewhere must complete a minimum of 30 units of course work; of these, at least 21 units (seven courses) must be in regularly scheduled literature classes, unless otherwise approved by the program director. Students in rhetoric, composition, and the teaching of English must complete at least 45 units of course work at the 500-level or above; those seeking to transfer credits from another institution or program should consult with the program director. In addition to these course requirements, all students in both programs must pass the qualifying and preliminary examinations, must complete 18 units of dissertation credit, and must write a dissertation acceptable to the Department of English.

Contact the Director of Graduate Study of the Department of English for further information.

501. **Advanced Creative Nonfiction Writing** (3) [Rpt./24 units] I II For M.F.A. candidates working on personal essays, or consult department before enrolling.

502. **Professionalizing Presentation Skills** (1) I II (Identical with BIOL 502)

505. **History of the English Language** (3) I II The evolution of English sounds, inflections, and vocabulary from earliest times to the present, with attention to historical conditions. (Identical with GER 505)

506. **Modern English Grammar** (3) I II S Introduction to the nature of grammar and approaches to the description of English grammar, emphasizing Chomsky's transformational-generative model. Focus is on grammatical structure, but scope includes phonology and social/historical factors which influence the form and use of English in various contexts. Includes practice in phonemic transcription and sentence diagramming. P, LING 500.

508. **English as a Second Language in Bilingual Education** (3) I II Methodology for the teaching of English as a component of bilingual education.


511. **Teaching of Literature** (3) I II Theory and practice of teaching literature, with intensive study of genres and works commonly taught in secondary schools. P, nine units of literature.


513. **Poetry in Forms** (3) [Rpt.] I II Explores prosody through discussing and writing of forms and types, research paper. P, 309.

514. **Advanced Scientific Writing** (3) I II Preparation of professional literature for publication.

515. **History of Criticism and Theory** (3) [Rpt./1] I II A systematic introduction to the history of criticism and/or modern and contemporary critical theory.

516. **Theories of Linguistic Structure** (3) I II In-depth examination of at least two recent theoretical models of linguistic structure, including Chomsky's, with attention to English and cross-linguistic differences. P, 506 or an introductory linguistics course.


520. **History of the German Language** (3) II 1995-96 (Identical with GER 520)

521. **American English** (3) I II History of the development of American English from the colonial period to the present. Topics include regional and social varieties, language contact, and slang. Geographic atlas, social survey, and lexicographic research methods are utilized. P, 405 or introduction to linguistics.

524. **Studies in Southwest Literature** (3) I II (Identical with AINS 524)

525a-525b. **Old English** (3-3) 525a: Introduction to the language and literature. 525b: Beowulf. Study of the poem in the original language. (Identical with GER 525a-525b)

526. **Medieval English Literature** (3) I Survey of Old and Medieval English literature (excluding of Chaucer) with some use of modernized or glossed versions.

527. **Chaucer** (3) I The Canterbury Tales and other poems, read in Middle English.

529. **Chinese-American Literature 1960 - Present** (3) I (Identical with CHN 529)

531. **Advanced Studies in Shakespeare** (3) I

533. **Studies in the Renaissance** (3) [Rpt./1] I

534. **Advanced Studies in Milton** (3) I

541. **Studies in the Restoration and Eighteenth Century** (3) [Rpt./1] I

543. **Mexican-American Literature** (3) [Rpt./1] I II Study of the literature, in English or English translation, by Mexican-American authors, or important to the development of Mexican-American literature.

545. **Introduction to TESL: An Overview** (2) I The development of the field of English as a second language with emphasis on current trends, the influence of linguistic theory, and the international role of English.

548. **Theory and Practice of Writing** (3) 1996-97 (Identical with FREN 548)

549a-549b. **Folklore** (3-3) 549a: Forms of verbal folklore. 549b: Non-verbal folklore and material culture (Identical with AINS 549a-549b, ANTH 549a-549b and CCLS 549a-549b).

550. **Modern Theories of Cultural Studies** (3) (Identical with CCLS 550)

554. **Contemporary Feminist Theories** (3) I (Identical with WS 554)


565. **Studies in American Literature to 1900** (3) [Rpt./3] I Reading course in American literatures before 1900.

566. **Studies in Twentieth-Century American Literature** (3) [Rpt./3] I II Reading course in twentieth-century American literatures.

577. **American Indian Literature** (3) I II (Identical with AINS 577)

585. **Linguistics and Computer-Assisted Approaches to Literature** (3) [Rpt./6 units] I II (Identical with GER 585).

587. **Testing and Evaluation in Foreign/Second Language Programs** (3) (Identical with GER 587)

595. **Colloquium**
   a. **Professional Studies** (1-6) [Rpt./4] I I Designed for teaching assistants in English. May also be used, at discretion of graduate program directors in English, for other professional training.
596. Seminar
a. British Literature (3) [Rpt./8] I II
b. Studies in Colonial and Post-colonial Literature and Theory (3) [Rpt./3] I II
c. American Literature (3) [Rpt./8] I II
d. Comparative Literature (3) [Rpt./4] I II (Identical with CCLS 596g)
e. Modern Language Literature (3) [Rpt./24 units] I II
f. Open to creative writing majors only.
g. Germanic Linguistics (3) [Rpt.] I II
h. Second Language Acquisition Research (3) [Rpt./4] II P, 506
i. Methods and Materials of Literary Research (3) [Rpt.] I II
j. Theories of Criticism (3) [Rpt./4] I II
k. Studies in the Oral Tradition (3) [Rpt./9 units] II (Identical with ANS 596m)
l. Discourse Analysis (3) [Rpt./3]
m. Topics in Second Language Teaching (3) [Rpt./9 units] II P, 613 or equivalent. May be repeated only when topic changes.

597. Workshop
a. Southern Arizona Writing Project (3-9) [Rpt./12 units] II S (Identical with LRC 597a)
b. The Teaching of English (3) I II S [Rpt.3] (Identical with LRC 597b)
c. Research and Composition (3) II

*May be repeated with 400-level course.

604. Writing Project in Fiction (1-6) [Rpt./24 units] I II For M.F.A. candidates working toward book-length writing project in fiction.

609. Writing Project in Poetry (1-6) [Rpt./24 units] I II For M.F.A. candidates working toward book-length writing project in poetry.


613. Methods of Teaching English to Speakers of Other Languages (3) I Foundations, theory, and methodology in English as a second language. (Identical with LRC 613)


615. Second Language Acquisition Theory (3) I Survey of major perspectives on second language acquisition processes, including interlanguage theory, the Monitor Model, acculturation/pidginization theory, cognitive/constructivist theory, and linguistic universals. Analysis of research from the different perspectives includes consideration of grammatical, pragmatic, and sociolinguistic dimensions of language learning. P, 506.


693. Internship

696. Seminar
b. Linguistics (2 to 4) I II (Identical with GER 696b)
d. History of Rhetoric (3) [Rpt./6] I II

e. Studies in Rhetoric and Composition (3) [Rpt./6] I II S

Entomology (ENTO)
Forbes Building, Room 410 (520) 621-1151; FAX: (520) 621-1150

Professors: H. Hagedorn, Head, Elizabeth A. Bernays, William S. Bowers, Reginald F. Chapman (Neurobiology), René Feyereisen, John G. Hildebrand (Neurobiology), Roger T. Huber, John H. Law (Biochemistry), Leon Moore (Emeritus), José M.C. Ribeiro, Nicholas J. Strausfeld (Neurobiology), Donald M. Tuttle (Emeritus), George W. Ware (Emeritus), Theo F. Watson

Associate Professors: Nancy A. Moran (Ecology and Evolutionary Biology), Robert L. Smith, Diana E. Wheeler

Assistant Professors: David R. Maddison, Daniel F. Papaj (Ecology and Evolutionary Biology), Martin F. Taylor

Research Associates: Stephen L. Buchmann, Assistant Specialist Peter Ellsworth

The department offers programs leading to the Master of Science and Doctor of Philosophy degrees with a major in entomology. Faculty interests include behavioral ecology, plant-insect interactions, chemical ecology, biochemistry and physiology of vector arthropods, vector-host interactions, biological control, insect migration, integrated pest management, toxicology, biochemistry, and evolution of resistance, physiology, social insects, evolutionary biology, and systematics. Research opportunities with insects also exist in the departments of Biochemistry, and Ecology and Evolutionary Biology, the Committee on Neuroscience, and the Program in Insect Science. The Center for Insect Science provides opportunities for collaborative research with a large group of insect scientists in the state. Facilities for field studies include University Agricultural Centers in Maricopa and Yuma counties and a farm with an entomology lab three miles from campus. Natural habitats can be studied on University land in the Sonoran Desert and in the rangelands and canyons of the Santa Rita Mountains. Several excellent field centers are available in the diverse biomes of southern Arizona.

Admission requirements include the completion of an undergrad major in the biological sciences. The undergraduate program should include coursework in physics, organic chemistry, mathematics, and the evolutionary, ecological, organismic, cellular and molecular aspects of biology. Applicants must submit scores on the general and subject tests of the Graduate Record Examination and three letters of recommendation from persons in a position to assess the applicant's potential as a graduate student. Inquiries concerning financial aid should be addressed to the department.

Graduate study programs are individually planned and approved by the student's committee. Candidates for the Master's degree in entomology will be required to take 2 units of seminar and two courses selected from ENTO 507, 508, 511, 515, 516, and 544. A thesis is required. Candidates for the Master's degree with a concentration in applied entomology can specialize in agricultural entomology, urban entomology, or medical and veterinary entomology. Course requirements are ENTO 508, 516, 544, and 3 courses selected from the area of specialization. A non-thesis option is available. The doctoral program requires 4 units of seminar and three courses selected from ENTO 507, 508, 511, 515, 516 and 544, plus 6 credits from upper-division courses offered by the Department of Entomology.

502.* Agriculture and the Environment: Focus on Pesticides (3) II (Identical with AGTM 502) Huber

503R.* Biological Control of Arthropods (3) I (Identical with V SC 503R)

507R.* Biological Control of Arthropods (3) II (Identical with V SC 507R)

507R.* Insect Physiology Research (3) I 1996-97 Introduction to the diverse and unique ways insects solve physiological problems. A whole-animal approach will be used centered around various aspects of an insect's life (i.e., growing, flying, reproducing). P, 201; CR, 507R, biology requirement with V SC 503R, plus 3 units from Upper Division offered by the Department of Entomology. Chapman/Hagedorn


508.* Insect Behavior and Ecology (3) I 1995-96 The evolution of arthropod behavior in ecological context. Ultimate causation with some consideration of physiological and morphological constructs. 2R, 3L. Field trips. (Identical with ECOL 511 and INSC 511) Smith/Papaj

515R. Insect Biology (3) I Insects and other land arthropods, their functional anatomy, perception of the environment, relationships to other animals and plants. Insect classification and taxonomy to order and major families. P, ECOL 182. (Identical with ECOL 515R and INSC 515R) Chapman


527. Insect Chemical Ecology (4) I 1995-96 The chemistry of relationships regulating insect growth, development, reproduction, diapause and communication. Derivation of biorational methods of insect control. Laboratory includes experience with modern instrumentation focused on the isolation, identification and biological assay of natural products. 3R, 3L, P, 201, 507 or equivalent, and 3 units of organic or biochemistry. (Identical with V SC 527) Bowers

533. Teaching Biology Labs (2) II (Identical with BIOL 533)

544. Insect Ecology (3) I 1996-97 The study of how variation in the environment, interactions with other species and the special features of insect "design" have determined the evolution of diverse insect life histories, the dynamics of insect populations and the roles of insects in communities. 2R, 3L. Field trips and project. P, 201R. (Identical with ECOL 544 and INSC 544) Taylor

552. Medical-Veterinary Entomology (4) [Rpt. /3] II 1996-97 Survey of arthropods of public health and veterinary importance, with emphasis on transmission dynamics of pathogens, biometrics of vector populations, and current control concepts. 3R, 3L, P, 201; parasitology recommended. (Identical with INSC 552 and V SC 552) Hagedorn

555. Professional Skills (2) I 1996-97 Development of oral, visual and written communication skills. Includes writing scientific papers and grants, giving talks and developing posters, as well as discussion of scientific ethics with emphasis on problems that affect every scientist. (Identical with ECOL 555)


568. Insect Pest Management (3) II 1994-95 Principles underlying the management of arthropod in agricultural systems. P, 201R. Watson

570. Biological Control (3) II 1995-96 Principles of the biological control of arthropod pests and weeds, emphasizing their application to agricultural and rangeland entomology. P, 444 and 468. (Identical with INSC 570) Watson

575. Entomology for Teachers (3) I Introduction to insects—diversity and importance. Methods of collection/pollination/social insects/forensic entomology, insects in agriculture, using insects to learn biological principles. Field trips. P, previous biology course (by approval), Bernuga

576. Environmental Toxicology (3) II (Identical with TOX 576)

596. Seminar
   a. Entomology (1) [Rpt. /6] I II
   b. Medical-Veterinary Entomology (1-3) I P, 452
   c. Insect Ecology and Evolution (1) [Rpt. /5] I II
   d. Plant-Insect Interactions (1) [Rpt. /5] I II (Identical with PL S 596d)
   e. Insect Physiology, Biochemistry, Toxicology (1) [Rpt. /5] I II
   f. Topics in Pest Management (1) [Rpt. /5] I II
   g. Ecology, Epidemiology, and Control of Vector-borne Diseases (1-3) [Rpt. /5] I II

*May be convened with 400-level course.

612. Biological Electron Microscopy (4) I (Identical with MCB 612)

660. Infectious Disease Epidemiology (3) [Rpt. /1] I II (Identical with EPI 660)

696. Seminar
   a. Entomology (1) [Rpt. /6] I II

Epidemiology (EPI)

AHSC, Room 2332
(520) 626-6379; FAX: (520) 321-6970

Graduate Interdisciplinary Program in Epidemiology

Executive Council:
   Professors, Michael D. Lebowitz, Chair (Internal Medicine), Eskild Petersen (Medicine)
   Associate Professor Larry C. Clark (Family and Community Medicine)
   Assistant Professor Denise J. Roe (Family Community Medicine)

The graduate interdisciplinary program in epidemiology offers the opportunity for study in the scientific discipline concerned with the causes and prevention of disease in human populations. Advances in clinical medicine, laboratory science, environmental health, nutrition, statistics, computer data processing and the basic understanding of the pathogenesis of disease enable epidemiology researchers to better examine causes of disease and to evaluate more effective strategies for disease prevention and control. Multidisciplinary collaborations between program faculty and members of university departments and state and national health institutions provide classroom and community training opportunities. To accomplish this goal, faculty program members with overlapping expertise from several health science departments have been selected to direct courses and research.

Degrees
   The Graduate Program in Epidemiology offers a major in epidemiology for the Master of Science and Doctor of Philosophy degrees.

Admission Requirements
   In addition to an undergraduate degree, applicants should provide scores of the Graduate Record Examination. Three letters of recommendation are required.

515. Subspecialty
   h. Cancer Epidemiology and Prevention (3) I P, none; statistics helpful. (Identical with RONC 515h)
   i. Cancer Prevention and Control (3-5) II (Identical with RONC 515i)

610. Biostatistics for Research (3) II Descriptive statistics and statistical inference relevant to biostatistics, research methodology, data analysis, survival analysis, multivariate analysis, study designs, clinical trials, and biostatistics for the social sciences.

650. Quantitative Epidemiology (3) I Study of computer intensive multivariate epidemiologic methods including evaluation of potential etiologic environmental exposures in human populations to the risk of disease. 2R, 1L, P, FCM 596a, 596b.

660. Infectious Disease Epidemiology (3) [Rpt. /1] II Introduction to epidemiologic methods used in infectious disease investigations. An emphasis will be placed on understanding the relationships between the host, the parasite and the environment as they relate to disease causation. P, FCM 596a, 596b. (Identical with ENTO 660, PHL 660, and V SC 660)

670. Chronic Disease Epidemiology (4) II Nutritional epidemiology, pharmacoepidemiology, occupational epidemiology and environmental epidemiology. P, FCM 596a, 596b.

680. Respiratory and Environmental Epidemiology (3) I Epidemiologic methods and research in respiratory diseases and environmentally related diseases, with emphasis on adult and childhood chronic lung diseases, effects of air pollution and occupational exposures. P, 596a, 596b, STAT 509.

696. Seminar
   l. Epidemiology (3) I II [Rpt. /8 units]

986. Seminar
   a. Basic Principles of Epidemiology (3) [Rpt. /1] (Identical with PHL 596a)
   b. Epidemiologic Methods (3) II
   c. Psychosocial Epidemiology (2)
   d. *Human Biology (3) (Identical with MCB 596)
   e. *Community Health (4) (Identical with MCB 596)
   f. *Epidemiology of Human Reproduction (3) (Identical with MCB 596)
   g. *Ecology and Epidemiology (3) (Identical with MCB 596)
   h. *Infectious Disease Epidemiology (1) [Rpt. /5] I II
   i. *Epidemiology of Human Reproduction (3) (Identical with MCB 596)
   j. *Medical -Veterinary Entomology (1 -3) I P, 452
   k. *Insect Ecology and Evolution (1) [Rpt. /5] I II
   l. *Plant-Insect Interactions (1) [Rpt. /5] I II (Identical with PL S 596d)
   m. *Insect Physiology, Biochemistry, Toxicology (1) [Rpt. /5] I II
   n. *Topics in Pest Management (1) [Rpt. /5] I II
   o. *Ecology, Epidemiology, and Control of Vector-borne Diseases (1-3) [Rpt. /5] I II
   *May be convened with 400-level course.

*Available as both 596 and 896.

Exercise and Sport Sciences

(See Health-Related Professions)

Family and Consumer Resources

(FCR/FS/HE E/RCS)

FCR Building, Room 205
(520) 621-1075; FAX: (520) 621-9445

Professors Rodney M. Cate, Director, Victor A. Christopherson (Emeritus), Oscar C. Christensen (Emeritus),...
Family Studies: Family studies involves the scientific study of family structures, interactions, and outcomes, emphasizing change over time in individual, interacational, and group level phenomena. Emphasis are available in interpersonal relationships and human development.

When students are accepted into the concentration in family studies within the family and consumer resources major for the Ph.D., it is assumed that all have the ability and interest to pursue the doctoral degree and are expected to meet all university requirements for doctoral studies with a major concentration in family studies and a minor from a domain outside of the School of Family and Consumer Resources. Contact the Division of Family and Consumer Resources for specific degree requirements.

Family and Consumer Resources (FCR)

565. Women in International Development (3) [II (Identical with ANTH 565)]

*May becon tensed with 400-level course.

696. Seminar
z. Family and Consumer Resources (1-3) [Rpt./1] [II]
571. Counseling Women (3) II Examination of the counseling needs of contemporary women and current types of intervention designed to meet these needs. P, 6 units of counseling or related area. (Identical with W S 571)

572. Application of Family and Interpersonal Theory (3) II Identification of current issues in family and interpersonal relationships and the application of selected theories and research to the analysis of the issues. P, 6 units of family studies, psychology or sociology.

574. Professional Relationships: Building Cooperation and Mediating Conflict (3) I S
j. Anger, Depression and Guilt (3) S P, 6 units of counseling or related area.
k. Psychodrama (3) S P, 6 units of counseling or related area.
m. Counseling Mexican Americans (3) I S (Identical with GER 597m)

*May be convened with 400-level course.

601. Foundations of Counseling (3) I Relationship and contributions of various fields to the work of the counselor at all levels, in current and historical perspective; derivation of principles and objectives; integrated laboratory experience in selected settings.

607. Topics in Family Studies (1 to 3) [Rpt./3]
I II Variable content: cognitive development, biological theories of development, role theory, middle childhood, and others.

613. Family Issues in Aging (3) II 1996-97 Critical analysis of selected family and social issues, and related current research in gerontology (Identical with GEO 613)

622. Appraisal of the Individual (3) I Methods of appraising and reporting individual behavior, with emphasis on nonpsychometric data.


631. Career Counseling (3) I Theories of vocational development; types, sources, and use of occupational and educational information in career counseling and decision making. P 601 or CR.

636. Economics of Aging (3) I Analysis of economic issues and policy as they affect the aging individual, family, and society. (Identical with GERO 636)

637. Trends in Human Relations (3) Philosophy, content, and resources for understanding, teaching and working in the field of human relations.

644. The Counseling Process (3) II Introduction to theories of counseling: collation and interpretation of counseling data; the counseling process; study of cases. P, 601, 622.

645. Theories of Counseling (3) II Rationale, development, and research underlying major counseling theories. P, 631, 644.

647. Premarriage and Marriage Counseling (3) I Contemporary issues, concepts, and procedures in premarriage and marriage counseling.

648. Procedures in Family Counseling (1 to 3) II Theory and process in family counseling; problem solving techniques applied to parent-child conflict; laboratory experience. P, 403.


672. Cross-Cultural Counseling (3) II Issues, research and procedures involved in counseling with culturally different persons. P, 601, 622.

673. Group Counseling (3) S I Theory and process in group counseling; applications in community and mental health settings; laboratory experience. P, 644.


607n) II 1996-97 Analysis of current consumer socialization and retailing system, structure, demand and consumer behavior. P, CR.


507. Research Methods in Merchandising and Consumer Studies (3) II Research literature, methods, techniques, and procedures for conducting research, and analysis and interpretation of data. P, 3 units of graduate statistics.

534. Strategic Retail Management (3) II Application of retail planning and control procedures with emphasis on development and evaluation of retail practices and strategies using the case method. P, MKTG 361, MKTG 385 or CR.


555. Visual Merchandising and Display (3) I S All aspects of displaying merchandise, including window display, interior display, color and lighting techniques, line and composition, three-dimensional presentation, fixtures and systems, planning and layout. P, 115 or ART 101.

556. Store Planning and Design (3) II Study of the retail environment, the physical and psychological effects that initiate and motivate customer activity. P, 455.

*May be convened with 400-level course.

606. Advanced International Consumption and Retailing (3) I 1996-97 Understanding of international market environment and retailing structure, system, issues and trends in the contemporary global market; analysis of cultural, social, legal, political influence on international consumption pattern and retailing process. Developing retailing strategies on a global basis.

607. Topics in Merchandising and Retailing (3) II 1995-96 Analysis of current major topics or issues facing merchandising and retailing industries. P, 540, 606.

608. Topics in Consumer Issues and Psychology (3) I 1995-96 Exploration of new topics, critical examination of current literature and selectively distributed research reports and analysis of studies in consumer issues and psychology. P, graduate statistics and/or research methods.

634. Retail Merchandising Analysis (3) I 1995-96 Analysis of current literature and case studies of major issues facing retail management.


**Family and Consumer Resources—Finance (FIN)**

McClelland Hall, Room 315R
(520) 621-7554; FAX: (520) 621-1261
Professors Edward A. Dyl, Head, Willard T. Carleton, Nestor R. Roos (Emeritus)
Associate Professors Erich K. Bleck (Emeritus), Joseph S. Gerber (Emeritus)
Chris Lamoureux, Michael Weisbach
Assistant Professors Allen B. Atkins, Robin J. Brenner, Corinne M. Bronfman, Simon K. Kwan, Joel S. Stemberg, Jose Suay

The department offers programs leading to the Master of Science degree with a major in finance. The department also participates in the programs leading to the Master of Business Administration and the Doctor of Philosophy degree with a major in management. For information concerning these degrees, see Requirements for Master's Degrees/Master of Business Administration and the headnotes of Business Administration elsewhere in this catalog.

For admission, the applicant is expected to have completed undergraduate work in managerial accounting, economics, finance, marketing, organizational behavior, production, business policy, statistics, and mathematics through calculus (Math. 111 and 123). A score on the Graduate Management Admissions Test in the seventy-fifth percentile or above and an academic average of approximately "B" or better are required for admission consideration.

The program for the Master of Science degree with a major in finance includes a minimum of sixteen units at the 500 level and either a thesis or a research report.

Managerial Finance (3) I Integration of the basic principles and underlying theory of finance, with emphasis on analytical financial management of business firms and other organizations. Open only to students admitted to a BPA graduate program. P, ACCT 550.

Advanced Corporation Finance (3) II Financial theory applied to capital structure; investment decisions; corporate valuation; and corporate financial policies. P, 412 or 511.


Investment Analysis (3) I Portfolio theory with applications to the markets for equities, fixed income securities, and options. Risk analysis and investment strategies. P, 511.


Topics in Public and Nonprofit Financial Management (3) I (Identical with PA 528)


Finance for New Ventures (3) I Value maximization; simulation of value distribution; sources of venture capital; timing of initial public offering; new venture ownership structuring. Open only to students in the entrepreneurship program. P, 511, Mktg. 500. (Identical with MAP 557)

Planning of New Ventures (3) II (Identical with MAP 599)


Financial Decision Making Under Uncertainty (3) II Theoretical and applied financial economics relating to uncertainty in markets, information, and choice. P, 513.


Colloquium a. Research and Finance (1-3) [Rpt./4] I II

Seminar a. Investments (3) [Rpt./1] II
b. Financial Markets (3) [Rpt./1] II
c. Corporation Finance (3) [Rpt./1] II
d. Financial Institutions (3) I
f. Research Methods (3) [Rpt./1] II

Workshop a. Research Issues (1-3) [Rpt./5] I II, F, Admission to a graduate program in BPA.

French and Italian (FREN/ITAL)

Modern Languages Building,
Room 549
(520) 621-7349; FAX: (520) 621-6104

Professors Robert A. Ariew, Acting Head, Jonathan Beck, Frank M. Chambers (Emeritus), Monique Wittig
Associate Professors Edward G. Brown, Irene S. d’Almeida, Ingeborg M. Kohn (Emerita), Lise Leibacher, Henri Servin, Gianni Spera, Ronnie H. Terpening Assistant Professors Brunella Bigi, S. Prosper Sanou

The department offers programs leading to the Master of Arts and the Doctor of Philosophy degrees with a major in French. In cooperation with the College of Education, the department also offers courses leading to the Master of Education degree with a major in French. For information regarding this degree see Requirements for Master’s Degrees/Master of Education elsewhere in this catalog. A doctoral minor is available in French.

The department cooperates with the Arizona Center for Medieval and Renaissance Studies.

Admission to graduate programs in French requires the completion of a bachelor’s degree with a major in French. Admission to a doctoral program is dependent upon the completion of a Master of Arts degree with a major in French. Students with a master’s degree from another institution must take a qualifying examination during the first two weeks of residence.

Degrees

Master of Arts (Major in French): Students must complete at least 30 units of course work. A thesis option is available. Concentrations are available in the literature of France, Francophone literature, and second language acquisition/pedagogy. Candidates must pass a final written and oral examination.

Doctor of Philosophy: The major in French consists of a minimum of 50 units of graduate course work in the department in addition to the dissertation. The minor, consisting of 12 or more units, may be taken within the department or in a field approved by the department. All students are required to demonstrate knowledge in two other foreign languages. After successful completion of the written and oral preliminary examination, each candidate will write and defend a doctoral dissertation.

French (FREN)

510. Introduction to Graduate Study in French Language and Literature (3) I 1995-96 Problems and methods of advanced research in French language and literature. Use of specialized library resources and computerized data bases. Issues in the history, sociology, and politics of the professional practice of language and literature study in American universities.

511. Topics in Literary History, Criticism, and Theory (3) [Rpt./3] II 1995-96 Current, recent, and traditional ways of analyzing and interpreting literary texts and the cultural contents in which they are produced, with emphasis on French, and attention to understanding various means by which knowledge of literary issues is transmitted to others. May be repeated when topics vary.


518. Literature of the 18th Century (3) [Rpt.] Studies in the French Enlightenment, including theater; fiction; essays. Analysis of the main literary, artistic, and socio-cultural movements in France and in Europe during the 18th century-the French Enlightenment. P, graduate standing.

519. Literature of the 19th Century (3) [Rpt.] Examinations various aspects of literary works ranging from poetry, the theater; the novel and critical essays. Studies in French Romanticism and Realism. P, graduate standing.

520. Literature of the 20th Century (3) [Rpt.] Studies in contemporary French literature, including theater, fiction, poetry, essays.
Genetics (GENE)

Forbes Building, Room 319A
(520) 621-7511

Graduate Interdisciplinary Program in Genetics

Committee:

Professors Harris Bernstein (Microbiology and Immunology), Danny L. Brower (Molecular and Cellular Biology), Robert F. Erickson (Pediatrics, Molecular and Cellular Biology), William B. Heed (Emeritus), Conrad Istock (Ecology and Evolutionary Biology), Margaret G. Kidwell (Ecology and Evolutionary Biology), Brian A. Larkins (Plant Sciences), John W. Little (Biochemistry), Robert G. McDaniel (Plant Sciences), Neil H. Mendelson (Molecular and Cellular Biology), Richard E. Michod (Ecology and Evolutionary Biology), David W. Mount (Molecular and Cellular Biology), David C. Rowe (Family and Consumer Resources), Hans VanEtten (Plant Pathology), Samuel Ward (Molecular and Cellular Biology)

Associate Professors Kenneth A. Feldmann, Chair, (Plant Sciences), Sue K. DeNiese (Animal Sciences), Carol L. Dieckmann (Biochemistry), Jennifer D. Hall (Molecular and Cellular Biology), H. Eugene Hoyme (Pediatrics, Pathology, Obstetrics and Gynecology), Christina K. Kennedy (Plant Pathology, Molecular and Cellular Biology), Dennis T. Ray (Plant Sciences), Steven E. Smith (Plant Sciences), J. Bruce Walsh (Ecology and Evolutionary Biology)

Assistant Professors Alison E. M. Adams (Molecular and Cellular Biology), Randall A. Heidenreich (Pediatrics, Biochemistry), Lynn J. Manseau (Molecular and Cellular Biology), Marc J. Orbach (Plant Pathology), Roy Parker (Molecular and Cellular Biology), Leland Pierson III (Plant Pathology), Linda L. Restifo (Neurobiology/Neurology), Mary C. Rykowski (Anatomy), Scott B. Selleck (Neurobiology, Molecular and Cellular Biology), Martin F. Taylor (Entomology)

Genetists from various departments comprise the interdepartmental Program in Genetics, which offers programs leading to the Master of Science and Doctor of Philosophy degrees with a major in genetics. The areas of study emphasized by the program are molecular and cellular genetics, cytogenetics, and population genetics. Research opportunities include bacterial and bacteriophage genetics, gene regulation, developmental plant genetics, plant and animal cytogenetics, somatic cell genetics, cancer and clinical cytogenetics, quantitative genetics and animal breeding, ecological and evolutionary genetics, population genetics, human genetics, and biometrical principles as applied to individuals and populations.

Admission requirements include: completion of bachelor's degree with one year of biology, courses in genetics, ecology, physiology and development biology, chemistry through organic, mathematics through integral calculus, introdutory physics, and statistics. In addition to materials required by the Graduate College, applicants are required to furnish the program with completed Committee on Genetics application forms, GRE scores on quantitative and verbal tests, and three letters of recommendation from persons qualified to evaluate the applicant's scholarly potential. The deadline for receipt of completed application forms for fall admission is March 1 and for spring admission, November 1.

Courses are available in a number of departments depending on the interests of the students.

501. Molecular and Medical Genetics (3) I (Identical with PED 501)

509. Statistics for Research (4) I II (Identical with STAT 509)

512. Medical Ethics (1) [Rpt./9] Ethical issues in genetic counseling, genetic testing, and gene therapy. The student will prepare a paper suitable for publication on a selected topic.

513. Quantitative Genetics (3) I 1995-96 (Identical with AN S 513)

516. * Computer Analysis of Sequences (3) II (Identical with MCB 516)

520. History of Genetics (1) I 1994-95 Experiments and discoveries which have led to the present state of knowledge in the various areas of genetics. P. ECOL 530 or 531.

523.* Cytogenetics (3) II (Identical with ECOL 523)

524. Theoretical Population Genetics (3) I (Identical with ECOL 524)

525. Speciation (2) II (Identical with ECOL 525)

533.* Human Genetics (3) I Genetic theory and technique, as applied to man; methods of analysis of genetically determined cytological and biochemical differences in individuals and populations. P. ECOL 520 or 532. (Identical with ECOL 533) Ward

535.* Evolution II (4) I (Identical with ECOL 535)

545. Concepts in Genetic Analysis (3) I (Identical with MCB 545)

555. Molecular Mechanisms of Development (3) II (Identical with MCB 555)

568. Nucleic Acids (4) I (Identical with BIOC 568)

570. Molecular Genetics and Evolution (3) I 1995-96 (Identical with MBIM 570)

574. Advances in Mammalian Genetics (2) [Rpt./1] I 1995-96 (Identical with BIOC 574)

581. Genetic Counseling (1) [Rpt./6] II Principles of genetic counseling, general topics related to issues raised during genetic counseling (such as coping with chronic illnesses), and specific genetic counseling issues related to unique disorders encountered in the genetics clinic and other genetic counseling situations. Such disorders include prenatal, pediatric, and adult genetic conditions. Limited to students in the genetic counseling training program except by consent of instructor.

589. Cancer Genetics and Cytogenetics (3) I 1993-94 (Identical with CBIO 589)

595. Colloquium I

a. Genetics (1) [Rpt.] II

596. Seminar I

j. Genetic Counseling (1) [Rpt.6] II Limited to students in the genetic counseling training program except by consent of instructor.

*May be convened with 400-level course.

601. Molecular and Cellular Biology (4) I Acquire a basic understanding of modern genetics, molecular biology, and cell biology, and learn how to apply that understanding to human disease. Open to students in the Masters degree program in Genetic Counseling only.
627. Advanced Genetics (3) II 1996-97 (Identical with PL S 627)

666. Human Microevolution (3) II 1996-97 (Identical with ANTH 666)

670. Recent Advances in Genetics (2) I Recent advances in the field of genetics. (Identical with ECOL 670)

695. Colloquium
   e. Science, Society and Ethics (1) II (Identical with MCB 695e)

Geography and Regional Development (GEOG)

Harvill Building, Room 409
(520) 621-1652; FAX: (520) 621-2889

Professors David A. Plane, Head, Michael E. Bonine (Near Eastern Studies), Terence Burke, Robert D. Carpenter (Emeritus), Lay J. Gibson, Lawrence D. Mann, Janice J. Monk (Southwest Institute for Research on Women), Gordon F. Mulligan, Leland R. Pederson, Richard W. Reeves, Thomas F. Saarinen (Emeritus), Arthur L. Silvers (Public Administration), Dan Stanislawski (Emeritus), Andrew W. Wilson (Emeritus), Ervin H. Zube (Renewable Natural Resources)

Associate Professors D. Robert Altschul, Adrian Esparza, Lisa J. Graumlich (Dendrochronology), Charles F. Hutchinson (Arid Lands Resource Sciences), Katherine K. Hirschboeck (Climatology), Stuart E. Marsh (Arid Lands Resource Sciences), Sallie A. Marston, Brigitte Waldorf, Marvin Waterstone

Assistant Professors Andrew C. Conmie, Beth A. Mitchneck

Research Social Scientist Janice Monk

The department offers programs leading to the Master of Arts and the Doctor of Philosophy degrees with a major in geography. In cooperation with the College of Education, the department offers work leading to the Master of Education degree with a major in geography. The department also offers courses in regional planning leading to the Master of Science degree with a major in planning.

All applicants are required to submit scores on the verbal, quantitative, and analytical sections of the Graduate Record Examination, as well as complete transcripts, three letters of recommendation, and a statement of intended research. Admission to the Doctor of Philosophy degree program requires the recommendation of the committee administering the final examination for the Master of Arts degree or, if the master’s degree was earned elsewhere, admission is subject to (a) completion of Geography 500, 657, and 689 with a grade of B or better in each, (b) submitting an acceptable research paper from one of these courses to the Director of Graduate Studies, and (c) receiving a positive evaluation of progress and potential from the mentor and the Director of Graduate Studies at the close of the first year of doctoral study.

Degrees

Master of Arts: A minimum of 30 units of graduate credit, to include (1) a core of 9 units consisting of 500, 657, and 689; (2) a minimum of 12 units of graduate work in geography exclusive of both core and thesis, at least 6 of which must be in courses or seminars exclusive to graduate students (i.e., not jointly convening 400/500-level courses, and not independent studies); and (3) an additional 9 units of approved electives, which may include up to 6 units of thesis, which is optional. In addition to the 30-unit coursework minimum, students also are required to register for 1 unit of 695a, colloquium, each semester they are in residence. Students electing the non-thesis option must pass a written and oral comprehensive examination; those electing the thesis option must pass a final oral examination.

Master of Education: A total of 17 units of geography including 500 and 689, and 11 additional approved units, to include at least one regional and one topical course. No thesis is required, but candidates must pass a 3-hour written examination and an oral examination. For further information concerning this degree, see Requirements for Master’s Degrees/Master of Education elsewhere in this catalog.

Master of Science (major in planning): The department cooperates with the Graduate Committee on Planning in offering courses for students seeking professional preparation for careers in planning for urban and rural regions. For further information, see Planning elsewhere in this catalog.

Doctor of Philosophy: Doctoral students must complete the requirements for the master’s degree and in addition a minimum of 18 units in geography (exclusive of the dissertation) of which at least 12 units must be from courses or seminars exclusive to graduate students, i.e., not convening 400/500 level courses, and not independent studies. In addition to the requirements specified above, doctoral students are required to register for 1 unit of 695a, colloquium, each semester they are in residence. Students must also achieve high-level competence in two fields of concentration, one topical and one regional, and will ordinarily complete a minimum of six units in each. Topical concentrations are available in behavioral, cultural, economic, historical, physical, and urban geography, and in regional development. Regional concentrations available are Anglo-America (or United States), arid lands, and Latin America, the Middle East, Russia and the former Soviet Union. In addition, doctoral students must demonstrate reading knowledge of an approved foreign language and proficiency in a scholarly research tool. The minor or minors must be complementary to the student’s program of specialization, and the dissertation should incorporate aspects of both the topical and regional concentrations chosen.

500. Current Geographical Research (3) I Major trends and issues in human and physical geography. Marston

504. Public and Policy Economics (3) II (Identical with PA 504)

505. Principles of Economic Geography (3) II Survey of micro- and macro-level theory in economic geography, location theory, central place theory, spatial behavior and interaction, development issues, impact models, and project evaluation. Mulligan

507. The American Landscape (3) II Origin and character of the visual aspects of places viewed individually and regionally; changes in habitat, vernacular structures and landscapes, townscape, countryside, and special features. Field trips. (Identical with L AR 507) Zube

508. Arizona and the Southwest (3) I The changing character of the land and human occupation of it, with emphasis on Arizona; historically and problem oriented. Field trip.

509. Russia and the Former Soviet Union (3) II Political, population, and economic elements of the contemporary Soviet state and their internal regionalization. Emphasis on human settlement, economy, and resource development. Mitchev

510. Development of Regional Planning (3) I Survey of the historical development of the planning profession; the evolution of American planning as a response to urbanization. Open to majors only. Credit allowed for this course or 301, but not both. (Identical with PLNG 510) Mann

511. Middle America (3) II Land, man, and culture in the major natural and cultural regions of Mexico, Central America, and West Indies. (Identical with LA S 511)

512. South America (3) I Physical and cultural bases of South America’s geographic patterns, with emphasis on human settlement and problems of resource development. (Identical with LA S 512)

513. Africa (3) II Physical and human bases of regional contrasts, with emphasis on tropical environmental systems and changing patterns of resource utilization and development.

515. Introduction to Water Resources Policy (3) II (Identical with HWR 515)

517. Introduction to Geographic Information Systems (3) II (Identical with RNR 517)

518. Advanced Geographic Information Systems (3) II (Identical with RNR 518)

530. The Climate System (3) I Systematic examination of processes and circulations...
comprising Earth's climate. Emphasis on circulations influencing geographic processes using examples of atmospheric environmental issues. P. 190a or ATM05/GEOL171. (Identical with AR L 530) Comrie

531. Global and Regional Climatology (3) II 1993.00-1995.00 Description and analysis of the atmospheric circulation process that produces differences in climates throughout the world. Emphasis on the Earth's problem climates and climatically sensitive zones most susceptible to floods, droughts, and other environmental stresses due to global change. P. ATMO171/GEOL1701 or GEOL103a.

550. Metropolitan and Regional Planning (3) II Survey and evaluation of examples and examples, including metropolitan, economic development, state and national, and environmental plans in the U.S. and abroad. (Identical with PLNG 550) Mann

553. Locational Analysis (3) II Industrial location theory and location factors, consumer travel behavior and market areas, geography of economic impacts, location of public facilities. (Identical with PLNG 553) Mulligan

557. Statistical Techniques in Geography, Regional Development and Planning (3) I Methods of gathering and analyzing data for the solution of geographical, urban, and regional planning problems, with emphasis on quantitative and statistical techniques used in spatial analysis and cartography, on the one hand, and program planning, on the other. (Identical with PLNG 557)

559. Land Use and Growth Controls (3) II Current planning and legal techniques to regulate the rate of growth, the sequence of growth, and the eventual total size of towns, regions, and states; concentration on case studies. (Identical with PLNG 559) Mann

561. Resource Management (3) I Examination and critical appraisal of social and behavioral science aspects of resource management, with special emphasis on factors affecting decision making. (Identical with PLNG 561)

563. Perception of Environment (3) II Examination of interdisciplinary research on environmental perception; consideration of social and behavioral variables at all scales of environmental perception and planning. (Identical with PLNG 563)

564. The Arid and Semiarid Lands (3) II Past, present, and future of settlement and resource utilization in the world's arid lands; spatial interrelationships of environmental, demographic, socioeconomic, and political systems. (Identical with AR L 564) Bonne

565. Physical Aspects of Arid Lands (3) I The climate, landforms, hydrology, soils, vegetation of deserts, with special emphasis on processes and distribution at micro-Lands. (Identical with AR L 565) Royce

567. Geographical Analysis of Regional Development (3) II Analysis of regional development, population growth trends, market, role of transportation in development, regional specialization and economic structure, interregional migration, and regional policy issues. (Identical with AREC 571 and PLNG 571) Mitchneek

574. Land Development Process (3) I II A case-oriented approach to site selection, rezoning, financing, architectural design, economic feasibility, and other facets of the land development process. Field trip. Consult with department before repeating course. (Identical with PLNG 574) Mann

576. Global Change (3) II (Identical with GEOS 579)

581. Computer Cartography (3) II Introduction to the use of computers for map production, with emphasis on cartographic principles and practical experience with several user-oriented mapping programs. (Identical with PLNG 581)

583. Geographic Applications of Remote Sensing (3) II Use of aircraft and satellite imagery for monitoring landforms, soils, vegetation, and land use, with the focus on problems of land-use planning, resource management, and related topics. 2R, 3L. Field trip, P. two units of remote sensing or equivalent experience. (Identical with PLNG 583) Marsh

596. Seminar I k. Risk and Society (3) I (Identical with ANTH 596k, HWR 596k) Waterstone u. Interdisciplinary Environment-Behavior Design (3) II (Identical with PSYC 596u)

597. Workshop a. Geography for Teachers (3) S *May be convened with 400-level course.

605. Planning Theories and Perspectives (3) I A critical examination of normative and methodological assumptions of alternative planning models, with emphasis on developing a perspective on contemporary planning issues. (Identical with PLNG 605) Mann

611. Projects in Regional Planning (1 to 5) [Rpt. /5 units] II Lectures, laboratory, and field projects covering various aspects of professional practice. P. 605, 24 units toward a graduate degree in planning. Field trips. (Identical with PLNG 601) Mann

617. Spatial Analysis (3) I Forward analysis and modeling of spatial processes and concepts and point pattern analysis, networks, surfaces, and related interaction. P. 457 or 557. (Identical with PLNG 657) Mulligan/Conner

618. Historical Geography (3) I II (Identical with PSYC 657) Mulligan/Conner

619. Colloquium I. (Rpt. /1 to 4) I Required of all graduate students each semester in residence.


Geological Engineering
(See Mining and Geological Engineering)

Geology
(See Geosciences)

Geosciences (GEOS)
Gould-Simpson Building, Room 208 (520) 621-6024; FAX: (520) 621-2672


Laboratory of Tree Ring Research

3rd Stadium Building, Room 109 (520) 621-6469

Professors Malcolm K. Hughes, Director, Bryant Bannister (Emeritus), Jeffery S. Dean, Harold C. Fritts (Emeritus), William J. Robinson (Emeritus), Charles W. Stockton, Marvin A. Stokes (Emeritus)

Associate Professors Lisa J. Graumlich, Katherine K. Hirschboeck, Steven W. Leavitt, Thomas W. Swetnam

The Department of Geosciences offers graduate studies leading to the Master of Science and the Doctor of Philosophy degrees with a major in geosciences. Applicants for graduate degrees must have completed the baccalaureate with a major in geosciences or in an allied discipline. All applicants must submit their scores on the General Graduate Record Examination directly to the department and provide three letters of recommendation and a personal resume including a statement of proposed academic and research activities. Application materials are available from the department.
Degrees

Master of Science: Designed to train students aspiring to professional employment in industry, local, state or federal government, or in the teaching profession at the community college level. The program also serves as a foundation for graduate studies continued beyond the M.S. level, especially for those students whose M.S. research experiences are vital to their professional growth and for those who develop strong research interests and abilities. Requirements include 30 units of course work. A thesis or pre-publication manuscript is required.

Doctor of Philosophy: Designed for students who plan to work as professional geoscientists in research-oriented capacities in the academic community, industry, or government. Qualified students with a bachelor's degree or a master's degree may be accepted into the Ph.D. program. Requirements include 36 units of graduate credit in addition to 18 units of dissertation credit. A dissertation is required. A 12-unit minor is required in a related subject.

The Department of Geosciences focuses on research and education dealing with the nature, genesis, and history of the Earth and its crust, and with the evolution of the environment and biota at the Earth's surface. Our faculty and students are active in the following areas:

**Tectonics:** structural geology and regional tectonics

**Geochemistry/petrology:** isotope geochemistry, geochronology, and thermodynamics

**Economic geology:** regional metallogeny and the role of fluids in the ore genesis

**Chemical and isotopic studies of water**

**Geophysics:** earthquake and reflection seismology, paleomagnetism, and plate dynamics

**Planetary geology**

**Archaeological geology**

**Quaternary studies:** geomorphology and paleoenvironmental studies

**Stratigraphy/paleontology:** paleoclimatology and paleobiology

The Department of Geosciences encourages interdisciplinary approaches to research in the geosciences, both within the department and through interdepartmental programs.

500.* Introduction to Geochemistry (3) I Nuclear systematics and thermodynamics with applications to geologic processes. P. 101, 103; CHEM 103b, 104b. Ruiz


502.* Statistical Analysis of Geological Data (3) I Application of statistical methods to the analysis of and description of geologic data. Geologic similarity, estimation, classification of geologic objects, and structure of data on multiple features. Examples and case studies from major subdisciplines of geosciences. P. MATH 124, 125b. Harris

503.* Physics of the Solar System (3) II 1995-96 (Identical with PTYS 503)

505. Applied Multispectral Imagery (3) II (Identical with G EN 505)

506.* Conservation Biology (3) II 1996-97 (Identical with ECOL 506)

507.* Photogeology (3) II (Identical with G EN 507)

508.* Mammalian Phylogeny and Evolution (3) II 1996-97 A study of the mammalian fossil record, with emphasis on taxonomy and morphological evolution of selected mammal orders. 2R, 3L. Field trips. Lindsay

509a.* Magmatic and Metamorphic Processes (3-3) 1996-97 509a: II An integrated quantitative approach to process-oriented problems in igneous and metamorphic petrology, especially in dynamic environments, through the applications of physico-chemical principles and experimental data to geologic observations. P, 315 or equivalent, calculus. Ganguly


510. Principles of Cosmochemistry (3) I 1996-97 (Identical with PTYS 510)

514. Late Quaternary Geology (3) I Paleoenvironment and geochronology of Late Quaternary alluvium as read from the stratigraphic records and geomorphology at key localities in North America. The interaction of fluvial and aeolian processes in the eastern Sahara will be evaluated using enhanced LANDSAT and Shuttle Imaging Radar. Domestic field trips. Enrollment limited to 10 students. P, 102, 104. (Identical with ANTH 514) Haynes

516.* Field Studies in Geophysics (3) I II S (Identical with G EN 516)

517.* Sedimentary Basin Analysis (3) II Physical mechanisms of sedimentary basin formation, including flexure, thinning, and thermal contraction of the lithosphere; isostasy; subsidence analysis; sequence stratigraphy; paleocurrents and sediment provenance; tectonics of sedimentary basins. Graduate requirements include an independent research report. P, 502 or 544. DeCelles

518.* Advanced Mineralogy (3) II Principles of crystallography and crystal chemistry; thermodynamics and kinetics of minerals; macroscopic treatment and atomistic basis; phase transformations; systematic mineralogy. Graduate requirements include an independent research report. P, 209 or consult department before enrolling. Barton/Ganguly

519.* Global Tectonic Processes (3) II Plate tectonics: thermal properties and processes in the Earth; mechanical behavior of lithosphere and mantle; global gravity and geoid. P, MATH 254; PHYS 142. (Identical with PTYS 519) Richardson/Chase

520. Meteorites (3) I II 1996-97 (Identical with PTYS 520)

522. Well Logging and Interpretation (3) II (Identical with G EN 522)

523.* Regional Structural Geology (3) [Rpt./3] I Geologic mapping in a variety of rock types and structural regimes, with emphasis on the recognition and solution of regionally significant structural problems. Field trips. P. 413. G. Gehrels/C. Davis

524.*Paleomagnetism: Principles and Applications (3) II Physical basis for remanent magnetism in rocks, techniques of sample collection, measurements, and statistical treatment; review of polarity time scale, apparent polar wander, plate tectonics. P. PHYS 132 or 241. Butler

525.* Regional Tectonics (3) I Discussion of the geology, geophysics, petrology, and geochemistry of different types of orogenic systems and their tectonic evolution. Methods of tectonic regionalization and integration based on lithotectonic assemblages and terranes, and regional structural geology. Plate tectonic regimes and kinematics. Coney

526.* Cordilleran Tectonics (3) II Geologic and tectonic evolution of the North American Cordillera based on analysis of geologic, paleomagnetic, and paleobiogeographic constraints and tectonic models. Gehrels

527. Orogenic Systems (3) I II An analysis of the geology, geophysics, and geochemistry, and the tectonic evolution of selected world mountain systems ranging from currently active belts in both oceanic and continental settings back through Phanerozoic, Proterozoic, and into Archean time. Coney


530.* Chemical Evolution of the Earth (3) I Chemical differentiation and evolution of Earth's mantle and crust according to major-element, trace-element, and isotopic characteristics of neodymium, hafnium, strontium, lead, and other isotopes. (Identical with PTYS 530) Patchett

531.* Hydrogeology (3) I (Identical with HWR 531R)

531.* Hydrogeology Laboratory (1) (Identical with HWR 531L)

532.* Introduction to Seismology (3) I Fundamentals of earthquake seismology; wave propagation, interpreting seismograms, and quantifying earthquake sources. P. MATH 254. Wallace

533.* Mine Investment Analysis (3) I Economic factors, including taxation, mineral depletion allowance, and finance in the mining industry; includes fundamentals of engi-

535. Advanced Subsurface Hydrology (3) II (Identical with HWR 535)

536. Ground Water Resource Evaluation (3) II (Identical with HWR 536)

537. Economics of Mineral Resource Development and Production (3) II Concepts and methods of mineral economics; analyses of selected mineral and energy commodities, current economic and political issues and investment strategies in selected mineral industries. P, ECON 201 a, 210, or equivalent. Harris

538. * Biogeography (3) II (Identical with ECOL 538)


540. * Geodynamics (3) [Rpt.] 1995-96 Large-scale tectonic problems approached by combined geophysical and geologic analysis in regional context. P, 20 units of geology, including 321, 3 units geophysics, MATH 254; consult with department before enrolling. Chase

541. Soil Genesis (3) II 1996-97 (Identical with SW 541)

542. Ore Deposit Petrology (3) II 1996-97 Orthomagmatic, porphyry base metal, skarn, and leached capping lithologic-mineralogic studies by petrographic microscope, electron probe, and advanced techniques. 1R, 6L. P, 425/525 or CR, 646a. Titley/Barton

543. Mathematical Theory of Magma-Hydrothermal Systems (3) I Dynamics and chronology of magma chambers are reconstructed using mathematical systems and computer models to represent the redistribution of thermal and mechanical energy around magma chambers. Norton

544. Advanced Physical Sedimentology (3) I First half of course deals with mechanics of flows and sediment transport, oscillatory and unidirectional flows, waves and wave theory, bedforms and flow regimes, sediment gravity flows, liquefaction and fluidization. Second half presents detailed treatment of physical processes and facies: alluvial fan, fluvial, eolian, deltaic, nearshore, shelf, slope, and turbidite fan systems. Emphasis is on clastic systems. Field trips. P, 302, MATH 254 or consent of instructor. DeCelles

545. Geochemical Processes in Magma-Hydrothermal Systems (3) II Migration of chemical components in natural fluid-rock systems are analyzed using the geochemical theory that represents irreversible, equilibrium, and advection mass transfer. Norton


548. * Geophysical Exploration and Engineering (3) I (Identical with G EN 548)


551. * Sedimentary Petrology (4) I Hand specimen, detrital grain, and thin section study of tectonically cycled, iron-rich rocks; carbonate rocks and associated evaporites; cherts, iron-rich rocks, and phosphorites. 2R, 6L. Field trips. P, 302, 315. DeCelles

552. * Petroleum Geology (3) I Origin, migration, chemistry, and accumulation of petroleum; reservoir mechanics, types of traps; recovery of petroleum; oil shales and tar sands. 2R, 3L. Ngy


554. Evolution of Planetary Surfaces (3) II 1996-97 (Identical with PTYS 554)

555. Remote Sensing of Planetary Surfaces (3) II 1996-95 (Identical with PTYS 555)


558. * Geochemistry (3) I Introduction to geochronologic methods used in the geological sciences including K-Ar, 40Ar/39Ar, Rb-Sr, Sm-Nd, U-Th-Pb, and fission track techniques. Application of isotopic dating techniques to the study of crustal dynamics. Baldwin

559. * Thermochronology (3) II Closure temperature theory and methods used to determine temperature - time histories of igneous and metamorphic rocks. Applications of thermochronology and P-T-t paths of crustal terranes. Baldwin

560. Electrical Exploration Methods (3) I (Identical with G EN 560)

561. Paleoindian Origins (3) I (Identical with ANTH 561)


563. Isotope Hydrology (3) I Theory and application of light stable and cosmogenic isotopes to hydrological and paleoenvironmental problems. Radiometric dating of ground water. (Identical with HWR 563) Long

564. * Introduction to Dendrochronology (4) Survey of dendrochronological theory and methods. Applications to archaeological, geological, and biological dating problems and paleoenvironmental reconstruction. Emphasis on dating methods, developing tree-ring chronologies, and evaluating tree-ring dates from various contexts. 2R, 4L. Field trips. (Identical with ANTH 564 and WS M 564) Swetnam


567. Inverse Problems in Geophysics (3) Linear and nonlinear inverse theory, including least squares, generalized and maximum likelihood methods. P, MATH 422b. (Identical with ATMO 567 and PTYS 567) Richardson

568. Advanced Seismology (3) II 1995-96 Computational techniques in seismology. The application of synthetic seismograms to model source processes and complex structure. P, 432/532, MATH 422b. Wallace

569. * Seismic Data Processing (3) I Fundamental theory and practical applications of time-series analysis and digital filtering. A problem-solving approach to seismic reflection data processing. P or CR, 434, MATH 422a or consent of instructor. Johnson

571. Terrestrial Planets (3) I 1995-96 (Identical with PTYS 571)

572. Global Biogeochemical Cycles (3) I (Identical with GC 572)

573. * Geology and the Urban Environment (3) II Geologic processes that result in loss of life and/or property damage; emphasis on case studies of urban areas in the Southwest. Implications for public policy. 2R, 3L. All-day field trips. (Identical with PLNG 573) McCulloch

576a-576b. * Analysis of Biological Diversification (3-2) I II (Identical with ECOL 576a-576b)

578. * Global Change (3) II Analysis of the entire Earth system through an examination of how its component parts and their interactions have changed in the past and may be expected to change in the future. P, upper-division standing; introductory course work in biological and physical sciences. (Identical with ECOL 576, GEOG 578 HWR 578 and RNR 578) Graumlich

581. * Quaternary Palynology and Plant Macrofossils (2-4) I Theory and techniques of identification and interpretation of pollen, spores, seeds, leaves, and wood of plants from lake sediments, marshes, caves, and archaeological sites. P, ECOL 472. (Identical with ANTH 581) O Davis

582. * Paleoclimatology (3) I 1996-97 Topics in paleoclimatology including prediction of paleoclimatic patterns, proxy paleoclimatic indicators, and paleoclimatic cycles. Parrish

583. Thermodynamics in Geosciences (3) Principles of classical and elementary statis-
596. Seminar
a. Petrography-Petrology (1-4) [Rpt. / 6 units] I II
b. Structural Geology (1-4) [Rpt. / 6 units] I II
c. Mineral Deposits (1-4) [Rpt. / 6 units] I II
d. Petroleum Geology (1-4) [Rpt. / 6 units] I II
e. Tectonics (1-4) [Rpt. / 6 units] I II
f. Mineralogy-Crystallography (1-4) [Rpt. / 6 units] I II
g. Vertebrate Paleontology (1-4) [Rpt. / 6 units] I II
h. Paleontology (1-4) [Rpt. / 6 units] I II
i. Paleocology-Paleoenvironments (1-4) [Rpt. / 6 units] I II
j. Geomorphology (1-4) [Rpt. / 6 units] I II
k. Geophysics (1-4) [Rpt. / 6 units] I II
l. Geomatics (1-4) [Rpt. / 6 units] I II
m. Sedimentology (1-4) [Rpt. / 6 units] I II
n. Stratigraphy (1-4) [Rpt. / 6 units] I II
c. Regional Tectonics (1-4) [Rpt. / 6 units] I II
p.* Macroevolution (2) [Rpt. / 6 units] I II
(Identical with ECOL 596p, which is the home)
q. Geochronology (1-4) [Rpt. / 6 units] I II
r. Quaternary Geochronology (1-4) [Rpt. / 6 units] I II (Identical with ANTH 596r)
s. Sedimentary Petrography (1-4) [Rpt. / 6 units] I II
t. Organic Geochemistry (1-4) [Rpt. / 6 units] I II
u. Isotopic Geochronology (1-4) [Rpt. / 6 units] I II
v. Dendrochronology (1-4) [Rpt. / 6 units] I II
w. Palynology (1-4) [Rpt. / 6 units] I II
x. Paleobotany (1-4) [Rpt. / 6 units] I II
y. Geosystems (1-4) [Rpt. / 6 units] I II
z. Topics in Geophysics (1-4) [Rpt. / 6 units] I II

597. Workshop
a. Dendrochronology (2) 3L (Identical with ANTH 597c and WS M 597c)

*May be counted with 400-level course.

646a-646b. Advanced Ore Deposit Geology (4-4) Geology, characteristics and origins of ore deposits in igneous, sedimentary, and metamorphic rocks. Labs include field trips, analytical techniques, problem solving. 2R, 6L. P, 446/546, CHEM 480a or CR. Titley/Bartont


651. Climatic Geology (3) I 1995-96 Effects of climatic changes on geomorphic processes, landforms, and soils; paleoclimatic and earthquake hazards interpretations. 2R, 3L. Field trips. Bull


German Studies (GER)

Modern Languages Building, Room 571
(520) 621-7385; FAX: (520) 621-7385

Professors David H. Chisholm, Albrecht Classen, Max Dufner (Emeritus), Louis F. Helbig, Steven D. Martinson, Renate A. Schulz, David J. Woloshin (Emeritus)
Associate Professors Thomas Kovach, Head, Dennis I. Greene (Emeritus), Gabette Luz (Emerita), Kamakshi P. Murti, Roland Richter (Emeritus), Mary Wildner-Bassett
Assistant Professors Barbara Kosta, C. Jane Rice

The department offers a program leading to the Master of Arts degree with a major in German. In cooperation with the College of Education, the department also offers work leading to the Master of Education degree with a teaching major in German. For information concerning this degree, see Requirements for Master's Degrees/Master of Education elsewhere in this catalog. Studies are available in the various areas of German language, literature, and culture in their more modern and contemporary aspects as well as in earlier historical and linguistic developments. Courses are also available in second language teaching methodology, applied linguistics, theory of second language acquisition and testing for a minor option in the M.A. degree in German.

Prerequisite for admission to the graduate program is the completion of at least 16 acceptable units of upper-division, undergraduate course work in German.

Students working toward the Master of Arts degree must complete a minimum of 33 units of graduate work, including at least 24 units in courses offered by the Department of German Studies. GER 601a and 601b are required of all master's candidates; GER 579 and 580 are required of all teaching assistants.

M.A. Thesis Option: Students may be permitted to write a thesis upon application to and consultation with the departmental Graduate Committee. Students approved for the thesis option must complete the 24 unit course work requirement (excluding 910). No more than 6 units may be earned for writing the thesis; thesis students enroll for GER 910, thesis.

The student must pass both a written and an oral comprehensive examination. Prior to this examination each student must either have passed 575a or 575b successfully or give evidence of an equivalent proficiency in the use of written German and must rate Superior on the ACTFL/ETS Oral Interview Test or an equivalent test.

500. Intensive Reading German for the Sciences and Humanities (4) S Rapid acquisition of reading proficiency in German. No prior knowledge of German is necessary. Proficiency certification obtained from this course fulfills graduate foreign language requirement in some departments (consult department for information). Credit for nonmajors only. Credit is not available for German majors.

501. Appropriating and Reshaping the Past (3) I 1996-97 Examines the creative reception of cultural artifacts found in oral traditions, religion, politics, historical events, and the arts in German-speaking cultures. P, 6 units of upper-division German.

502. Genre as a Category for Organizing Experience (3) I 1995-96 Examination of individual texts in relation to theories of genre, with attention to shifting definitions of genre and resistance to generic categories. P, 6 units of upper-division German.

503. Erziehung and Bildung in German Culture (3) II 1995-96 Investigates theories of education and their reflection in literary works. The Bildungsroman, for instance, discloses central elements of German culture and society. P, 6 units of upper-division German.

505.* History of the English Language (3) I II (Identical with ENGL 505)

506. The Other (3) II 1995-96 Explores narratives that construct the Other,
the foreigner, and the outsider; discusses the politics of racism, sexism, and exclusion using texts from various fields. P, 6 units of upper-division German.


509. Traditions and Modernism (3) I 1995-96. Provides a critical overview of literary and intellectual currents of the "modern" period; explores the changing status and social function of literature. P, 6 units of upper-division German.


511. Communication and Miscommunication in Middle High and Later German Literature (3) II 1996-97. Explores the way German writers have dealt with basic issues of human communication. P, 302b, 315b.

520. History of the German Language (3) II 1995-96. Examination of the semantic, socio-historical, and structural development of German from the age of migrations to the present. P, 8 units of upper-division German. (Identical with ENGL 520)

525a-525b. Old English (3-3) (Identical with ENGL 525a-525b)

555.* Music and German Literature (3) I 1996-97. The interrelationship between music and German literature from the 18th through the 20th century. Concentrates on major works of German drama, poetry, and prose, and their musical settings. Lectures in English. Readings primarily in English. German. P, 202. (Identical with MUS 555)

575a-575b.* Advanced Oral Expression and Written Composition (3-3) Practical training in written German through the study of the more complex refinements of German grammar and style, as found in representative documents. P, 315b. 575a is not prerequisite to 575b.

579.* Issues in Foreign Language Teaching (3) I Modern methods of language teaching with emphasis on German as a foreign language.

580.* Applied Linguistics for Foreign Language Teaching (3) II Issues in and methods of applied linguistics with emphasis on German language.

585.* Linguistic and Computer-assisted Approaches to Literature (3) [Rpt./6 units] II Application of computers to literary style, authorship, vocabulary measures, indexes and concordances, metrics and versification. P, 5 units of literature at the 300 level or above. (Identical with ENGL 585, FREN 585, CLAS 585, LING 585, and RUSS 585)

587. Testing and Evaluation in Foreign/Second Language Programs (3) Introduction to fundamental concepts, principles, and problems of psychometric measurement relevant to FL/L2 learning. Types of tests and their uses, test construction, analysis and interpretation of results. (Identical with CLAS 587, EAS 587, ENGL 587, FREN 587, RUSS 587 and SPAN 587)

594. Practicum

596. Seminar

597. Workshop

601a-601b. Approaches to German Studies (3-3) II An overview of research materials, methods, theories, and issues from which individual interests and concentrations in German studies can develop. Provides for the selection of faculty mentors.

696. Seminar

699. Workshop

Gerontological Studies (GERO)

800 East University Boulevard
Suite 340
(520) 622-9092

Graduate Interdisciplinary Program in Gerontological Studies

Committee:
Keith E. Meredith, Chair
Professors Audrey L. Holland (Speech and Hearing Sciences), Alfred W. Kaszniaik (Psychology), Theodore H. Koff (Public Administration and Policy)
Associate Professors Patricia C. Fairchild (Exercise and Sports Sciences), Donna Iams (Family Studies), Roy B. Verderly (Medicine)
Assistant Professor Wanda H. Howell (Nutritional Sciences)

Because of its multidisciplinary nature, gerontological studies serves several educational purposes. Graduate students may pursue a Master of Science with a major in gerontology, a doctoral minor or a graduate certificate in gerontology. In addition to these formally structured academic programs, gerontological studies plays a facilitating role in the coordination and development of aging studies and will guide students interested in incorporating a gerontological emphasis into their own chosen field.

The doctoral minor requires 15 units and is particularly appropriate for students in areas such as education, administration, policy, social welfare, health, nutrition and other disciplines in the social and behavioral sciences.

The Graduate Gerontology Certificate Program offers formal recognition for gerontological study in an 18-unit structured course of graduate study that offers a foundation of gerontological knowledge and theory and an opportunity for the application of knowledge in field work. The program is designed to supplement an undergraduate or graduate degree. It is particularly appropriate for individuals planning to enter or to continue in a profession that involves provision of services and/or administration of programs for the aged, and is well-suited for the working adult. Fifteen units of coursework and 3 units of internship are required. A 3.0 grade-point average is necessary for admission.

The 46-unit Master of Science with a major in gerontology is comprised of 21 units of core courses, a concentration in a related field, internship and electives. Students may elect to complete a thesis or a master's project. Each student's study plan is individually designed to meet the student's special interests and professional objectives. Applicants to the Master of Science program must submit scores from the Graduate Record Exam, three letters of recommendation and a statement of intent. For full standing, a 3.0 grade-point average is required.

Many courses included in the curriculum are offered in other departments. Courses identified as having content which deals specifically with elderly and
with aging processes include: EXSS 566, FS 613, 636; PA 427/527; PSYC 556, 574; SER 555. Courses originating in gerontological studies and courses cross-listed with gerontology include:

524.* Gerontology: A Multidisciplinary Perspective (3) III (Identical with PSYC 524)

527.* Aging and Public Policy (3) II (Identical with PA 527)

530a-530b. Aging and Social Sciences (3) I (Identical with PA 527)

540.* Survey of Health Education/Health Promotion (3) II (Identical with PHSC 547)

548.* Perspectives in Geriatrics (2) II (Identical with PHSC 548)

550. Biology of Aging (3) I Introductory graduate course focusing on human aging for students with backgrounds in biological sciences, psychology, social science or health care. Designed to introduce current data and thinking on the biological aspects of aging in animals. Includes demographic aspects of aging, changes occurring in aging humans, longevity and its measurements, comparative studies in animals other than people and current theories of why all animals age. A recent course in a biological science is recommended but not required.

557.* Law of the Elderly (3) II Examines the law as it affects the elderly in such areas as legislation, finance, housing, death, guardianship, access to service and ethics. Focuses upon the recognition and analysis of legal problems and identification of legal resources. (Identical with MAP 557)

559.* Adult Development and Aging (3) I (Identical with PSYC 559)

560a-560b. Methods in Aging Research (3-3) I Emphasizes understanding and application of fundamental methodology concepts in research design, assessment and statistics as they relate to the conduct of research and program evaluation in aging. Application of concepts through critique of articles and development of research and evaluation projects. 560a is prerequisite to 560b.

570a.* Human Adaptability (3) I (Identical with ANTH 570a)

576. Communicative Aspects of Aging (1) I (Identical with SP H 576)

589. Health of the Older Adult (3) I (Identical with NURS 589)

595. Colloquium
   a. Current Topics in Aging (1) I
   *May be convened with 400-level course.

613. Family Issues in Aging (3) II 1996-97 (Identical with F S 613)

636. Economics of Aging (3) I (Identical with F S 636)

695. Colloquium
   a. Research in Gerontology (1) I II (Identical with PHSC 695a)

Global Change (GC)

The Institute for the Study of Planet Earth offers a minor in global change for students pursuing the Ph.D. degree. For information consult the Institute for the Study of Planet Earth at 1439 E. Helen St., Tucson, Arizona 85719. Telephone (520) 621-9010.

572. Global Biogeochemical Cycles (3) I Study of processes affecting global chemical fluxes. Particular attention to current global concerns, i.e., ozone hole, carbon cycle, climate warming, atmospheric oxidation, hydrologic cycle. (Identical with GEOS 572 and HWR 572)

Graduate Interdisciplinary Programs

1010 N. Martin Avenue

(520) 621-8368

Graduate interdisciplinary programs are offered by the following committees:

- American Indian Studies
- Applied Mathematics
- Arid Lands Resource Sciences
- Cancer Biology
- Cognitive Science
- Comparative Cultural and Literary Studies
- Epidemiology
- Genetics
- Gerontological Studies
- Global Change
- Insect Science
- Latin American Studies
- Neuroscience
- Nutritional Sciences
- Optical Sciences
- Pharmacology and Toxicology
- Physiological Sciences
- Planning
- Remote Sensing
- Second Language Acquisition and Teaching

For course offerings in these programs, refer to the specific program in the Departments and Courses of Instruction section of this catalog.

*Affiliate Program

Greek

(See Classics)

Health-Related Professions (HLTH/OSH/EXSS/MEDT)

Anne E. Atwater, Interim Director

At the time this catalog was being edited, the School of Health Related Professions and its major programs were undergoing review and reorganization. All current and prospective students considering application to one of the graduate majors offered by the School should check with the academic advisors for that major. The School of Health-Related Professions offers programs leading to the Master of Arts and Master of Science degrees with a minor in exercise and sport sciences. A minor in exercise and sport sciences is available for doctoral students with majors in other disciplines. Students may specialize in exercise physiology at the Ph.D. level by majoring in physiological sciences (see that entry elsewhere in this catalog), an interdisciplinary major that incorporates faculty from several departments and colleges within the University. Faculty in the School also offer courses that are included as electives for the Master of Public Health degree.

All applicants must submit scores in the General Test of the Graduate Record Examination, a statement of professional goals, and three letters of recommendations from persons in a position to evaluate the applicant's potential as a graduate student.

The purpose of these graduate programs is to prepare individuals for careers in exercise science, research, and teaching. Students are permitted to use graduate or undergraduate courses for satisfaction of identified deficiencies.

Community and Environmental Health

1435 N. Fremont Ave., Room 111

(602) 882-5852

Associate Professors Richard L. Papenfuss (Family and Community Medicine), Kam Nasser (Family and Community Medicine)

Assistant Professors Scott J. Leischow (Family and Community Medicine), Mark D. Van Ert (Family and Community Medicine)

Clinical Assistant Professor Clifton D. Crutchfield (Family and Community Medicine)

Health Education (HLTH)

530.* Theory-based Approaches in Health Education/Health Promotion (3) I Analysis of the epidemiological data to determine the health problems of our people; behavioral relationships; and the study and application of theory-based educational strategies designed to prevent health problems.

532.* Program Planning and Education in Health Education/Health Promotion (3) II Principles for planning, implementing, administering, and evaluating health education programs utilizing the "PRECEDE Model" as a framework.

535. Multicultural Health Beliefs (3) II Designed to provide a sensitivity to health promotion professionals to the varying multicultural health beliefs and needs of our society. Special emphasis on ethnic characteristics of minority populations in America with recommendations for programming strategies.

540.* Survey of Health Education/Health Promotion Literature (3) I Examination of
health education/promotion literature from ancient societies to present, including an
analysis of current health literature from various
professional, community, voluntary, pub-
lic, and international health organizations.

**Occupational Safety and Health**

502. *Industrial Hygiene Instrumentation and
Analysis (2-4)* I Introduction to field sam-
ping instruments and strategies, quality con-
trol, and statistical analysis, with emphasis on
instrument selection and calibration. 2R, 3L, P,
586. (Identical with TOX 502)

510. *Physical Exposures (3)* II Recognition,
evaluation, and control of physical exposures,
including radiation, noise, vibration, and heat
stress. Student is required to recognize poten-
tial exposures, use correct instrumentation to
collect and evaluate data, and develop controls.
2R, 3L, P, 486. (Identical with TOX 510)

554. *Industrial Toxicology and Chemical
Exposure (2-4)* Principles of Toxicology related
to industry; dose response; mechanisms of tox-
icity; hazard evaluation principles; toxicology
of major classes of industrial compounds. P, 6
units each of biological science and organic
chemistry. (Identical with PHL 554, TOX 554)

555. *Industrial Ventilation (3)* III Design and
evaluation of industrial ventilation systems.
Emphasis is on level evaluation of industrial
contaminants. Five laboratory exercises and course
design project. 3R, 1L

586. *Fundamentals of Industrial Hygiene (3)*
I Introduction to the principles of occupational
safety and health, with emphasis on industrial
hygiene aspects including recognition, evalu-
ation, and control of environmental and indus-
trial health hazards. (Identical with C E 586
and TOX 586)

587. *Advanced Industrial Hygiene and
Safety (3)* III An in-depth coverage of the
industrial hygiene and safety professions
emphasizing the principles of contaminant
behavior and the design of industrial hy-
giene/safety programs. P, 486. (Identical with
C E 587 and TOX 587)

*May be convened with 400-level course.

**Exercise and Sport Sciences**

(Ina E. Gittings Building, Room 101
(602) 621-6989)

Professors Anne E. Atwater, Interim Head,
Timothy G. Lohman, Donna Mae
Miller (Emerita), Frederick B. Roby
(Emeritus), Mary P. Roby (Emerita),
Charles M. Tipton, Jean M. Williams
Associate Professors Boyd B. Baker,
Gary D. Delforge, Patricia C. Fairchild,
Ralph F. Fregosi, Bruce A. Larson,
Richard A. Munroe (Emeritus), Ka-
thryn R. E. Russell, Darrell G. Simko
Assistant Professor Erik J. Henriksen

Study programs for both the Master of
Arts and Master of Science degrees are
individually planned, in consultation with
an advisor, around a principal area
of interest. The Department of Exercise
and Sport Sciences offers two options for
the major, one that is clinical in nature and
the other that is thematic (individu-
alized). Clinical exercise science includes
three specializations: athletic training, stress
management and wellness, and sports science.
The thematic option permits students to develop a study plan
that builds on the student's background,
special interests, and future goals. In con-
sultation with an advisor, students are
able to develop a program that may
encompass the more traditional areas of
study, or they can develop totally new
ones.

Students should have an undergradu-
ate academic background which supports
their interest area(s) at the graduate level.
For example, some specializations/study
plans require an undergraduate science
background that includes anatomy, phys-
iology, chemistry, and similar subjects,
while others do not.

Master's degree candidates may select
one of three plans: (1) a thesis option
which requires 30 units, including prepa-
ration of a thesis for which six units may be
earned, or (2) a non-thesis option
which requires completion of 32 to 36
units, depending on the program of
study, and a comprehensive written
exam, (3) a research project option, which
requires completion of 32 to 36 units,
depending on the program of study, and
preparation of a manuscript for publi-
cation and presentation of findings in a
seminar in lieu of the comprehensive
written exam.

For all plans, at least 20 units must be
completed in the Department of Exercise
and Sport Sciences, but students are
encouraged to take work in fields outside
the department if it is relevant to their
course of study.

502. *Principles of Neuroanatomy (4)* III
(Ide-
tical with CBA 502)

510. *Sport in Contemporary Society (3)* I
Study of contemporary sport from the per-
spectives of its personal, social, cultural,
educational dimensions. Russell

520. *Exercise Physiology (3)* I Regulation and
adjustment of physiological systems during
acute exercise and adaptations with chronic
exercise in various populations and environ-
ments; emphasizes physiological mechanisms.
P, BIOM/460 or 462A, CHEM 103a-103b, 104a-
104b, 241a-241b, 243a-243b, EXSS 201, 202,
MATH 117R/S, 118, PHYS 102, 103, 181, 182.
Fregosi

521. *Exercise Physiology Laboratory (2)* I P,
CR, 520.

524. *Behavioral Management of the Injured
Athlete (3)* II Behavioral/psychological
processes involved in the rehabilitation of the
injured athlete, pain perception, and the use of
behavioral approaches in sports medicine. P,
201, 202.

527. *Psychology of Sport and Exercise (3)* I
Examines the effects of motivation, personal-
ity, attitudes, competition, and group dynam-
ics on sport performance as well as the psy-
chological effects of exercise, exercise adher-
ence, and exercise addiction. (Identical with
PHL 527) Williams

528. *Stress Management for Performance and
Health (3)* I Examines within a bio-
psychosocial framework the concept of stress
as it relates to performance and the etiology of
stress-related health disorders. Also examines
and applies stress management interventions
to enhance performance and promote health.
Williams

529. *Psychological Interventions and Er-
genic Aids for Peak Performance (3)* III
The application and effectiveness of ergogenic aid
mechanisms, particularly psychological inter-
Williams

536. *Administration of Sports Programs (3)*
I Designed to provide a theoretical framework
for students pursuing sports management
careers and others interested in various func-
tions involved in the conduct of sport pro-
grams. Baker

540. *Nutrition in Exercise and Sport (3)* I
I Integration of current concepts and principles
in nutrition with known biochemical and
physiological responses to acute and chronic
exercise. P, 520 and N SC 208. Tipton

545. *Evaluation and Regulation of Body
Build and Composition (3)* I Laboratory and
field assessment of body fat, lean body mass,
and somatotype; anthropometry; body build
and composition of the athlete; morphology of
fat and lean tissue; exercise and dietary regu-
lation of obesity and chronic underweight. P,
201, 202.

560. *Biomechanics of Human Movement (3)*
II Analysis of human motion focusing on the
mechanical interaction between the human
body and the external environment. P, 201,
202, 562, MATH 124 or 125a, PHYS 102, 103,
181, 182. Atwater

562. *Neuromechanical Kinesiology (3)* II
Neuromechanical bases of human movement.
P, EXSS 201, 202, MATH 118, PHYS 102, 103,
181, 182.

566. *Physical Activity in Aging and Chronic
Diseases: Psychosocial Aspects (3)* I
Psychosocial dimensions of exercise programs
designed for populations with chronic diseases
as well as for older populations. Fairchild

570. *Research Design in Exercise and Sport
Sciences (2)* I Study of research designs,
methodologies, and data analysis procedures
pertinent to the exercise and sport sciences;
emphasis is on the selection of research prob-
lems and interpretation of research articles.
Lohman

571. *Laboratory in Research Design for
Exercise and Sport Sciences (1)* I Laboratory
experiences in literature retrieval systems; data
analysis procedures by calculator, microcom-
puter, and mainframe computer; critical analy-
sis procedures of research articles, and
participation in a research project. CR 570.
Lohman

575. *Statistical Analysis (3)* II Analysis of
research designs and data analysis procedures
in the field of exercise and sport sciences with
emphasis on appropriateness of selected
designs and interpretation of various data
580. Evaluation of Athletic Injuries (3) I Advanced study of the etiology, pathology, and clinical signs of common athletic injuries. Emphasis on clinical evaluation of athletic injuries by the athletic trainer. P, 577; 800 hours of clinical experience in athletic training. *Delforge*

581. Therapeutic Modalities (2) II Advanced study of the role of hydrotherapeutic and electrotherapeutic agents in the rehabilitation of athletic injuries. P, 580.

582. Anatomical Basis of Sport Injuries (3) I Comprehensive survey of bones, ligaments, muscles, nerves, and vessels of the trunk and upper and lower extremities, with emphasis on their relationship to sport injuries. 2R, 3L. P, 580.


584. Rehabilitation of Athletic Injuries (3) Principles in the planning and implementation of rehabilitation programs for injured athletes with emphasis on application of contemporary therapeutic exercise techniques. P, 580. *Delforge*

585. Issues in Athletic Training and Sports Medicine (3) II Current issues and trends in athletic training and sports medicine with emphasis on the professional preparation of athletic trainers and the role of the certified athletic trainer in athletic health care delivery systems. P, 580. *Delforge*

586. Physical Education and the Law (3) I Investigation and analysis of legal parameters within which the physical educator and coach operate; negligence theory; common defenses; product liability; insurance; legal implications for program development and methodology. *Baker*

588. Legal Aspects of Sports Administration (3) II Development of administrative and coaching techniques from the legal perspective. Analysis of personnel procedures, purchase of equipment, athletic associations, certification, transportation, medical procedures, officiating, and the handicapped athlete as influenced by litigation. P, 586. *Baker*

593. Internship
   b. Sport Psychology (1-3) [Rpt./6 units] I II S P, 528 or 529.

595. Colloquium
   a. Research in Exercise Sciences (1-2) [Rpt./3 units] II. Open to majors only.
   b. Biomechanics (2) [Rpt./1] I P, 562.
   c. Current Issues in Space Physiology (2) [Rpt./1] I P, 520.
   d. Environmental Physiology (2) [Rpt./1] II P, 520.
   e. Endocrinology and Metabolism (2) [Rpt./1] II P, 520.
   f. Integrative Cardiorespiratory Physiology (2) [Rpt./1] I I P, 520.
   g. Kinesiology (2) [Rpt./1] II P, 562.

596. Seminar
   b. "Introduction to Microcomputers (1) I II Atwater"

597. Workshop
   a. "Biofeedback: Theory and Application (1) "May be counted with 400-level course."

691. Preceptorship
   a. Laboratory Rotations (1-3) I II S 3-9L Open to majors only. P, 570, 571.

695. Colloquium
   a. Motor Control (2) [Rpt./8 units] II P, PSIO 480 and consult department before enrolling. (Identical with NEUR 695a, NSRC 695a, PSIO 695a, PSYC 695a, SPH 695a)

793. Internship
   a. Sport Psychology (1-3) [Rpt./12 units] I II S P, 528 or 529.

Medical Technology (MEDT)

1435 N. Fremont Avenue, Room 124 (602) 626-4084

Although no graduate degree programs are offered by the Division of Medical Technology, the graduate courses listed below are available to graduate students enrolled in related programs such as microbiology and chemistry, as well as to post-baccalaureate students who meet the requirements for the professional training to become M.T. certification eligible.

571R. Lectures in Clinical Hematology (5) [Rpt./1] II Lectures in basic hematology and hematological procedures including cell structure and function, inherited and acquired anomalies, hemostasis, cell enumeration and differentiation, cytogenetics. P, consult program director before enrolling.

571L. Fundamental Laboratory Techniques in Clinical Hematology (2) [Rpt./1] II Basic laboratory techniques in clinical hematology with emphasis on manual and automated hematological procedures. Instruction includes proper procedural methodologies, quality control, the use of controls and standards, and interpretation of laboratory test results. P, CR, 471R/571R, consult program director before enrolling.

572R. Lectures in Clinical Immunology and Immunohematology (4) [Rpt./1] II Lectures in serological methods used in the clinical laboratory and interpretation of results; blood banking procedures. P, consult program director before enrolling.

572L. Fundamental Laboratory Techniques in Clinical Immunology and Immunohematology (2) [Rpt./1] I Basic laboratory techniques in serological procedures and blood banking. Emphasis will be placed on procedural methodologies, quality control, the use of controls and standards, and interpretation of laboratory test results. P, CR, 472R/572R, consult program director before enrolling.

573R. Lectures in Clinical Chemistry (5) [Rpt./1] II Lectures encompassing the fundamental concepts of clinical laboratory chemistry, including pathophysiology and clinical correlations. P, consult program director before enrolling.

573L. Fundamental Laboratory Techniques in Clinical Chemistry (2) [Rpt./1] II Basic laboratory techniques in clinical chemistry, emphasis will be placed on procedural methodologies, quality control, the use of controls and standards, and interpretation of laboratory test results. P, CR, 473R/573R, consult program director before enrolling.

574R. Lectures in Clinical Bacteriology (5) [Rpt./1] I Lectures relating to laboratory techniques used to safely isolate and identify pathogenic bacteria. Special media/tests, organismal virulence factors, pathological effects occurring within the host, and antibiotic susceptibility testing of bacteria are covered. P, consult program director before enrolling.

574L. Fundamental Laboratory Techniques in Clinical Bacteriology (2) [Rpt./1] I Basic laboratory techniques used in the isolation and identification of clinically relevant microorganisms. P, consult program director before enrolling.

575a-575b-575c. Topics in Clinical Microbiology (2-1) [Rpt./1] I II 575a: Clinical Parasitology. Diagnostic methodologies with emphasis on the laboratory identification of clinically relevant parasites. 575b: Clinical Virology. Diagnostic methodologies with emphasis on the laboratory identification of clinically relevant viruses. 575c: Clinical Mycology and Mycobacteriology. Diagnostic methodologies with emphasis on the laboratory identification of clinically relevant fungi and Mycobacterium sp. P, consult program director before enrolling.

576. Principles of Laboratory Science (3) [Rpt./1] II Basic principles of laboratory mathematics, biostatistics, body fluids analysis, urinalysis, quality control, and laboratory safety. P, consult program director before enrolling.


*May be counted with 400-level course.*
History (HIST)

Social Sciences Building, Room 215 (520) 621-1586; FAX: (520) 621-2422

Professors Helen Nader, Head, Herman E. Bateman (Emeritus), Alan E. Bernstein, Gail Bernstein, Robert P. Browder (Emeritus), Paul A. Carter (Emeritus), Richard A. Cosgrove, Leonard Dinnstein, Richard M. Eaton, Donna J. Guy, Harwood Hinton (Emeritus), Ursula Lamb (Emeritus), Oscar Martinez, John V. Mering (Emeritus), Michael C. Meyer, Roger L. Nichols, Heiko A. Oberman, J. Gregory Oswald (Emeritus), Thomas W. Parker (Emeritus), Michael Schaller, Robert Vignery, Donald Weinstein (Emeritus)

Associate Professors Karen S. Anderson, George Brubaker (Emeritus), Roger deLaix (Emeritus), Edwin M. Gaines (Emeritus), Juan R. Garcia, Kevin Gosner, Frederick Kellogg, Jack D. Marietta, Hermann Rebel, Laura Tablil, Douglas Weiner

Assistant Professors Bert Barickman, John Campbell, Linda Darling, Mau reen Fitzgerald, Alison Futrell, Nancy Hunt, James Millward, Katherine Morrissey

The department offers programs leading to the Master of Arts and the Doctor of Philosophy degrees with a major in history. Applicants for the graduate program must have completed the equivalent of the bachelor's degree with a major in history or related subject and are required to submit scores on the aptitude tests of the Graduate Record Examination, a statement of purpose, and three letters of recommendation. All Ph.D. students must participate in a formal review of their program during the first year of doctoral studies.

Degrees

Master of Arts: At least 24 units must be completed in history, including 18 units in one of the following areas: Early Europe, Modern Europe, Latin America, United States, and Asia. The student who elects to submit a thesis for six units will receive thesis credit for six units and will be required to complete at least 12 additional units at the 695-696 level in history. The student who elects to present two research seminar papers (six units) in lieu of a thesis is required to complete at least 18 units at the 695-696 level in history. Each student must demonstrate reading knowledge of one second language. In special cases computer programming or statistics may be substituted for the second language requirement. During the first year of study all graduate students must take History 695k, the department's course in historiography/methodology. This course cannot count as part of the 18 units required in the fields listed above, or as part of the 12 units of 695 or 696. Each student must pass a final examination in his or her major field. A total of 30 units is required for the degree.

Doctor of Philosophy: In consultation with an advisor, each beginning student will select primary and secondary areas of concentration within the history major. Each student must demonstrate a reading knowledge of two second languages. In United States history, a reading knowledge of one second language and possibly other skills will be required. All students must take History 695k during the first year in the program.

Prior to admission to formal candidacy, each student must pass an examination covering the fields chosen. Following this examination, the candidate must prepare and defend a dissertation displaying mature research in original sources, competence in assembling and presenting historical data, and critical scholarship.

Primary areas of concentration: Early Europe, Modern Europe, Latin America, and United States. Secondary areas of concentration: Any primary area of concentration other than the chosen one; an approved minor in another department; or Asian history; comparative women's history; comparative/ world history.

501.* Ancient Mesopotamia (3) I (Identical with NES 501)

504a-504b.* History of Rome (3-3) 504a: The Republic to the death of Caesar. 504b: The Empire through the reign of Constantine the Great. 504a is not prerequisite to 504b.

505a-505b.* Medieval Europe (3-3) Major institutions and trends in Europe from the breakup of the Roman World to the 14th century. 505a is not prerequisite to 505b.

506.* Medieval England (3) II From the Norman conquest to the Hundred Years War, with emphasis on political, social, and cultural developments.

507a-507b.* Intellectual History of Medieval Europe (3-3) Major medieval cultural and intellectual trends. 507a: High Medieval Europe. Emphasis on the period before 1300. 507b: Late Medieval/Early Modern Europe. Emphasis on the period after 1300. 507a is not prerequisite to 507b.

508.* The Renaissance (3) I Europe between the 14th and 16th centuries with special emphasis on Italy as the seat of the Renaissance. Topics include the city states, humanism, the Church in an age of Schism and secularization, Renaissance art, the New Monarchies, and European exploration and imperialism.

509.* The Reformation (3) II The Reformation in thought and action both from the perspective of its religious origins and of the political and social conditions. Analysis of its impact on sixteenth century Europe, including the spread of Protestant reformation and its companion movement, counter-reformation.

510.* History of Hell in Early Europe (3) II The concept of punishment after death in Western Europe from the Bible to Dante. Includes the Hebrew, Greco-Roman, Germanic, and Christian traditions.

511.* European Social and Intellectual History to 1750 (3) I Dominant themes in European intellectual history from the end of the Middle Ages to the period of the Enlightenment. Reading and discussions of texts from Petrarch to Locke.

512.* European Intellectual History: 1750 to 20th Century (3) II Dominant themes in European intellectual history from about 1750 to the 20th century. Reading and discussions of texts from David Hume to Friedrich Nietzsche.

513.* Twentieth Century Europe: War, Peace and Social Change (3) II History of twentieth century Europe, examining global processes including imperialism and the two world wars interacting with ongoing changes in domestic politics, society, and culture.

514.* Cultural History of Germany to 1714 (3) I The political, social, economic, and cultural history of Germany from the late Middle Ages to about 1800.

515.* Cultural History of Germany 1714 to 1989 (3) II The political, social, economic, and cultural history of Germany from the period of the French Revolution to the present.

516.* Tudor-Stuart England (3) I An intensive study of English history from the accession of Edward IV to the Hanoverian dynasty.

517.* History of Modern Britain (3) II An intensive study of English history from the accession of Edward IV to the Hanoverian dynasty.

518.* France under the Old Regime, 1589-1789 (3) I French political development, institutions, and culture from Henry IV to the eve of the French Revolution.

519.* The French Enlightenment (3) I Cultural history of France in the 18th century, with emphasis on the works of the philosophes.

520.* The French Revolution and Napoleon (3) II The origins and progress of the Revolution in France.

521.* History of Russia: Early Period (3) I Political, socio-economic, and cultural history of Russia in medieval and early modern times.

522.* History of Russia: Modern Period (3) II Political, socio-economic, and cultural history of Russia in the modern era until the Bolshevik Revolution.

523.* Intellectual History of Russia (3) II Historical significance of social, political, and scientific thought in 19th- and 20th-century Russia.

524.* The Modernization of Russia, 1856-1935 (3) I Social history of Russia from the emancipation of the serf to the establishment of the Stalinist system.

525.* History of the Soviet Union (3) I The Bolshevik Revolution and problems of Soviet and Russian history from 1917 to the present.
c. Advanced Studies in European History (3) [Rpt./10] II

Hydrology and Water Resources (HWR)

Harshbarger Building, Room 122
(520) 621-5082; FAX: (520) 621-1422

Professors Soroosh Sorooshian, Head (Systems and Industrial Engineering), Randy L. Bassett, Nathan Busas, Donald R. Davis, Stanley N. Davis (Emeritus), Robert E. Dickison (Atmospheric Physics, Tree Ring Lab), Lucien Duckstein (Systems and Industrial Engineering), Daniel D. Evans (Emeritus), Martin M. Fogel (Emeritus), Martha Gilliland, Richard H. Hawkins (Watershed Management), Simon Ince (Civil Engineering), Helen Ingram (Political Science), Austin Long (Geosciences), William B. Lord (Agricultural and Resource Economics), Thomas Maddock III, Shlomo P. Neuman, William J. Shuttleworth, Eugene S. Simpson (Emeritus), Ernest T. Smerdon (Civil Engineering)

Associate Professors Roger C. Bales, Michael D. Bradley, Mark Brusseau (Soil and Water Science), Bonnie Colby (Agricultural and Resource Economics), Katherine Hirschboeck (Tree Ring Lab), T.-C. Jim Yeh

Assistant Professors Martha H. Conklin, Kevin Lansey (Civil Engineering), Marek Zreda

Hydrologist L. Graham Wilson

The department offers programs leading to the Doctor of Philosophy degrees with majors in hydrology and in water resources. The faculty offers competence in hydrogeology, hydrogeochemistry, hydrometeorology/hydroclimatology, environmental hydrology, ground-water hydrology, surface-water hydrology, mathematical and statistical methods in hydrology (including numerical modeling), and in water resources planning, management, and administration.

The area of water resources engineering is currently being developed; consult the department for further information.

Applicants need not have completed an undergraduate major in hydrology; however, previous study in a related field is beneficial. The programs have been developed to enable students with a basic science and mathematics background from such fields as geology, engineering, agriculture, meteorology, economics, and political science to enter directly. Applicants should submit Graduate Record Examination scores (general test only), a statement of purpose or career objective, and three letters of recommendation. All students are expected to acquire basic computer programming skills.

Graduate study programs are individually planned to meet the student's special interests and professional objectives. Department core courses in hydrology and water resources are required of each master's candidate unless equivalent courses were taken elsewhere. A Master's thesis is a requirement of the degree program. Master's Thesis-Equivalent (for current professionals) and Master's Publication-Thesis options are also available.

Applicants for admission to the Doctor of Philosophy degree program should have completed the Master of Science degree with a major in hydrology, water resources, environmental sciences, environmental engineering, or a related field. Where gaps exist in background knowledge of relevant subject matter, the student may be required to take additional course work prior to the oral qualifying examination.

 Majors

Hydrology: The program is designed for students with special interest in the physical, chemical, and biological aspects of the hydrologic cycle as it relates to water resources. Students may concentrate in one or in a combination of these fields but should acquire some proficiency in all aspects of hydrology and water resources.

Water Resources: This program is for students with special interests in operations research, administration and management, environmental studies, or the social sciences as related to water resources. Students majoring in the program are expected to have or acquire a basic knowledge in hydrology. Areas of concentration currently defined are water policy and planning, water resources systems, and environmental and water quality management.

500. Ecosystemology for Urban Planning (3) I Introduction to conceptual tools used in complex ecosystems, particularly cities and urban areas; integration of human residents with larger natural systems (human ecology); environmental impact assessment (EIA) and statement (EIS). Water resource planning and impact on regional ecosystems; technical, legal, ethical dimensions of water transfer. (Identical with PLNG 500) Bradley

503. Subsurface Fluid Dynamics (3) I Dynamics of immiscible fluids in porous and fractured media; anisotropy and scale; advective solute transport; consolidation and land subsidence; flow to wells in multiaquifer systems; free surface flow and salt water/fresh water interfaces. CR, MATH 322 or 422a or 422b. P, C E 321. (Identical with C E 503) Neuman

504. Numerical Methods in Subsurface Hydrology (4) II Finite difference, finite element and boundary integral methods for subsurface fluid flow and mass transport; applications to aquifers, unsaturated soils, earth structures. P, MATH 422a or consult department before enrollment. (Identical with C E 504) Neuman


506. Water Quality Dynamics (3) I Chemical and physical methods are used to study the quality of ground and surface waters with emphasis on organic contaminants, colloids, and surface processes including sorption phenomena. Equilibrium and dynamic models of water chemistry. P, 517R-517L. Conklin

508. Vadose Zone Monitoring (2) II 1995-96 Laboratory and field methods for characterizing water flow and contaminant transport through unsaturated geologic media. 6L. P, 407 or 503 or 505 or 518 or 5 W 470.


514. Field Hydrology (Surface Water) (1) S Field methods of collection, compilation, and interpretation of data in surface water. Stream gauging, hydrography and limnology exercises; evaporation studies; slope-area method of
indirect discharge measurement; flood-plain mapping. Daily field work. Fee. P, 519. Ince

515.* Introduction to Water Resources Policy
(3) II Water resources policy including the identification of regional problems of water use, the elements of water planning, water rights, and a consideration of institutional structures and processes. P, MATH 125a. (Identical with GEOG 515) Bradley

516. Hydrologic Transport Processes (3) I Development and application of equations describing mass and energy transport in the surficial environment. P, 503 or 535, SIE 270. Yeh

517R. Fundamentals of Water Quality (3) I Introduction to chemical processes affecting the behavior of major and minor chemical species in the aquatic environment. Physical, equilibrium, organic, and analytical principles as applied to natural waters. 517R may be taken in conjunction with or independent of 517L; however, 517R is prerequisite to 517L. P, 517, or GEOS 101, 103, MATH 125b, CR, or F, MATH 254. Bales/Basset/Conklin

517L. Fundamentals of Water Quality Laboratory (1) I Field and laboratory methods in water quality sampling and analysis. Includes both wet chemistry and instrumentation methods of analysis. Fee. 3L. P, CR, 517R. Bales/Basset/Conklin

518. Survey of Subsurface Hydrology (3) I Survey of physical, mathematical, geometric, and engineering concepts fundamental to subsurface hydrologic processes. P, CR, AME 331a or C E 321; MATH 254; P, GEOS 101. Maddock/Zreda


520. Water Resources Management, Planning, and Rights: A Policy Approach (3) I An introduction to basic concepts and issues of water resources management and administration, emphasizing water law and rights, water resources planning, institutional and organizational arrangements, and policy processes such as adjudication and rule-making. Bradley/Waterstone

521. Introduction to Water Resources Systems Analysis (3) I Quantitative analytical methods in water resources planning and management; introduction to systems analysis, benefit/cost, multi-objective planning and risk assessment. P, MATH 125a. Ciras/Davis

522. Well Logging Interpretation (3) II (Identical with G EN 522)

523.* Hydrology (3) I (Identical with C E 523)

524. Hydroclimatology (3) I Precipitation formation processes, the surface and atmospheric branch of the hydrologic cycle, land-surface-atmosphere interaction, surface energy balance, evapotranspiration, heat and moisture fluxes into the soil and atmospheric boundary layer. P, non-majors should consult department before enrolling. Shuttleworth

525. Water Quality Modeling (3) I (Identical with C E 525)

526. Water Quality Management (3) II Optimization and systems analysis techniques used in modeling; current models used in formulation and implementation of water quality policy. P, 525. (Identical with C E 526) Buras

527.* Computer Applications in Hydraulics (3) I (Identical with C E 527)

531R.* Hydrogeology (3) I II Hydrogeologic and geochemical factors controlling the occurrence and dynamics of groundwater on regional and local scales. P, GEOS 101, 103, MATH 125a. (Identical with GEOG 531R) Zreda


535. Advanced Subsurface Hydrology (3) II Advanced aquifer and well hydraulics; heterogeneity, unsaturated flow; natural and artificial recharge; ground-water and surface-water interaction; mass and heat transport. P, MATH 223 or 422a or 422b. (Identical with GEOS 535) Yeh

536. Ground-Water Resources Evaluation (3) I Geologic and hydrologic techniques for evaluating aquifer systems with case studies of ground-water management on local and aquifer scales, their environmental and societal impacts, case studies of ground-water contamination. Field methods. Fee. Field trips. (Identical with GEOG 536) Zreda

540.* Advanced Surface Water Hydrology (3-4) II Theory and selected design problems from fluvial dynamics, flood hydrology, flood routing, and water supply hydrology. 3R, 1D. Discussion section is optional for graduate students. Field trip. P, 519 or 523. Ince

543.* Quantitative Planning Methods in Water Resources Administration (3) I Applications of quantitative methods to water resources management; benefit-cost analysis; optimization; structure and basis of planning process; risk analysis. P, microeconomics, MATH 125a. Davis

545.* Statistical Hydrology (3) II Application of statistics and probability to uncertainty in the description, measurement, and analysis of hydrologic variables and processes, including extreme events, error models, simulation, sampling, and optimization. P, knowledge of computer language, SIE 305 or equivalent. Davis

550a-550b.* Environmental Hydrology (3) I II Chemistry of surface and subsurface water, the predominant chemical processes affecting composition in relation to man’s use; classification, identification, and mobility of contaminants; introduction to chemical and transport modeling. 550a: II focuses on inorganic chemistry. 550b: I focuses on organic aquatic chemistry. P, CR, 550a, or SIE 305. Basset/Conklin

551.* Environmental Hydrology Laboratory (3) I II Laboratory procedures and field methods related to chemistry of surface and subsurface waters. Fee. P, CR, 550a or equivalent. Basset

557.* Low Temperature Geochemistry (3) II 1995-96 (Identical with GEOS 557)

560.* Watershed Hydrology (4) I (Identical with WS M 560)

563. Isotope Hydrology (3) (Identical with GEOS 563)

566.* Soil and Groundwater Restoration (3) II 1995-96 (Identical with S W 566)

570. Computer Simulation of Hydrochemical Processes (3) I Introduction to the fundamentals of solving complex water chemistry problems using computer codes as tools. Equilibrium, mass transfer, or 1-D transport models with multielement chemistry, thermodynamic concepts, and use of equations in models; placing natural chemical processes into an interpretable framework, evaluation of error and uncertainty. P, CR, 506 (recommended) or 517R-517L. Bassett

572. Global Biogeochemical Cycles (3) I (Identical with GC 572) Bales

576. Advanced Natural Resource Economics (3) I (Identical with AREC 576)

577. Advanced Topics in the Economics of Environmental Regulation (3) II (Identical with AREC 577)

578.* Global Change (3) I (Identical with GEOS 578)

581.* Environmental Policy (3) I (Identical with POL 581)

582.* Applied Groundwater Modeling (3) I Introduction to ground-water flow and transport modeling, with emphasis on model construction and simulation. 2R, 3L. Maddock

583.* Physical Oceanology and Limnology for Hydrologists (2) II Origin, distribution, and characteristics of oceanic water; advective and convective processes; estuarine and shoreline processes; effect on coastal aquifers; classification and hydrologic regimen of lakes. P, MATH 125b. Bales/Conklin

584. Advanced Applied Groundwater Modeling (3) II Advanced applied ground-water flow and transport modeling for saturated and unsaturated media using variety of current computer models. P, 482 or 582. Maddock

590.* Remote Sensing for the Study of the Planet Earth (3) II 1995-96 (Identical with REM 590)

595. Colloquium
b. Global Climate Change (2) [Rpt./1] I (Identical with ATMO 595b) Dickinson
c. General Circulation Observations and Modelling (3) II (Identical with ATMO 595c) Dickinson

596. Seminar
c. Advanced Topics in Hydrochemistry (1-3) I
k. Risk and Society (3) [Rpt./1] I (Identical with GEOG 596k) Davis/Waterstone

597. Workshop
a. Computational Tools EOS Hydrology (1-2) [Rpt./1] I II, P, some previous knowledge of UNIX desirable. Bales

*May be taken with 400-level course.

603. Advanced Topics in Subsurface Hydrology (2) II 1996-97 (Identical with AREC 603a) Topic to be selected among (a) geostatistical and stochastic analyses of flow and transport, (b) well hydraulics, pumping test analysis, and (c) flow and transport in fractured rocks. P, 503 or 535. Newman

605. Soil Water Dynamics (3) II 1996-97 (Identical with SW 605)

642. Analysis of Hydrologic Systems (3) I Presentation and evaluation of a variety of
mathematical modeling techniques; presentation of theoretical basis of linear/nonlinear systems, advantages and limitations of various approaches, e.g., linear vs. nonlinear, lumped vs. distributed, used in hydrologic modeling; interrelation between function development and model calibration requirements. P, MATH 254. Sorooshian

643. Water Resources Systems Analysis (3) II Applications of mathematical programming to the analysis of interactions of hydrology, engineering, economics, and socio-institutional environment in regional water resources systems. P, 521 or consult department before enrolling. Buras


653. Stochastic Hydrology (3) I 1995-96 Advanced application of statistics and probability to hydrology; multivariate regression, Bayesian techniques, stochastic hydrology, time series and frequency analysis. P, 519 or 545 or basic statistics and hydrology. D. Davis, Maddock

695. Colloquium

- Hydrology and Water Resources Administration (1-3) [Rpt./1] I II For majors only; consult department before enrolling.
- Seminar

- Advanced Topics in Vadose Zone Hydrology (1-3) II
- Advanced Topics in Subsurface Flow Modeling (1-3) [Rpt./1] II
- Pollutants in the Hydrologic Environment (1-3) II
- Advanced Hydrologic Modeling (1-3) II
- Conflict Resolution (3) [Rpt./1] II (Identical with SIE 695g) P, consent of instructor
- International Water Resources Management (1-3) [Rpt./2] I (Identical with POL 6961, NES 6961)
- Science and Technology of Radioactive Waste Management (1-3) [Rpt./1] II 1996-97
- Advanced Methods in Hydrometeorology/Hydroclimatology (1-3) [Rpt./1] I

Industrial Engineering

(See Systems and Industrial Engineering)

Insect Science (INSC)

Forbes Building, Room 410
(520) 621-1152
idpis@ag.arizona.edu

Graduate Interdisciplinary Program in Insect Science

Committee:
Professors Elizabeth A. Bernays (Entomology), William S. Bowers (Entomology), Danny L. Brower (Molecular and Cellular Biology), Reginald F. Chapman (Arizona Research Laboratories, Division of Neurobiology), René R. Feyereisen (Entomology), Henry H. Hagedorn (Entomology), John G. Hildebrand (Arizona Research Laboratories, Division of Neurobiology), Margaret G. Kidwell (Ecology and Evolutionary Biology), John H. Law (Biochemistry), Richard B. Levine (Arizona Research Laboratories, Division of Neurobiology), José M.C. Ribeiro (Entomology), Nicholas J. Strausfeld (Arizona Research Laboratories, Division of Neurobiology), Marc E. Tischler (Biochemistry), Michael A. Well (Biochemistry)

Associate Professors Diana E. Wheeler, Chairperson (Entomology), Edmund A. Arbas (Arizona Research Laboratories, Division of Neurobiology), Nancy A. Moran (Ecology and Evolutionary Biology), Robert L. Smith (Entomology), Leslie P. Tolbert (Arizona Research Laboratories, Division of Neurobiology), Assistant Professors Leticia Avilés (Ecology and Evolutionary Biology), Judith L. Bronstein (Ecology and Evolutionary Biology), David R. Maddison (Entomology), Wayne P. Maddison (Ecology and Evolutionary Biology), Lynn J. Manseau (Molecular and Cellular Biology), David B. Morton (Arizona Research Laboratories, Division of Neurobiology), Daniel R. Papaj (Ecology and Evolutionary Biology), Linda L. Restif (Arizona Research Laboratories, Division of Neurobiology), Martin F. Taylor (Entomology)

The Interdisciplinary Program in Insect Science offers a graduate program leading to the Ph.D. degree that trains students broadly in insect biology, with individually designed programs suited to each student's interests and needs. Programs of study combine a broad knowledge of insects as organisms and training in one or more specialized disciplines, such as ecology, evolution, vector biology, neurobiology, biochemistry, and molecular biology. The faculty members, made up of insect scientists based in five departments, can serve as major advisors for students majoring in the Insect Science Program. Information about their research interests can be obtained from the program office. Two semesters each of biology, chemistry, physics, and mathematics are required for admission. A baccalaureate degree must be completed in some area of the biological sciences. Candidates should take the general Graduate Record Examination as well as an advanced examination in a biological field.

500a-500b. Advanced Topics in Ecology and Evolutionary Biology (4-3) (Identical with ECOL 500a-500b)
503R. Biology of Animal Parasites (3) I (Identical with V SC 503R)
503L. Parasitology Laboratory (1) I (Identical with V SC 503L)
505. Aquatic Entomology (3) II 1996-97 (Identical with ENTO 505)
507R. Insect Physiology (3) III 1996-97 (Identical with ENTO 507R)
507L. Insect Physiology Laboratory (1) II 1996-97 (Identical with ENTO 507L)
508. Insecticide Toxicology (3) II 1995-96 (Identical with ENTO 508)
511. Insect Behavior (3) II 1995-96 (Identical with ENTO 511)
515R. Insect Biology Laboratory (1) I (Identical with ENTO 515L)
515L. Insect Biology Laboratory (1) I (Identical with ENTO 515L)
516. Insect Systematics (4) I 1995-96 (Identical with ENTO 516)
524. Theoretical Population Genetics (3) I (Identical with ECOL 524)
544. Insect Ecology (3) I 1996-97 (Identical with ENTO 544)
545. Concepts in Genetic Analysis (3) I (Identical with MCB 545)
552. Medical-Veterinary Entomology (4) [Rpt./3] II 1996-97 (Identical with ENTO 552)
568. Nucleic Acids (4) I (Identical with BIOC 568)
570. Biological Control (3) II 1995-96 (Identical with ENTO 570)
588. Principles of Cellular and Molecular Neurobiology (4) I (Identical with NRSC 588)
589. Principles of Systems Neurobiology (4) II (Identical with NRSC 589)

Italian

(See French and Italian)

Japanese

(See East Asian Studies)

Journalism (JOUR)

Franklin Building, Room 101M
(520) 621-7556; FAX: (520) 621-7557

Professors Donald W. Carson, Abraham S. Channing (Emeritus), Philip Mangelsdorff (Emeritus), George W. Ridge, Jr. (Emeritus), Jacqueline E. Sharkey

Associate Professors Jim Patten, Head, Ford N. Burkhart, William F. Greer, James W. Johnson

The department offers a program leading to the Master of Arts degree with a major in journalism. The program is designed for students dedicated to developing or improving professional skills while attaining an academic background in one or more specializations.

An undergraduate major in journalism is not necessary for admission. Students are required to complete 205, 206, and 320 as deficiencies without graduate credit.

A minimum of thirty units is required for the master's degree. Electives are cho-
sen from journalism or related fields with the approval of the advisor. A complete program of study must be approved by the graduate advisor in the first semester, and the advisor must approve any subsequent changes. No foreign language proficiency is required, although for those interested in Latin America, the department has an exchange program in Guadalajara.

Students are required to work on one departmental newspaper and to demonstrate a high level of skill in reporting and writing courses. The program of study must include 502, 511, 513, 539 or 570, 550 or 551, and 909. Advanced-degree credit will not be given for a grade lower than "B."

The graduate program has been accredited by the American Council for Education in Journalism and Mass Communications.

502. Freedom of Expression (3) II Analysis of access to information and communication at local, state, national, and international levels; intensive study of the legal relationship between mass media and society. Open to majors only.

503.* Advanced Photojournalism (3) I II Reporting and interpreting the news through photos, photo documentaries, and photo analysis. Open to majors only. P, 501, 502.

505.* The Study of News (3) I II [Rpt.] Critical study and problem analysis of the media. Field work may include publication of conclusions.

506.* Magazine Color Photography (3) S Techniques for taking and editing color photographs to illustrate magazine articles. Preparation of resumes and photo portfolios. Field trips.

511.* News Features (3) I II Writing the basic news feature article, specialized reporting and rewriting techniques. P, 206. Department permission required to enroll.

513.* Reporting Public Affairs (3) I II Study and practice of news gathering on executive, legislative, and judicial levels in city, county, state, and federal governments, with emphasis on news sources and interpretive writing. P, 206, 208, 210. Department permission required to enroll.

514.* The News Agency: Arizona News Service (1) [Rpt.] I II Role and operations of the news agency, wire service, or syndicate. Class members will form staff of Arizona News Service to supply client newspapers from bureaus in Tucson and Phoenix. Field trips. P or CR, 411 or 413. Department permission required to enroll.

517.* Sports News Writing (3) I Students will cover sports events and write sports features. Interview and rewriting techniques. P, 206. Department permission required to enroll.


539.* Ethics and the News Media (3) I Analysis of ethical theory and how it relates to journalists' roles and responsibilities in a democratic society. Case studies involve questions of bias, accuracy, privacy, and national security. (Identical with LAS 539)

540.* Community Journalism: The Tombstone Epitaph (3) [Rpt.] I II Class members work as editorial staff to produce the local newspaper for Tombstone, Arizona. Intensive study of problems and responsibilities of community newspapers. P, 206, 208, discussion of preparation with instructor.

551.* Community Journalism: El Independiente (3) [Rpt.] I II Class members work as editorial staff to produce a publication for the community of South Tucson. Intensive study of problems and responsibilities of journalism. P, 206, 208, discussion of preparation with instructor.

560.* The Press and Society (3) I II Critical study of press performance in current affairs; changing requirements for socially responsible and professional journalism in a democracy.

571.* International Communications (3) I II Study of world news systems, including news-gathering agencies, role of the foreign correspondent, the foreign press, the factors influencing international news flow.

596. Seminar (3) A, B, C
   a. History of the Press (3) I II
   b. Latin-American Press (3) I II (Identical with LAS 596h)
   i. News Analysis (3) I II
m. Directions in News Technology (3) [Rpt./J1/S]

*May be convened with 400-level course.

Landscaping Architecture
(See Renewable Natural Resources)

Language, Reading and Culture (LRC)

Education Building, Room 512
(602) 621-1311

Professors Patricia L. Anders, Gary D. Fenstermacher, Kenneth G. Goodman, Yetta M. Goodman, Amelia Melnik (Emerita), Judy Nichols Mitchell, Manuel D. Pacheco, William J. Valmont Associate Professors Richard Ruiz, Head, Adela A. Allen, John M. Bradley, Margaret B. Fleming (Emerita), Marcello Medina, Jr., Luis C. Moll, Kathleen Short Assistant Professors Dana L. Fox, Teresa McCarty, Octaviana Trujillo Clinical Assistant Professor Arminda Fuentevilla

The department offers programs leading to the Master of Education degree with majors in bilingual/multicultural education and in language, reading and culture. The department also offers programs leading to the Educational Specialist, Doctor of Education, and Doctor of Philosophy degrees with a major in language, reading and culture.

An undergraduate grade-point average of at least 3.00 is required for admission to full standing in a graduate degree program. However, applicants with undergraduate grade-point averages of 2.50 to 2.99 may be admitted on a provisional basis. A master's degree (any field) is a prerequisite for admission to a specialist or doctoral program. Beyond these minimal requirements, applicants must also meet the specific admission requirements for all majors offered in the department.

504. Language and Culture in Education (3) I II Introduction to aspects of language and culture that affect education, particularly in reading, writing, and the language arts; discussion of social and political concerns.

505. Essentials of Reading and Writing (3) I II Survey of reading and writing relationships: development, instruction, and evaluation.

507. Teaching of Reading: Decoding and Comprehension (3) I II Linguistic, psychological, and cultural bases of decoding and comprehension; theories that influence practice; materials and practices that facilitate learning to read.

510.* Foundations of Bilingual Education (3) I II Socio-cultural factors, language practices, and education; analysis of theories and practices affecting bilingual learners; historical, social, and cultural influences; relationship of theory to the characteristics and needs of the bilingual learner.

512.* Educating the Culturally Diverse (3) I II Issues faced in education associated with ethnic and linguistic pluralism in the United States; analysis of the interaction of school, community, cultural, and family factors in the education of diverse populations.

514.* Bilingual Reading and Writing (3) I Analysis of reading and writing situations encountered by bilingual students; phonological, semantic, and syntactic aspects of instruction; methods and materials.

515.* Media and Reading, Language, Arts (3) I II S Procedures for planning, creating, and using effective media presentations in reading and language arts instructional settings.

516.* Methods and Materials in Bilingual Education (3) I II Analysis and evaluation of methods and materials used in bilingual education programs; effective strategies in first and second languages; concurrent and separate language approaches and cooperative models. P, 504.

527. Developing Language Arts Curriculum (3) I II Curriculum theory and models; staff development for implementing change; scope and sequence; planning effective learning experiences. P, 504 and 505.

528.* Bilingual Curriculum Development (3) I II Theory and application of curriculum devel-
opment to bilingual instructional programs; designs, organizational patterns, materials and media, change strategies, and evaluation.

530.* Computer Application for Teachers (3) I II Introduction to computer applications for language arts and other educators; examination of current and proposed hardware and software; survey of technological developments and trends impacting education; examination of social, psychological, and educational consequences of technology in education.

532. Pre-Reading and Beginning Reading Development (3) I II An examination of various aspects involved in pre-reading and beginning reading development, including psychological, sociological, physiological, linguistic, and educational considerations.

535.* Content Area Literacy in a Multicultural School (3) I III Prepares teachers to integrate knowledge of cultural diversity and literacy processes with their content and specialization.

537. Classroom Diagnosis and Instruction (3) I II Procedures for diagnosing and developing reading and writing skills for pupils of below-average achievement level. P, 505, 507 or CR.

551. Reading, Writing and Texts: A Psychosociolinguistic Perspective (3) I II Readers and writers as users of language; reading and writing as language processes; what makes a text a text.

553. Language Acquisition and Development (3) I Study of the development of language in young children; focus on oral language and its relationship to emergent literacy; instructional strategies that build on language development.

554. Applied Linguistics in Education (3) I The application to curriculum, teaching, and learning of concepts from linguistics, psycholinguistics, and sociolinguistics. P, 551 or CR.

557. Application of Miscue Analysis (3) I II Study of miscue analysis to explore the reading process, reading research, and readability, as well as to evaluate readers; applications to reading strategies and curriculum; focus on comprehension. P, 551 or CR.

570. Language Research Methodology in Education (3) I II Investigation of procedures for conducting literacy research; examples of literacy research paradigms; critical analysis of evidence supporting literacy practices. P, 507 or 551.

578. Field Experience (3) I II Supervised experience in assessment and instruction of literacy-related practices. P, 504, 505 or CR.

580.* Children's Literature in the Classroom (3) I II S Analysis and discussion of classic and contemporary children's literature of all genres, and its relationship to language, reading, and culture.

581. Multilingual Literature and Literacy (3) I Analyzes the use of multilingual literature that fosters self-concept, acceptance, and a sense of identity to develop literacy. Includes readings from the major categories of multilingual literature about Black, Native, Hispanic, and Asian Americans.

583. Literature Discussions (3) I Issues related to dialogue about children's literature within a community of readers. Research, theory, and practice related to literature discussion groups, text, sets, reader response, and collaborative learning.

595. Colloquium (3) I II S Issues in Language, Reading and Culture (1-3) I II S, 504, 505. [Rpt./12 units] Language, Learning, and Reading Disabilities (3) I II S (Identical with SER 595b) Issues in Educating Bilingual/Multicultural Children (1-3) I II S. [Rpt./9 units] Applications of Language and Literacy (3) I II S. [Rpt./9 units] II S

597. Workshop (3) I II S Southern Arizona Writing Project (3-9) [Rpt./12 units] I II S (Identical with ENGL 597a) Miscue Analysis in Teacher Education (2-3) II Teaching of English (3) I II S. [Rpt./3] (Identical with ENGL 597e)

*May be convened with 400-level course.

612. Grammatical Analysis (3) I (Identical with ENGL 612)

627. Curriculum Development and Supervision in Language Arts (3) I II Organization of patterns of language arts curricula; approaches to improvement of language arts instruction; personnel relations. Designed for the language arts supervisor and school administrator.

632. Pre-Reading and Beginning Reading Development (3) I II Procedures for diagnosing and developing reading and writing skills for pupils of below-average achievement level. P, 505, 507 or CR.

634. Reading Comprehension: Theories, Research and Methods (3) I II S Factors affecting cognitive development; methods of influencing growth in reading comprehension; examination and analysis of instructional materials; research related to comprehension and cognitive development. P, 507.

635. Reading and Writing in Content Areas (3) I II S Methodology appropriate for reading and writing to learn content; compatible organizational models; program implementation. P, 504, 505, 507 or 551 or CR.

636. Reading Diagnostic Laboratory (3-6) [Rpt./6 units] I II Supervised practice in reading assessment; identification of factors influencing reading achievement, evaluation, construction, and administration of assessment procedures; development of interview techniques. P, 507, 537.

637. Reading Instructional Laboratory (3-6) [Rpt./6 units] I II Supervised practice in teaching reading and writing; preparing, analyzing, and critiquing special instructional programs for students. Open to majors only. P, 507, 537.

638. Reading and Writing in Content Areas (3) I II S Methodology appropriate for reading and writing to learn content; compatible organizational models; program implementation. P, 504, 505, 507 or 551 or CR.

639. Reading Instructional Laboratory (3-6) [Rpt./6 units] I II Supervised practice in teaching reading and writing; preparing, analyzing, and critiquing special instructional programs for students. Open to majors only. P, 507, 537.

652. Written Language Development (3) I II S Study of latest research in the writing and reading development of preschool and schoolaged children; relationships between reading and writing development explored through student research; applications to instruction. P, 505, 553.

694. Practicum (3) I II S Language, Reading and Culture (1-3) [Rpt./12 units] I II S. [Rpt./15 units] II S

Latin American Studies (LA S)

(a) Seminar (3) I II S (May be convened with 400-level course.)
(b) Colloquium (3) I II S
(c) Workshop (3-9) [Rpt./12 units] I II S

Latin American Studies

Director: Oscar J. Martinez
Assistant Director: Raul P. Saba
Graduate Interdisciplinary Program in Latin American Studies

Committee:
Professors: Nathan Buras (Hydrology and Watershed Resources), Donald W. Carson (Journalism), Ken Clark (Architecture), T. Patrick Culbert (Anthropology), Celestino Fernandez (Sociology), Roger Fox (Agricultural and Resource Economics), Donna J. Guy (History), Lanin A. Gyurko (Spanish and Portuguese), Boris S. Kozolchyk (Law), Oscar J. Martinez (History), Michael C. Meyer (History), Andrew Nichols (Family and Community Medicine), Leland Pederson (Geography and Regional Development), Jose Promis (Spanish and Portuguese), Eliana Rivero (Spanish and Portuguese), Jacqueline Sharkey (Journalism), Arthur Silvers (Public Administration and Policy), Charles M. Tatum (Spanish and Portuguese), Edward J. Williams (Political Science)

Associate Professors: John Crow (Political Science) (Emeritus), Kevin Gosner (History), Keith McElroy (Art), Alfonso Moises (Media Arts), Richard Obregon (Music), Richard Ruiz (Language, Reading and Culture), Kathleen Schwartzman (Sociology), Barbara Timmermann (Pharmaceutical Sciences)

Assistant Professors: Ana Alonso (Anthropology), Maria Jose Barbosa (Spanish and Portuguese), Bert J. Barickman (History), Daniel Nugent (Anthropology), Ana Virginia Perches (Spanish and Portuguese), Raul P. Saba (Latin American Studies), Stacie Widdifield (Art), Amy Williamsen (Spanish and Portuguese)
The Latin American Area Center offers an interdisciplinary M.A. program combining Spanish and Portuguese language skills with courses focusing on two fields of study, a core Latin American Studies research seminar and optional electives. The student chooses one of the fields as the primary area of concentration and the other field as a secondary area of concentration. Principal areas of concentration include the disciplines of anthropology, geography and regional development; history; language, reading and culture; political science; and Portuguese or Spanish. An area of concentration also may include a cohesive program of related courses with a geographic focus. Presently, these geographic areas include Mexico studies and Brazil studies. A thematic area in women’s studies offers another possibility for primary concentration. Related fields for the secondary area of concentration include the disciplines of: agricultural and resource economics; art history; anthropology; economics; geography and regional development; history; journalism; language, reading and culture; law; political science; sociology; and Portuguese or Spanish. The student might also focus this secondary field around more thematic areas such as inter-American political economy and trade, race and class, women’s studies, indigenous cultures, and border studies (if the Mexico studies option has not been selected for the concentration). A total of 36 graduate units are required for the M.A. degree. A minimum of 15 units, including a research seminar, are chosen in the area of concentration. The secondary area consists of a minimum of nine units. The research seminar (596a) is three units. The nine minimum of nine units. The research seminar and optional electives.

Because of the interdisciplinary nature and regional emphasis of the Latin American studies program, both Spanish and Portuguese skills are required; one at the level of competence demonstrated by completing Portuguese 206 or Spanish 251b or by an equivalency exam; the other at the level of proficiency demonstrated by completion of Portuguese 425 or Spanish 330 with a grade of B or by an equivalency exam. Students accepted into the program who do not meet one or both of the language requirements may satisfy this deficiency during the course of their graduate studies. Moreover, if a student has a regional or country focus in the area of primary concentration, he or she must take at least two courses emphasizing other areas or countries in Latin America.

Applicants are asked to submit two letters of recommendation, a one-page statement of purpose or goals, and scores on the Graduate Record Examination. An admissions subcommittee takes into consideration all factors when evaluating applicants to the graduate programs.

Doctoral students in other departments may elect a minor in Latin American studies. Requirements include a minimum of 15 units in courses related to the student’s major and demonstrated competence, as defined above, in either Portuguese or Spanish.

Law (LAW)

Law Building, Room 110
(520) 621-1373; FAX: (520) 621-9140


The College of Law offers course work leading to the Juris Doctor degree and the Master of Laws in International Trade, and it participates in several joint degree programs. Courses leading to the Juris Doctor degree are numbered at the 600-
level. For a description of College of Law courses and degree requirements, please see the College of Law Catalog. The LLM in International Trade may be earned by a limited number of students. For degree requirements, write David A. Gantz, Director of Graduate Studies, College of Law, The University of Arizona, 1201 E. Speedway Blvd., Tucson, AZ 85721. The 500-level courses below identify law-related courses offered by other departments that are cross-listed with law. They may be taken to support special student interests or as part of a program for students seeking joint degrees. For information on joint degree programs, consult the College of Law and the departments offering the joint degrees with the College of Law.

540. Theories of Crime and Public Policy (3) II (Identical with PA 540)
562. Mental Health Law & Policy (3) [Rpt. /3] II (Identical with PSYC 562)
584a-584b. Development of Federal Indian Policy (3-3) (Identical with POL 548a-548b)
596. Seminar
  g. Philosophy of Law (3) (Identical with PHIL 596g)
  h. Law, Psychology and Policy (3) (Identical with PSYC 596h)
600. Contracts (5)
601a-601b. Introduction to Legal Process and Civil Procedure (3-2)
602. Criminal Procedure (4)
603a-603b. Research and Writing (1-1) 603a is First-year Legal Research and 603b is First-year Legal Writing
604a-604b. Torts (2-3)
605. Property (5)
606. Constitutional Law I (3)
607. Appellate Practice and Moot Court (1)
608. Evidence (4)
609. The Legal Profession (2)
610. Health Law (3)
611. Employment Law (3)
612. Family Law (3)
613. Law and Medicine (3)
615. Constitutional Law II (4)
616. Corporations I (3)
617. Corporate Finance (2) P, 616.
618. Antitrust Law (3)
619. Estates and Trusts (4)
620. Immigration Law (3)
621. Administrative Law (3)
622. Law Review (1-3)
623. Conflict of Laws (3)
624. Labor Law (3)
625. American Legal History (2)
626. Jurisprudence (2-3)
627. Mexican Law (2) II
628. Property (5)
629. Employee Benefits (3)
630. Scientific Evidence (3)
631. Federal Indian Law (3) (Identical with AINS 631)
633a-633b. Commercial Transactions (3-3) 633a is not prerequisite to 633b.
635. Basic Insurance (3)
638. Real Estate (3)
639. Community Property (2)
640. Mining and Public Land Law (2)
641. Water Law (3)
642. Federal Jurisdiction (3)
644. Remedies (3)
646. Federal Income Taxation (5)
647. Corporate Taxation (3) P, 646.
648. Estate and Gift Taxation (3)
649. Torts II (3)
650. Criminal Law (3)
653. Advanced Appellate Practice and Moot Court (2)
654. Environmental Legislation (2)
655a-655b. Intellectual Property Law (3-3)
656. Sentencing Law (2)
657. Partnership Taxation (3) P, 646.
658. Securities Regulation (3)
659. International Humanitarian Law (3)
660. Land-Use Planning (3) (Identical with PLNG 660)
661a-661b. Moot Court Board (2-2) 661a: Moot Court National Team. 661b: Moot Court Board.
662. Debtor-Creditor Law (3)
663. Individual Income Tax (3)
664. Law and Social Science (2)
665a-665b. Interviewing and Negotiating (1-1) 665a: Interviewing. 665b: Negotiating. 665a is not prerequisite to 665b.
666. Law and Economics (3)
669. Environmental Law (3)
670. Public International Law (3)
671. Law and Humanities (2)
672. Legal Analysis and Legal Reasoning (2)
673. Law of Mass Media (2)
674. Law of "White Collar Crime " (2-3)
675. State and Local Government (3)
676. Advanced Legal Writing (2)
678. Jessup Moot Court (2)
679. International Civil Litigation (2)
684. Law and the Elderly (2)
687. The European Community (1)
688. Energy and Natural Resources (3) GRD (Identical with AINS 688)
689. Advanced Legal Research (2) P, 603.
690. Law Office Management and Technology (3)
695. Colloquium
  b. Feminist Jurisprudence (2)
  d. Supreme Court in the History of the United States (1)
  e. Judicial Clerking Program (1-2)
  f. ASUA/Legal Aid Interviewing Program (1)
  g. High School Teaching Program (1)
  h. Florence Immigrant and Refugee Rights Project (2-3)
  i. Ares Fellows (1-2) [Rpt.]
  l. Civil Rights Law (2)
  m. Commodities Regulation (3)
696. Seminar
  a. Estate Planning (3) P, 619, 646, 648
  c. Clinical Practice (3-4) P, 608, 609
  d. Tribal Law Clinic (3-4)
  f. Legal Ethics (3)
  g. International Investment and Technology Transfer (2)
  i. International Environmental Law (3)
  l. International Trade Law (3)
  m. Juvenile Law (2)
  n. Advanced Writing Seminar (3)
  o. Therapeutic Jurisprudence (2)
  q. Tax Policy (3)
  s. Information Technology and the Judicial System (3)
  u. Constitutional Values in Public School Settings (2)
  v. Regulated Industries (3)
  y. Air Pollution Seminar (2)
  z. AIDS and the Law (2)

Library Science (LI S)
1515 East First Street
(520) 621-3565; FAX: (520) 621-3279
School of Library Science

Professors Charlie D. Hurt III, Director, Ellen Allman, Donald C. Dickson, Margaret F. Maxwell (Emerita), Lawrence Clark Powell (Emeritus), Ellenor C. Saltus (Emerita), Arnulfo D. Trejo (Emeritus)

Associate Professors Helen M. Gothberg (Emerita), Charles A. Seavey, Ronald A. Van DeVoorde (Emeritus)

Assistant Professor H. Martin Frické

The School of Library Science offers a Master of Arts degree with a major in library science, which is heavily weighted in technology and emphasizes theoretical constructs of information resources. Competence and adaptability in managing information and in utilizing advancing
technologies are key aims of the curriculum. The program is fully accredited by the American Library Association and requires a minimum of 36 units of graduate credit. Students may elect the thesis option replacing six units of course work. The school offers course work that leads toward the Doctor of Philosophy degree with a major in library science. Doctoral students must complete at least 48 hours of course work in the major, a minor subject supporting the major and the dissertation. More detailed descriptions of the program are available from the school.

501.* Introduction to the Organization of Information (3) Introduction to the theories and practices used in the organization of information. Overview of national and international standards and practices for access to information in collections.


503.* Library Collection Development (3) Principles of collection development; evaluation and review of materials; selection tools; acquisition of materials; problems in selection, including censorship.

504.* Foundations of Library and Information Services (3) Elements of librarianship, historical backgrounds, types of libraries, the role of the library in American life, current issues.

505.* Basic Reference (3) Survey of general reference sources; discussion of reference technique.

506. Research Methods (3) Need and opportunities for research in librarianship; types of research; research methodology; study of research design; elementary statistics.

507.* Library Management (3) Introduction to management concepts, the organizational structure of libraries, systems analysis, financial administration, and the utilization of library personnel.

509. Information Sources for Agricultural Scientists (1) (Identical with PL S 509)

510.* Introduction to Information Science (3) Methods, theories, and technology of information science; elements of computer programming and systems design; implementation and management of computer systems in libraries and information centers.

511.* Information Storage and Retrieval (3) Student involvement in on-line, interactive systems.

512. Automation in Libraries (3) Introduction to automated procedures currently in use in libraries, including systems analysis of actual technical services and planning for their automation.

513. Library Systems Analysis (3) Introduction to quantitative methods for the design, analysis, and control of library systems.

519. Cartographic Information Management (3) Cartographic format as an information transfer medium. History of cartography and problems in interpretation of cartographic products. Role and place of maps in the information environment.


526. Introduction to Bibliography (3) Introduction and critical examination of various styles of bibliographic description; practical application in construction of a systematic bibliography.

530.* Public Librarianship (3) Administration of tax-supported libraries serving the general public, including problems of governmental relationships, community responsibilities, financial support, buildings, personnel, collections.

540.* Academic Librarianship (3) Present trends in academic libraries, including financial administration, collection evaluation, personnel requirements, and building needs.

543.* Knowledge and Society (3) I II (Identical with PHIL 543)

550.* Special Librarianship (3) Mission, organization and administration of the special library.

551. Corporate Librarians (3) History, types of libraries, staffing, development, and future of company libraries in the United States.

559. History of Books and Printing (3) Survey of the history of books and printing from early times to the present, including development of the alphabet, manuscript books, the invention and dissemination of printing, and modern printing techniques. (Identical with HIST 559)

570. Literature of Science and Technology (3) Creation, organization, and dissemination of scientific and technical literature; reference function and problems of bibliographic control. A science background is not required.

571. Information Sources and Services in the Humanities (3) Information resources and services in art and architecture, music, language and literature, theatre and dance, philosophy and religion.

573. Government Publications (3) Examination of the variety of government publications available from municipal, county, state, national, and international agencies, with emphasis on selection and use of publications of the U.S. government.


581.* School Librarianship Administration and Organization (3) Services, finances, personnel, evaluation, quarters, organization, and technical services in the school library.

582. Management of Nonprint Resources (3) Examines management of nonprint resources and their role in providing informational, recreational and educational services.

585.* Literature for Adolescents (3) Literature to meet recreational and developmental needs of the junior and senior high school age, including some books for adults. Reviewing and book talks.

588. Issues in Library and Information Science (3) (Rpt.) Examines problems associated with current issues in information resources, libraries, and other information centers.

589. Scholarly Communication (3) Structure and workings of scholarly communication and products in the U.S. Examines the content and technology of scholarly communication in various disciplines. (Identical with COMM 589)

*May be convened with 400-level course.

600. Introduction to Graduate Study in Music (5) (Identical with MUS 600)

607. Planning Library Services (3) The total planning cycle as a management approach to various library information center services. Open to majors only.

608. Evaluation of Libraries (3) Examines the process of evaluation and analytical decision making in assessing library services and procedures.


695. Colloquium e. Theory of Classification (1-3)

a. Children's and Youth Services and Literature (2-3) [Rpt.]

796. Seminar a. Current Research Trends (1-4) [Rpt.]

b. Government Information Issues (3)

c. Current Research in School Libraries (3)

796. Seminar a. Advanced Topics in Library Science (3) [Rpt./2] 11.15

**Linguistics (LING)**

Douglass Building, Room 200E
(520) 621-6897; FAX: (520) 621-9424

Professors D. Terence Langendoen, Head, Richard Demers, Merrill Garrett (Psychology, Speech and Hearing Sciences), Robert M. Harnish (Philosophy), Jane Hill (Anthropology), Adrienne Lehrer, Susan Steele

Associate Professors Diana Archangeli, Michael Hammond, Richard T. Oehrle, Ofelia Zepeda (American Indian Studies)

Assistant Professors Andrew Bars, Paul Bloom (Psychology), Willem de Reuse (Anthropology), Kerry Green (Psychology), Simin Karimi (Near Eastern
The Department of Linguistics offers programs leading to the Master of Arts and the Doctor of Philosophy degrees with a major in linguistics. For the doctorate, specializations are available in such areas as: linguistics and philosophy, theoretical syntax, theoretical phonology, semantics, morphology, Native American linguistics, Persian linguistics, educational/pedagogical linguistics, socio-cultural linguistics, language acquisition and development, and language processing.

Applicants for admission must forward to the department scores on the aptitude test of the Graduate Record Examination, three letters of recommendation from previous instructors or academic advisors, a sample of work, and a departmental application form.

Degrees

All students, regardless of their intended specialization or degree objective, are expected to complete the following courses: 501, 503, 510, 514, 535, 564, 595a (two semesters), and either 504 or 505. These courses cover the foundations and major current developments in the phonology, morphology, syntax and semantics of natural languages.

Master of Arts: A total of 30 units of course work is required, including all of the courses listed above. A master's examination consisting of the submission of an expanded term paper is required. The paper must be approved by a committee of the student’s advisor and two other faculty members. No thesis is required.

Doctor of Philosophy: In addition to the courses listed above, students must complete 697a, two seminars, and a dissertation. Additional courses and seminars are required depending on the student's area of specialization and minor field. A minor taken within the department consists of 12 units. The qualifying examination consists of the submission of two research papers to the faculty, normally at the end of the third semester. The written preliminary examination consists of the submission to the faculty of a research paper of the scope of a journal article, normally at the end of the fifth semester. A dissertation proposal must be approved by the student's dissertation director within six months of passing the oral preliminary examination. Further information about the graduate program is provided in the Handbook of Policy for the Graduate Program in Linguistics, which is available upon request from the department.

Linguistics for Nonmajors (3) I Conceptual foundations, methodology, and current theoretical frameworks. Students will carry out actual linguistic analysis. For students in fields other than linguistics.

501. Formal Foundation of Linguistics (3) I A survey of the aims of linguistic research and introduction to the basic mathematics of formal linguistics; logic, sets, algebras, graphs, feature structures, formal language theory.

502. Gender and Language in Japan (3) II (Identical with JPN 502)

503. Foundations of Syntactic Theory I (3) I Introduction to fundamental issues in the theory of syntax. Familiarizes the student with the essentials of (1)政府 binding theory and its precursors, and (2) standard categorial grammar and its relatives. P, 101, 300.

504. Government Binding Theory (3) II Continuation of 503, focusing on government, control, binding, thematic relations, and the theory of logical form.


510. Foundations of Phonological Theory I (3) I Investigation of the principles that underlie current phonological theory, concentrating on the representation of sounds and the regular patterns of sound in natural language. Topics include distinctive feature theory, syllable theory, the core skeleton, rule formulation, and rule interactions. P, 101, 315.

511. Introduction to Japanese Linguistics (3) (Identical with JPN 511)

512. Advanced Japanese Linguistics (3) (Identical with JPN 512)

514. Foundations of Phonological Theory II (3) II Investigation of the evidence and arguments for non-linear representations (autosagnostic and metrical) and of the organization of the phonological component of grammar, including evidence for its interaction with morphological structures and rules.

515. Phonological Phonetics (3) I 1996-97 Study of the acoustic and articulatory properties of sounds and of the patterns of sounds that occur in human language. Focus on the significance of the properties of sounds for phonological theory, in particular, distinctive feature theory. Role of psycho-acoustic studies as a source of evidence for phonological theory.

519. Linguistic Structure of Modern Chinese (3) (Identical with CHN 519)

520. Linguistic Structure of Modern Chinese (3) (Identical with CHN 520)

522. Linguistic Semantics and Lexicology (3) II 1994-95 Study of word and sentence meaning, relationship between the lexicon and the grammar, idioms, metaphor, etymology, and change of meaning. P, one course in linguistics. (Identical with PHIL 522)

525. Language Variation (3) II 1993-94 Study of geographical and social dialects, stylistic differences, and idiolectal variation and the implications of variation for writing grammars and for understanding language change. (Identical with ANTH 525)

526. Introduction to Arabic Linguistics (3) II (Identical with ARB 526)

532. Natural Language Processing (3) I Introduction to the processes underlying speech production and comprehension: speech sounds, words, parsing, semantics and pragmatics. (Identical with PHIL 532 and PSYC 532)

533. Morphology (3) I Morphology is the internal structure of words and the relationship between words and the syntactic, phonological, and semantic properties of the units that include them. Course work includes the development of morphological theory.

536. Japanese Sociolinguistics (3) [Rpt./1] (Identical with JPN 536)

538. Computational Linguistics (3) I 1995-96 Fundamentals of formal language theory; syntactic and semantic processing; the place of world knowledge in natural language processing. P, 388 or a course in one of the following: formal languages, syntax, data structures, or compilers. (Identical with C SC 538 and PSYC 538)

541. Language Acquisition (3) II (Identical with SP H 541)

542. Psycholinguistics (3) [Rpt./1] I II (Identical with PSYC 542)

543. Lexical and Syntactic Development (3) I II (Identical with PSYC 543)

544. Syntactic Analysis (3) II 1995-96 An examination of the syntactic diversity presented by natural human languages and an exploration of the issues that such diversity presents for syntactic analysis. Topics include AUX, word order, constituency, and subjects.

545a-545b. Structure of a Non-Western Language (3-3) [Rpt./2] In-depth linguistic analysis of selected phonological, syntactic, and semantic problems in a non-Western language, concentrating on native languages of the Southwest area. P, 101. (Identical with ANTS 545a-545b)

548. Topics in Language and Cognition (3) [Rpt./1] II (Identical with PSYC 548)

562. Linguistics and the Study of Literature (3) (Identical with ENGL 562)

563. Philosophy of Language (3) (Identical with PHIL 563)

564. Formal Semantics (3) I Introduction to model-theoretic investigations of natural language interpretation, including coordination, quantification, referential relations, tense, aspect, and modality. (Identical with PHIL 564)

565. Pragmatics (3) II (Identical with PHIL 565)

568. Speech Perception (3) II (Identical with SP H 568)

574. Linguistic Perspectives on Mexican-American Spanish and Bilingualism (3) I II (Identical with SPAN 574)

576. Language in Culture (3) II (Identical with ANTH 576)

577. Discourse and Text (3) II 1995-96 (Identical with ANTH 577)

580. Historical Comparative Linguistics (3) I (Identical with ANTH 580)
583. Sociolinguistics (3) I (Identical with ANTH 583)
585. *Linguistic and Computer-assisted Approaches to Literature (3) [Rpt./6 units] II (Identical with GER 585)
589. *Areal Survey of Native North American Languages (3) (Identical with ANTH 589)
595. Colloquium
   a. *Linguistics (1) [Rpt./3] I II
596. Seminar
   c. *Topics in Japanese Linguistics (3) [Rpt./2] II (Identical with JPN 596c)
   *May be convened with 400-level course.
600. Current Issues in Linguistic Research (3) [Rpt./2] I II Current research in linguistics, with emphasis on relationships among syntax, semantics, and phonology.
696. Seminar
   a. Syntax and Semantics (3) [Rpt./2] I II
   b. Topics in Phonological Theory (3) [Rpt./2] II
   d. Current Issues in Syntactic Theory (3) I II
   f. Linguistic Investigations and Applications (3) I II (Identical with COMM 696f and PSYC 696f)
   h. Topics in Morphology (3) [Rpt./2] I II
697. Workshop
   a. Linguistic Theory (3) I Open to majors only.

Management and Policy
(MAP)
McCllelland Hall, Room 405
(520) 621-1035; FAX: (520) 621-4171
Professors Barbara A. Gutke Head, Lee R. Beach, Terence Connolly, Edwin B. Flippo (Emeritus), Michael R. Gottfredson, Travis W. Hirschki (Sociology), James P. Logan (Emeritus), H. Brinton Milward, June M. Morrison (Emeritus), Raymond A. Mulligan (Emeritus), Thomas R. Navin (Emeritus), Gregory B. Northcraft, Amnon Rapoport, George W. Summers (Emeritus) Associate Professors Marvin Fortman, David A. Tansik, Robert E. Tindall Assistant Professors Terri L. Griffith, Kenneth W. Koput, Lisa D. Ordóñez The department participates in programs leading to the Master of Business Administration, the Master of Public Administration, and the Doctor of Philosophy degree with a major in management. For information concerning these degrees, see Requirements for Master's Degrees/Master of Business Administration and Master of Public Administration elsewhere in this catalog.

For admission, the applicant is expected to have completed undergraduate work in statistics and mathematics through calculus (MATH 119 and 123). Applications must submit scores on the Graduate Record Examination or the Graduate Management Admissions Test.

The program for the Doctor of Philosophy degree is designed to prepare individuals for careers in academia with an emphasis on the ability to make original and significant contributions to the disciplines of management and policy, and judgment and decision making, through high quality research. To this end, the Ph.D. program provides strong theoretical and methodological training to doctoral students.

500. Management Case Analysis and Presentation (3) I II Written analysis of cases and other reports; development of skills in analysis, decision making, and written and oral presentation, with emphasis on the total situation of each case considered.

502. Organization Theory and Behavioral Relations (3) I II The interactions, effects, and interrelationships of managers, employees, and organizational structures and systems. Open only to students admitted to a B.P.A. graduate program. (Identical with PA 502 and PHIL 502)

503. Human Resource Management (3) I Principles, methods, research relevant to management of an organization's human resources, with emphasis on employment psychology, training, development, compensation. P, 305 or 502.

505. Organizational Power (3) II Development of organizational power and influence techniques for individuals and groups. Uses cases and practical experience to build on motivation, negotiation, and group dynamic skills. P, 502.

532. Conflict and Cooperation in the Dyad (3) I Critical exposition of the essential ideas of two-person game theory and the findings of experimental research on strategic interactions in the dyad.

535. *International Management (3) I II S Analysis of management opportunities and challenges; evaluation and formulation of strategies of firms expanding internationally. (Identical with PA 535)

537. Finance for New Ventures (3) I (Identical with FIN 537)

538. Marketing, Negotiation and Decision Tactics (3) II Development of bargaining and decision-making skills through simulated negotiations and role playing. Open only to students in the entrepreneurship program. P, ECON 500a or ECON 500b, FIN 511, MKTG 500. (Identical with MKTG 538)

539. Planning of New Ventures (3) II New venture development; financial projections, resource assessment, and long-range planning. Open only to students in the entrepreneurship program. P, ECON 500a or ECON 500b, FIN 511, MKTG 500. (Identical with FIN 539)

543. White Collar and Organizational Crime (3) I The nature and distribution of white collar and organizational crime. Sociological and economic explanations for crime in organizational settings. Societal response and control mechanisms (Identical with SOC 543)

545. Interactive Behavior in Small Groups (3) II Critical survey of the essential ideas of n-person game theory (n>2) and the findings of experimental research on social dilemmas, bargaining, and coalition formation.

554. Research Methodology (3) I Behavioral research techniques; bias, validity, reliability, and applicable statistical techniques; critique of research articles and reports.

556. Gender Issues in Organizational Behavior (3) Reviews the research on several topics having to do with gender and organizations, including: social determinants of choice; occupational sex segregation; perceptions of men and women as managers; gender issues in motivation, leadership, and job satisfaction; work and family issues; implications of technological change for women's employment; organizational change including affirmative action and comparable worth. (Identical with SOC 556)

560. Management of Technology (3) I Issues in formulating and implementing technology strategy as organizations and industries grow, mature and stagnate. Topics include patterns of diffusion, role of licensing and joint ventures, and the divergence between leading edge and profitable science. P, 305 or 502.

568. Environmental Scanning and Business Strategy (3) I II (Identical with MKTG 568)


580a-580b. Theory of Management and Organization (3-5) 580a: Analysis of behavior in organizational systems; review of classical, behavioral, and contingency theories of management with a focus on internal systems phenomena. 580b: Organizations in their environments; analysis of organizations in the context of their environmental interfaces. P, 305 or 502. 580a is not prerequisite to 580b.

586. Behavioral Research in Judgment and Decision Making (3) I Theories and research on the strategies and abilities of human judges and decision makers. Focus is upon behavioral, as contrasted with normative, investigation, and upon methods of improving judgment and decision performance. P, statistics.

595. Colloquium
   *May be convened with 400-level course.

600. Behavioral Science Theory and Method in Management (3) [Rpt./1] I Conceptual and theoretical frameworks for the analysis of management problems from a behavioral science perspective. Emphasis on formulation of research questions and alternative research strategies for answering them.

635. Issues in Rural Health Care (3) II (Identical with NURS 635)

696. Seminar
   a. Development Administration (1-3) I II
   b. Program Planning and Development (1-3) I II
   c. Performance Measurement and Accountability (1-3) I II
   e. Health Services Administration (1-3) I II
   g. Criminal Justice Administration (1-3) I II
   h. Land-Use Regulation (3) I II (Identical with PLNG 696h)
Management Information Systems (MIS)
McClelland Hall 430
(520) 621-2748; FAX: (520) 621-2433
Professors David E. Pingry, Head, and Andrew D. Bailey, Jr., Moshe Dror, Seymour Goodman, James F. LaSalle, Jay F. Nunamaker
Associate Professor Nicholas Aquilano, Sudha Ram, Olivia R. Liu Sheng, Douglas R. Vogel
Assistant Professors Ai-Mei Chang, Hsinchun Chen, Anindyadatta, Byungtae Lee, Janny Leung, David Meader, Sarma Nidumolu, Suzanne Weisband
Research Director, Center for Management of Information Mark O. Pendergast

The department offers a program leading to the Master of Science degree with a major in management information systems. The department also participates in programs leading to the Master of Business Administration, Master of Public Administration, and Doctor of Philosophy (major in management) degrees.

Management information systems involves the use of computers in organizations and the integration of computer skills with the functional areas of management. Education in management information systems enables students to pursue careers involving the use, definition, analysis, design, implementation, and operation of computer information systems.

To be considered for admission, applicants must have earned a competitive, acceptable score on the Graduate Management Admissions Test and a competitive undergraduate cumulative grade-point average. Applicants must also have completed preparatory work in mathematics, statistics, and business.

The program requires the completion of 30 graduate units, including a master’s project (696h).

507a-507b. Information Systems Architecture and Data Communications (3-3) 507a: Fundamental concepts of operating systems. The principles and techniques required for engineering and understanding operating systems are covered. Examples from real systems are given to illustrate application of particular concepts. Hardware architecture that is relevant for understanding operating systems. 507b: Comprehensive view of data and computer communications. Explores key issues in the field, in the general categories of principles (including basic concepts and terminology used in the field); design approaches and applications in business; standards such as the IEEE, OSI, TCP/IP, and others. P, 507a.

511. Social Issues of Computing (3) I Introduces survey of the individual, organizational, cultural, social and ethical issues provoked by current and projected uses of computers.

521a-521b. Systems Modeling and Simulation (3-3) 521a: Topics include concepts of simulation, simulation software, model validation, selecting input distributions, random variate generation, statistical analysis of output data. SIMAN simulation language is covered. Previous programming experience is helpful, but not required. P, fundamental knowledge of probability and statistics. 521b: Modeling and analyzing complex business systems using advanced simulation and statistical techniques. A semester project is required. P, 521a or equivalent course. (Identical with SC 521a-521b and SIE 521a-521b)

522. Linear Programming and Applications (3) I Recognition, formulation and solution of linear programming models for decision making. Modeling issues illustrated using examples from systems design, manufacturing, logistics, finance, etc. P, MATH 119. May be convened with 422.

531a-531b. Data Structures and Database Management (3-3) 531a: Abstract data types, data structures and their implementation in Pascal programs. Data structures covered include stacks, queues, lists, and trees. 531b: Introduction to database processing in comparison with file processing. Review of file organization and relevant data structures. Detailed study of various tools needed for logical and physical design, including data flow diagrams and the entity-relationship model. Examines the Relational and Coddasyl database models. Several commercially available database management systems are reviewed. Course covers implementation. Students learn to develop database applications using Sybase or Sun/Unix machines. P, 531a.

541a-541b. Computer-Aided Information Systems Analysis and Design (3-3) 541a: Introduction to the management and techniques associated with software development, both domestically and internationally with focus on the analysis and design stages. Emphasizes international issues. Involves "hands-on" experience with Computer-Aided Software Engineering (CASE) tools. (Identical with SC 541a-541b)

546. Algorithms for Graphs and Network (3) 1996-97 Formulation and solution of problems formulated on graphs and networks. Topics include heuristics and optimization algorithms for shortest paths, min-cost flow, matching, and traveling salesman problems. Credit is allowed for this course or SIE 546. P, 552 or SIE 544 or consent of instructor.

550. International Dimensions of Information Technologies (3) I National and regional information technology development strategies and policies; IT and national sovereignty; development and control of global "information highways," impact of public and business policies on information systems design and use; international institutions and IT; convergence or divergence of information systems across countries, regions and international economic sectors.

551. Advanced Business Programming (3) I Business systems programming environment; basic and advanced COBOL; file organization and access methods; external sorts and multi-key files; 4GLs in data processing. P, 531a.

553. Software Systems (3) I II Software development and software engineering; brings together the elements of programming language, operating system, and development techniques; teaches and uses the C programming language and the Unix operating system. P, 531a.

554. Computer Graphics (3) I II Interactive computer graphics; user interface design; pictorial data structures and management. P, 531a.

567. Design and Control of Production Systems (3) I II Introduction to the basic concepts in operations management. Topics covered include project planning, aggregate planning, forecasting, classical inventory models, linear programming and simulation. Open only to graduate students in BPA.

570. Management and Evaluation of Information Systems (3) I II The methodologies of economics and management information systems are applied to the problem of designing and evaluating information systems for a profit-maximizing firm. An MBA integrative course. Open only to students admitted to MBA graduate programs. P, ECON 506 or consent of instructor.

572. Operations Management (3) I Manufacturing operations from a tactical standpoint. Major topics include materials requirements planning, capability management, scheduling and JIT planning and control. P, 567 or consent of instructor.

573a-573b. Production and Operations Management (3-3) Productive systems, including service type industries; activities entailed in selecting, designing, operating, controlling, and updating systems. 573a: Forecasting, aggregate planning, MRP, inventory models under uncertainty, scheduling. P, 573; 573b: Capacity expansion and facility location, facility layout, assembly line balancing, new technologies (GT, FMS, CAD/CAM) project management, case studies in manufacturing and services.

574. Current Topics in Operations Management (3) I II Coverage of new techniques and technologies in operations management. Examples of topics that may be covered are JIT, OPT, robotics. P, 473b or CR.

575. Managing for Quality Improvement (3) I Operational aspect of quality improvement. Topics include statistical process control, total quality management. P, 573. May be convened with 475.

576. Management of Service Operations (3) I Application of operations management concepts to service organizations; exploration of critical issues such as facility location, layout, scheduling, and capacity management; case analyses and/or term project. P, 573.
577.* Materials and Logistics Management (3) I Organization and control of material flow processes; logistical strategies and relationships of procurement, handling, warehousing, transportation, and inventory control. P, 373, 473a.

578. Project Management (3) I Definition of programs and projects, organizational forms, developing the work breakdown structure, scheduling techniques (PERT and CPM), control mechanisms such as milestones, cost reports and progress reports. Lectures and case analyses. P, 305, 373.

579.* Computer Models for Operations Management (3) II Use of available software packages to analyze complex operations management problems. P, 473b or CR.

580.* Introduction to Expert Systems (3) I II An in-depth technical background of the concepts and skills essential to analysis, design and development of business expert systems. Open only to BPA graduate students.

583. Stochastic Models in Management Science (3) II Markov chains, models or arrival processes, continuous-time Markov chains, queuing theory, models of computer and manufacturing systems.

585. Manufacturing Strategy (3) II 1994-95 Strategic issues in operations management. Topics include process choice and positioning, product profiling, focused manufacturing, infrastructure development, integration of marketing, accounting and manufacturing strategy and JIT manufacturing. P, 572 or consent of instructor.


588. Systems Design for Management (3) I II Focuses on automated tools to support managers in organizations including office automation, decision support systems, GDSS; applications and methodologies for designing, implementing, and evaluating such systems and their organizational impact.

597. Workshop a. * Collaboration Computing (3) I II *(May be counted with 400-level course.

611a-611b. Topics in Research Methodologies in MIS (3-3) 611a: Introduces beginning doctoral degree students and advanced master's degree students to important research and survey articles in the field of management information systems. 611b: Provides a knowledge of research methodologies used in the MIS discipline, including experimental design, surveys, case studies, field work, and software engineering.

646. Combinatorial Optimization and Integer Programming (3) II 1995-96 Formulation, solution, and implementation of integer programs for decision making where choices are discrete. Methods include branch-and-bound, cutting-plane methods, and Lagrangean relaxation. Credit is allowed for this course or SIE 646. P, 522 or SIE 544 or consent of instructor.

671. International Issues (3) I Analyses of industry successes and failures in global markets, focusing on the national characteristics, company strategies and national policies behind them. Case studies of more than 20 countries around the world (most of which will be student generated). Regional developments and problems. Sectorial emphasis on international technological developments and issues related to the globalization of the information technologies. P, graduate standing and at least one 500-level MIS or equivalent course.

680. Artificial Intelligence and Expert Systems (3) I In-depth discussions of advanced AI topics such as natural language processing, cognitive modeling techniques, machine learning techniques, and neural network computing. Hands-on projects are required. P, 531a. Open to all graduate students.


Marketing (MKTG)
McClelland Hall, Room 320 (520) 621-7479; FAX: (520) 621-7483 Professors Ambar G. Rao, Head, Dipankar Chakravarti, Joseph W. Newman (Emeritus), Melanie Wallendorf Associate Professors Merrie L. Brucks, Susan E. Heckler, Christopher P. Puto, Richard A. Scott Assistant Professors Pallassana Kannan, Praveen Kopalle

The department participates in programs leading to the Master of Business Administration degree with a major in business administration and the Doctor of Philosophy degree with a major in management. A Master of Business Administration with a major in business administration and an emphasis in marketing research also is available. A superior score on the Graduate Management Admissions Test and evidence of strong academic performance at the undergraduate level are required for admission consideration.

For information concerning these degrees see Requirements for Master's Degrees/Master of Business Administration and the headnotes under Business Administration elsewhere in this catalog.

500. Marketing Management (3) II Scope, environment and nature of marketing management; customer and market analysis for product, service, price, promotion and distribution decisions. Open only to students admitted to B.P.A. graduate programs.

530. Management of Marketing Communications (3) I Application of communications theory and research findings in advertising, sales promotion, publicity, personal selling; planning, conducting, and administration of programs of information and persuasion. P, 500.

536. Innovation and Economic Growth (3) I Role of entrepreneurship and innovation in economic growth. Development of the new venture idea and assessment of market potential. Open only to students in the entrepreneur program. P, ECON 500a, FIN 511, MKTG 500. (Identical with ECON 536)

538. Marketing, Negotiation and Decision Tactics (3) II (Identical with MAP 538)

554.* Management of Sales Operations (3) I II The sales function and its relationship to the total marketing program; sales strategies and objectives; development and administration of sales organizations; control and evaluation of sales operations. P, 361, 376, MATH 123.

555.* Management of Sales Operations (3) I II The sales function and its relationship to the total marketing program; sales strategies and objectives; development and administration of sales organizations; control and evaluation of sales operations. P, 361, 376, MATH 123.

552. Statistical Decision Making (3) I II Probability and statistical analysis; random variables, sampling distributions, hypothesis testing, Bayesian analysis, time series, statistical investigation. Open only to students admitted to a B.P.A. graduate program. P, MIS 400, or MATH 119 and 123.

554.* Management of Sales Operations (3) I II The sales function and its relationship to the total marketing program; sales strategies and objectives; development and administration of sales organizations; control and evaluation of sales operations. P, 361, 376, MATH 123.

556. International Marketing (3) II Problems and methods of marketing decision making in industrial, government and high-tech markets. P, 500.

559. Product Strategy (3) II Formulating and implementing strategy for growth; analyzing and influencing market structure; developing, pricing, testing, new entries; managing the portfolio. P, 500.

560. International Marketing (3) II Marketing planning and strategies for foreign environments; cultural, political, economic factors affecting the international marketer, multinational corporation and multinational market groups. P, 500.

565. Management for Global Competitive Success (3) II Developing comprehensive strategies and programs for delivering quality goods and services to consumers as a basis for global competitive success. P, 500 or consent department before enrollment.

568. Environmental Scanning and Business Strategy (3) II An MBA integrative course. How information from the economy can be used to develop a firm's competitive strategy. Multi-disciplinary, using concepts from economics, marketing, and management. Open only to BPA graduate students. Includes case method approach to problems facing top management in making and effecting a strategic plan. P, 500, ECON 500, FIN 511. (Identical with ECON 568 and MAP 568)
The graduate programs in the department are designed to provide advanced study in the fields of materials properties, materials structures, and materials processing. Emphasis is placed on metals, alloys, electronic materials, ceramics, and composites. Courses and research are provided in extraction, thermodynamics, kinetics, transport, microstructural characterization, physical properties, processing, and application.

**Degrees**

**Master of Science:** The course requirements for the Master of Science degree are 18 units of regularly scheduled 500-level courses specified by the department; 4 units from a combination of seminar, independent study and regularly scheduled graduate-level courses; and 8 units of thesis (30 units total). Precise details of the course requirements are available from the department office.

Students may transfer up to six units of course work completed at other institutions. Transfer of graduate credit must be requested from the Graduate Office by the student after he or she has satisfactorily completed one semester at the University. A student must take a minimum of 20 units in residence.

Applicants with undergraduate backgrounds in materials science and engineering or in related science disciplines such as chemistry, physics, or other related engineering fields can be admitted to the Master of Science program. Graduate students entering the program from other disciplines should have similar mathematics, chemistry, and physics backgrounds as in the undergraduate curriculum in materials science and engineering. Those students who are deficient in any of these courses should take them after admission to the Master of Science program.

**Doctor of Philosophy:** A graduate study program will be designed to ensure that each student acquires a thorough understanding of advanced work in the major field as well as in an appropriate minor. The dissertation, based on original research, is expected to represent a distinct contribution to materials knowledge. It should establish the fact that the candidate is capable of independent, original, and creative thinking. It is not necessary that the research be entirely on a scientific aspect of materials, but may include economic and design considerations of a process as well.

As a general policy, applicants with an M.S. degree in materials science and engineering or an allied field will be admitted to the Ph.D. program. Exceptional B.S. applicants may be admitted directly into the Ph.D. program. Completion of the Ph.D. program requires at least 63 units of graduate courses. These will include (1) 36 units of courses in the major subject (one-half of which must be in regularly-scheduled classes); (2) 18 units of dissertation; and (3) 10-12 units of courses in a minor program chosen in consultation with the dissertation director. Up to 30 units from a completed M.S. degree program may be credited towards the Ph.D. Precise details of the Ph.D. course requirements are available from the department office.

**501. Planning for Discovery: Problem Selection and Proposal Preparation (3)** I Generation and organization of ideas into an effective research program. Problem selection, research planning, research proposal preparation and presentation. (Identical with ENGR 501)

**502. Research Proposal Preparation (3)** I Organization and planning of a specific research initiative in consultation with a potential advisor; to expedite the selection and definition of a dissertation topic. (Identical with ENGR 502)

**523.* Electrochemistry in Materials Science (3)** I Principles and applications of electrochemistry in materials science with emphasis on charge-transfer reactions at electrodesolution interfaces; including electrodeposition, electroforming, and electrosplating. P, 240.

**524.* Physics and Chemistry of Ceramic Materials (3)** I Ceramic crystal structures, crystal chemistry, phase equilibria and sintering theory. P, 260 or consult department before enrolling.

**532. Solid-Fluid Reactions (3)** I (Identical with CHEE 532)

**533. Imperfections in Solids (3)** I Nature and behavior of imperfections in metal, ceramic, and semiconductor crystals and polycrys-
534. Advanced Topics in Electronic Materials (3) [Rpt./2] 1996-97 Topics to be selected from ferroelectrics, opto-electronics, wave guides, and semiconductor materials. (Identical with ECE 534 and OPTI 534)

535.* Corrosion and Degradation (3) II The science of corrosion and degradation reactions and its application to engineering problems. P. 331R; 412 or CHEM 480b or CR. (Identical with CHEE 535)

536. Advanced Microstructural Characterization by Transmission Electron Microscopy (3) I Theory and applications of high-resolution transmission electron microscopy, nanodiffraction, energy-dispersive x-ray spectroscopy, and electron energy loss spectroscopy for characterizing microstructural and chemical features of solids. 2R, 3L; P. 480,489.

540.* Thermodynamics of Condensed Phases (3) I Advanced treatment of the principles of thermodynamics with application to electronic and optical materials; emphasis on solutions, defect chemistry and modeling of multicomponent systems. P. 240.


544.* Design Competition (3) II Students utilize their research experience in formulating and developing a materials design project which they present and defend before a review panel. Team design and research is emphasized.

551. Atomistic Computational Techniques in Materials Science (3) II Monte Carlo and molecular dynamics techniques; classical and quantum dynamical models; application to calculation of materials properties (structural, thermodynamic, transport, electronic properties).

552.* Nondestructive Evaluation of Materials (3) I Introduction to the nondestructive testing and evaluation of the various classes of engineering materials. Methods considered include leak detection, penetrant, electromagnetic, radiographic, ultrasonic, electrical, electronic, eddy current, acoustic emission, and thermal. 2R, 3L; P. 331R or 360, or CR.

554. Electronic Packaging Principles (3) I II (Identical with ECE 554)

555.* Physical Metallurgy and Processing of Steel (3) I Equilibrium and nonequilibrium transformations and phases, effects of alloy elements on important transformations in steel, isothermal transformation diagrams and continuous cooling diagrams. Processing aspects include heat treating, heat transfer during cooling and quenching, segregation effects, and surface hardening techniques. 2R, 3L; P. 331R or 380; 409 or A ME 442.

557.* Integrated Circuit Laboratory (3) I II (Identical with ECE 557)

560.* Materials Science of Polymers (3) II Introduction to physical properties of polymers. Microstructure, crystallization, rheology, relaxation and mechanical properties.

561.* Biological and Synthetic Materials (3) II 1995-96 Discussion of structure and properties of biological materials and composites, such as bone, teeth and elastin. Synthetic materials as substitutes for biological materials, biocompatibility.

562.* Structure and Properties of Polymers (3) I 1996-97 Topics of intensive current development in polymer science. In each case, the relation between molecular structure, morphology and properties will be explored. Shows how polymers can be designed and tuned to have the properties needed to fulfill specialized functions. Topics include high modulus fibers, nonlinear optical properties, conducting polymers and resins for composite materials.

565.* Microelectronic Packaging Materials (3) I Design of microelectronic packaging systems based on the electrical, thermal and mechanical properties of materials. Chip, chip package, circuit board and packaging designs are considered. (Identical with ECE 565)

570.* Technology of Polymers and Ceramics (3) I Processing and properties of glasses and ceramics in a wide range of technological applications. Discussion of patent literature.

571.* The Formation and Structure of Glass (3) I The glass transition, Kauzmann’s paradox, kinetic theory of glass formation, physics and chemistry of glass making, glass structure, thermal properties.


579.* Culture and Materials Technology (3) I (Identical with ANTH 579)

580.* Experimental Methods for Microstructural Analysis (3) II An introduction, through a combination of lectures and laboratory experiences, to both established and new techniques for microstructural characterization of materials.

585.* Technological Forecasting (3) I introduction to basic forecasting technologies which include causal models, trend extrapolation, growth curves, relevance trees and other models. The role of forecasting in business and government will be discussed. P. MATH 125b or knowledge of calculus.

586.* Technology and Society (3) I The evolution of our technological civilization will be discussed with emphasis on possible future models of technological organizations and on the changing roles of the scientist and engineer.


589.* Transmission Electron Microscopy of Materials (3) I Transmission electron microscopy in materials characterization. Specimen preparation; instrumental techniques; interpretation of micrographs and diffraction patterns. 2R, 3L; P. 480 or 580 or consult department before enrolling.

595. Colloquium
a. Materials Science (1) [Rpt./5] II
May be conveived with 400-level course.

Mathematics (MATH)
Mathematics Building, Room 108 (520) 621-6892; FAX: (520) 621-8322
Assistant Professors Bruce J. Bayly, Moesey Brie, Kwok Chow, Marta Civil, Samuel Evans, Paul Farin, Leonid Friedlander, Jiang-Hua Lu, Robert S. Maier, Marek Rychlik, Douglas Ulmer, Jan Wehr, Xue Xin

The department offers programs leading to the Master of Arts, Master of Science, and Doctor of Philosophy degrees with a major in mathematics. Concentrations are available in pure, applied, or computer mathematics or in probability and statistics. As there are no sharp boundaries between these concentrations, students are encouraged to pursue a broad range of mathematical topics. Programs are planned in consultation with the departmental faculty. In cooperation with the College of Education, the department also offers work leading to the Master of Education degree with a teaching major in mathematics. For information concerning this degree see Requirements for Master's Degrees/Master of Education elsewhere in this catalog.
To be admitted, applicants must have completed the equivalent of an undergraduate major in mathematics with at least fifteen units of upper-division or higher level work including one semester each of advanced analysis at the level of Math 425, modern algebra at the level of 415, and linear algebra at the level of 413. Applicants are asked to submit scores on the Graduate Record Examination.

Students in master’s degree programs are required to pass the Computer Programming examination of the Department of Mathematics as a part of the graduate program.

**Degrees**

**Master of Arts:** This program is for students who wish to combine mathematics with some other discipline. The program must include between 9 and 12 units of approved work outside the department. No thesis is required.

**Master of Science:** This program is for students who wish to concentrate their graduate credits in mathematics. At least one of the sequences 511a-511b, 520a-520b, 523a-523b, or 534a-534b is required, and at most, six units of approved work outside the department may be included in the program.

**Doctor of Philosophy:** The major course work consists of at least 36 graduate units. Commonly the minor, consisting of at least 12 units of approved courses, is within the department in a concentration different from the major. A minor consisting of approved courses outside the department is also encouraged. There is a language requirement which can be satisfied in any two of the following: French, German, Russian, or computer programming. The principal component of the program is the completion of a dissertation involving original creative research. Ph.D. candidates with other majors who wish to minor in mathematics are required to take four graduate level courses in mathematics and a written examination which covers the content of those courses.

The faculty of the Department of Mathematics carries on research (and research seminars) in a variety of purely mathematical and interdisciplinary fields. In algebra and number theory, research includes finite groups, rings, associative algebras, algebraic number theory, and primality testing. Research in analysis is being carried out on unbounded operators, quantum fields, relativism, and non-linear problems of ecology, chemistry, and fluid dynamics. In geometry, there is work on convex sets, incidence geometry, and fibre bundles; in probability and statistics, projects involve geostatistics, reliability theory, and nonparametric inference. A detailed summary of faculty research appears yearly and is available on request.

**Mathematical Logic (3)** I 1995-96 Satisfiectial calculus, predicate calculus; consistency, independence, completeness, and the decision problem. Designed to be of interest to majors in mathematics or philosophy. P, 124 or 125a or PHIL 325. (Identical with SC 502)

**Foundations of Mathematics (3)** I 1996-97 Topics in set theory such as functions, relations, direct products, transfinite induction and recursion, cardinal and ordinal arithmetic; related topics such as axiomatic systems, the development of the real number system, recursive functions. P, 215. (Identical with PHIL 503)

**History of Mathematics (3)** I The development of mathematics from ancient times through the 17th century, with emphasis on problem solving. The study of selected topics from each field is extended to the 20th century. P, 125b.

**Geometry for Elementary School (1-3)** Rpt./3 units I 1995-96 Surveys geometry of elementary and middle school teachers, such as tessalations, symmetry, length, area, volume, projective constructions, polyhedra, efficiency of shapes, scale drawings taught with a variety of tools and approaches. Students will construct models, use hands-on materials, do laboratory activities, use the computer for geometric explorations and participate in geometric problem solving. P, certificated elementary teachers with two or more years experience or consent of instructor.

**Modern Algebra (3-3)** I 1996-97 Dedekind domains, complete fields, class groups, rings, modules, algebra; Galois theory. P, 415 and 416, or 413 and 415.


**Algebraic Number Theory (3)** I 1995-96 Dedekind domains, complete fields, class groups, rings, modules, algebra; Galois theory and algebraic number fields. P, 511b.


**Second Course in Abstract Algebra (3)** I 1995-96 Continuation of 515. Topics may include Galois theory, linear and multilinear algebra, finite fields and coding theory, Polya enumeration. P, 415.

**Group Theory (3)** I 1995-96 Selections from such topics as finite groups, non- commutative groups, abelian groups, characters and representations. P, 511b.

**Topics in Algebra (3)** I 1995-96 Advanced topics in groups, rings, fields, algebras; content varies.

**Topics in Number Theory and Combinatorics (3)** I 1995-96 Advanced topics in algebraic number theory, analytic number theory, class fields, combinatorics; content varies.


**Real Analysis of Several Variables (3)** I 1996-97 Continuity and differentiation in higher dimensions, curves and surfaces; change of coordinates; theorems of Green, Gauss and Stokes, exact differentials. P, 425.


**Topics in Modern Analysis (3)** I 1996-97 Subjects may include low-dimensional topology; map coloring on surfaces (Heawood's estimate, Ringel-Young theorem), knots and links or projective geometry. P, 215. Not applicable to M.A., M.S., or Ph.D. degrees in Mathematics.

**Algebraic Topology (3)** I 1995-96 Poincare duality, fixed point theorems, characteristics classes, classification of principal bundles, homology of fiber bundles, higher homotopy groups, low dimensional manifolds. P, 534a-534b.

**Topology-Geometry (3)** I 1995-96 Point set topology, the fundamental group, calculus on manifolds. Homology, de Rham cohomology, other topics. Emphasis will be emphasized. P, 415 and 425.

**Algebraic Geometry (3)** I 1995-96 Affine and projective varieties, morphisms and rational maps. Dimension, degree and smooth-


538. Topics in Geometry and Topology (3) [Rpt./36 units] II Advanced topics in point set and algebraic topology, algebraic geometry, differential geometry; content varies.

539. Algebraic Coding Theory (3) II 1995-96 Construction and properties of error correcting codes; encoding and decoding procedures and information rate for various codes. P. 415. (Identical with ECE 539)

453.* Theory of Graphs and Networks (3) I Undirected and directed graphs, connectivity, circuits, trees, partitions, planarity, coloring problems, matrix methods, applications in diverse disciplines. P. 215 or 223 or 243. (Identical with C SC 543)


547.* Combinatorial Mathematics (3) II 1996-97 Enumeration and construction of arrangements and designs, generating functions; principle of inclusion-exclusion; recurrence relations; a variety of applications. P. 215 or 243.

550. Mathematical Population Dynamics (4) II (Identical with ECOL 550)

553a-553b. Partial Differential Equations (3-3) 1994-95 Theory and examples of linear equations; characteristics, well-posed problems, regularity, integral properties, asymptotics. Topics in nonlinear equations, such as shock waves, diffusion waves, and estimates in Sobolev spaces. P. 523b or 527b or 583b.


557a-557b. Dynamical Systems and Chaos (3-3) Qualitative theory of dynamical systems, phase space analysis, bifurcation, period doubling, universal scaling, onset of chaos. Applications drawn from atmospheric physics, biology, ecology, fluid mechanics and optics. P. 422a-422b or 454.

559a-559b. Lie Groups and Lie Algebras (3-3) 1996-97 Correspondence between Lie groups and Lie algebras, structure and representation theory, applications to topology and geometry of homogenous spaces, applications to harmonic analysis. P. 511a, 523a, 534a-534b, or consent of the instructor.

560. Elementary School Probability (1-3) [Rpt./3 units] II S Games and other activities that lead naturally to consideration of chance events and data analysis. Activities will relate to numbering and number systems, algebra, geometry and other topics in mathematics to emphasize the integrated nature of mathematics. Students work in groups to create and analyze activities. P. certified elementary teachers with two or more years of experience or consent of instructor.


564.* Theory of Probability (3) II Probability spaces, random variables, weak law of large numbers, central limit theorem, various discrete and continuous probability distributions. P. 322 or 323. (Identical with STAT 564)


566a.* Theory of Statistics (3) I (Identical with STAT 566a)

568.* Applied Stochastic Processes (3) II Applications of Gaussian and Markov processes and renewal theory; Wiener and Poisson processes, queues. P. 464. (Identical with STAT 568)

573. Theory of Computation (3) II (Identical with C SC 573)

575a-575b. Numerical Analysis (3-3) Error analysis, solution of linear systems and non-linear equations, eigenvalues interolation and approximation, numerical integration, initial and boundary value problems for ordinary differential equations, optimization. P. 475b and 455 or 456. (Identical with C SC 575a-575b)


577. Topics in Applied Mathematics (3) II 1996 Advanced topics in asymptotics, numerical analysis, approximation theory, mathematical theory of mechanics, dynamical systems, differential equations and inequalities, mathematical theory of statistics; content varies.

578. Computational Methods of Algebra (3) II Applications of machine computation to various aspects of algebra, such as matrix algorithms, character tables and conjugacy classes for finite groups, coset enumeration, integral matrices, crystallographic groups. P. 415 and a knowledge of scientific computer programming language. (Identical with C SC 578)

579.* Game Theory and Mathematical Programming (3) II 1996-97 Linear inequalities, games of strategy, minimax theorem, optimal strategies, duality theorems, simplex method. P. 410 or 413 or 415. (Identical with C SC 579)


583a-583b. Principles and Methods of Applied Mathematics (3-3) Boundary value problems; Green's functions, distributions, Fourier transforms, the classical partial differential equations (Laplace, heat, wave) of mathematical physics. Linear operators, spectral theory, integral equations, Fredholm theory. P. 424 or 422b or CR, 520a.

584.* Operational Mathematics (3) I Basic concepts of systems analysis, Fourier and Laplace transforms, difference equations, stability criteria. P. 421 and 424 or 422b.

585.* Mathematical Modelling (3) II Development, analysis, and evaluation of mathematical models for physical, biological, social, and technical problems; both analytical and numerical solution techniques are required. P. 421, CR 475b, SIB 320a.

586. Case Studies in Applied Mathematics (1-3) [Rpt./6 units] II In-depth treatment of several contemporary problems or problem areas from a variety of fields, but all involving mathematical modeling and analysis; content varies.


588. Topics in Mathematical Physics (3) [Rpt./36 units] I II Advanced topics in field theories, mathematical theory of quantum mechanics, mathematical theory of statistical mechanics; content varies.

590. Colloquium
a. Math Instruction (1) [Rpt./12 units] II
b. Research in Mathematics (1) [Rpt./4] II
c. Research in Applied Mathematics (1) [Rpt./4] II

596. Seminar
a. Topics in Mathematics (1-3) [Rpt./12 units] S
b.* Mathematical Software (3) [Rpt.] I P. 254 or 355, knowledge of "C" programming.
c. Research on Learning (1) [Rpt./3] S $P$ must be accepted into NSF-funded grant program, PRIME.
d. Initiating Reform in the Schools (1) [Rpt./3] S $P$ must be accepted into NSF-funded grant program, PRIME.

597. Workshop
a. Numbers, Algebra and Functions (1-2) [Rpt./3] S $P$ must be accepted into NSF-funded grant program, PRIME.

*May be convened with 400-level course.

636. Information Theory (3) II 1996-97 (Identical with ECE 636)
Mechanical Engineering
(See Aerospace and Mechanical Engineering)

Media Arts (MAR)
Modern Languages Building,
Room 265
(520) 621-7352; FAX: (520) 621-9662

Professors J. Michael Gillette, Interim Head, Caren J. Deming, Peter Lehman
Associate Professors Harry Atwood (Emeritus), Mary Beth Haralovich, Wesley B. Marshall, Eileen R. Meehan, Alfonso Moises, Robert J. Sabal
Assistant Professors Donald Kirihara, Beverly A. Seckinger

The department offers a program leading to the Master of Arts degree with a major in Media Arts. The degree is exclusively in critical studies of the media including theory, criticism and history of film and television. The degree involves no production opportunities. Applicants are required to submit a statement of purpose, a sample of their writing and three letters of recommendation. Applicants to the program may have undergraduate majors in areas other than media studies.

The Master of Arts degree with a major in media arts consists of 31 units. All students take 10 units of required core courses and then select additional courses from such areas as gender and sexuality, media industry and economics, and social/cultural history. Students have two elective courses, of which one may, with advisor approval, be taken outside the Department of Media Arts. In addition to satisfactorily completing all required coursework, students must pass a comprehensive written examination during their fourth semester in the program.

500. Graduate Study in Media Arts (1) Responsibilities of graduate students, forms and procedures, campus resources, research tools, writing standards and Media Arts content areas in approaches.

521. * Cultural Theory and Criticism of Media (3) I Critical and cultural theories and their application to media arts, including mass culture, empiricism, technoculture, political economy.

523. * Representation of Gender in the Media (3) I Investigation of gender as a social and cultural construct through the critical analysis of media products including television, film, and advertisements.

524. * Film Theory and Criticism (3) I Advanced studies in current cinematic theory and criticism. Historical examination of major film theories, including formalism, realism, classical Hollywood, structuralism, semiotics, and psychanalytic theories.

526. * Sexuality in Media Narratives (3) I Analysis of sexual representation in popular and underground film, music video and avant-garde video art.

527. * Feminist Media Theory (3) I Includes psychoanalysis, semiotics, materialism, race and class analysis, and feminist media production.

528. Current Issues in Media Theory (3) I Advanced study of major concepts, issues and movements in contemporary film theory: psychoanalysis, semiotics, Marxism, deconstruction, postmodernism.

532. Media Political Economy (3) I Theories and analytic techniques of political economy approaches to media arts through history of telecommunications, broadcasting, film, recorded music and cable television.


576. * Broadcast and Cable Programming (3) I Investigation of principles, techniques, and current issues in programming for radio and television stations (commercial and public) and cable systems.

639. Methods of Media History (3) II Analysis of methods used in film and broadcast histories; theories of media history; empirical evidence and interpretation; approaches to placing a media text within its industrial and social context.

*May be converted with 400-level course.

696. * Seminar
a. Theory and Criticism (3) [Rpt./6 units] II
b. Media Arts History (3) [Rpt./6] I II

526. * Sexuality in Media Narratives (3) I
527. * Feminist Media Theory (3) I
528. Current Issues in Media Theory (3) I
639. Methods of Media History (3) II
696. * Seminar

576. * Broadcast and Cable Programming (3) I

*Available as both 596 and 896.

Anatomy
See Cell Biology and Anatomy elsewhere in this catalog.

Anesthesiology (ANES)

Professors Burnell R. Brown, Jr., Head, A. Jay Gandolfi, Charles W. Otto, I. Glenn Sipes (Pharmacology and Toxicology)

Associate Professors Edward J. Frink, Stuart R. Hameroff, Stuart F. Quan (Medicine)

Assistant Professor T. Philip Malan, Jr.

800. Research (1-6) [Rpt./1]

810. Clerkship
a. Anesthesiology (4-6)
b. Pain Management (4) I P, fourth year medical students or permission of instructor.
c. Clerkship in Critical Care Medicine (Maricopa Medical Center, Phoenix) (4) I P, fourth year medical students or permission of instructor.

815. Subspecialty
a. BNI Neuroanesthesiology (4)
b. Obstetrical Anesthesia (4)
p. Critical Care Medicine (4-6) (Identical with MEDI 815p)

891. Preceptorship
a. Anesthesiology and Subspecialties (1-18)

Biochemistry
See Biochemistry elsewhere in this catalog.

Interdepartmental (MED)

501. Preparation for Clinical Medicine (12) I II P, formal admission to the Ph.D./M.D. program and permission of the course director.

505. Social and Behavioral Science (6) I II P, formal admission to the Ph.D./M.D. program and permission of the course director.

596. Seminar

501. Preparation for Clinical Medicine (12) I II
505. Social and Behavioral Science (6) I II
830. Supplementary Registration (1-9)

896. Seminar
a. * Introduction to Forensic Pathology (2) I II P, PATH 801 or permission of instructor.
b. Physical and Biological Basis of Nuclear Medicine (2)
c. *Medical and Biological Basis of Nuclear Medicine (2)
d. *Medicine and Literature: The Human Perspective (2)
e. Medical Jurisprudence (2)
f. Comprehensive Cancer Care (1) [Rpt./1] I 1995-96 (Identical with RONC 896)
g. *Cognitive and Behavioral Medicine (2) [Rpt./1] II
h. *Methods of Epidemiological Research (2)
i. *Space Biology (1-2) II
j. Salt, Water and Kidney Disorders (2)
t. Pathophysiology of Respiratory Diseases (2)

*Available as both 696 and 896.

**Available as both 596 and 896.

Medical Technology
(See Health-Related Professions)

Medicine
(MED/ANES/FCM/MEDI/NEUR/OBG/OPH/PATH/PSY/RONC/RADI/SURG)

Arizona Health Sciences Center
Room 2208
(520) 626-6518

Please note: Some College of Medicine courses follow a schedule different from the standard academic calendar.
Cancer Biology
See Cancer Biology elsewhere in this catalog.

Family and Community Medicine (F CM)


Directors of FCM Graduate and Continuing Education: Myra M. Muramoto, Robert G. Rhode, Catherine M. Shisslak, Douglas L. Taren

Graduate Director: Myra M. Muramoto

Assistant Professors of Clinical Family & Community Medicine: Frank A. Hale, Lawrence M. Moher, Augusto Ortiz

Research Professor Ronald R. Watson

Associate Professors of Clinical Family & Community Medicine: Head, Louise Canfield, Larry C. Clark, Jennie Joe, Daniel O. Levinson, Kambiz Nassar, Richard L. Papenfuss, Cheryl K. Ritenbaugh, Arthur B. Sanders (Surgery), Catherine M. Shisslak, Douglas L. Taren

Associate Professors of Clinical Family & Community Medicine: Craig L. McClure, Bernhardt E. Stein

Assistant Professors of Clinical Family & Community Medicine: Dorian H. Cordes, Antonio L. Estrada, Paul R. Gordon, Scott J. Leischow, Mark A. Nichter, Denise J. Roe

Assistant Professors of Clinical Family & Community Medicine: James R. Allen-Der, Enrique S. Corvalan, Pam Reid Duffy, Sharon J. Isikoff, Lane P. Johnson, James P. Kerwin, Patricia Lebenssohn-Chialvo, Steven A. Menhennett, Myra M. Muramoto, Robert G. Rhode, Michael S. Shafer

Clinical Assistant Professors: Clifton D. Crutchfield

The department emphasizes the values of family and community orientation to medical practice. By means of preceptorships, seminars, projects, lectures, community assignments and clinics and in collaboration with other departments, students learn family medical practice, clinical preventative medicine, occupational medicine and the elements of epidemiology, nutrition, public health and medical care organization.

500. Research (3-12) [Rpt. /2 P, basic science courses. (Identical with PHL 500)

501. Cognitive-Behavioral Medicine (2) [Rpt. ] I Critical thinking and working principles in cognitive, mind-body, behavioral aspects of sickness and health; empowerment, stress, coping, conditional/unconditional mind, decision making, addictive-abusive behaviors, communication, and relationships, self awareness; health and health, P, upper division or graduate or credit in FCM 195a.

531. Art Therapy Techniques (3) [Rpt.] Focuses on art expression as non-verbal communication and as a healing agent for children and persons with disabilities. P, previous course work in art and/or special education.

532. Survey of Art Therapy (3) [Rpt /3 units] I Surveys the development of art therapy in the United States through examination of the literature, theories, and current trends in the field.

539. Art, Symbolism, and Psychopathology (3) [Rpt /3 units] Introduction to behavioral and psychological characteristics of various disorders, with emphasis on the types of artistic symbolism manifested by each group.

570. Issues and Trends in Public Health (3) I II S Public health methods, organizations and services such as environmental/occupational health; disease control; health education and promotion; policy and legislation; and medical care. (Identical with PHL 570)

571. International Comparison of Health Care Systems (3) I II S Comparison of health care systems in developing and industrialized countries in relation to other social systems; public/private component analyses; health care methods and finance. (Identical with PHL 571)

572. Population Dynamics and Family Planning (3) I II S Social/economic determinants and consequences of population growth; behavioral and health aspects of human reproduction; organization/evaluation of selected family planning programs. (Identical with PHL 572)

573. Health Issues of Women and Children (3) I II S Knowledge base, social strategies, health policies and programs relating to health and well-being of women, especially of childbearing years, and children from infancy to adolescence. (Identical with PHL 573)

574. Health Administration and Policy (3) I II S Management processes/roles of public health professionals; health service organization; policy issues and resource utilization/ control; human resources management; public health trends. (Identical with PHL 574)

575. Environmental and Occupational Health (3) I II S Examination of living/working environments impacting human health; chemical and physical stressors affecting health; techniques for assessing and controlling risks in air, soil and water. (Identical with PHL 575)

576. Biostatistics in Public Health (3) I II S Analysis and interpretation of measurements of wellness and disease association, disease outbreaks, population surveillance and health promotion program evaluation. (Identical with PHL 576)

577. Social and Behavioral Basis of Public Health (3) I II S Social learning theory, diffusion of innovations, relationship of cultural values to behavioral change, social marketing, high risk behavior change strategies, and communication issues. (Identical with PHL 577)

578. Public Health Nutrition (3) I II S Community and individual nutritional assessment; risk profiles; planning, implementing and evaluating programs; international; national and local resources/programs; Healthy People 2000 goals. (Identical with PHL 578)

587. Poverty and Health (3) I II (Identical with NURS 587)
Medicine (MEDI)

* Available as both 596 and 896.

- **555. Cancer Biology** (3) II 1996-97 (Identical with CBI0 555)

- **596. Seminar**
  - a. Pathophysiology and Immunology of the Clinical Manifestations of Coccidioidomycosis (2) II
  - c. Geriatrics: The Continuum of Care (3-12) [Rpt./12 units] II (See College of Medicine Electives Manual)
  - d. Ambulatory Geriatrics (3-12) P, MEDI 803.

- **800. Research** (3-30) [Rpt./30 units] (See College of Medicine Electives Manual)

- **803. Clinical Clerkship** (12)

- **810. Clerkship**
  - a. Ambulatory Care (4-8) [Rpt./12 units] II S P, completion of third year medical school.
  - b. Ambulatory Diagnosis and Therapeutics (6)
  - e. Honors Course in Internal Medicine (12) I P, internal medicine clerkship.
  - f. Primary Care Combined Internal Medicine/Pediatrics (4) P, internal medicine and pediatric clerkships.
  - g. Medical Intensive Care Unit/Coronary Care Unit (4-6)
  - h. General Medicine — Acting Internship (4-6)

- **815. Subspecialty**
  - a. Clinical Cardiology (4-8)
  - b. Clinical Dendatology (3-6)
  - c. Endocrinology (4-12)
  - d. Clinical Gastroenterology (3-6)
  - e. Hematology-Oncology (3-6)
  - f. Internal Medicine and Special Studies (4-12) P, 3rd or 4th year medical students.
  - g. Neurology (3-6) P, 3rd or 4th year medical students.
  - h. Hematology/Oncology (3-6) P, 803.
  - i. Medical Intensive Care Unit/Coronary Care Unit (4-6)

- **818. Subspecialty**
  - a. Clinical Cardiology (4-8)
  - b. Clinical Dendatology (3-6)
  - c. Endocrinology (4-12)
  - d. Clinical Gastroenterology (3-6)
  - e. Hematology-Oncology (3-6)
  - f. Internal Medicine and Special Studies (4-12) P, 3rd or 4th year medical students.
  - g. Neurology (3-6) P, 3rd or 4th year medical students.
  - h. Hematology/Oncology (3-6) P, 803.
  - i. Medical Intensive Care Unit/Coronary Care Unit (4-6)

**Microbiology and Immunology**

See Microbiology and Immunology elsewhere in this catalog.

**Molecular and Cellular Biology**

See Molecular and Cellular Biology elsewhere in this catalog.

**Neurology (NEUR)**

- **605. Human Neuroscience** (6) I II (Identical with CBA 605)

- **695. Colloquium**
  - a. Motor Control (2) [Rpt./8 units] II (Identical with EXSS 695a, which is home)

- **800. Research** (1-12) [Rpt./1] (See College of Medicine Electives Manual)

- **803. Clinical Clerkship** (3-6)

- **805. Human Neuroscience** (6) I II (Identical with CBA 805)

- **810. Clerkship**
  - a. Neurology Consult Service (4)
  - b. Neurology (3-6) P, 803

- **815. Subspecialty**
  - b. Epilepsy Elective (4-6)

- **911. Seminar**
  - a. Pathophysiology and Immunology of the Clinical Manifestations of Coccidioidomycosis (2) II

**Associate Professors**


Assistant Professors Mary E. Gilles, Howard Lien, John D. Palmer (Pharmacology), Thomas E. Raya, David S. Shimm (Radiation Oncology), Charles W. Taylor

Assistant Professors: Mary I. Johnson (Pediatrics), Mary I. Johnson (Pathology), Steven Z. Rapcsak, Linda McMullen (Anatomy), Naomi E. Rance (Pathology), Steven Z. Rapcsak, Linda Restifo (A.R.L.)
Obstetrics and Gynecology (OBG)

Professors M. Wayne Heine, Head, John R. Davis (Pathology; Chief, Anatomical Pathology), Kenneth Hatch, Jack Pearson, Kathryn L. Reed, Earl A. Surwit (Associate Professor for Clinical Surgery)
Associate Professors Ponjola Coney, Diane S. Fordney (Psychiatry), H. Eugene Hoyme (Pathology; Pediatrics), Catherine Racowsky

800. Research (3-18) [Rpt./1]
803. Clinical Clerkship (6)

810. Clerkship
a. Preparation for Practice (4-6) P, 803.
b. Preparation for Private Practice (3-6) P, 803.
c. Gynecologic Oncology (4) P, 803 and one other junior clerkship.
d. Gynecologic Surgery (4-6)

811. Subinternship
a. Gynecologic Oncology (3-6) [Rpt./1] P, 803.

915. Subspecialty
a. Clinical Infertility (4-6) I II S
c. High Risk Obstetrics (4-6) P, core Ob/Gyn rotation completed.
d. Gynecology-Endocrinology (3-6)
f. Medical Gynecology (3-4)
g. Reproductive Endocrinology and Fertility (4-6) P, 804.

891. Preceptorship
a. Obstetrics and Gynecology (1-18)

Ophthalmology (OPH)

Professor Barton L. Hodes
Associate Professor Robert W. Snyder, Head
Assistant Professors Theresa R. Kramer, Joseph M. Miller, Millicent C. Palmer

800. Research (6-18) I II

815. Subspecialty
a. Ophthalmology (3-6)

891. Preceptorship

Pathology (PATH)

Associate Professors James M. Byers III, H. Eugene Hoyme (Pediatrics), Ronald B. Schifman, Catherine M. Spier
Assistant Professors William T. Bellamy, Kathryn A. Bowen, Steven H. Erdman, Courtney R. Johnson, Paula D. Johnston, Anne L. Wright

501. Molecular and Medical Genetics (3) I
Acquire a basic understanding of human molecular genetics and learn how to apply that understanding in the pathophysiology of disease. (Identical with GENE 501)

800. Research (1-18) (See College of Medicine Electives Manual)

801. Molecular and Medical Genetics (3) I
Acquire a basic understanding of human molecular genetics and learn how to apply that understanding in the pathophysiology of disease.

803. Clinical Clerkship (6)

810. Clerkship
c. Clinical Research Elective (6-12) [Rpt.]
d. Inpatient Pediatrics (4)

811. Subinternship
a. Ambulatory Pediatrics (1-18)
g. Primary Care Combined Internal Medicine/Pediatrics (4) P, Internal medicine and pediatric clerkships. (Identical with MED 811a)

815. Subspecialty
a. Advanced Neonatology (4-6)
b. Pediatric Infectious Diseases (3-6)
d. Cardiac Ultrasound Echo and Doppler (4-6) P, pediatric cardiology.
e. Pediatric Cardiology (4-6)
f. Pediatric Neurology (4-6)
g. Pediatric Hematology/Oncology (4-6)
h. Pediatric Orthopaedics (3-6) P, completion of basic sciences.
i. Development and Behavioral Pediatrics (4-6) P, pediatric clerkship.
j. Pediatric Pulmonary (4-6) I II P, 803.
l. Clinical Allergy (1-6) (Identical with MED 815a)
m. Ambulatory Pediatrics/Newborn Nursery (4-8) P, 803.
o. Pediatric Gastroenterology and Nutrition (4-8) P, 803 or equivalent
p. Pediatric Endocrinology (4-6) P, 803.
q. Pediatric Nephrology (4)
s. Pediatric Gastroenterology (4-6) P, 803.
t. Pediatric Critical Care (3-6) Limited to fourth-year medical students.

816. Subspecialty
a. Pediatric Surgery (4) (Identical with SURG 816a)
b. Pediatric Orthopaedics (3-4 or 6) P, must be taken after at least two weeks in conjunction with SURG 815p or PED 815h. (Identical with SURG 816a)

891. Preceptorship
d. BNI Pediatric Neurology (4) P, 803.
e. Pediatric Critical Care (4) P, 803.

Pharmacology

See Pharmacology elsewhere in this catalog. Toxicology courses are listed under Pharmacology and Toxicology.
Physiology

See Physiology elsewhere in this catalog.

Psychiatry (PSYI)

Professors Alan J. Gelberg, Head, Judith V. Becker (Psychology), Allan Beigel, Richard R. Bootzin (Psychology), Henry W. Brosin, Alfred W. Kasznia (Psychology), Alan I. Levenson, John C. Racy, Bruce D. Sales (Psychology), Gary E. Schwartz (Psychology), Henry I. Yamamura (Biochemistry)

Associate Professors Harold S. Arkowitz (Psychology), Patrick M. Burke, Pedro L. Delgado, Diane S. Fordney (Obstetrics and Gynecology), Philip D. Karoff, Richard D. Lane, Eric M. Reiman

Assistant Professors Iris R. Bell, Shirley N. Fahey, John S. Jachna, Rachel Marber

*May be convened with 400-level course.

800. Research (1-12) (See College of Medicine Electives Manual)

803. Clinical Clerkship (6-9) [Rpt./1]

810. Clerkship
a. Clinical and Community Psychiatry (4-6)
b. Child Psychiatry (6).
c. Psychiatry (6) P, 803; consult department before enrolling.

815. Subspecialty
a. Consultation Psychiatry (4-6) P, 803.
b. Geriatric Psychiatry (4-6) P, 803; consult department before enrolling.
c. Outpatient Psychiatry (4-6) P, 803.
d. Forensic Psychiatry (3-6) I II S P, 803.
e. Geriatric Psychiatry (4-6) P, 803; consult department before enrolling.

851. Molecular Mechanisms of Carcinogenesis (3) II 1995-96 (Identical with CBIO 851)

855. Cancer Biology (3) I 1996-97 (Identical with CBIO 551)

856. Seminar
a. Cancer Biology Series (1) I (Identical with CBIO 596h)
b. Comprehensive Cancer Care (1) [Rpt./1] I 1995-96 (Identical with MED 596h)

857. Workshop
a. Mechanisms of Cancer Prevention (3) II 1995-96 P, graduate status in biological sciences (Identical with CBIO 597a)

880. Research

815. Subspecialty
a. Introduction to Radiation Oncology (1-6)
b. Cancer Epidemiology and Prevention (3) I P, none; statistics helpful. (Identical with FCM 815h)
c. Cancer Prevention and Control (3-15) II (Identical with FCM 815i)

851. Molecular Mechanisms of Carcinogenesis (3) II 1995-96 (Identical with CBIO 851)

Radiology (RADI)

Professors Theron W. Ovitt, Head, Harrison H. Barrett (Optical Sciences), M. Paul Capp, Raymond F. Carmody, William Dallas (Optical Sciences), Tim B. Hunter, Dennis D. Patton (Chief, Nuclear Medicine, Optical Sciences), Gerald D. Pond (Chief, Diagnostic Radiology), Joa-chim F. Seeger, William L. Wolfe, Jr. (Optical Sciences), James M. Woolfen den

Associate Professors Robert J. Gillies (Biochemistry), Arthur F. Gmitro (Optical Sciences), Evan C. Unger, Walter H. Williams

Assistant Professor Pamela J. Lund

800. Research (1-6) [Rpt./1]

815. Subspecialty
a. Diagnostic Radiology (4)
b. Nuclear Medicine (4-6)

891. Preceptorship

Surgery (SURG)

Professors Bruce E. Jarrell, Head, Charles W. Putnam,Associate Head (Pharmacology), L. Milos Chvapil (Emeritus), Jack G. Copeland (Associate Director, University Heart Center), George W. Drach, John B. Fortune, Theodore J. Glattke (Speech and Hearing Sciences), Kenneth V. Iserson, Douglas Lindsey (Emeritus), Noel D. Matkin (Speech and Hearing Sciences; Supervisor, Douglas Lindsey), Paul F. McDonagh (Physiology), Harvey W. Meislin (Director, Emergency Services), Leonard F. Peltier (Emeritus), Arthur B. Sanders (Associate Professor, Family and Community Medicine; Clinical Lecturer, Internal Medicine), Gulshan K. Sethi, Donald P. Speiser (Anatomy), Robert F. Spetzler, Thomas H. Stanisic, Charles M. Tipton (Head, Exercise and Sport Sciences; Director, Health Related Professions), Hugo V. Villar (Radiation Oncology), Robert G. Volz (Emeritus), Stuart K. Williams (Physiology), Charles L. Witte, Marlys H. Witte, Charles F. Zukoski, III

Associate Professors Robert M. Anderson (Emeritus), James B. Benjamin, Ronald Heimark, Glenn C. Hunter, Douglas F. Larson (Director, Instructional Research/Development; Assistant Professor, Pharmacology), Joseph L.R. Mills, Paul Nakazato, William D. Rappaport, Daniel W. Spalte, John B. Sullivan, Jr. (Adjunct Assistant Professor, Pharmacology and Toxicology; President and CEO, University Physicians, Inc.), Tere nce D. Valenzuela (Clinical Associate Professor, Internal Medicine), David B. Van Wyck (Internal Medicine)

Assistant Professors Francisco Arabia, W. Bradford Carter, Bruce L. Dalkin, Michael J. Esser, Allan J. Hamilton (Clinical Assistant Professor, Radiation Oncology), Jon K. Nisbet, Luis J. Rosado, William Smith, Francisco G. Valencia, James A. Warneke, Martin E. Weinand, Craig S. Williams

Professors of Clinical Surgery Eric G. Ramsey, Martin Schiff, Jr.

Associate Professors of Clinical Surgery Robert B. Dzioba, Frederick A. Green wood, Samuel M. Keim, Frederick J. Menick, Frank Walter

Assistant Professors of Clinical Surgery Scott S. Berman, William J. Brooks, Heeten Desai, John A. Guisto, Irwin E. Harris, Sharon J. Isikoff (Clinical Family and Community Medicine), Rockwell Jackson, Christopher T. Johnson, Rebecca J. Kennedy, David Neal, John T. Ruth, Wendell B. Whitacre

670. Principles of Perfusion Techniques I (3) I (Identical with PHCL 670)

671. Perfusion Technology Laboratory (1) I (Identical with PHCL 671)

672. Principles of Perfusion Techniques II (2) I (Identical with PHCL 672)

800. Research (1-12) P, 803. (See College of Medicine Electives Manual)

Microbiology and Immunology (MBIM)

Graduate Program
Life Sciences North Room 644
(520) 626-6061; FAX: (520) 626-2100

Professors John J. Marchalinos (Head),
Harris Bernstein (Chairperson), John Gal-
giani (Medicine), Charles Gerba (Soil and Water Science), Thomas Grogan (Pathology), Marilyn Halonen (Pharmacology), Evan Hersh (Medicine),
Junetsu Itô, Lynn Joens (Veterinary Science), Marguerite Kay, Rein Kilkson (Physics), Henry Koffler (Emeritus),
William Meinke (Emeritus), Neil Mendel-
son (Molecular and Cellular Biology),
George B. Olson (Emeritus), Ian Pepper
(Soil and Water Science), Kenneth Ryan
(Pathology), Norval Sinclair (Veterinary
Science), Glenn Songer (Veterinary
Science), John Spizizen (Emeritus),
Charles Sterling (Veterinary Science),
Paul Sypared, Raymond Taetle (Inter-
"medicine"").

Associate Professors Rodney Adam
(Medicine), Emmanuel Akporiaye,
Neil Ampel (Medicine), Dominick De-
Luca, Richard Friedman, David Harris,
Christina Kennedy (Plant Pathology),
Kit Lam (Medicine), James T. Sinski
(Emeritus), David Yocum (Medicine)

Assistant Professor Nafees Ahmad,
Raina Miller (Soil and Water Science),
Michael Riggs (Veterinary Science)

Research Associate Professors Carol
Bernstein, Jan Decker (Veterinary Science)

The graduate program in microbiology
and immunology offers research oppor-
tunities in all major areas of microbiology
and immunology. The research systems
used include viruses, viroids, bacteria,
bacterial plasmids, fungi, protozoans,
parasites, cell and tissue culture, and ani-
mal models. The department offers the Master of Science and Doctor of Philosophy degrees with a major in microbiology and immunology.

Applicants are required to submit scores on the verbal, quantitative and analytical sections of the Graduate Record Examination. Scores in an advanced section are recommended. At least two letters of recommendation are required for both the M.S. and Ph.D. programs.

501. Medical Microbiology (6) I The biological characteristics of microorganisms of impor-
tance in human health and disease; the
reaction of the host to infectious agents
and the mechanisms of host defense;
diagnosis and management of infectious disease. Lectures, discussions, and laboratory experiments. P, CHEM 241b.

503R. Biology of Animal Parasites (3) I (Ident-
tical with V SC 503R) May be convened with
MIC 403R.

503L. Parasitology Laboratory (1) I (Identical
with V SC 503L) May be convened with MIC
403L.

504. Molecular Parasitology (3) II (Identical
with V SC 504) May be convened with
MIC 404.

505. Eukaryotic DNA Replication (3) [Rpt./1]
I (Identical with CBIO 505)

511. Molecular Biology (1) (Identical with MCB
511) May be convened with MIC 411.

517. Microbial Physiology and Gene Cloning
(3) II 1995-96 Biochemical and physiological activities of microorganisms. P, MIC 317,
CHEM 241b, 243b.

519. General Immunological Concepts (4)
Basic concepts of the immune system.
Presentation of the roles of antigen, immunoglobulins, complement, lymphokines and types of immune cells play in humoral and cell-
mediated immunity. P, MIC 317R, CHEM
241b, 243b. (Identical with V SC 519). May be convened with MIC 419.

520. Pathogenic Bacteriology (3) II Etiology
and pathogenesis of bacterial diseases in
humans, domestic animals and wildlife. P,
MIC 317, CHEM 241b, 243b. (Identical
with V SC 520) May be convened with
MIC 420.

523. Mechanisms of Disease (5) II (Identical
with V SC 523) May be convened with MCB
423.

525. Environmental Microbiology (3) I (Identical
with SW 525) May be convened with MIC
425.

526. Environmental Microbiology Labora-
tory (2) I (Identical with S W 526) May be con-
vened with MIC 426.

527R. General Mycology (3) I General myco-
logy, with emphasis on the microfungi. P, MIC
205.

527L. General Mycology Laboratory (2) I General mycology laboratory, with emphasis
on the microfungi. P, 527R or CR.

529. General Virology (3) Essential features of the viruses, including structure, gene
expression, and life cycle. Introduction to
pathogenesis with respect to humans, other
animals, and plants. P, MIC 181 or 205,
CHEM 241b, 243b. (Identical with MCB
529 and V SC 529) May be convened with
MIC 429.

530. Introduction to Biophysics (2) I (Identical
with PHYS 530) May be convened with
MIC 430.

531. Biophysical Theory (2) II (Identical with
PHYS 531)

532. Pathogenic Virology (3) [Rpt.] I (Identical
with V SC 532)

538. Ecology of Infectious Disease (3) II (Identical with V SC 538) May be convened with
MIC 438.

540. Biodegradation of Pollutants in Soil and
Groundwater (3) II 1995-96 (Identical with
SW 540) May be convened with MIC 440.

543. Research Animal Methods (3) I (Identical
with V SC 543) May be convened with MIC
443.

546. Environmental Biotechnology Labora-
tory (2) II (Identical with S W 546)
596. Seminar b. Hands-on techniques necessary for pursuing a research career in Microbiology and Immunology. 12L. P, MIC 419, MBIM 501, 560 or 561, BIOC 460. Consult department before en-rolling. (Identical with V SC 630)

672. Food Safety (2) I 1995-96 (Identical with NSC 672)

695. Colloquium a. Readings in Microbiology (1) [Rpt.] II b. Immunopathology (1) I I d. Molecular and Cellular Immunology (1) [Rpt.] II f. Tumor Virology (1) II g. Host-Parasite Interactions (1) [Rpt.] II k. Readings in Immunology (1) I II 800. Research (3-6) P, permission of instructor and coordinator.

801. Medical Microbiology (6) I 851. Molecular Mechanisms of Carcinogenesis (3) II 1995-96 (Identical with CBIO 851)

859. Preceptorship a. Microbiology and Immunology (3-12) [Rpt./12 units]

**Mining and Geological Engineering (G EN/MN EC/MN E)**

Mines Building, Room 229 (520) 621-6063

Professors Jay C. Dotson (Emeritus), DeVerle P. Harris (Geosciences), Y. C. Kim, Richard Newcomb (Agricultural and Resource Economics), William C. Peters (Emeritus), Michael Rieber (Economics)

Associate Professors Ben K. Sternberg, Head, Charles E. Glass, Satya Harpalani, Pinnaduwa Kulatilake

Assistant Professors John Kemeny, Douglas LaBrecque, Paul J. A. Lever, Mary Foulton

The department offers programs leading to the Master of Science and the Doctor of Philosophy degrees with majors in mining engineering, and in geological and geophysical engineering. Advanced work in mining engineering is directed toward research and professional development in several fields including mine planning, geomechanics, operations research, robotics, mine health and safety, and the development of new extractive techniques. Advanced work in geological engineering is directed toward the fields of geophysical engineering, ground stabilization, earthquake engineering, urban planning, remote sensing, and conservation.

Advanced work normally requires the completion of an undergraduate major in these fields. Students with undergraduate majors in other engineering fields or in the physical sciences, however, are encouraged to apply because training in such fields provides an excellent background for approaching some areas of graduate study in this department. The department requires that scores on the Graduate Record Examination be submitted by all applicants for mining engineering and geological engineering.

Students working toward the Master of Science degree in either mining engineering or geological and geophysical engineering will be required to complete a thesis and must pass a final examination covering both the thesis and course work. At least fifteen units of course work must be completed in the major field. Programs leading to the Doctor of Philosophy degree require completion of at least six units of graduate-level course work in computer science, computer programming, or mathematics. Any questions regarding the qualification of a particular course in satisfying this requirement should be submitted to the department's graduate committee for clarification. Foreign language competency for doctoral candidates in the Department of Mining and Geological Engineering is not required. Due to the increasingly international nature of engineering and the mineral fields, however, the department recommends that doctoral candidates give serious consideration to developing communication skills in a foreign language.

An environmental engineering option is available in the Department of Geological Engineering. This discipline applies fundamental engineering principles to the prevention and solution of problems effecting our environment. Coursework concentration in this option covers important environmental topics such as air and water pollution, hazardous waste management, remediation and reclamation, site characterization and environmental regulations.

There are specific course requirements for both the master's and the doctor's degrees in all three majors. These requirements along with other policies and procedures are contained in "Guide to Graduate Study," which is available on request from the Department of Mining and Geological Engineering.

**Geological Engineering (G EN)**

502.* Probability and Statistical Concepts in Geologic Media (4) I Univariate probabilistic and statistical methods: data reduction, basic probability concepts, discrete and continuous probability distributions, sampling distributions, confidence intervals, hypothesis testing, goodness-of-fit tests; applications in geologic media. Introduction to several statistical packages. 3R, 3L. P, MATH 223. (Identical with NSC 502) Kulatilake
503. Rock Mass Joint Geometry Modeling (3) [Rpt.] 1995-96 Sampling techniques; statistical homogeneity; delineation of joint sets; corrections for sampling biases of joint parameters; inference of statistical distributions for orientation, spacing, intensity and size; joint system modeling and validation. 2R, 3L. P, 402, S 270. Kalulitake

505. Applied Multispectral Imagery (3) II Application of image processing to mineral exploration, engineering geology, groundwater location, and pollution monitoring. P, 407. (Identical with GEOS 505) Glass

507.* Photogeology (3) I Use of aerial photographs in geologic mapping. 1R, 6L. P, GEOS 321. (Identical with GEOS 507) Glass

515.* Rock Excavation (3) II (Identical with MN E 515)

516.* Field Studies in Geophysics (3) II S Seismic, magnetic, electrical, and gravity exploration techniques. Field trips. Special fee may be required. P, 448 548. (Identical with GEOS 516) Sternberg

522. Well Logging Interpretation (3) II Basic well logging theory. Fundamentals of quantitative formation evaluation. Detailed investigation of aspects of well logging applicable to student's research interests. P, consult department before enrolling. (Identical with GEOS 522 and HWR 522) Labrecque


525.* Geotechnical Investigations (3) II Investigation and analysis of geologic factors in the design and construction of engineering projects. 1R, 6L.

526.* Health and Safety in Mining (1-1) I (Identical with MN E 526)

527.* Geomechanics (3-4) I (Identical with MN E 527)

529. Rock Slope Analyses and Design (3) I (Identical with MN E 529)

533.* Elements of Coal Mining (3) Coal geology, properties and use. Surface and underground methods and equipment: strip mining; continuous, conventional, longwall mining; ground control; ventilation; haulage; electrical power; drainage. Preparation and reclamation. P, 220, 406, ECE 207.

535.* Mine Design (3) II Computer-aided design of a modern mine; feasibility study, pit limit design, mining sequence development and short-term mine planning. 2R, 3L. P or CR, 430, 440. Kim

536.* Subsurface Environmental Engineering (3) I Analysis of sources of heat, humidity, gases and dust in mines and other subsurface facilities. Design of engineering systems to control these pollutants. P, 406 or consult with department before enrolling. Kalulitake

537. Developments in Rock Mechanics (2) I (Identical with MN E 537)

543.* Fundamentals of Geostatistics (3) Rpt./6 units II (Identical with MN E 543)

548.* Geophysical Exploration and Engineering (3) Principles of gravity, magnetic, and electrical exploration; acquisition and interpretation of data to define geologic structure and evaluate resources. 3R, 2L. P, PHYS 110, 116, MATH 223. (Identical with GEOS 548) Sternberg/Johnson


550. Earthquake Engineering (3) I Applied course in earthquake causes and effects, integrating the fields of seismology, engineering, and seismic geology. P, MATH 254. Class

557. Fundamentals of Geomechanics (4) II (Identical with MN E 557)

560. Electrical Exploration Methods (3) I Electrical properties of minerals and rocks, resistivity and resistivity exploration, induced polarization and complex resistivity, magnetotelluric methods, and electromagnetic prospecting methods. P, 448. Consult department before enrolling. (Identical with GEOS 560) Sternberg

570.* Computer Methods in Geophysical Engineering (3) II Use of computers to solve problems in geophysical engineering, including data bases, computer contouring, map filtering and enhancement, and multivariate analysis of geologic data. P, introductory courses in computer programming, math, and earth science. Poulton/Sternberg

580.* Remote Sensing for the Study of the Planet Earth (3) II 1995-96 (Identical with REM 590) *May be convened with 400-level course.

649. Probabilistic Methods in Geotechnical Engineering (3) II (Identical with C E 649) Kalulitake

696. Seminar a. Research (1-3) [Rpt.] I II (Identical with MN E 696a and MNEC 696a)

Mineral Economics (MNEC)

696. Seminar a. Research (1-3) [Rpt.] I II (Identical with GEN 696a)

Mining Engineering (MN E)

501.* Analysis of Mine Operations (3) I Use of operations research principles and techniques to analyze various problems in mine operations. Harpalani

502.* Probability and Statistical Concepts in Geologic Media (4) I (Identical with G EN 502)

503. Analysis of Mining Decisions (3) I Use of geostatistics, system simulation languages and computers to analyze various mining decisions related to reserve estimation and mine planning. P, 401, 402, 430. Kim

506.* Fundamentals of Mine Ventilation (3) II Determination of quality and quantity of respirable air in mining operations. Thermodynamics of mine ventilation and design of ventilation systems. 2R, 3L. Harpalani

511.* Mining Processing (3) I Physical and chemical unit operations used to separate and recover the economic minerals and metals from their ores. The modern scientific and engineering background for the operations are presented as well as economic aspects. Includes field trips to major mining operations in Tucson area. (Identical with MSE 511)

515.* Rock Excavation (3) II Methods of excavation of rock in surface and underground mines and construction, ranging from the empiricism of conventional blasting practice to the application of the fundamental mechanics of rock fracture. 2R, 3L. Field trips. P, C E 217. (Identical with G EN 515)

526.* Health and Safety in Mining (1) Fundamentals in the recognition, evaluation, and control of health and safety hazards encountered in industrial operations; includes a review of engineering and plant management. P, 406 or consult with department before enrolling. Harpalani

527.* Geomechanics (3-4) I Mechanical behavior of rock and rock masses; response to load changes; deformations, failure, discontinuity slip; in situ stress state; rock testing; geomechanical classifications; engineering applications: slopes, pillars, tunnels, dam foundations; reinforcement design. 3R, 3L. P, C E 217, GEOS 321. (Identical with G EN 527) Kemeny


530.* Mine Examination and Valuation (3) I Principles and procedures in mineral property valuation, geostatistical ore reserve estimation, engineering, economy, investment analysis; use of a microcomputer. P, 402, 220. Kim

533.* Elements of Coal Mining (3) Coal geology, properties and use. Surface and underground methods and equipment: strip mining; continuous, conventional, longwall mining; ground control; ventilation; haulage; electrical power; drainage. Preparation and reclamation. P, 220, 406, ECE 207.

535.* Mine Design (3) II Computer-aided design of a modern mine; feasibility study, pit limit design, mining sequence development and short-term mine planning. 2R, 3L. P or CR, 430, 440. Kim

536.* Subsurface Environmental Engineering (3) I Analysis of sources of heat, humidity, gases and dust in mines and other subsurface facilities. Design of engineering systems to control these pollutants. P, 406 or consult with department before enrolling. Kalulitake

537. Developments in Rock Mechanics (2) I Discussion of new developments in rock mechanics and of areas of interest for future research. Field trips. P, 427 or 527. (Identical with G EN 537)


545.* Fundamentals of Geostatistics (3) [Rpt./6 units] II Theory and application of
Assistant Professors Alison Adams, Herman Gordon (Anatomy), Lynn Manseau, Roy Parker, Bruce Patterson, Mani Ramaswami, Mary Rykowski (Anatomy), Scott Selleck (Arizona Research Laboratories), Ted Weinert The University Department of Molecular and Cellular Biology is a research-oriented department in which students may receive advanced training in all aspects of research which employ cellular, molecular, biochemical, and genetic approaches. The department offers programs leading to the Master of Science and the Doctor of Philosophy degrees with majors in molecular and cellular biology. Except in unusual circumstances, the department will only admit graduate students whose stated objective is the Doctor of Philosophy degree. Applicants for admission should be prepared in chemistry, physics, and mathematics in addition to biology and must submit scores on the aptitude tests of the Graduate Record Examination. Applicants must communicate directly with the department regarding other admission requirements. The priority deadline for completion of all application files for admission to the programs beginning with the fall semester is February 1. All students who are accepted into the program receive full financial assistance (stipends, fees and health insurance).

Students are expected to specialize in areas of interest to the faculty. These include viral oncology, regulation of gene expression, neurobiology of simple systems, cellular ultrastructure and function, structure and function of nucleic acids, developmental biology of higher plants, plant molecular and cellular biology, molecular genetics, invertebrate development, and yeast molecular biology. A listing of the faculty of the department and their research interests can be obtained from the department on request.

505. Eukaryotic DNA Replication (3) [Rpt./I] II (Identical with CBIO 505)
510. Plant Molecular Biology (3) II 1996-97 (Identical with PL S 510)
511. * Topics in Molecular Biology (1) Provides experience in critical thinking, in making and testing hypotheses, in evaluation original research papers and in expressing ideas in discussions. Complements the lecture format of 411. (Identical with BIO 511 and MBIM 511)
516. * Computer Analysis of Sequences (3) II Analysis of protein and DNA sequence information using computer methods. Before enrolling, consult instructor for appropriate prerequisites (Identical with BIO 516, ECOL 516 and GENE 516)
520. Pathways and Signals in Cells (3) II (Identical with BIO 520)
529. * General Virology (3) II (Identical with MBIM 529)
545. Concepts in Genetic Analysis (3) I Methods of genetic analysis including mutant isolation, genetic and physical mapping, reverse genetics, evolutionary mechanisms, molecular variation and genomic evolution. P, introductory undergraduate genetics course or biology course. (Identical with BIO 545, ECOL 545, GENE 545 and INSC 545)
550. Topics in Pigment Cell Biology (2) I (Identical with CBA 550)
555. Molecular Mechanisms of Development (3) III Detailed examination of molecular, genetic and cellular approaches to selected problems in developmental biology. P, 545, 568 or consult department before enrolling. (Identical with BIO 555, GENE 555)
556. * Developmental Biology (3) I (Identical with AN S 556)
557. * Experiments in Developmental Biology (4) II (Identical with CBA 557)
558. Advanced Subjects in Endocrinology (2) [Rpt./I] (Identical with CBA 558)
560. Current Advances in Plant Physiology (3) I (Identical with PL S 560)
566. * Physiology Laboratory (2) II (Identical with ECOL 566)
567R. * Endocrinology (3) II (Identical with CBA 567R)
568. Nucleic Acids (4) I (Identical with CBIO 568)
569. Topics in Gene Regulation (2) II 1995-96 (Identical with BIO 569)
571. * Human Embryology (4) II (Identical with CBA 571)
572. Biological Regulation (4) I (Identical with BIO 572)
574. Advances in Mammalian Genetics (2) [Rpt./I] I 1995-96 (Identical with BIO 574)
575. Special Topics in Biological Imaging (2) (Identical with CBA 575)
576a-576b. * Analysis of Biological Diversification (3-2) I (Identical with ECOL 576a-576b)
577. Principles of Cell Biology (4) II (Identical with CBA 577)
582. Topics in Neural Development (2) II 1995-96 (Identical with NRSC 582)
583. Topics in Neural Plasticity (2) II 1996-97 Reading and discussion of primary literature on molecular, cellular, biochemical, physiological, and structural changes that occur on the adult nervous system. P, a course in neurobiology, consult department before enrolling. (Identical with CBA 583 and NRSC 583)
584. Cellular Neurobiology (2) II 1996-97 (Identical with CBA 584) Tolbert-St.John
586. Intracellular Messengers (2) I 1995-96 (Identical with NRSC 586)
587. Biology of Neurological Disease (3) II 1995-96 (Identical with NRSC 587)
588. Principles of Cellular and Molecular Neurobiology (4) I (Identical with NRSC 588)
Music (MUS/MUSI)

Music Building, Room 109
(520) 621-1655; FAX: (520) 621-8118

Professors Gary D. Cook, Interim Director, James R. Anthony (Emeritus), John Bloom (Emeritus), John Boe (Emeritus), Andrew Buchhauser (Emeritus), Edna Church (Emeritus), Robert Cutietta, Larry J. Day, Gordon Epperson (Emeritus), Billie K. Erlings, Thomas Ervin, Richard Faith (Emeritus), Paula Fan, John R. Ferrell (Emeritus), Greg C. Hanson, O. M. Hartsell (Emeritus), Jeffrey Haskell, Steven Hedden, Robert Hull (Emeritus), Henry Johnson (Emeritus), Roy A. Johnson, Jean-Louis Kashy, Timothy Kloskioc, Jack Lee (Emeritus), Robert McBride (Emeritus), Carrol McLaughlin, Theodora M. McMillan (Emerita), Elizabeth Mosher, Robert Muczynski (Emeritus), Edward W. Murphy, James P. O'Brien, Marguerite Ought (Emerita), Leonard A. Pearlman (Emeritus), Richard E. Peters (Emeritus), Joselyn Reiter, Charles Roe, Anita Sammarco (Emerita), Maurice Skones (Emeritus), R. Warren Sutherland, Nicholas L. Zumbo

Associate Professors Daniel I. Asia, William Dietz, Elizabeth Thompson, Ervin, Nancy Ferguson, Noehema Fernandez, John R. Fitch, Grayson Hirst, Keith M. Johnson, Jerry Kirkbride, R. Warren Sutherland, Nicholas L. Zumbo

Assistant Professors John T. Brobeck, Enrique Feldman, Mark Rush

The school offers a program leading to the Master of Music degree with majors in composition, music education, musicology, music theory, and performance. The school also offers a program leading to the Doctor of Musical Arts degree with majors in composition, conducting, and performance. With the doctoral performance major, concentrations are available in bassoon, cello, clarinet, flute, guitar, horn, harp, oboe, organ, percussion, piano, saxophone, string bass, trombone, trumpet, viola, violin, and voice. A reading proficiency examination in either German, French or Italian will be required for the Doctor of Musical Arts degree with the major in performance and the concentration in voice. The school also offers programs leading to the Doctor of Philosophy degree with majors in music theory or music education. All candidates for admission to the Ph.D. program with a major in music theory will show evidence of satisfactory competency in their fields of concentration. There are two minors, one in music with a minimum of nine units and one in a field outside of music, also with a minimum of nine units. German and French are the required languages for this degree. In the event a candidate works in a field of specialization that warrants it, another language, such as Greek, Latin, or Italian, can be substituted for French with the permission of the School of Music Graduate Committee. If the research specialization lies within a computer-assisted field, expertise in that technology can be substituted for French. Applicants for the Ph.D. program in music education will be required to furnish evidence of at least three years of successful teaching or administrative experience in the field of music whether in the public schools or at the college level. Additional details regarding the Ph.D. Program in music education are available from the Director of Graduate Studies in Music. For further information concerning these degrees see Requirements for Master’s Degrees/Master of Music and Requirements for Doctor’s Degrees/Doctor of Musical Arts and Doctor of Philosophy elsewhere in this catalog.

Applicants are required to audition by personal interview or by submitting a tape recording. Beginning graduate students must take placement tests in music theory and in music history/literature. Doctoral students are not admitted to a particular curriculum until they have passed a qualifying examination administered each semester by the School of Music. Admission is limited to applicants who exhibit superior musical aptitude and training and who show continued growth in their chosen fields of music.

510a-510b. * Pedagogy (2-2) Study of methods and repertory suitable for studio teaching. Open to music majors in their major performance area only.

520a-520b. * Counterpoint (3-3) Practical study of the counterpoint of the 16th (in 520a) and 18th (in 520b) centuries. P; 220b.

521. Introduction to Graduate Music Theory (3) II Introduction to graduate analysis with emphasis on the survey of analytical systems as applied to a number of stylistic periods. Both cognitive and aural procedures will be investigated. This course may not be used to fulfill doctoral requirements in music. Open to majors only.

522a-522b. Art Song Repertory (2-2) 1994-95 Class performance of representative selections from the standard repertory of German, Italian, French, Russian and English language art songs; problems of accompaniment, interpretation, style and ensemble. Registration restricted to singers and pianists. Open to majors only.

523a-523b. History of the Opera (3-3) 1993-94 Detailed study of the course of opera from its inception by the Florentine Camerata through Berg, Menotti, Stravinsky, Ginastera, Penderecki, Britten and others. Open to majors only.
524. History and Literature of Guitar (3) II 1994-95 In-depth study of the evolution of the guitar, lute, and vihuela, including repertoire, style periods, and composers. Open to majors only.

525. History and Literature of the Wind Band (3) A research-oriented study of wind band history and literature from the Renaissance to the present.

526a-526b. Piano Literature (3-3) 1994-95 Historical and stylistic study of keyboard literature, instruments and performance practices. 526a: Baroque through the early Romantic periods. 526b: Mid-Romantic through the Contemporary periods. P, 285. 526a is not prerequisite to 526b.

330. Music in the Renaissance (3) II 1996-97 Vocal and instrumental genres from Dufay through Palestrina. Open to majors only.

331. Music in the Baroque (3) II 1995-96 The age of the basso-continuo; instrumental and vocal genres from Monteverdi through J. S. Bach. Open to majors only.

332. Music in the Classical Period (3) I 11996-97 The Viennese classical tradition from its origins to Beethoven. Open to majors only.

533. Music of the Twentieth Century (3) I Contemporary idioms in music; study of genres, styles, and techniques from post-Romanticism to the present. Open to majors only.


337. Survey of Early Music (3) II Intensive survey of music history from Gregorian chant to the late Baroque. This course may not be used to fulfill doctoral requirements in music. Open to majors only.

541. Electro-Acoustic Music (3) I Comprehensive study of electronic music. Introduction to the electronic music studio, tape composition, acoustics, music synthesis and sound processing, with actual lab applications. Majors only.

542. Electro-Acoustic Studio Resources (3) II Advanced techniques: synthesis, processing, synthesizer programming, sampling, MIDI, computer-assisted techniques, sequencing and notation.

550. Advanced Studies in Music Teaching (3) II S Contemporary practices in planning, organizing and evaluating learning experiences in music for K-12 students.

551. Behavioral Research in the Arts (3) I S 1995-96 Research methodologies as they apply to artistic behavior; emphasis on applying the results of existing studies to practice and on conducting original research.

555. Music and German Literature (3) I 1996-97 (Identical with GER 555)

560. Aesthetics of Music (3) I Exploration of the problems of musical meanings, including a panoramic examination of what philosophers, philosophic musicians and artists, and others of critical intelligence have contributed to comprehensive theory.

570. Advanced Conducting (3) [Rpt.] II Styles of choral, band, and orchestral literature, as they pertain to the problems of the conductor; references to the styles of all periods, with emphasis on the contemporary and modern.

597. Workshop * Level I Orff Schulwerk (2)

*May be convened with 400-level course.

600. Introduction to Graduate Study in Music (3) I Bibliographical materials; research resources, techniques, and problems directed toward graduate study in music. Required of all doctoral candidates in music. (Identical with LI S 600)

620a-620b. History of Speculative Theory (3-3) I II 1995-96 Survey of speculative theory in music, classical Greeks to present.

621a-621b. Analysis of Music of the 18th and 19th Centuries (3-3) Intensive analysis of works written in the larger forms. 621a: 18th century. 621b: 19th century. Open to majors only. 621a is not prerequisite to 621b.

622. Theory Pedagogy (3) Study of the philosophies, procedures, techniques, and materials used in teaching theory at the college level.


630. The Music of Bach (3)

631. The Music of Mozart (3)

635. Choral Literature and Techniques (3) I II A research-oriented study of choral literature from all stylistic periods and genre from the Renaissance to the present, together with appropriate conducting techniques. 2R, 3L. Open to majors only. P, graduate standing with appropriate conducting techniques. 2R, 3L.

636. Choral Literature and Techniques (3) II A research-oriented study of choral literature from all stylistic periods and genre from the Renaissance to the present, together with appropriate conducting techniques. 2R, 3L. Open to majors only. P, graduate standing with appropriate conducting techniques. 2R, 3L.

650. Foundations and Principles of Music Education (3) I S History and philosophy of music education in the public schools, with emphasis on the basic concepts needed for effective teaching in the field of music, curriculum development and evaluation of the music program.

651. Curriculum Development in Music (3) Principles and techniques of curriculum construction applied to the field of music.

652. Management Techniques in Music (3) The management of music at all levels of education, industry, and performance.

654. Psychology of Music (3) II S 1996-97 Music perception, physiological and psychological responses to music, basic acoustics, music pedagogy, and evaluation/measurement of music behaviors.

672. Teaching Music in Higher Education (3) II Contemporary practices in planning, organizing, and evaluating learning experiences in music for college and university students. Open to music majors only.

696. Seminar a. Music Education (1-6) [Rpt./9 units] I II
b. Musicology (1-6) [Rpt./9 units] I II
c. Music Theory (1-6) [Rpt./5] I II
d. Composition (2) [Rpt./8 units] I II Open to majors only.
e. Keyboard Studies (2) II [Rpt./8 units]

Ensembles

All courses listed below may be repeated during each semester of registration. Prerequisite for entrance to all ensembles is by audition or by permission of the School of Music.

500. Large Conducted Ensembles (1)

b. Marching Band
c. Campus Band
d. Symphonic Band
e. Wind Symphony
f. Summer Chorus
i. Symphonic Choir
j. University Singers
k. University-Community Chorus
l. Chamber Choir
m. Choraliers
o. Symphony Orchestra
q. Collegium Musicum
t. Jazz Ensemble
s. Honor Choir

501. Coached Ensembles (1) Offering chamber music experience; designed to develop musical independence.

a. Accompanying
b. Brass Ensemble
c. Percussion Ensemble
d. Guitar Ensemble
e. Jazz Combo
f. Saxophone Choir
g. String Ensemble
h. Woodwind Ensemble
i. Steel Band
j. Mariachi Arizona
k. Electronic Music Ensemble
l. Harp Ensemble (1) [Rpt./9 units total at all levels] II

502. Small Conducted Ensembles (1)

a. Chamber Winds
b. Contemporary Ensemble
c. Clarinet Choir
e. Pep Band
f. Flute Choir
g. Recital Choir
j. Trombone Choir

605L Opera Theatre (1-4) [Rpt./12 units] Training in all aspects of operatic production, including major singing roles, minor roles, opera chorus, opera scenes and chamber operas; technical training in set construction, makeup, costumes and lighting. 605 may also include operatic staging techniques. P, 4 units of 405 or permission of the School of Music.

Composition Studies: Individual and Group Instruction

640. Advanced Composition (2-6) I II [Rpt.] Individual projects in composition. Open to theory and composition majors only.

Performance Studies: Individual and Group Instruction (MUSI)

All of the courses listed below are offered both first and second semester.

See schedule of fees below.
### Music—Near Eastern Studies

#### Courses

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Course Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piano</td>
<td>580-P</td>
</tr>
<tr>
<td>Piano Accompanying</td>
<td>685-W</td>
</tr>
<tr>
<td>Voice</td>
<td>580-V</td>
</tr>
<tr>
<td>Vocal Coaching</td>
<td>685-J</td>
</tr>
<tr>
<td>Organ</td>
<td>580-O</td>
</tr>
<tr>
<td>Conducting</td>
<td>585-Q</td>
</tr>
<tr>
<td>String Instruments</td>
<td>580-N</td>
</tr>
<tr>
<td>String Bass</td>
<td>585-N</td>
</tr>
<tr>
<td>Cello</td>
<td>580-M</td>
</tr>
<tr>
<td>Harp</td>
<td>580-H</td>
</tr>
<tr>
<td>Guitar</td>
<td>580-G</td>
</tr>
<tr>
<td>Viola</td>
<td>580-L</td>
</tr>
<tr>
<td>Harpsichord</td>
<td>580-I</td>
</tr>
<tr>
<td>Wind Instruments</td>
<td>580-E</td>
</tr>
<tr>
<td>Euphonium</td>
<td>580-B</td>
</tr>
<tr>
<td>Bassoon</td>
<td>580-A</td>
</tr>
<tr>
<td>Clarinet</td>
<td>580-C</td>
</tr>
<tr>
<td>Flute</td>
<td>580-F</td>
</tr>
<tr>
<td>Horn</td>
<td>580-D</td>
</tr>
<tr>
<td>Oboe</td>
<td>580-A</td>
</tr>
<tr>
<td>Saxophone</td>
<td>580-S</td>
</tr>
<tr>
<td>Trombone</td>
<td>580-R</td>
</tr>
<tr>
<td>Trumpet</td>
<td>580-T</td>
</tr>
<tr>
<td>Tuba</td>
<td>580-Y</td>
</tr>
<tr>
<td>Percussion Instruments</td>
<td>580-Z</td>
</tr>
</tbody>
</table>

#### Fees

- **Music Fees**
  - All students registering for private or group instruction are charged special fees per semester according to the following schedule.
  - Group lesson or one-half hour private lesson: $40.
  - One-hour private lesson: $60.
- **Rentals**
  - Instruments are rented as available for use in regularly scheduled music activities according to the following fee schedule.
  - Any damage beyond normal wear and tear will be paid for by the renter of the instrument. All rental instruments must be returned by the end of the semester or on demand.
  - **Practice Room and Piano Rental**: Pianos will be rented only to those enrolled in group, private instruction or keyboard class. $5 for one hour practice per day. $10 for two hours practice per day. $15 for three hours practice per day.
  - **Organs, Harpsichords, and Synthesizers**: $10 for one hour practice per day. $15 for two hours practice per day. $20 for three hours practice per day.
  - **Harp**: $20 for one hour practice per day. $25 for two hours practice per day. $30 for three hours practice per day.
  - **Band and Orchestra Instruments**: Rented only to those enrolled in ensembles or techniques and literature classes. $10 per semester.
  - Refunds will be made according to the refund schedule. No refund will be made on rental charges of $5 or less.

#### Degrees

- **Master of Arts**: Requirements include 30 units of course work with a thesis or, when a departmental paper is submitted in lieu of thesis, no fewer than 32 units. Two degree plans are available in consultation with an advisor: (1) a nonspecialist terminal program, multi-area if desired, and (2) a specialist program requiring a minimum of two years of an appropriate language. The specialist program normally requires three or more semesters and often serves as preparation for the Doctor of Philosophy degree program.

- **Doctor of Philosophy**: This program requires completion of the Master of Arts degree (specialist program) or equivalent training plus those additional courses in the major and minor areas selected by the student’s guidance committee.

#### Arabic (ARB)

- **503** Advanced Arabic I (3) Emphasis on oral and written comprehension and expression. P, 402.
- **504** Advanced Arabic II (3) Emphasis on oral and written comprehension and expression. P, 403 or 503.
- **524a-524b** Conversational Levantine Arabic (3-3) 1994-95 Extensive oral drill, with emphasis on the acquisition of facility in normal conversation and comprehension. P, 101.
- **525a-525b** Conversational Gulf Arabic (3-3) Extensive oral drill, with emphasis on the acquisition of facility in normal conversation and comprehension. P, 101.
- **562** Introduction to Arabic Linguistics (3) History and structure of the Arabic language in its various forms. P, 102, LING 101. (Identical with LING 526)
- **539a-539b** Egyptian Arabic (3-3) Introduction to the Cairene dialect. Phonology, con-
mon greetings, basic vocabulary and grammar. P, one year of Standard Arabic.

548.* Arabic Literature in English (3) Historical survey of Arabic literature of the Middle East and Mediterranean world, with readings in English translations.

595. Colloquium
1. Modern Arabic Prose (3) [Rpt./1] P, two years of Arabic.
2. Classical Arabic Prose (3) [Rpt.1] P, two years of Arabic.
3. Readings in Classical Arabic Poetry (3) S P, three years of Arabic for non-native speakers of Arabic.

Persian (PRS)

504.* Advanced Persian I (4) CDT Readings in Persian, with the objective of preparing the student for independent research. P, 402.

505.* Advanced Persian II (4) CDT Readings in Persian, with the objective of preparing the student for independent research. P, 404.

549.* Classical Persian Literature in English (3) II Historical, cultural, and literary issues related to the readings will be discussed.

550.* Contemporary Persian Literature in English (3) Historical, cultural and literary issues related to the readings will be discussed.

Near Eastern Studies (NES)

501.* Ancient Mesopotamia (3) Sumerian, Babylonian, and Assyrian civilization from the first cuneiform documents to the fall of the neo-Babylonian empire, with special attention to issues of sociopolitical organization. P, 171, ANTH 101, 110 or consult department before enrolling. (Identical with HIST 501)

503b. Introduction to Comparative Literature and Literary Theory (3) II (Identical with CCLS 503b)

509a-509b.* Biblical Hebrew (3 to 4 — 3 to 4) Study of Biblical Hebrew grammar and literature. 509a: Prose texts. 509b: Poetry. (Identical with JUS 509a-509b)

534.* Islamic Thought (3) II Traditional ideological systems of Islamic countries and their evolutionary transformations.

535.* Jewish Mysticism (3) II (Identical with JUS 535)

542.* Transformation of Agrarian Societies in the Middle East (3) II Dynamics, processes, and implications of rural change in the Middle East; focus on changes in peasant communities, nomadic pastoralists, rural-urban relations, and planned change. (Identical with POL 542)

557.* Prehistoric Mesopotamia (3) I (Identical with ANTH 557)

567.* Population and Development in the Middle East (3) I Review of theories and research in population, resources and socio-economic development, with emphasis on determinants and consequence of population growth and migration in contemporary Middle East. (Identical with POL 567)

568a-568b.* Asia and the West (3-3) (Identical with HIST 568a-568b)

570.* Religious History of India (3) (Identical with HIST 570)

572.* History of Medieval India (3) I (Identical with HIST 572)

573.* History of Modern India and Pakistan: 1750-1950 (3) II (Identical with HIST 573)

574.* Archaeometry: Scientific Methods in Art and Archaeology (3) II 1993-94 (Identical with ANTH 574)

577a-577b.* History of the Middle East (3-3) History of civilization in the Middle East from the rise of Islam to the 18th century. 577a: Period of Arab dominance. 577b: Period of Turkish dominance. 577a is not prerequisite to 577b. (Identical with HIST 577a-577b)

578.* Modern History of the Middle East (3) I Near and Middle Eastern history since the late 18th century, with special emphasis on Egypt and areas to the east. (Identical with HIST 578)

581a-581b.* Archaeology of Syria-Palestine in the Bronze and Iron Ages (3-3) Survey of the Bronze and Iron Age cultures of Syria-Palestine, ca. 3500-500 B.C., with emphasis on the use of archaeological materials in historical reconstruction.

585.* Social Organization of India and Pakistan (3) Survey of family, kin, and caste in the peasant societies of India and Pakistan. (Identical with ANTH 585)

586.* Political Systems of India and Pakistan (3) II Survey of post-independence political developments in Pakistan and India. (Identical with POL 586)

590.* Women in Middle Eastern Society (3) I (Identical with ANTH 590)

595. Colloquium
d. Middle East (3) [Rpt.] I II
f. Ancient Near East (3) [Rpt.] I II Consult department before enrolling (Identical with JUS 595)

596. Seminar
b. *Special Topics in Near Eastern Studies (3) [Rpt.]
m. Middle East: Topics in History and Civilization (3) [Rpt.] I II
q. Near Eastern Archaeology (3) [Rpt./6] I II (Identical with ANTH 596q)
w. Feminist Approaches to the Bible (3) I (Identical with JUS 596w)

*May be convened with 400-level course.

695. Seminar
d. Cultural Anthropology (1-3) I II (Identical with ANTH 569b, which is home)
i. International Water Resource Management (1-3) [Rpt./2] I (Identical with HWR 661)

Neuroscience (NRSC)

Gould-Simpson Building, Room 401
(520) 621-8380; FAX: (520) 621-8282

Graduate Interdisciplinary Program in Neuroscience

Committee:
Professors John G. Hildebrand, Chairperson
(Arizona Research Laboratories, Division of Neurobiology), Carol A. Barnes
(Pharmacology), Bryant Benson (Anatomy), James R. Bloedel (Physiology), Richard Bootzin (Psychology), Thomas P. Davis (Pharmacology), Merrill F. Garrett (Psychology), Theodore Glattke (Speech and Hearing Sciences), Raphael P. Gruner (Physiology), Thomas J. Hixon (Speech and Hearing Sciences), Victor J. Hruby (Chemistry), Mary I. Johnson (Pediatrics), Alfred W. Kasznia (Psychology), Richard B. Levine (Arizona Research Laboratories, Division of Neurobiology, Physiology), Ronald J. Lukas (Pharmacology), Bruce L. McNaughton (Psychology), Lynn Nadel (Psychology), L. Claire Parsons (Nursing), Paul Porreca (Pharmacology), William R. Roese (Internal Medicine), Alan R. Rubens (Neurology), Joachim F. Seeger (Radiology), Robert E. Spetzler (Surgery), Nicholas J. Strausfeld (Arizona Research Laboratories, Division of Neurobiology, Physiology), Douglas G. Stuart (Physiology), Henry I. Yamamura (Pharmacology)

Associate Professors Edmund A. Arbas (Arizona Research Laboratories, Division of Neurobiology, Physiology), Gail D. Burd (Anatomy, Molecular and Cellular Biology), William M. Feinberg (Neurology), Ralph E. Fregosi (Exercise and Sport Sciences), Edward D. French (Pharmacology), Erwin B. Montgomery, Jr. (Neurology), John A. St. John (Anatomy), Linda Swisher (Speech and Hearing Sciences), Leslie P. Tolbert (Arizona Research Laboratories, Division of Neurobiology), Gary L. Wenk (Psychology, Neurology)

Assistant Professors Geoffrey L. Ahern (Neurology, Psychology), John J. Allen (Psychology), Herman Gordon (Anatomy), Jeannette D. Hoit (Speech and Hearing Sciences), Josephine Lai (Pharmacology), Chad J. Marsulek (Psychology), Nathaniel T. McMullen (Anatomy, Neurology), David B. Morton (Arizona Research Laboratories, Division of Neurobiology, Physiology), Mani Ramaswami (Molecular and Cellular Biology), Naomi E. Rance (Pathology), John W. Regan (Pharmacology and Toxicology), Linda L. Restifo (Arizona Research Laboratories, Division of Neurobiology, Physiology), Scott B. Selleck (Arizona Research Laboratories, Division of Neurobiology, Molecular and Cellular Biology), Andrea Yool (Pharmacology, Physiology)

Associate Research Scientist Thomas A. Christensen

The graduate interdisciplinary Program in Neuroscience offers a graduate program leading to the Doctor of Philosophy degree with a major in neuroscience, as well as a graduate minor in neuroscience. A Master of Science degree is offered only
Science. In addition, the program fosters Arizona Research Laboratories. The members of the Program in Neuroscience are the principal faculty of the graduate program and thus may serve as major advisors for students majoring in neuroscience. In addition, the program fosters research and communication in interdisciplinary neuroscience throughout the University. Research interests of the faculty range from molecular mechanisms of synaptic transmission to human neurological disorders. Faculty groups focus upon cognitive neuroscience, developmental neurobiology, human speech and hearing, insect neurobiology, neuropeptides, neuropharmacology, and motor control. Information about the research interests of the faculty can be obtained from the program office.

503a. * Principles of Mammalian Systems Neurophysiology (2) II (Identical with PSYC 503a)
503b. * Laboratory in Mammalian Systems Neurophysiology (3) II (Identical with PSYC 503b)
506. Neural Encoding, Memory and Computation in the Mammalian Brain (3) II (Identical with PSYC 506)
524. Gerontology: A Multidisciplinary Perspective (3) III (Identical with PSYC 524)
582. Topics in Neural Development (2) I An in-depth analysis of the cellular and molecular basis of neural development. Students will read and discuss journal articles dealing with the development of neurons and their synaptic connections. P, consult program office before enrolling. (Identical with MCB 582, MCB 587 and PSIO 582)
583. Topics in Neural Plasticity (2) II 1996-97 (Identical with MCB 583)
584. Cellular Neurobiology (2) II 1996-97 (Identical with ANAT 584) Tolbert-St. John
585. Neural Mechanisms of Behavior (2) II 1994-95 Discussion of the neural mechanisms of behavior: the control of movement; and integrative mechanisms and plasticity. Examples from vertebrates and invertebrates. (Identical with PSIO 585)
586. Intracellular Messengers (2) I 1993-94 Intracellular messenger systems in the nervous system, description of salient features of each mechanism, and discussion of a particular system which uses that messenger. P, 586, or permission of instructor. (Identical with MCB 586 and MCB 587)
587. Biology of Neurological Disease (3) II 1993-94 Emphasis on the study of nervous system disorders, including multiple sclerosis, stroke, epilepsy.

For graduate and medical students. Consult instructor before enrolling. (Identical with MCB 587)
589. Principles of Systems Neurobiology (4) II Detailed introduction to the organization, physiology, and function of neural systems, emphasizing sensory systems, motor control, integration, and plasticity. P, 588, consult program office before enrolling. (Identical with ANAT 589 INSC 589 and PSIO 589)
595. Colloquium a. Developmental Neurobiology (1) [Rpt./6 units] II S
b. Brain, Behavior and Computation (1) [Rpt./6 units] II S
*May be counted with 400-level course.
695. Colloquium a. Motor Control (2) [Rpt./8 units] II (Identical with EXSS 695a)
b. Science, Society and Ethics (1) II (Identical with MCB 695e)

700. Methods in Neuroscience (3) II S [Rpt.] Research rotations in the laboratories of faculty members within the neuroscience program. Consult neuroscience program office before enrolling.
701. Communication in Neuroscience (2) II Preparation of an essay, and instruction in scientific writing. Open to majors only. P, consult neuroscience program office before enrolling.

**Nuclear and Energy Engineering (NEE)**

Engineering Building, Room 200 (520) 621-2551; FAX: (520) 621-8096

Professors Barry D. Ganapol, David L. Hetrick (Emeritus), Roy G. Post (Emeritus), Robert L. Seale, Morton E. Wacks, John G. Williams

Associate Professors Morris Farr, Acting Head, Rocco Fazzolari

The department offers programs leading to the Master of Science and the Doctor of Philosophy degrees with a major in nuclear engineering. These programs prepare the student for advanced study and research in various applications of nuclear energy including the analysis and design of fission and fusion reactors, the dynamics of nuclear systems, the interaction of radiation with matter, nuclear safety, energy systems analysis and management, and nuclear fuel cycle evaluation, and the many specialized uses of isotopes. Master's degree students may select one of the following interdisciplinary options: biomedical engineering or systems engineering. For details concerning these options, see Engineering elsewhere in this catalog.

The applicant should have completed the equivalent of the undergraduate major in nuclear engineering; but liberal substitutions are allowed for those with undergraduate majors in mathematics, physics, chemistry, or other engineering disciplines.

For the Master of Science degree a thesis is required of all students except those working in the energy systems engineering option.

501. Computational Methods of Engineering Science (3) I Numerical analysis, introduction to linear algebra, the Monte Carlo technique, complex variables, supercomputing, P, MATH 254.
506. * Nuclear Engineering Laboratory (4) I Experimental techniques for determining various parameters in nuclear systems; experiments using the critical and subcritical reactors. 3R, 3L, P, 580 or 588, 483 or 583. Non-majors may substitute 486 or 586 for the prerequisites.
507. Radiochemistry and Radiation Detection (3) I Radiation detection and measurement, health physics, ionita applications, activation analysis, and instrumentation. 3R, 3L, P, CHEM 480b OR PHYS 242. (Identical with CHEM 507)
514a-514b. * Nuclear Engineering Design (3-3) (a) Modern engineering design methods to effectively use thermal energy and power. Covers: economic analysis and modeling of thermal equipment; optimization techniques; steady state and dynamic simulation of energy systems. Comprehensive project. CR, A ME 452. (b) A multi-disciplined design project of modern energy systems. Covers: project management tools, design techniques, proposal and project reports, written and oral presentations. Comprehensive team project based on environmental impact, cost optimization, engineering analysis, and resource allocations. P, 514a.
540. * Energy Utilization and Management (3) I Methods for evaluating the technical and economic aspects of energy conversion and usage directed toward the effective utilization of resources, including economics, HVAC system, electric power, lighting and industrial processes. (Identical with A ME 540)
541. Industrial Energy and Power Management (3) II Analysis of effective energy utilization in industrial operations: availability analysis, combustion, heat recovery, process energy, building systems, cogeneration, electrical loads, lighting and machinery. (Identical with A ME 541 and CHEE 541)
542. * HVAC System Design (3) II Computer analysis and design of air conditioning systems for commercial and industrial buildings, including equipment and component selection. Energy-efficient concepts and controls will be emphasized. CR, 441. (Identical with A ME 542)
543. Power Plant Engineering (3) II The application of fluid dynamic heat transfer and mechanical interaction principles to the engineering design of a power plant. P, 582, 588.
545. * Solar Energy Engineering (3) I Energy analyses of active and passive solar collectors, selective surfaces; solar cells; energy storage;
systems for solar heating and cooling; mechanical and electrical power; perspective. P, AME 230.

546. * Photovoltaic Systems Engineering (3) I Presents system performance prediction methods, load estimation, power conditioners, battery storage principles, system design, and qualitative semiconductor device physics.

547. * Direct Energy Conversion (3) II Engineering requirements for achieving direct conversion of energy to electrical power; the engineering of thermoelectric and thermionic converters, fuel cells, magneto-hydrodynamic, and photoelectric systems. P, MATH 254; AME 230; or PHYS 142. (Identical with AME 547 and ECE 547)

556. * Engineering System Simulation (3) II Dynamic modeling and simulation of engineering systems, including energy conversion systems, nuclear and chemical reactors, and control systems, using digital continuous-simulation system languages. P, AME 230 or CHEE 306a; MATH 254.

563. * Energy from Biomass (3) II (Identical with ABE 563)


582. * Contemporary Nuclear Power Systems (3) I Analysis of present nuclear power plants, with emphasis on design decisions as they affect performance of individual systems; advanced design concepts; proposed standard designs; operational considerations of different contemporary systems. P, 380 or 486.


584. * Radiation Effects (3) II Radiation effects on solids and radiation chemistry of gases and liquids, with emphasis on effects encountered in nuclear reactor, detector, and dosimeter systems. P, 200, CR, MIE 331R.

585a-585b. * Radiation Health Physics and Safety (3-3) (a) Study of health physics practices and safety, including instrumentation, regulations, record keeping and monitoring of facilities. (b) Shielding methods, normal and off-normal working practices, national and international regulations and practices. P, 585a.

586. * Nuclear Energy and Power (3) I Fundamentals of nuclear energy and radiation; engineering applications; the basic concepts of nuclear reactors and power systems. Designed for nonmajors.

587a-587b. * Introduction to Radioactive Waste Management (3-3) (a) Background in the technology of low level radioactive wastes from institutional, research, and fuel cycle sources. (b) Background in the technology of high level wastes, including reprocessing and disposal, from the fuel cycle, both national and international approaches. P, 587a.


596. Seminar s. *Advanced Nuclear Power Activities (1) [Rpt. /3] II

*May be convened with 400-level course.

645. Advanced Solar Engineering (3) II Research and development studies related to solar applications: engineering design, analysis, and economics. Course includes invited lectures, literature research, and an original paper. P, 545. (Identical with CHEE 645)

681a. Analytical Methods of Transport Theory (3) I 1995-96 Application of the Boltzmann equation to neutron and photon transport problems; exact solutions, the method of singular eigenfunctions, spherical harmonic expansions, the moments methods, integral transport theory, invariant embedding, variational techniques, applications to slowing-down problems. P, 689, MATH 422a-422b.

682. Nuclear Safety (3) II Possible incidents involving nuclear materials in critical reactors, chemical processing systems, fuel shipment operations or subcritical arrays, including assessments of the magnitudes and consequences of nuclear incidents; determination of criteria for evaluating nuclear system safety; including plant siting and operational procedures. P, 380.

683. Nonlinear Reactor Dynamics (3) II Nonlinear dynamics of nuclear reactors; shutdown mechanisms, inertia effects, nonlinear stability criteria, time-dependent neutron transport, neutron waves and applications to pulsed reactors, start-up transients, reactor stability, and reactor safety. P, 583.


689. Reactor Theory II (3) II Fundamental theory of heterogeneous reactors, integral transport, blackness theory, perturbation theory, and applications; temperature coefficient, changes in reactivity due to fission product accumulation, fuel consumption, and conversion. P, 588.

Nursing (NURS)

Nursing Building, Room 316
(520) 626-6151; FAX: (520) 626-2211

Professors Suzanne Van Ort, Dean, Agnes M. Aamodt (Emerita), Eleanor E. Bauwens (Emerita), Pearl P. Coulter (Emerita), Sandra Perketh, JoAnn Gilt- tenberg, Margarita A. Kay (Emerita), Alice J. Longman (Emerita), Beverly A. McCord (Emerita), Carolyn Murdach, L. Claire Parsons, Linda R. Phillips, Arlene M. Putt (Emerita), Gladys E. Sorensen (Emerita), Joyce Verran

Associate Professors Torrey Badger, Carrie Jo Braden, Judith Dempster, Evelyn M. DeWalt (Emerita), Rose Gerber, Mary E. Hazzard (Emerita), Elaine B. Jones, Lillian Lynch (Emerita), Betty J. McCracken (Emerita), Virginia Miller (Emerita), Ida M. Moore, Alice Noyes (Emerita), Jessie V. Pergin (Emerita), Lois E. Prosser (Emerita), Pamela Reed, Gayle A. Traver, Mary J. Welty (Emerita), Mary-Opal Wolanin (Emerita), Anne Woodtli

Assistant Professors Julie Erickson, Joan Haase, Kathleen May, Carrie Merkle, Lee Sennott-Miller, Geraldine Paier

The College of Nursing offers programs leading to the Master of Science and Doctor of Philosophy degrees with a major in nursing. The graduate curriculum is currently under review. Prospective students should consult the College of Nursing for current information.

The College of Nursing graduate program is planned for four years and a minimum of 108 units of graduate credit. Thirty-three units of credit are required for admission to doctoral standing. A student who elects to exit with a master's degree will complete a thesis and graduate with 36 units. If the nurse practitioner option is selected, a total of 42-48 units is required. This includes an internship of 6 units. Students progressing directly through the doctoral program are not required to complete a master's thesis.

Applicants for all degree programs are required to submit (1) evidence of completion of an undergraduate program in nursing substantially equivalent to the Bachelor of Science in Nursing degree program at The University of Arizona, (2) a current license to practice as a registered nurse in Arizona, (3) references attesting to professional competence, (4) evidence of satisfactory completion of a course in elementary statistics, (5) scores on the aptitude test of the Graduate Record Examination, (6) a statement indicating academic and professional goals as well as research interests, and (7) evidence of skills in physical assessment. In addition, (8) computer literacy is required.

An automobile is essential since the clinical facilities are located throughout the Tucson area.

Degrees

The College of Nursing offers a graduate program with multiple exit options: 1) Students may elect to complete a M.S. program including a thesis, or 2) elect to use the master's level courses as the first year of the Ph.D. program. In this option, a research proposal, rather than a thesis, is required and the M.S. degree is not awarded.

The nurse case manager option within the master's level of the graduate program provides advanced nursing preparation in the care provider role of nurse case manager. The College of Nursing also offers nurse practitioner options in the areas of adult nurse practitioner, family nurse practitioner, geriatric nurse practitioner and psychiatric/mental health nurse practitioner.
Master of Science — Admission is based upon the evaluation of the criteria mentioned above as well as the following: undergraduate cumulative grade point average of at least 3.00 or "B"; Graduate Record Examination minimum scores of 500 each on the verbal, quantitative and analytical portions of the aptitude test; and references attesting to potential as a graduate student.

Doctor of Philosophy — The major purpose of the program is the preparation of the clinical nurse researcher. Applicants must present evidence of the completion of a baccalaureate degree or both baccalaureate and master’s degrees substantially equivalent to those nursing programs at The University of Arizona. Admission is based upon the evaluation of the following criteria: undergraduate cumulative grade point average of at least 3.00 or "B"; graduate grade point average of 3.50; Graduate Record Examination minimum scores of 550 each on the verbal, quantitative and analytical portions of the aptitude test; references attesting to potential for doctoral study; copies of published materials or research reports; and an evaluation of professional record and experience. A personal interview is required after all credentials are available.

A minor area of study which includes a minimum of 12 semester credits is required. The area of study may be selected from behavioral or biological sciences, or the disciplines of anthropology, philosophy, physiology, psychology, management and policy, sociology or statistics.

Upon completion of the M.S. or Ph.D. degree, a student will have met the following objectives: devise, negotiate, implement and evaluate alternative solutions for health problems affecting client populations; expand and communicate the body of nursing knowledge; and generate solutions for society’s health concerns through collaboration with the broader scientific and health communities.

502. Professionalizing Presentation Skills (1) I II (Identical with BIOC 502)

504. Conceptual Models (3) I S Theory and research surrounding conceptual models with emphasis on description of conceptual models.

521. Nursing Care of the Child with a Handicap or Chronic Illness (3) I Overview of congenital and acquired handicaps or chronic conditions in school age children. Assessment and management of behavior associated with these conditions and their families. Open to majors only. P, 481, or consult college before enrolling.

522. School Nursing Practice (3) I Analysis and application of nursing in school systems. Program development and evaluation, health curriculum development, and principles of epidemiology for identification of high risk groups. Open to majors only. P, 481, or consult college before enrolling.

530. Methods in Nursing Research (3) II Critical examination of selected problems and methods in the nursing research process. Consideration is given to both qualitative and quantitative methods. (Identical with PHL 530)


583. Perspectives of Cancer Care for Health Professionals (3) S Current methods of care for individuals with cancer and for their families. 6F, 9L. Not accepted in doctoral program of study in nursing. P, enrollment in baccalaureate or graduate programs in nursing or pharmacy. (Identical with PHPR 583)

587. Poverty and Health (3) S Study of the relationship between poverty and health. Concepts and theories from anthropology, psychology and sociology will be used to analyze problems associated with poverty. Advanced degree credit available for non-Ph.D. majors only. P, six units of social science. (Identical with FCY 587 and PHL 587)

588. Healing Systems in the Southwest (3) I II Application of principles from anthropological theory to the actual practice of patient care, with emphasis on culture content of groups living in the greater Southwest. P, nine units of behavioral science. (Identical with ANTH 588 and PHL 588)

589. Health of the Older Adult (3) I Current research of the aging process including physical and mental alterations; emphasis on physiological changes. Consult college before enrolling. (Identical with GERO 589)

590. Principles of Physiology in Health Care (4) S Selected physiologic functions and adaptive changes which occur in health and illness. Cellular physiology, the immune system, neurophysiology, cardiovascular, pulmonary, renal, and endocrine physiology. P, undergraduate physiology.

592. Professionalizing Presentation Skills (1) I II (Identical with BIOC 502)

594. Conceptual Models (3) I S Theory and research surrounding conceptual models with emphasis on description of conceptual models.

600a. Health Assessment (3) I Synthesize physical and psychosocial data by utilizing current research and theoretical models appropriate to advanced nursing practice. Emphasizes physiologic, physical, cultural and psychosocial assessment. Provides a basis for understanding the normal ranges for adults including the older adult as well as emphasizes health promotion, maintenance and preventative practices. P, 580.

601. Pathophysiological Alterations (3) Examination of selected alterations in physiologic mechanisms including alterations in immunologic function, gas exchange and transport, fluid transport and balance, and/or maintenance of homeostatic mechanisms. Process of application to clinical care of individuals will be incorporated. P, 580 or 3 hours of graduate-level physiology.

603. Public Health Science (3) I Health promotion and primary prevention in communities and populations, epidemiology and legal/political issues in advanced public health nursing. Nursing and public health theories synthesized. Open to majors only. (Identical with PHL 603)

604. Developmental Concepts in Nursing (3) II Examination of the principles and philosophy of the lifespan developmental framework and other models of development, particularly as it relates to understanding a variety of nursing phenomena in practice and research.

605. Issues in Family Relations (3) II Examination of issues in providing care to families using theory and research from nursing and related fields. Concepts included will apply to the young, developing, and mature family. Open to majors only.

606. Social, Psychological Problems in Nursing (3) II Focus on concepts of stress and training with emphasis on health-related outcomes. Nursing research on addictions, depression, abuse and violence will be explored. Open to majors only.

607. Cross-Cultural Nursing (3) S Focus on a synthesis of theories from nursing and related fields to explore cultural variations in response to actual or potential problems of health or illness. The methods for caring and treating culturally influenced responses will be examined. Open to majors only. (Identical with PHL 607)

608. Cognitive Alterations (3) S Client problems related to the processing of sensory information including etiological factors. Research-based nursing interventions for clients with cognitive alterations are examined. Open to majors only.

609. Health Assessment (3) I Synthesize physical and psychosocial data by utilizing current research and theoretical models appropriate to advanced nursing practice. Emphasizes physiologic, physical, cultural and psychosocial assessment. Provides a basis for understanding the normal ranges for adults including the older adult as well as emphasizes health promotion, maintenance and preventative practices. P, 580.

611. Educational Process (3) I Theoretical and practical application of teaching-learning process in classroom and clinical settings. Principles of teaching-learning, instructional design, testing, Microteaching included. 2R, 3L. Open to majors only. (Identical with PHL 621)

612. Nurse Educator Role (3) II Theoretical and practical application of curriculum development and process. Use of teaching-learning process. Preparation for nurse educator role. Directed practice teaching included. 1R, 6L. Open to majors only. P, 621. (Identical with PHL 622)

623. Clinical Agency Administration (3) II Practical application of administrative processes in a nursing care delivery setting. Focuses on the use of selected skills essential to effective administration. Open to majors only. P, 624.

624. The Administrative Process (3) I Theoretical background for nursing administration in care settings. Emphasis is on accountabilty, budgeting, management skills, constraints, and influences as related to nursing administration. Open to majors only. (Identical with PHL 624)
625. Advanced Role Development (3) I Exploration of models of advanced nursing practice during (APN) roles in the health care system. Emphasizes factors that influence the process of defining and implementing an advanced practice nursing role. Open to majors only. P, 580.

626. Primary Care of Adult (3-4) II Basic concepts and knowledge needed to assess and manage therapeutically common acute and chronic health problems in adults. Emphasis will be placed on pathophysiology, abnormal aging, principles of pharmacology and medication use as therapeutic adjuncts and the use of diagnostic procedures as aids to clinical decision making. Open to majors only. P, 609.

627. Advanced Psychiatric Mental Health Nursing II (3) I Focus on concepts of personality development using psychodynamic and cognitive/behavioral theories oriented to the practice of mental health nursing: employing individual, family and group nursing techniques for the amelioration of problems. P, 600b, graduate standing in nursing.

632. Research Utilization (3) S Development and use of models and tools for facilitating the use of research in science-based nursing practice within organizational settings. 2R, 3L. P, 530.

633. Evaluation Research (3) I Development and use of models and tools for assessing nursing processes, programs and performances. Approaches to and psychological reactants of evaluation are explored. Issues and development of market packages with cost consideration are discussed along with program grant preparation. (Identical with PHIL 633)

635. Issues in Rural Health Care (3) II Topics include community assessment, planning and evaluation; interprofessional practice; health care issues for southwestern ethnic minority populations. (Identical with MAP 635, PHIL 635, PPSPR 635, and PSYC 635)

696. Seminar
   a. Nursing Theory (1-3) I II
   b. Nursing Metatheory (3) I Examination of philosophical and historical foundations of knowledge and metatheoretical structures and processes of theory development. In-depth analysis of extant and emerging philosophical bases of nursing for scientific inquiry. Open to majors and minors in nursing. P, 504 or equivalent.
   c. Middle Range Theory (3) II Introduction to ways of knowing, focus on middle range theories in nursing and related sciences. Emphasis on critique, elaboration and theory testing strategies. Open to majors only. P, 705.

724a-724b-724c. Professional Role Development (1-1-1) I II III I assist student socialization into the role of nurse scientist. Ethics of research, development of grant proposals, dissemination of scholarly work through publication and presentation, balancing roles of scholar, educator and clinician. Open to majors only. P, admission to Ph.D. program.

725. Study of Social Influences (3) S In-depth examination of social forces affecting the health care system. Open to majors only. P, admission to Ph.D. program. (Offered in the even-numbered years)

730. Quantitative Methods in Clinical Nursing Research (3) I Investigation of selected quantitative strategies appropriate to researching problems in clinical nursing. P, 530, 633, admission to Ph.D. program.

731. Qualitative Methods in Clinical Nursing Research (3) I Application of selected qualitative research methods from the social sciences to clinical nursing. Open to majors only. P, 530, admission to Ph.D. program.

781a-781b. Instrument Construction (3-3) S Deductive and inductive processes for constructing/testing instruments to measure nursing care interventions/patient outcomes. 781a: Instrumentation for behavior and objective phenomena. 781b: Instrumentation for subjective phenomena. Includes instrument strategies; experience developing a pilot measure. 2R, 3L. Open to majors and minors only. P, 705, 730, graduate level statistics. 781a is not prerequisite to 781b. (781a and 781b offered alternate summers.)

782a-782b-782c. Field Work in Nursing Research (3-3-3) S I II Individualized course of study incorporating research and clinical knowledge in a selected area of nursing practice in the laboratory and field setting. P, 530, 600a or 600b or 600c or 600d or 600e, 633, 705, 730.

---

### Nutritional Sciences (N SC)

**Shantz Building, Room 309**

**(520) 621-1187; FAX: (520) 621-9446**

**Professors** James W. Berry (Emeritus), Mary Ann Kight, K.Y. Lei, John A. Marchello, William F. McCaughhey (Emeritus), Eugene Nelson (Emeritus), Franklin D. Rollins (Emeritus), Mitchell G. Vavich (Emeritus), Charles W. Weber


The department offers programs leading to the Master of Science degree in food science, nutritional sciences, and dietetics. Graduate study prepares students for careers in academia, health care, industry and government. The department also participates through the Committee on Nutritional Sciences in programs leading to the Doctor of Philosophy in nutritional sciences. (See Nutritional Sciences in the following section).

---

**Nutritional Sciences (N SC)**

**Shantz Building, Room 309**

**(520) 621-1187; FAX: (520) 621-9446**

**Professors** James W. Berry (Emeritus), Mary Ann Kight, K.Y. Lei, John A. Marchello, William F. McCaughhey (Emeritus), Eugene Nelson (Emeritus), Franklin D. Rollins (Emeritus), Mitchell G. Vavich (Emeritus), Charles W. Weber

**Associate Professors** Ralph L. Price, Act-Head, Edward T. Sheehan, Ann M. Vavich

**Assistant Professors** Wanda Howell, Ann A. Jenkins

The department offers programs leading to the Master of Science degree in food science, nutritional sciences, and dietetics. Graduate study prepares students for careers in academia, health care, industry and government. The department also participates through the Committee on Nutritional Sciences in programs leading to the Doctor of Philosophy in nutritional sciences. (See Nutritional Sciences in the following section).

---

**Prerequisites for admission include: for the M.S. in food science: one semester each of analytical chemistry with lab and microbiology with lab, one year (or its equivalent) each of physics, general biology, organic chemistry with lab and math (calculus recommended); for the M.S. in nutritional sciences: one semester of analytical chemistry with lab, one year each (or its equivalent) of physics, organic chemistry with lab, biochemistry and physiology, and math (calculus recommended); for the M.S. in dietetics: completion of an ADA-approved DPD undergraduate program.

Graduate students must complete at least 30 units including an approved thesis to receive the M.S. in food science, nutritional sciences, or dietetics. Students are encouraged to select an advisor and two additional faculty members for their graduate committee as soon as possible, but no later than their second semester.

---

**Research Utilization (3) S Development and use of models and tools for facilitating the use of research in science-based nursing practice within organizational settings. 2R, 3L. P, 530.**
597. Workshop
  a. Mechanisms of Cancer Prevention (3) II 1995-96 P, graduate status in biological sciences (Identical with CBIO 597a) *May be co-registered with 400-level course.
  c. Metabolic Integration (3) II Analysis of current knowledge regarding the interactions between the intake, absorption, transport, processing, storage, catabolism and excretion of nutrients and the regulation of metabolic homeostasis in the intact organism. Emphasis areas include interrelationships between protein, carbohydrate and fat metabolism and their regulation by dietary, hormonal and genetic factors in humans. P, BIOG 460 or BIOG 462a-462b.
  d. Nutritional Biochemistry Techniques (3) II Biochemical methods for evaluating metabolic functions of nutrients. 1R, 6L P, 408, CHEM 324 or 325, and 323 or 326. (Identical with AN S 609)
  e. Chemistry and Metabolism of Lipids (3) II 1995-96 Chemistry and structure of lipids and their digestion, adsorption and storage; emphasis current research in lipid metabolism and the role of lipids in certain disease states. (Identical with AN S 615)
  g. Mineral Metabolism (2) I 1995-96 Metabolism and biological function of minerals; current research in mineral requirements and toxicity. P, 408. (Identical with AN S 622)
  h. Steroid and Lipoprotein Chemistry and Metabolism (2) I 1995-96 Biochemistry and metabolism of steroids and lipoproteins in mammalian systems; regulation of the biosynthesis and catabolism of steroids and lipoproteins in health and abnormalities related to disease and dietary regulations of sterol and lipoprotein metabolism as related to cardiovascular disease risk and prevention. P, 602, BIOG 460 or BIOG 462a-462b.
  i. Field Methods in Human Nutrition (3) II 1995-96 Case-oriented approach to nutritional assessment, diagnosis, prescription, plan and evaluation; application of dietary, clinical and biochemical methodologies. 2R, 3L. Open to majors in nutrition and other health sciences areas only.
  j. Chemistry of Food Carbohydrates (2) II 1996-97 Chemical and physical properties of carbohydrates important to their presence in food. P, BIOG 460, 462a.
  k. Analysis and Purification of Proteins (3) II 1995-96 (Identical with AN S 665)
  l. Food Safety (2) I 1995-96 Significance and control of foodborne hazards associated with pathogenic microorganisms, microbial toxins, industrial chemicals, and other environmental contaminants. P, 471, CHEM 241b. (Identical with MBIM 672)

598. Seminar
  a. Dietetic Internship, ADA Accredited (1-6) [Rpt./2] I II Field trips. Begins Mid-July and continues for 46 weeks. Consult dept. before enrolling. Open to majors only. P, Course work equivalent to American Dietetic Association DPD.
  b. Nutrition (1) [Rpt./6 units] I II (Identical with NUSC 696b)

Nutritional Sciences (NUSC)
Shantz Building, Room 309
(520) 621-5630; FAX: (520) 621-9446
Graduate Interdisciplinary Program in Nutritional Sciences
Committee:
Professors Charles W. Weber (Nutritional Sciences), Chair, David S. Alberts (Internal Medicine), Ronald E. Allen (Animal Sciences), Harris Bernstein (Microbiology and Immunology), David L. Earnest (Internal Medicine), Charles Gerba (Soil and Water Science), J. Tai Huber (Biological Sciences), Mary Ann Kight (Nutritional Sciences), Otakar Kolodovsky (Pediatrics), K.Y. Lei (Nutritional Sciences), Timothy Lohman (Exercise and Sport Sciences), Anthony F. Philips (Pediatrics), William A. Stini (Anatomy) (Microbiology), C. Brent Theurer (Animal Sciences), Marc E. Tischler (Biochemistry), Associate Professors Larry C. Clark (Family and Community Medicine), Carlos Flores (Pediatrics), Donald V. Lightner (Veterinary Science), Ralph L. Price (Nutritional Sciences), Cheryl K. Ritenbaugh (Family and Community Medicine), Edward T. Sheehan (Nutritional Sciences), Associate Professors Iris R. Bell (Psychiatry), Wanda H. Howell (Nutritional Sciences), Research Professor Ronald Watson (Family and Community Medicine), Associate Specialist Linda K. Houkopper
The interdepartmental Program on Nutritional Sciences offers graduate work leading to the Doctor of Philosophy degree with a major in nutritional sciences. Options in nutritional biochemistry, food safety, human nutrition (clinical or community), or animal nutrition may be selected within this major. The Committee on Nutritional Sciences represents a group of faculty members located in various departments of the University, who participate in graduate training in all areas of nutrition. Open to majors only. P, Course work equivalent to American Dietetic Association DPD.

Undergraduate preparation must include a semester each of algebra and calculus or trigonometry (calculus is recommended) and one year each of general biology, physics, and organic chemistry with laboratory. A semester of quantitative analysis is required for students selecting the options in nutritional biochemistry or animal nutrition. GRE scores for quantitative and verbal tests are required for admission.

Degree
Doctor of Philosophy: The student's course of study will be developed by the student and the major advisor and approved by the student's graduate advisory committee and the Committee on Nutritional Sciences. Students must meet the minimum requirements established for the master's degree in their options, plus additional requirements specified by the student's graduate advisory committee, before obtaining the Ph.D. A maximum of ten units of individual studies (599, 699, 900) and seminar (696) credits will be counted toward requirements for the degree.

A minor may be chosen from a variety of areas including biochemistry, animal physiology, physiology, molecular and cellular biology, ecology and evolutionary biology, food science, anthropology, pharmacology, and chemistry.

596. Seminar
  a. Alcohol, Drugs: Biology to Treatment (3) I
  b. Nutrition (1) I II (Identical with NUSC 696b)

Optical Sciences (OPTI)
Optical Sciences Center, Room 401
(520) 621-4111
Graduate Interdisciplinary Program in Optical Sciences
Committee:
Professors Richard C. Powell, Director (Materials Science and Engineering), J. Roger P. Angel (Astronomy), George H. Atkinson (Chemistry), Harrison H. Barrett (Radiology), Peter H. Bartels (Pathology), James J. Burke, William J. Dallas (Radiology), Eustace L. Dereniak (Electrical and Computer Engineering), Charles M. Falco (Physics), Peter A. Franken (Physics), B. Roy Frieden, Kenneth F. Galloway (Electrical and Computer Engineering), Jack D. Gaskill (Electrical and Com-


Associate Professors Arthur F. Gmitro (Radiology), John E. Greivenkamp, Jr. (Ophthalmology), Raymond K. Kostuk (Electrical and Computer Engineering), Robert R. Schowengerdt (Electrical and Computer Engineering), Arid Lands Resource Sciences), Robin N. Strick- land (Electrical and Computer Engineering), Ewan M. Wright (Physics) Assistant Professors Rudolf H. Binder, Poul S. Jessen, Galina Khitrova, Mark A. Neifeld (Electrical and Computer Engi- neering), Jose Sasian Research Professor Hans Roehrig (Radiology) Associate Research Professor James M. Palmer

The Program in Optical Sciences offers programs leading to the Master of Science and the Doctor of Philosophy degrees with a major in optical sciences. Areas in which research is currently being conducted include optical systems design, interferometry and optical testing, infrared technology, radiometry, remote sensing, optical detector systems, thin film deposition, image processing, scanning tunneling microscopy, nuclear, x-ray and MRI medical imaging, optical data storage, optical computing compo- nents, diffractive and binary optics, novel optical materials, adaptive optics, nonlinear optics, optical trapping and cooling of atoms, semiconductor and solid state laser physics. Interdisciplinary programs in progress involve the depart- ments of Materials Science and Engineer- ing, Ophthalmology, Physics, and Radi- ology, as well as Steward Observatory, the Arizona Research Laboratory, the Optical Circuitry Cooperative and the Optical Data Storage Center.

Applicants should hold a bachelor's degree in engineering, mathematics, or physics. Applicants must submit to the Associate Director, Academic Affairs, Optical Sciences Center, University of Arizona, Tucson, Arizona 85721, one complete set of transcripts and at least two letters of recommendation. Scores on the general test and one subject (enginee- ring, mathematics, or physics) test of the Graduate Record Examination are normally required. Students are normally admitted to begin their studies in optical sciences during fall semester. The deadline for submission of all application materials is February 1 for foreign, March 1 for domestic with assistantship and March 15 for domestic without assistant- ship. However, because of the large num- ber of applications received each year, early submission is encouraged.

Degrees

Master of Science: There is no core curriculum for the Master of Science degree, and students are allowed considerable free- dom in planning their study programs. Students may elect either of two options: Thesis option: A minimum of 32 units of graduate credit in optics or optics-related courses, giving 8 units of 910 (thesis), at least 2 units of optics laboratory courses, and a final oral examination based primarily on the thesis. Non-thesis option: A minimum of 35 units of graduate credit in optics or optics-related courses, including at least 2 units of optics laboratory courses; 3 units credit for demonstrated competence in written communication (either by writ- ing an acceptable Master's Report or suc- cessfully completing an appropriate course in technical writing); and a final oral examination, based primarily on the subject matter of the courses taken.

In addition, the Master of Science degree may be awarded to prospective candidates for the Doctor of Philosophy degree upon successful completion of the preliminary examination.

Doctor of Philosophy: A core curriculum, including courses 501, 502, 503, 504, 505, 506, 507, 508, has been developed to help doctoral students prepare for the prelimi- nary examination. These courses are not required, but students are expected to know the material presented in them. There is no foreign language requirement for the Doctor of Philosophy major in optical sciences. Students must include at least two units of optical laboratory courses or provide evidence of equivalent laboratory experience. At the discretion of the committee, doctoral students with majors in optical sciences, as well as those majoring in other disciplines, may elect a minor in optical sciences. Such students must complete, for the minor, twelve units of course work with a grade of "B" or better in optical sciences or obtain approval for the equivalent in transferred course work. No more than six of these units may be crosslisted with the student's major department (if other than optical sciences).


502. Introduction to Optical Design (3) I Rays and wavefronts, Snell's Law, mirror and prism systems, Gaussian imagery and cardinal points, paraxial ray tracing, stops and disper- sion, systems of thin prisms, system analysis using ray trace code, chromatic aberrations and achromatization, monochromatic aberrations, ray fans, spot diagrams, balancing of aberra- tions, aspheric systems. P, PHYS 116, 121.

503. Quantum Optics and Lasers (3) I Quantum background, interaction of light with matter, two-level atom, lasers, nonlinear optics. P, PHYS 435 (Identical with PHYS 503)

504. Mathematical Methods for Optics (3) I Complex variables, Fourier theory and appli- cations to imaging, coherent and incoherent imaging, other integral transforms, special functions and orthogonal polynomials, linear algebra, integral equations, Green's functions. P, MATH 223, PHYS 116 or PHYS 121.

505. Diffraction and Interferometry (3) I Interference and interferometry, concepts of coherence, holography, diffraction theory, Fraunhofer and Fresnel diffraction, volume diffraction, Gaussian beam propagation, optical transfer function, speckle, P, 501.

506. Radiometry and Detectors (3) I Generation and propagation of blackbody and other radiation, projected areas, solid angle, inverse square and other laws, isotropic and other sur- faces, absorption, reflection, transmission, scattering, imaging and non-imaging detectors, figures of merit, vision, color, film, cali- bration and measurement, spectrometers and radiometers. P, 502.

507. Solid-State Optics (3) I Basic concepts in crystals and in optical response, optical prop- erties of phonons and semiconductors, quantum wells, electro-optical properties of bulk semiconductors, optical nonlinearities, solid state devices and laser diodes. P, 503, 511 or PHYS 435.


509L. Fundamentals of Physical Optics Laboratory (1) I Laboratory in support of 501 and 505. P, 501 or 505.

510L. Fundamentals of Applied Optics Laboratory (1) I Optical systems; Gaussian optics, aberrations, radiometric sources, detectors, optical engineering, P, 506.

511L. Lasers and Solid-State Devices Laboratory (1) II Gas and semiconductor lasers, modes and beats, modelocking, spectrum analysis, exitons and quantum wells, noise, modulators and detectors, second-harmonic generation. P, 503 or 511, CR 507.

512. Introduction to Fourier Optics (3) I Mathematical background, convolution, the Fourier transform, linear filtering, two-dimensional operations, diffraction, image formation. P, MATH 223, PHYS 116 or PHYS 121.

512L. Mathematical Optics Laboratory (1) I Laboratory in support of 504, 508 and 512. P, 504 or 512 and SC 227 or SEE 270.


514. Aberration Theory (3) I Aberration theory; geometrical image formation; diffraction; pupil, spread, and transfer functions; random wavefront perturbations; system effects; image evaluation; image processing. P, 506.

517. Lens Design (4) I Fundamentals of optical system layout and design; exact and paraxial ray tracing; aberration theory; chromatic and monochromatic aberrations; use of computer programs in lens design. P, 506.

518. Introduction to Aberrations (3) II Advanced first-order tools, chromatic aberrations, monochromatic aberrations, sources of aberration, computation, simple systems. P, 502.

527. Holography (3) I 1996-97 Historical background; the hologram as a zone plate; Fresnel, Fourier-transform, image, reflection and computer-generated holograms; practical holography; limitations. P, 505. (Identical with ECE 527)

529. Information and the Formation of Physical Laws (3) I Fisher measurement channel; Entropy; Fisher information and disorder; physical information; extremization implying physical laws and constants. P, 501 or PHYS 475b. (Identical with PHYS 529)

531. Image Processing Laboratory for Remote Sensing (3) I (Identical with ECE 531)

532. Computer Vision (3) II (Identical with ECE 532)

533. Digital Image Processing (3) I (Identical with ECE 533)

534. Advanced Topics in Electronic Materials (3) [Rpt./2] 1996-97 (Identical with MSE 534)


541. Introduction to Lasers (3) I Laser theory; properties of lasers, stimulated emission, dispersion theory, gain saturation and rate equations, optical resonators, mode locking, survey of laser types and mechanisms. P, PHYS 103b.


550. Fundamentals of Remote Sensing (3) I Historical development of remote sensing, the sun and the electromagnetic spectrum; radiometry; radiometry of optical systems; spectroradiometric instruments; reflectance, definitions and measurement; atmospheric properties, measurements and effects; satellite optical sensors; radiometric calibration of sensors; atmospheric correction.

560. Optical Radiometry (3) I 1996-97 Units and nomenclature; Planck's law; black body; gray body; spectral emitters; Kirchhoff's law; flux concepts; axial and off-axis irradiance; radiative transfer; normalization; coherent illumination; radiometric instruments. P, 501.

565. Infrared Techniques (3) I 1995-96 Radiometry review; the radiant environment; blackbody and other radiation; properties of materials; detectors; optical systems; scanners; system design techniques and examples.

561. Physics of the Solid State (3) II (Identical with PHYS 561)

563. Photovoltaic Imaging Devices (3) II Intensifiers; camera tubes storage tubes; specifications; evaluation; applications; electronic optics, human visual process, photon detection. P, PHYS 116.


568. Solid-State Imaging Devices (3) II 1995-96 Charge transfer devices, monolithic and hybrid focal plane, photodiodes, photovoltaic, and pyroelectric detectors, figures of merit, time-delay integration (TDI), fat zero, transfer efficiency, MTF, double-correlated sampling, input techniques, output techniques, buried channel vs. surface channel devices. Composited video characteristics. P, 507.

573. Atomic and Molecular Spectroscopy for Experimentalists I (3) (Identical with PHYS 573)

574. Atomic and Molecular Spectroscopy for Experimentalists II (3) (Identical with PHYS 574)


577. Optics of Thin Films (3) I Dielectric interference films; semiconductor and metallic films; planar wave guide films; design methods for multilayer interference filter coatings; thin film components for integrated optical circuits. P, 505.

587. Fiber Optics Laboratory (3) II Fiber characteristics; fiber preparation; single and multimode fibers; sources; coupling; communication systems; multiplexing techniques; fiber-optic sensors. P, ECE 456. (Identical with ECE 587)

590. Remote Sensing for the Study of the Planet Earth (3) II 1996-97 (Identical with REM 590)

595. Colloquium a. Current Subjects in Optical Sciences (1) [Rpt./2] II

597. Workshop a. Optical Shop Practices (3) II P, 513, 513L.

*May be continued with 400-level course.

637. Principles of Image Science (3) II 1995-96 Mathematical description of imaging systems and noise; introduction to inverse problems; introduction to statistical decision theory; prior information; image reconstruction and radial transform; image quality; applications in medical imaging; other imaging systems. P, 504 or 512, 508.

638. Advanced Medical Imaging (3) II Describes the principles behind the medical cross-sectional imaging modalities of magnetic resonance imaging (MRI), computed tomography (CT), ultrasound (US), positron emission tomography (PET), and single photon emission computed tomography (SPECT). P, 504 or 512 or equivalent.

656a-656b. Atmospheric Radiation and Remote Sensing (3-3) I 1995-96a 656b 1997-98 (Identical with ATMO 656a-656b)

670. Principles of Optical Data Storage (3) II 1996-97 Optics of polarized light in systems of high numerical aperture; automatic focusing and tracking schemes; interaction of light and magnetic media; readout enhancement through multilayering; physical mechanisms of optical recording in ablative, phase-change, thermomagnetic and dye-polymer media; sources of noise in optical recording; data encoding schemes. P, consent of instructor.


The Department of Pharmaceutical Sciences includes the academic disciplines of pharmaceutical chemistry, pharmacognosy, biopharmaceutics, pharmaceutical sciences, and pharmacy administration. It offers programs leading to a Master of Science and Doctor of Philosophy degrees with a major in pharmaceutical sciences.

Concentrations within the major include: (1) pharmacokinetics/biopharmaceutics, (2) pharmaceutics, (3) pharmacy administration/pharmaceutical economics, and (4) pharmaceutical chemistry/pharmacognosy.

A bachelor's in pharmacy or Pharm.D. degree is generally required for pharmacy administration/pharmaceutical economics. A bachelor's (or Pharm.D.) degree is required for the graduate student in pharmaceutical sciences.

A thesis/dissertation based upon research is required. Graduate study programs are individually planned after consideration of the student's preparation and professional objectives. A number of minor fields are acceptable. Many specialized facilities are available for the graduate student in pharmaceutical sciences.

A bachelor's in pharmacy or Pharm.D. degree is generally required for pharmacy administration/pharmaceutical economics. A bachelor's (or Pharm.D.) degree is required for the graduate student in pharmaceutical sciences.

A thesis/dissertation based upon research is required. Graduate study programs are individually planned after consideration of the student's preparation and professional objectives. A number of minor fields are acceptable. Many specialized facilities are available for the graduate student in pharmaceutical sciences.


508a. Pharmacokinetics Discussion (1-1) I I Discussion related to the application of pharmacokinetic principles with case-study examples. CR, 507 for 508a, 485 for 508b. (Identical with PHPR 508a-508b)

511. Advanced Pharmaceutical Care Systems (3) I History, organization and administration of pharmaceutical services within the institutional environment. (Identical with PHPR 511)

512. Quantitative Structure-Activity Relationships (3) 1993-94 Approaches to the quantification of pharmacological actions of drugs on the basis of chemical structure.

513. Pharmaceutical Economics (3) II The application of the concepts and tools of the microeconomist to the assessment of the costs and the outcome of drug use in disease treatment and therapy interventions. A modeling approach is adopted to evaluating drug impacts within various institutional environments.

515. * Toxikokinetik (3) II 1995-96 Introduction to the principles of pharmacokinetics as they are applied to the biological and chemical sciences for the quantitative study of drugs and toxic agents. Toxikokinetik involves the development of quantitative models to describe the time course of absorption toxicity, especially as it relates to the drug or toxin disposition: Issues in experimental design, extrapolation of data from animals to humans, and aspects or risk assessment.

527. * Antineoplastic Drugs (2) II Discovery and development of natural and synthetic antineoplastic drugs; preclinical screening and toxicity evaluation; phase I, II, and III clinical studies in humans. P. 437b or CR.

537a. * Medicinal Chemistry and Pharmacognosy (4-4) Relationships between the chemical structure and physiological activity, incompatibilities and stability of the organic and inorganic compounds obtained from natural and synthetic sources; essentials of pharmacognosy, including biologicales. P. 307, CHEM 241b, 242b.

542. * Professional Practice Management (5) I Management of professional situations and the interaction among patients, colleagues, and other health-care providers, with application to institutional, community, and clinical pharmacy practice.

545. * Medication Use and the U.S. Health Care System (3) I An overview of the U.S. health care system and the consumers, providers, payers, and regulators that comprise it. The role of pharmacy and pharmacists within the health care system will be explored, including an examination of social, behavioral, and economic factors associated with the prescribing, dispensing, and use of medications.

547. * Perspectives in Geriatrics Laboratory (1) II (Identical with GER 447 and N SC 447)

548. * Perspectives in Geriatrics (2) I Multidisciplinary approach to the health-care needs of the elderly, including medication use, nutrition, health care agencies and roles of individual health care professionals. Open to nonmajors. (Identical with GER 448 and N SC 448)

561. * Methodology in Pharmacy Research and Drug Literature Evaluation (3) I I Application of research design, statistical methods, evaluation techniques, and ethical dimensions to critically evaluate published literature, research reports and proposals. May be con- veyed with PHSC 561.

583. * Perspectives of Cancer Care for Health Professionals (3) I (Identical with NURS 483)

585. * Advanced Clinical Pharmacokinetics (3) II (Identical with PHPR 585)

589. * Clinical Pharmacotheraphy of Mental Disorders (2) I A multidisciplinary approach to clinical psychopharmacology, therapeutics, and diagnosis of mental disorders for health professionals.


d. Pharmaceutics (1) [Rpt. /5 units] I I e. Pharmacy Administration (1) [Rpt. /5] I f. Pharmacy Administration Research (1) [Rpt. /5] II

*May be conved with 400-level course.

601. Advanced Physical Pharmacy (3) I 1996-97 Applications of physical chemistry to pharmacy. P. physical pharmacy or physical chemistry course.


606. Industrial Manufacturing Pharmacy (3) II Pharmaceutics as applied to various aspects of industrial pharmacy. Field trips.


611. Pharmaceutical Education Research (3) I Cultural, social, behavioral, and organizational foundations of pharmacy, including the development of the present state of practice. (Identical with PHL 611)

612. Pharmaceutical Outcomes Research (3) I Survey of research methodology for studying administrative, social and behavioral aspects of health care and pharmacy practice; strategy for selecting and modifying existing research tools for particular purposes. (Identical with PHL 612)
Research Associate Professor Mark Lee Witten (Pediatrics)

The Department of Pharmacology in the College of Medicine cooperates with the Department of Pharmacology and Toxicology in the College of Pharmacy, through the Committee on Pharmacology and Toxicology, in offering programs leading to the Master of Science degree with a major in pharmacology (a specialization in pharmacology and toxicology), in offering programs leading to the Master of Science degree with a major in pharmacology (a specialization in pharmacology and toxicology), and offering programs leading to the Doctor of Philosophy degree with a major in pharmacology and toxicology. See Committee on Pharmacology and Toxicology for details on admission and degree requirements. Pharmacology is a broad discipline involving the investigation of the actions of chemicals upon living material at all levels of organization. The discipline occupies an important interface between the basic medical sciences and the clinical sciences, drawing strongly upon the former for its contribution to the latter. Research in pharmacology utilizes all appropriate techniques of modern biology from the molecular to the clinical levels. Pharmacologic knowledge is applied to the understanding of the basic mechanisms of drug action, the diagnosis, prevention, cure or relief of the symptoms of disease and the promotion of optimal health. The emphasis on basic pharmacologic principles enables the student to develop techniques of problem-solving to keep abreast of advances in pharmacology and its applications to other sciences.

501. The Pharmacological Basis of Therapeutics (6) II Actions of chemical agents upon living material at all levels of organization, with emphasis on mechanisms of action of prototype drugs; foundation for a rational approach to human therapeutics and toxicology. P, PSIO 580, 581 and graduate course equivalent to BIOL 562 or 501. (Identical with TOX 501)

520. Clinical Pharmacology (2) I Effects of drugs on natural history of disease; drug-drug interactions; drug testing designs; drug abuse; drug literature evaluation; aspects of clinical toxicology. P, 501.

545. Neurobiology of Drugs of Abuse (3) II Pharmacology and toxicology of abused drugs with emphasis on mechanisms of drug action, theories of addiction, involvement of AIDS and the immune system and treatment approaches. P, ECOL 182. (Identical with PCOL 545)

550. Drug Disposition and Metabolism (2) II Principles of absorption, distribution and excretion of drugs, with emphasis on mechanisms of drug metabolism. P, 501, TOX 602a. (Identical with CBIO 550 and TOX 550)

551. Molecular Biology of Pharmacological Agents (3) I Molecular mechanism of drugs and toxins at the cellular and subcellular levels, including effects on control mechanisms, cell-cell interactions, organelles, and nucleic acid and protein synthesis. P, 501, 550, 551b. (Identical with TOX 551)
Pharmacology and Toxicology (PCOL/TOX)

Pharmacy Building, Room 206
(520) 626-7218; FAX: (520) 626-4182
(10) College of Pharmacy)

Professors I. Glenn Sipes, Head (Pharmacology, Anesthesiology), James Blanchard (Pharmaceutical Sciences), G. Timothy Bowden (Radiation Oncology), Dean E. Carter, Lincoln Chin (Emeritus), Paul F. Consore, James R. Halpert, Joseph J. Hoffmann (Arid Lands Resource Sciences, Pharmaceutical Sciences), Wayburn S. Jeter (Emeritus), Hugh E. Laird II, Arnold Martin (Pharmaceutical Sciences), Albert L. Picchioni (Emeritus), William A. Remers (Pharmaceutical Sciences), Findlay E. Russell, Karl H. Schram (Pharmaceutical Sciences), Barbara N. Timmermann (Arid Lands Resource Sciences, Pharmaceutical Sciences), Theodore G. Tong (Pharmacy Practice)

Associate Professor Daniel C. Liebler, Neil E. MacKenzie (Biochemistry, Pharmaceutical Sciences), Charlene A. McQueen, John W. Regan

Assistant Professors William T. Bellamy (Pathology), Clifton D. Crutchfield (Health Education), William S. Dalton (Internal Medicine), Robert T. Dorr (Pharmacology, Cancer Center, Medicine), John Sullivan (Emergency Medicine and Pharmacology), Mark D. Van Ert (Health Education)

The department of Pharmacology and Toxicology in the College of Pharmacy cooperates with the Department of Pharmacology in the College of Medicine, through the Committee on Pharmacology and Toxicology, in offering programs leading to the Master of Science degree with a major in pharmacology. The Doctor of Philosophy degree with a major in pharmacology and toxicology is offered in the College of Medicine. See Committee on Pharmacology and Toxicology for details on admission and degree requirements.

Pharmacology (PCOL)

Pharmacology is the science concerned with all aspects of the actions of drugs and other chemicals on living systems. Its primary aim is the discovery of chemical mechanisms by which cellular and molecular functions are regulated for the purpose of understanding how existing drugs act and to develop new drugs for treatment of diseases. The broad scope of interests of pharmacology ranges from the study of intermolecular reactions of chemical constituents of cells with drugs to the effects of chemicals in our environment on entire populations. See Committee on Pharmacology and Toxicology for details on admission and degree requirements.

Toxicology (TOX)
The Department of Pharmacology and Toxicology in the College of Pharmacy offers a curriculum leading to the Master of Science degree with a major in toxicology. See Committee on Pharmacology and Toxicology for details on admission and degree requirements.

Toxicology is the science concerned with the harmful effects of chemicals (including drugs) on living systems. Training in this area prepares students for careers in hospital laboratories, police crime laboratories, medical examiners' offices, industrial hygiene laboratories, and toxicology laboratories in industry, government, and universities. The broad scope of interests in toxicology ranges from determining the mechanisms by which chemicals produce adverse biological effects to identification and quantification of hazards resulting from occupational and/or environmental exposure to chemicals.

Industrial hygiene is the applied science concerned with the anticipation, recognition, evaluation and control of chemical and physical agents that can affect health status in occupational and environmental settings. An industrial hygiene concentration is offered in the Master of Science program. The concentration prepares students for professional practice in a wide range of both private and public sector organizations.

1. The Pharmacological Basis of Therapeutics (6) II (Identical with PHCL 501) P, PSIO 601 and graduate course equivalent to BIOC 801.

2. Industrial Hygiene Instrumentation and Analysis (2-4) I (Identical with OSH 502)

3. *Insectic Toxicology (3) II 1993-94 (Identical with ENTO 508)

4. Statistics for Research (4) I (Identical with Stat 565)

5. *Physical Exposures (3) II (Identical with OSH 510)

6. Toxicokinetics (3) II 1995-96 (Identical with ECOL 515)

7. *Mechanisms of Disease (5) II (Identical with V SC 523)

8. Drug Disposition and Metabolism (2) II (Identical with PHCL 550)

9. Molecular Biology of Pharmacological Agents (3) I (Identical with PHCL 551)

10. Industrial Toxicology and Chemical Exposures (2-4) I (Identical with OSH 554)

11. Physiology Laboratory (3) I (Identical with ECOL 566)

12. Fundamentals of Pharmacology (4-4) (Identical with PCOL 571a-571b)

13. Clinical Toxicology (2) I (Identical with PCOL 574)

14. Environmental Toxicology (3) II Toxicity of natural toxins and of agricultural and industrial chemicals, with emphasis on air and
water pollutants; decision-making in environmental issues. P, 6 units of biology and of organic chemistry; CHEM 325, 326. (Identical with ENTO 576 and PHCL 576)

580. Human Physiology (5) II (Identical with PSIO 580)

581. Physiology Laboratory (1) I (Identical with PSIO 581)

582. Immunotoxicology (2) I Broad overview of the immune system, with emphasis on how chemicals affect the immune system (immunomodulation) and the role of the immune system in chemical-induced tissue injury/allergic responses. P, 602, MICR 419R, 567. (Identical with PHCL 582)

585. * Industrial Ventilation (3) II (Identical with OSH 585)

586. * Fundamentals of Industrial Hygiene (3) I (Identical with OSH 586)

587. * Advanced Industrial Hygiene and Safety (3) II (Identical with OSH 587)

596. Seminar
   a. Advanced Toxicology (1-2) [Rpt./3] I
   b. Current Concepts in Toxicology (1-2) [Rpt./3] II

*May be converted with 400-level course.

601. Analytical Instrumentation and Techniques (2-4) I Lecture and laboratory in the qualitative and quantitative determination of toxic substances in the environment and body fluids. Modern instrumental techniques will be employed whenever appropriate. Lecture may be taken separately by non-majors. 2R, 6L. P. CHEM 325, 326. (Identical with PHCL 601)

602a-602b. Biotoxicology (3-1) 602a: I Lecture. Mechanisms of organ directed toxicities in animals. Chemical carcinogenesis, teratogenesis and mutagenesis. Open to non-majors. P, two semesters of ecology. 602b: II Laboratory. Proper use of animals in toxicology and pharmacology research; focuses on organ specific toxicities. P, 602a. (Identical with PHCL 602a-602b and PHL 602a-602b) (602a is identical with CBIO 602a)

610. Topics in Advanced Toxicology (1-3) I II Current developments in toxicology including: chemical carcinogenesis, mutagenesis and teratogenesis; behavioral toxicology; inhalation toxicology; toxicokinetics; metabolism and environmental toxicology. P, 601, 602a-602b.

620. Principles of Pharmacology (3) I (Identical with PHCL 620)

653. Neuropharmacology (3-4) II (Identical with PCOL 653)

696. Seminar
   a. Student Research (1) [Rpt./4] II (Identical with PHCL 696a, which is home)

**Pharmacology and Toxicology**

Pharmacology and Toxicology

College of Medicine, Room 5103
(520) 626-7218: FAX (520) 626-4182

Graduate Interdisciplinary Program in Pharmacology and Toxicology

Committee:

Professors A. Jay Gandolfi, Chair (Anesthesiology), David S. Alberts (Pharmacology, Medicine), H. Vasken Aposhian (Pharmacology, Molecular and Cellular Biology), G. Timothy Bowden (Radiation Oncology), Klaus Brendel (Pharmacology), Rubin Bressler (Medicine, Pharmacology), K. R. Brown (Emeritus, Anesthesiology), Dean E. Carter (Pharmacology and Toxicology), Paul F. Consore (Pharmacology and Toxicology), Thomas P. Davis (Pharmacology), Marilyn Halonen (Microbiology, Pharmacology, Respiratory Sciences, Internal Medicine), James R. Halpert (Pharmacology and Toxicology), Ryan J. Huxtable (Pharmacology), David G. Johnson (Medicine, Pharmacology), Hugh E. Laird, II (Pharmacology and Toxicology), Michael B. Mayersohn (Pharmacological Sciences), Eugene Morkin (Heart Center, Medicine, Physiology, Pharmacology), John D. Palmer (Pharmacology, Medicine, Assistant Professor), Frank Porreca (Pharmacology), G. Powis (Pathology, Pharmacology), Charles W. Putnam (Surgery, Pharmacology), William R. Roeseke (Medicine, Pharmacology), Findlay E. Russell (Pharmacology and Toxicology), I. Glenn Sipes (Pharmacology, Pharmacology and Toxicology, Anesthesiology), Henry I. Yamamura (Pharmacology, Biochemistry, Arizona Research Labs, Psychiatry)

Associate Professors John W. Bloom (Pharmacology, Medicine, Respiratory Sciences), Robert D. Dorr (Pharmacology, Cancer Center, Medicine), Timothy C. Fagan (Pharmacology, Medicine), Edward D. French (Pharmacology), Daniel C. Liebler (Pharmacology and Toxicology), Charlene A. McQueen (Pharmacology and Toxicology), John W. Regan (Pharmacology and Toxicology)

Assistant Professors William S. Dalton (Pharmacology, Pharmacology and Toxicology, Internal Medicine), Bernard W. Futscher (Pharmacology, Cancer Center, Medicine), Josephine Y. Lai (Pharmacology), Douglas F. Larson (Pharmacology, Surgery), Ronald M. Lynch (Physiology, Pharmacology), John B. Sullivan (Emergency Medicine, Pharmacology), Andre J. Yool (Physiology, Pharmacology)

Associate Research Scientist Siraj I. Mutfi

The Graduate Interdisciplinary Program in Pharmacology and Toxicology offers a graduate program leading to the Doctor of Philosophy degree with a major in pharmacology and toxicology. The program also offers M.S. degrees with majors in pharmacology and in toxicology. The program faculty are from the Departments of Pharmacology and Toxicology, Pharmacology, Anesthesiology, Internal Medicine, Surgery, Molecular and Cellular Biology, Radiation Oncology, Pharmaceutical Sciences and Pediatrics.

Admission requires the completion of a bachelor's degree with a major in chemistry, biology, pharmacy or other related science. Minimal prerequisites include one year each of biology, organic chemistry and physics and coursework in mathematics through integral calculus. Applicants must submit general GRE scores, three letters of recommendation and a statement of purpose. Direct all correspondence and send all admission materials directly to: Chairperson, Graduate Program in Pharmacology and Toxicology. Graduate study programs are individually planned after consideration of the student's preparation and professional objectives. A dissertation/thesis is required.

For course descriptions, see Pharmacology (College of Medicine) and Pharmacology and Toxicology (College of Pharmacy).

**Philosophy (PHIL)**

Social Sciences Building, Room 213
(520) 621-3129; FAX: (520) 621-9559


Associate Professor Joseph T. Tollefson

Assistant Professors Thomas Christiano, David Owen, Margaret Reimer

The department offers programs leading to the Master of Arts and the Doctor of Philosophy degrees with a major in philosophy. In addition to the traditional areas of philosophy, concentrations are available that bridge philosophy with other disciplines such as law or cognitive science.

Applicants for the graduate program should normally have completed 30 units of undergraduate work in philosophy. In addition to application materials required by the Graduate College, applicants should submit to the department a copy of their completed application, copies of transcripts (these need not be official), three letters of recommendation from philosophy instructors, GRE general aptitude scores, and a sample of their written philosophy work.

**Degrees**

**Master of Arts:** A student must demonstrate proficiency in logic, and in addition...
must pass at least one course in each of the following three areas: history of philosophy, metaphysics and epistemology, and moral philosophy. A final examination must be passed, based on a research paper in an area chosen by the student. The student's program of study is designed individually. No thesis is required.

**Doctor of Philosophy:** A student must pass two courses in each of the following four distribution areas: (1) logic (required), philosophy of language, and philosophy of science; (2) history of philosophy; (3) epistemology and metaphysics; and (4) moral, social, and legal philosophy. A substantial proportion of one's courses must be at the seminar level. Students must pass a qualifying exam, based on a research paper. In addition, a preliminary exam must be passed in areas of the student's choice, and a doctoral dissertation is required. Further details about requirements and procedures can be obtained from the department. Teaching assistantships are available for qualified students.

503. *Foundations of Mathematics (3) II 1996-97 (Identical with MATH 503)
510-510b.* History of Moral and Political Philosophy (3-3) Reading and analysis of selected texts from the Greeks to the present. 510a focuses on the history of moral philosophy and 510b on the history of social and political philosophy.

512.* Readings in Greek Philosophy (3) [Rpt.] (Identical with GRK 512)
513a-513b.* Symbolic Logic (3-3) 513a: Intermediate propositional logic and quantification theory, natural deduction, axiom systems, elementary metatheorems, introduction notions of modal logic, selected topics in philosophy of logic. 513b: Advanced propositional logic and quantification theory; metatheorems on consistency, independence, and completeness; set theory, number theory, and modal theory; recursive function theory and Gödel's incompleteness theorem.

514.* Philosophical Logic (3) Introduction to modal logic; problems of interpretation and application; extensions to such areas as tense logic, epistemic logic, deontic logic.


516.* Induction and Probability (3) Basic philosophical problems concerning justification of induction, confirmation of scientific hypotheses, and meaning of probability concepts.

521.* Philosophy of the Biological Sciences (3) Laws and models in biology, structure of evolutionary theory, teleological explanations, reductionism, sociobiology. (Identical with ECOL 521)

522.* Linguistic Semantics and Lexicology (3) II 1995-96 (Identical with LING 522)

523a-523b.* Philosophy of the Physical Sciences (3-3) 523a: Theories and models. Measurement, experimentation, testing hypotheses. Philosophical problems concerning explanation, causation and laws of nature. 423b: Philosophical problems of space, time and motion. Topics may include the nature of geometrical knowledge, the philosophical impact of relativity theory, absolute versus relative conceptions of space and time.

524.* Philosophy of Social Sciences (3) Theories, concepts, and forms of understanding in the social sciences. Possible topics: rational choice and decision at the individual and social levels; democracy and market mechanisms. P, one course in philosophy.

525.* Philosophical Issues in Feminism (3) Issues in philosophy raised by feminism and recent studies of gender. Possible topics: the source of gender differences; gender and the nature of knowledge; gender differences in conceptions of morality; feminist political theories; the nature of mothering.

530a-530b.* Ethical Theory (3-3) 530a: Metaphysics—meaning of moral terms, relativism, subjectivism, ethics and science, social contract theory. 530b: Normative ethics—Utilitarianism, egoism, rights, natural law, justice, deontological duties, blameworthiness and excuses.

532.* Natural Language Processing (3) I (Identical with LING 532)

533.* Aesthetics (3) Classical and contemporary theories of art; the esthetic experience, form and content, meaning, problems in interpretation and criticism of works of art.

534.* Social and Political Philosophy (3) Fundamental concepts of politics; leading social and political theories, such as anarchism, social contract, Marxism.


538a-538b.* Philosophy of Law (3-3) 538a: Nature and validity of law; law and morality, judicial reasoning, law and liberty. 538b: Problems about justice, punishment and contracts and/or responsibility and punishment. (Identical with POL 538a-538b)

540.* Metaphysics (3) Topics include free will and determinism; causation; personal identity; necessity and essence; truth, realism and ontology.

541.* Theory of Knowledge (3) Critical examination of some of the major problems concerning evidence, justification, knowledge, memory, perception and induction.

542.* Knowledge and Cognition (3) I Issues in philosophy and psychology of knowledge, with emphasis on cognitive mechanisms. Perception, memory, concepts, mental representation, problem-solving, reasoning and rationality. P, one philosophy course.

543.* Knowledge and Society (3) II Social and interpersonal processes affecting the acquisition and diffusion of knowledge. Emphasis on philosophical perspectives, with interdisciplinary borrowings. P, one philosophy course. (Identical with LIT 543)

545.* Neural Network Modeling: What and Why (3) II (Identical with PSYC 545)

550.* Philosophy of Mind (3) Topics include the nature of mental states; the relation between mind and brain; and analysis of perception, emotion, memory and action.

551.* Philosophy and Psychology (3) Investigation of philosophical issues arising from current work in psychology including perception, reasoning, memory, motivation and action.

555.* Philosophy and Artificial Intelligence (3) Interdisciplinary problems lying at the interface of philosophy and artificial intelligence (Identical with PSYC 555)

563.* Philosophy of Language (3) Survey of basic issues in the philosophy of language such as: speech acts, reference, meaning, logical form. (Identical with LING 563)

564. Formal Semantics (3) I (Identical with LING 564)

565.* Pragmatics (3) II Study of language use, its relationships to language structure and context; topics such as speech acts, presupposition, implication, performatives, conversations (Identical with LING 565)

567.* Frege and the Rise of Analytic Philosophy (3) The writings of Frege on logic, language, and mathematics and their influence on contemporary philosophical thought.

570.* Greek Philosophy (3) [Rpt.] Topics in Greek philosophy. May be selected from the pre-Socratics, Socrates, Plato, Aristotle and post-Aristotelian philosophy. (Identical with CLAS 570)

571a-571b.* Rationalism and Empiricism (3-3) 571a: Rationalists of the 17th and 18th centuries: Descartes, Spinoza, Leibniz, and Kant. 571b: Empiricists of the 17th and 18th centuries: Locke, Berkeley, Hume.

572a.* Ancient Philosophy (3) [Rpt.] 572a: A philosophical introduction to the major works of Plato. 572b: A philosophical introduction to the major works of Aristotle. (Identical with CLAS 572a)

596. Seminar
a. Ethics (3) [Rpt.] [2]
b. Metaphysics (3) [Rpt.] [2]
c. Epistemology (3) [Rpt.] [2]
d. Social and Political Philosophy (3) [Rpt.] [2]

g. Philosophy of Law (3) [Rpt.] [2] (Identical with LAW 596g)

h. Philosophy of Physical Science (3) [Rpt.] [2] (Identical with PHYS 596h)
i. Philosophy of Mind (3) [Rpt.] [2]
j. Philosophy of Language (3) [Rpt.] [2]
k. History of Philosophy: Ancient (3) [Rpt.] [2]
l. History of Philosophy: Recent (3) [Rpt.] [2]

*May be convened with 400-level course.

**Physics (PHYS)**

PAS Building, Room 260
(520) 621-6824

Professors Daniel Stein, Head, W. David Arnett, Bruce R. Barrett, Stanley Bashkin
The department offers programs leading to the Master of Science and the Doctor of Philosophy degrees with a major in physics. In cooperation with the College of Education, the department also offers a minor in physics. For information concerning this minor degree see Requirements for Master's Degrees/Master of Education elsewhere in this catalog.

Prerequisites for admission to full graduate standing are thirty semester units of undergraduate work in physics. These will normally include the following work beyond introductory physics: one semester each of mechanics, thermodynamics, and optics; two semesters of electricity and magnetism; and two semesters of modern physics including quantum mechanics. All applicants must submit scores on the aptitude and advanced tests of the Graduate Record Examination.

An advisor is assigned to each graduate student to help plan a program for the advanced degree. Students without deficiencies are required to take, during the first week of classes, a qualifying comprehensive examination. This diagnostic examination covers undergraduate physics only; and the results will be used to help in determining an appropriate course of studies. Two attempts to pass this examination are permitted. Experience in teaching is an essential part of graduate training in physics. Graduate students are required to teach an amount to be determined on an individual basis by the graduate adviser and the department as a whole. Graduate students are required to take 695 until the preliminary examination is passed.

Degrees

Master of Science: At least fifteen of the required thirty units of graduate work must be in physics and must include 536, 511 and 515a or the equivalent. Also, each student must satisfy one of the following options: (1) write a thesis (for which up to six units may be allowed) and pass an oral examination on the thesis; (2) take 21 of the 30 required graduate units in physics and pass a comprehensive final oral examination; (3) pass the written and oral parts of the preliminary examination for the Doctor of Philosophy degree.

Doctor of Philosophy: Each student must complete at least 36 units of graduate work in physics exclusive of the dissertation and the supporting (minor) work. Courses will be chosen in consultation with the graduate adviser. Each student must complete four of the following courses: 513, 525, 535, 551, 559 or 561, 579a or 579b, 581 and 685. In addition, at least two of the four courses must be from the subset of courses 535, 551, 559 or 561 and 581. Note that only one of the courses 559 and 561 and only one of the courses 579a and 579b can be counted as part of the required four courses. The preliminary examination will cover classical mechanics, electromagnetic theory, relativity, statistical mechanics, experimental physics, quantum mechanics, modern physics, and questions on current developments. The courses 511, 515a-515b, 528, and 570a-570b indicate the areas covered in the examination and the level of understanding expected of the student. The preliminary examination must be taken, at the latest, during the fifth semester (excluding summer sessions) of residence. It is expected that the dissertation, based upon original research, will be published in a refereed journal. The minor work may be satisfied within the Department of Physics and, in this case, some courses taken in other departments may be used as well. An additional twelve units of work, chosen in consultation with the graduate adviser, are required for the minor in physics. Proficiency in one foreign language is required. Information on methods of demonstrating proficiency may be obtained from the Department of Physics.

Students intending to minor in physics (to supplement a major in another department) should consult the physics minor adviser early in their graduate work.

Experimental research is conducted in the following areas: elementary particle physics, cosmic rays and space physics, solid state physics, atomic and molecular physics, nuclear physics, carbon dating, surface science, quantum optics, biophysics, and general relativity. Theoretical research is conducted in: solid state physics, atomic physics, nuclear physics, elementary particles, field theory, general relativity, astrophysics and non equilibrium statistical mechanics. Prospective students should write to the department for information about specific research programs, the faculty involved, the facilities available, and the research and teaching assistantships or fellowship support which can be offered. It is the policy of the department to award financial aid in the form of teaching assistantships solely on the basis of the student's academic record and financial needs. Fellowships are also available to first-year graduate students.

502.* Medical Physics (3) I Basic physics of the human body: the principles of mechanics, electricity, sound, light, and radiation as they apply to physiology, with emphasis on instrumentation for diagnosis and treatment. P, 104b or 12b and MATH 124 or equivalent.

503. Quantum Optics and Lasers (3) I (Identical with OPTI 503)

508. Medical Physics (3) I Basic physics of the human body: the principles of mechanics, electricity, sound, light, and radiation as they apply to physiology, with emphasis on instrumentation for diagnosis and treatment. P, 104b or 12b and MATH 124 or equivalent.

511. Analytical Mechanics (3) I Laws of motion as developed by Newton, d'Alembert, Lagrange and Hamilton; dynamics of particles and rigid bodies. P, 321.

513. Topics in Advanced Mechanics (3) II Modern topics in classical mechanics, including canonical perturbation theory, invariant mappings, nonintegrated system stochastic behavior and applications to semi-classical quantum theory. P, 511.


528. Statistical Mechanics (3) II Physical statistics; the connection between the thermodynamic properties of a macroscopic system and the statistics of the fundamental components; Maxwell-Boltzmann, Fermi-Dirac, Einstein-Bose statistics. P, 475b.

529. Information and the Formation of Physical Laws (3) I (Identical with OPTI 529)

530.* Introduction to Biophysics (2) I Concepts and experimental techniques of molecular biophysics; physical properties of biological macromolecules and cell organelles, optical interactions, macromolecular transitions, molecular mechanism or regulation. P, 102b, CHEM 103a-103b. (Identical with MBIM 530)
531. Biophysical Theory (2) II Physical concepts and theories describing biomolecular structure and function; molecular evolution, limits to structure, symmetry, oligomer and virus structure, organelle structure and function. (Identical with MBMB 531)

533. Physics Demonstrations (1-3) II Introduction to teaching materials and laboratory demonstrations illustrating principles of classical and modern physics, with emphasis on inexpensive techniques and direct experience. Advanced degree credit available for nonmajors only. P, two semesters of physics.

535. Advanced Atomic Physics (3) II 1994-95 Details of atomic structure; interactions of atoms with electromagnetic fields, electrons and ions; techniques for calculating unper- turbated and perturbed energy levels, transition probabilities, and atomic interaction cross sections. P, 511, 515b, 570b.

545. Experimental Physics 545a-545b-545c are three five-week lecture courses; none is prerequisite to another.
   a. Experimental Spectroscopy (1) II S Laboratory experiments with spectroscopic sources, spectrometers, instrument func- tions, detectors, light collection optics, spectral recording and analysis. P, 110, 116, 121, or consult department before enrolling.
   b. Experimental Acoustics (1) II S Laboratory experiments with sound sources, oscilloscopes, spectrum analyzers, sound level meters, filters, musical instruments, recording, room acoustics. P, 110, 116, 121, or consult department before enrolling.
   c. Experimental Microscopy, Light Scattering and Optics of Small Particles (1) II S Laboratory experiments with micro- scopes and polarized scattered light to characterize small particles and surfaces, optical constants, lasers remote sensing. P, 110, 116, 121, or consult department before enrolling.

550. Introductory Nuclear Physics (3) II Basic concepts of nuclear physics: structure and stability of nucleus; nuclear forces; stable systems; nuclear reactions; decay of unstable systems; nuclear radiation characteristics. P, 330 or 112b, MATH 254.


556. Electrodynamics of Conducting Fluids and Plasmas (3) I 1996-97 (Identical with PHY 556)


560. Introductory Solid-State Physics (3) I II Properties of solids from molecular, atomic, and electronic theory; electric, magnetic, and thermal properties of metals, insulators, and semiconductors; free electron and band theo- ries. P, 330 or 112b.

561. Physics of the Solid State (3) II Elementary excitations in solids, phonons, electrons and holes, excitons, biexcitons, interaction of light with semiconductors, polaritons, high excitation phenomena, dielectric formalism of optical response, many-body effects in a Coulomb system. P, 460, 570, or OPTI 507 recommended but not formally required. (Identical with OPTI 561)

570a-570b. Quantum Mechanics (3-3) Principles of quantum mechanics; wave mechanics and matrix mechanics; applications to atomic structure and spectroscopy. P, 475a-475b recommended but not required.

571. Symmetry Groups in Physics (3) I Alge- braic results of the theory of groups that find repeated applications in atomic, molecular, nuclear and particle physics. Continuous groups, Lie algebras, discrete groups, irreduc- tible tensors. P, 570a-570b.

572. Applications of Introductory Quantum Theory (3) I II Applications of quantum theory to molecules, atomic nuclei, elementary particles and simple solids. P, 371.

573. Atomic and Molecular Spectroscopy for Experimentalists I (3) Experimental tech- niques to generate, analyze, and detect pho- tons from x-ray to infrared; interpretation of spectra from gases, liquids, solids and biological macromolecules; light scattering, polariza- tion. P, 242 or 252. (Identical with OPTI 573)

574. Atomic and Molecular Spectroscopy for Experimentalists II (3) Continuation of 573. P, 573 (Identical with OPTI 574)


576. Methods of Mathematical Physics II (3) Special functions, transform theory, integral equations, variational techniques, computer-based data acquisition and analysis; solar- energy physics; and others.

577a-577b. Theory of Relativity (3-3) 1994-95 Special theory of relativity and its application to mechanics and electrodynamics; tensor calculus and general relativity; relativistic astrophysics and cosmology. P, 475b.

579a-579b. Advanced Relativistic Quantum Mechanics (3-3) Continuous groups; scattering theory; relativistic wave equations; quantum electrodynamics, Feynman diagrams, dispersion theory, renormalization; strong and weak interactions. P, 515b, 570b.


581. Elementary Particle Physics (3) I II Production, interaction, and decay of mesons, baryons and leptons; high energy scattering of elementary particles; particle classification and symmetries; theoretical interpretation. P, 436.

582. High Energy Astrophysics (3) II 1995-96 (Identical with ASTR 582)

585. Stellar Pulsation (1-3) [Rpt. /9] I II Stellar pulsation, the solar atmosphere, solar seismology and long-term solar variability related to climate.

586. Techniques in Particle Physics (3) II 1994-95 Classification of elementary particles and their interactions with matter, relativistic kinematics, detectors, data acquisition tech- niques, statistical techniques, analysis of experiments, cosmic radiation, and accelerators.

598. Topics in Theoretical Astrophysics (3) [Rpt.] Current topics in theoretical astrophysics in depth, with emphasis on the methodology and techniques of the theorist and the cross-disciplinary nature of astrophysics theory. Example subjects are nuclear astrophysics, hydrodynamics, transient phe- nomena, planetary interiors and atmospheres, neutron stars, jets, and the evolution of star clusters. (Identical with ASTR 589 and PTYS 589)

   c. The Physics of Thin Films (3) II P, 460. h. Philosophy of Science (3) [Rpt. /2] (Identical with PHIL 596b, which is home)
   k. Topics in Colliding Beam Physics (3) [Rpt. /9 units] I P, 570a-570b

*May be convened with 400-level course.

685. Graduate Physics Laboratory (3) [Rpt. /2] II Introduction to modern research methods and experiments. Problems in low-temperature physics; solid-state, atomic, and nuclear spectroscopy; computer-based data acquisition and analysis; solar- energy physics; and others.


697. Workshop a. Problems in Computational Science (3) [Rpt. /1] I II (Identical with MATH 697a)
   b. Applied Mathematics Laboratory (3) II (Identical with MATH 697b)

Physiological Sciences

1501 N. Campbell Ave.
Tucson, AZ 85721
(520) 626-2898; FAX: (520) 626-2382

Graduate Interdisciplinary Program in Physiological Sciences

Committee:
Professors Stuart K. Williams, Chair (Surgery), Ronald E. Allen (Animal Sciences), Eldon J. Braun (Physiology), William H. Dantzler (Physiology), Robert W. Gore (Physiology), Joseph F. Gross (Emeritus), Raphael P. Grueber (Physiology), Otakar Koldovsky (Pediatrics), Timothy G. Lohnan (Exercise and Sport Sciences), Robert S. McCuskey (Anatomy), Eugene Morkin (Internal Medicine), William R. Roeske (Internal Medicine), Timothy W. Sec- omb (Physiology), Douglas G. Stuart

Physics—Physiological Sciences 141
Physiological Sciences—Physiology

(Physiology), Charles M. Tipton (Exercise and Sport Sciences), Marc E. Tischler (Biochemistry), Stephen H. Wright (Physiology)

Associate Professors Edmond A. Arbas (Division of Neurobiology, Arizona Research Laboratories), Ann L. Baldwin (Physiology), Janis M. Burt (Physiology), Ralph F. Fregosi (Exercise and Sport Sciences), Robert J. Gillies (Biochemistry), Ronald L. Heimark (Surgery), Patrick B. Hoyer (Physiology), Richard B. Levine (Division of Neurobiology, Arizona Research Laboratories), Paul F. McDonagh (Surgery), Catherine Racowsky (Obstetrics/Gynecology), Raymond Runyon (Anatomy), Mark E. Wise (Animal Sciences)

Assistant Professors Parker B. Antin (Animal Sciences), Erik J. Henricksen (Exercise and Sport Sciences), Gail F. Koshland (Physiology), Howard Y. Lien (Internal Medicine), Ronald M. Lynch (Physiology), Ana M. Pajor (Physiology), John W. Regan (Pharmacology and Toxicology), Andrea J. Yool (Physiology)

The interdepartmental Committee on Physiological Sciences offers graduate work leading to the Doctor of Philosophy degree with a major in physiological sciences. The Master of Science degree is offered only in rare instances. Research training is an integral part of the Ph.D. program. The research areas of the faculty in the program can be broken down into five broad categories: cardiovascular biology, cell physiology, exercise physiology, neurobiology and renal and transport physiology.

Applicants for the Ph.D. program in physiological sciences should hold a bachelor's degree in one of the physical or biological sciences. A basic knowledge of biology, biochemistry, mathematics, physics, and computer use is required. All candidates for admission, although in some cases deficiencies may be made up during graduate training. The Graduate Record Examination and three letters of recommendation are required to assist in evaluation of applicants.

In the first year, students in the program take a core sequence of courses including Cell Physiology (PSIO 503) and Systems Physiology (PSIO 580). Individual programs of study are determined with the student's mentor and the program committee. Considerable flexibility is possible so that the needs of each student can be best served. A wide variety of courses is available, including courses offered by the departments of Animal Sciences, Biochemistry, Ecology and Evolutionary Biology, Exercise and Sport Sciences, Nutrition and Food Science, Physiology, and Veterinary Science. Details of these courses may be found in listings of the relevant departments in this catalog.

**Physiology (PSIO)**

Arizona Health Sciences Center, Room 4103
(520) 626-7642; FAX: (520) 626-2382

(Office of Medicine)

Professors William H. Dantzler, Head, Eldon J. Braun, Robert W. Gore, Joseph F. Gross (Emeritus), Raphael P. Gruner, Paul C. Johnson (Emeritus), Murray Katz (Internal Medicine), Otakar Koldovsky (Pediatrics), Robert S. McCuskey (Anatomy), Eugene Morkin (Internal Medicine), Timothy W. Secomb, Douglas G. Stuart, Marc E. Tischler (Biochemistry), Stuart Williams (Surgery), Stephen H. Wright

Associate Professors Edmund A. Arbas (Division of Neurobiology, Arizona Research Laboratories), Ann L. Baldwin, Janis M. Burt, Ralph F. Fregosi (Exercise and Sport Sciences), Patricia B. Hoyer, Richard B. Levine (Division of Neurobiology, Arizona Research Laboratories), Paul McDonagh (Surgery), Wayne J. Morgan (Peditiatrics), L. Claire Parsons (Nursing), Catherine Racowsky (Obstetrics/Gynecology)

Assistant Professors Gail F. Koshland, Richard J. Lemen (Peditiatrics), Y. H. Howard Lien (Internal Medicine), Ronald M. Lynch (Pharmacology), Ana M. Pajor, Mark E. Wise (Animal Sciences), Andrea M. Yool (Pharmacology)

The Department of Physiology teaches and does scholarly work on physiological mechanisms of significance to medicine. In both teaching and research, the orientation of the department is broad, encompassing single cell, organ, and total body function.

The Department of Physiology participates in offering a program of instruction leading to the Doctor of Philosophy degree with a major in physiological sciences through the Graduate Interdisciplinary Program in Physiological Sciences. For admission and degree requirements, please see Physiological Sciences and Requirements for Doctor's Degrees elsewhere in this catalog. A Master of Science degree is offered only in rare instances when individuals qualified to study for the Ph.D. are forced to terminate their graduate education.

Current research areas of the faculty in the Department of Physiology include: cellular physiology and transport; circulation and respiration, including microcirculation; comparative physiology; endocrinology; gastrointestinal physiology; neurological physiology, neural mechanisms, including motor control; regulation of bone formation; renal mechanisms; and reproductive and developmental mechanisms.

The specialized nature of the material and equipment required for courses given in the College of Medicine may necessitate some limitation of enrollment. Medical students will receive preference in courses required for the M.D. degree. All other students must obtain the permission of the instructor before enrolling. Graduate students already enrolled in the College of Medicine departments will be given preference.

In addition to the courses listed below, the Department of Physiology offers temporary courses in the following areas, subject to faculty availability and student interest: neurophysiology, renal physiology, physiology of muscle, molecular and cellular endocrinology, peripheral vascular physiology, respiratory physiology, gastrointestinal and developmental physiology, membrane transport processes in physiology, and cardiac physiology.

### 503. Cellular Physiology (5)
Through examination of fundamental cellular processes, the integrated function of diverse cell types is discussed. Topics include: mechanisms involved in protein expression, intracellular protein targeting, and regulation of protein function; membrane transport phenomena; cell signaling mechanisms—excitability, ion-channel, synaptic function; muscle and vascular cell function. P, CHEM 103b, 104b, 241b, 243b; PHYS 102b; MATH 125a-125b; BIOC 460.

### 566. Physiology Laboratory (3) II (Identical with ECOL 566)

### 568. Comparative Physiology (3) II (Identical with ECOL 568)

### 575. Special Topics in Biological Imaging (2) (Identical with CBA 575)

### 580. Systems Physiology (5) II Principles of systems physiology. Designed for graduate students throughout the university. Consult department before enrolling. P, 503 or equivalent. CHEM 243b, MATH 123, PHYS 102b (Identical with TOX 580 and PCOL 580)

### 582. Topics in Neural Development (2) I 1995-96 (Identical with NRSC 582)

### 585. Neural Mechanisms of Behavior (2) II 1995-96 (Identical with NRSC 585)

### 588. Principles of Cellular and Molecular Neurobiology (4) I (Identical with NRSC 588)

### 589. Principles of Systems Neurobiology (4) II (Identical with NRSC 589)

### 595. Colloquium

- a.** Mathematical Techniques in Physiology (2) II I.P, MATH 125a-125b, STAT 160.
- b.** Muscle Physiology (2 I I.P, 503.
- c.** Endocrinology (2) [Rpt./12 units] II
- d.** Renal Physiology (2) II I.P, 580 or equivalent.
- e.** Molecular and Cellular Excitability (2) II
Planetary Sciences (PTYS)
Space Sciences Building, Room 325
(520) 621-6963; FAX: (520) 621-4933


Associate Professors Willy Benz, Jonathan I. Lunine, Carolyn Porco
Assistant Professor Timothy D. Swindle

Participating Scientists from the Lunar and Planetary Laboratory:
Senior Research Scientists Lyle A. Broadfoot, Larry A. Lebofsky, Bill R. Sandel
Associate Research Scientists Jay B. Holberg, Lon L. Hood
Assistant Research Scientists Robert McMillan, Ann Vickery, Roger Yelle

The department offers multidisciplinary programs leading to the Master of Science and the Doctor of Philosophy degrees with a major in planetary sciences. Areas of specialization include, but are not restricted to, experimental, observational, and theoretical study of planetary atmospheres; the interiors of the planets and planetary satellites; asteroid and cometary astronomy and physics; meteoritics, problems of plasma physics associated with cosmic rays; the solar wind and its interaction with solar system bodies; celestial dynamics; investigations of the formation of the solar system and other planetary systems. Students are normally admitted to the doctoral program only. In certain circumstances, however, students may be admitted to the Master of Science degree program as a terminal or intermediate degree.

Applicants should have completed an undergraduate major in a physical science such as astronomy, atmospheric sciences, chemistry, geology, mathematics, or physics. However, admission is based on the overall demonstrated capability and preparation of the applicant. For full consideration, applicants must submit applications, including scores on the aptitude and advanced (chemistry, geology, or physics) tests of the Graduate Record Examination, as well as the names of at least three references. Personal or telephone interviews are desirable in aiding the deliberations of the admissions committee.

Degrees

Master of Science: This program is available only in special circumstances, with the concurrence of the faculty. At least 18 units drawn from the graduate core curriculum and a thesis suitable for publication are required.

Doctor of Philosophy: All students must complete the 15-unit core program consisting of 505a-505b-505c, 510, and 554 (though exceptionally well-prepared students may have parts of this requirement waived). An additional minimum of 21 units must be completed in a specialized area of planetary sciences. A specified reading competence in a modern foreign language is required. Students are expected to complete all requirements for the degree within three or four years following successful completion of the preliminary examination, which itself should be taken by the end of the second year of graduate enrollment.

Minor areas of study: The department requires its students to take a minor consisting of at least 12 units in a scientific area relevant to planetary science. The purpose of the minor is to deepen a student's knowledge of a subject that will support his or her research in planetary sciences. There are two ways of fulfilling this requirement:

Minor outside the planetary sciences department: The student may elect to minor in another department or approved program of the University. The choice of the department and the courses within that department must be made in consultation with the student's advisor, the minor department, and the Graduate Admissions and Advising Committee. The student is responsible for determining and fulfilling the current requirements of the minor department.

Minor in planetary sciences: The student may elect to minor in planetary sciences with a program of courses approved by the planetary sciences department. The minor will consist of at least 12 units of 500-level courses in which a grade of 3.0 (B) or better is achieved. The courses must be approved by a minor committee established by the student in consultation with the Graduate Admissions and Advising Committee, which will also designate a chairman. The student must pass a written preliminary examination consisting of the final exams or the equivalent in the individual courses. If the student already possesses a master's degree in a relevant scientific discipline, the course requirement may be waived by petition and approval of the entire faculty. In this case the Graduate Admissions and Advising Committee will designate appropriate members of the University faculty to draw up and administer a two to three hour written examination. The Graduate Admissions and Advising Committee will advise the planetary sciences faculty on whether the student has performed satisfactorily in these examinations.

The planetary sciences program: Graduates from other departments in the University may obtain credit for a minor in planetary sciences by achieving an average grade of 3.0 (B) or better in a minimum of 12 units of 500-level planetary sciences courses (up to 3 units of which may be independent study super-
vised by a planetary sciences faculty member). The proposed curriculum of each student must be approved by a minor committee established by the student in consultation with the LPL Graduate Admissions and Advising Committee, which will also designate a chairman. The written preliminary examination will consist of the final exam or the equivalent in the individual courses.

The Department of Planetary Sciences' degree programs are conducted in collaboration with the research programs of the Lunar and Planetary Laboratory (LPL). Together, the department and laboratory form an institute uncommonly broad and complete in its approach to planetary science education and research. The department and laboratory participate in many NASA space science missions. Among the current missions in which the faculty are participating are the Voyager Mission, the Galileo Mission to Jupiter, the Cassini/Huygens Mission to Saturn, the Mars Pathfinder, Near Earth Asteroid Rendezvous, Discovery Missions, NASA Space Shuttle Missions and the Ulysses Heliospheric Probe. In addition, LPL scientists make use of Earth orbiting observatories, including the Hubble Space Telescope and the Ultraviolet Explorer. The laboratory's Space Imagery Center contains one of the most extensive collections of planetary images in the world, beginning with those obtained from the earliest space projects and continuing to most current missions. LPL's Planetary Imaging Research Laboratory is a modern image processing facility for the analysis of planetary and astronomical data. Also available for student research are cosmochemistry and geochemistry laboratories including a scanning electron microscope and microprobe facility, an experimental petrology laboratory, a radiochemistry separation and neutron activation laboratory, and a noble gas mass spectrometry laboratory. The numerous telescopes of the University of Arizona Observatories are available for research projects, including instruments on Kitt Peak and in the Santa Catalina Mountains, as well as the Multiple Mirror Telescope on Mt. Hopkins; all are within easy reach of the university campus. Laboratory staff and students also make use of major observatories around the world, including the NASA Infrared Telescope Facility on Mauna Kea, Hawaii, and conduct a regular program of planetary, solar, and stellar infrared spectrometry using the NASA Kuiper Airborne Observatory. The University is developing a new observatory site on Mt. Graham, northeast of Tucson. The department participates in interdepartmental programs in theoretical astrophysics and in applied mathematics.

The University's computer center, including a Convex supercomputer, is available to support educational and research activities. The Lunar and Planetary Laboratory maintains a variety of networked computers and workstations in support of the research and educational programs.

503. * Physics of the Solar System (3) II 1995-96 Survey of planetary physics, planetary motions, planetary interiors, geophysics, planetary atmospheres, asteroids, comets, origin of the solar system. This course does not count toward the major requirements in planetary sciences. P, PHYS 142 or PHYS 251. (Identical with ASTR 503 and GEOS 503)


510. Principles of Cosmochemistry (3) I 1995-96 Chemical compositions of solar system objects; equilibrium and nonequilibrium chemical processes applied to planets; cosmochemistry. (Identical with GEOS 510)

518. * Modern Astronomical Instrumentation and Techniques (3) 1995-96 (Identical with ASTR 518)

519. * Global Tectonic Processes (3) II (Identical with GEOS 519)

520. Meteorites (3) II 1996-97 Classification; chemical, mineralogical and isotopic composition; cosmic abundances; ages; interaction with solar and cosmic radiation; relation to comets and asteroids. P, 510. (Identical with GEOS 520)


530. * Chemical Evolution of the Earth (3) II (Identical with GEOS 530)

541a-541b. * Dynamic Meteorology (3-3) (Identical with ATM0 541a-541b)

544. Physics of High Atmospheres (3) II 1995-96 Physical properties of upper atmospheres, including gaseous composition, temperature and density, ozone, and ionospheres, with emphasis on chemical transformations and eddy transport. (Identical with ATM0 544)

545. Stellar Atmospheres (3) 1995-96 (Identical with ASTR 545)


554. Evolution of Planetary Surfaces (3) II 1996-97 The geologic processes and evolution of terrestrial planet and satellite surfaces including the Galilean and Saturnian and Uranian satellites. Course includes one or two field trips to Meteor Crater or other locales. (Identical with GEOS 554)

555. Remote Sensing of Planetary Surfaces (3) II 1995-96 Exploration of planetary surfaces, including that of the Earth, with remote sensing. Emphasis on compositional determination using visible and infrared methods. Basic principles, image and spectroscopic analysis techniques, and case studies in planetary remote sensing. (Identical with ASTR 555 and GEOS 555)


567. Inverse Problems in Geophysics (3) (Identical with GEOS 567)

571. Terrestrial Planets (3) I 1995-96 Geophysical and geochemical techniques used to deduce composition and evolution of terrestrial planets. Topics include the Earth, Moon, Mars, Venus, and meteorites. (Identical with GEOS 571)

582. High Energy Astrophysics (3) (Identical with ASTR 582)

583. Thermodynamics in Geosciences (3) (Identical with GEOS 583)

589. Topics in Theoretical Astrophysics (3) [Rpt.] (Identical with PHYS 589)

594. Practicum
a. Planetary Geology Field Studies (1) [Rpt./3] Field trip
b. Workshop
i. Image Processing for Teaching (1) P, B.S. in science or mathematics, or teaching experience.

*May be convened with 400-level course.

Planning (PLNG)

Graduate Interdisciplinary Program in Planning

Committee:
Professors Kenneth N. Clark, Chair (Architecture), Robert B. Bechtel (Psychology), Michael Bonine (Geography), Nathan Buras (Hydrology and Water Resources), Hanna J. Cortner (Renewable Natural Resources), Kenneth E. Foster (Arid Lands), Lay J. Gibson (Geography), R. Frank Gregg (Emeritus), William Havens (Landscape Architecture), Robert Hershberger (Architecture), Helen M. Ingram (Politics),...
Ecosystemology for Urban Planning (3) I (Identical with HWR 500)

Policy Problems in Structure and Change (3) II (Identical with PA 504)
At least twenty-two units in coursework must be completed for the master’s degree. A decision to require or waive the requirement for a master’s degree will be made after consideration of the student’s preparation, proposed graduate program, and professional objectives.

For information concerning the Doctor of Philosophy degree see Requirements for Doctor's Degrees/Doctor of Philosophy elsewhere in this catalog.

502.* Agriculture and the Environment: Focus on Pesticides (3) II (Identical with AGTM 502)

550. Advanced Plant Pathology (4) I 1996-97 Topics include major concepts in classical and molecular genetics of plant-pathogen interactions; physiology, biochemistry, and molecular biology of plant pathogenesis; principles of plant epidemiology and theories and practices of plant disease control. P, 305 or equivalent.

551.* Biology and Characterization of Plant Pathogenic Agents (4) II 1994-95 Examines the biological properties of the various groups of plant pathogens and the contemporary laboratory methods used to characterize these agents and the diseases they cause. 3R, 3L. P, 305 and at least one laboratory course (e.g., MIC 205, MCB 181/182, etc.) or consent of instructor.

575. Advanced Mycology (3) I 1995-96 Biology of fungi, including morphology, physiology, classification, genetics, ecological significance, and economic importance; emphasis on plant pathogens and environmentally essential fungi. 2R, 3L. P, ECOL 104 or PL S 100.

596. Seminar
   a. Contemporary Topics in Plant Pathology (1-3) Rpt./3 I II
   b. Research Discussions (1-3) Rpt./3

*May be convened with 400-level course.


612. Biological Electron Microscopy (4) I (Identical with MCB 612)

621. Molecular Plant-Microbe Interactions (3) I 1995-96 Molecular properties that control development of host, parasite, and symbiotic relationships. Contemporary molecular hypotheses are related to genetic and biochemical data available on disease resistance and pathogenesis. P, BIOC 460. (Identical with BIOC 621 and MCB 621)

694. Practicum
   b. Teaching Techniques in Plant Pathology (1-3) Rpt./2 II P, 551.

695. Colloquium
   a. Plant Biology (1) I (Identical with MCB 695a and PL S 695a)
   b. Plant Pathology (1) II (Identical with MCB 695b and PL S 695b)

**Plant Sciences (PLS)**

Forbes Building, Room 303
(520) 621-1977; FAX: (520) 621-7186


Associate Professors Kenneth A. Feldmann, William T. Molin, Dennis T. Ray, Steven E. Smith, Judith A. Verbeke

Assistant Professors Dean Della Penna, Lucinda A. McDade, Karen S. Schumaker, Kathryn C. Taylor, Gary A. Thompson, Carolyn A. Zeiher

In addition to a commitment to prepare undergraduates for careers after graduation, the department offers programs leading to the Master of Science and the Doctor of Philosophy degrees with a major in plant science. Specific areas of research emphasis include agronomy/horticulture with aspects of plant production, genetics both as the study of genomic structure and function as well as its more applied use for the improvement of crop plants, plant growth and development, physiology and cell and molecular biology. The department encourages students to integrate the more classical aspects of these areas with recent innovations in order to develop both breadth and depth in the field of plant sciences during their graduate studies. The ready availability of modern laboratories, field space, and greenhouses within the department requires that students have access to the very best facilities.

During their tenure all graduate students will take a core of advanced courses including plant physiology, genetics, and anatomy and are expected to participate in departmental teaching and seminar programs. The needs and goals of individual students will determine subsequent course work from the various departments on campus. For their own research programs, students should select an area of specific interest to the faculty which will eventually lead to the preparation of a thesis. Where appropriate, a terminal M.S. program without the requirement for thesis research but emphasizing a broader selection of course work in plant sciences and related areas is available. Admission to doctoral studies without prior completion of the M.S. degree will also be considered on an individual basis for interested candidates.

Applicants are expected to have completed a bachelor’s degree and possess a good background in biology, chemistry, and mathematics. Under exceptional circumstances, candidates with specific deficiencies will be accepted into the program and required to remedy deficiencies early in their graduate studies. Applicants must submit scores from the Graduate Record Examination (GRE) for both the General Test and one advanced test in an appropriately related area. They should also arrange to have three letters of recommendation from individuals in a position to assess their potential as a graduate student sent to the department. Requests for information on additional requirements or further questions concerning the application process should be addressed to the Graduate Student Coordinator, Department of Plant Sciences. Individuals wishing to start in the fall semester are strongly encouraged to apply prior to January 1, particularly if they desire financial assistance.

508.* Arid Land Crop Ecology (3) II Physical and biotic environment of crops in relation to crop culture, production, and geographical distribution; relations among the human population, crop productivity, and man's environment. P. ECOL 260, MCB 181, MCB 182.

509. Information Sources for Agricultural Scientists (1) I Information systems and retrieval techniques, with particular reference to concepts, uses and limitations; emphasis on abstracts, indexes, alerting services, journals, and government documents. (Identical with LI S 509)


515.* Principles of Plant Breeding (3) I Application of the principles of genetics, botany and biology to the improvement of plants. P. 312 or ECOL 320.

530.* Plant Propagation II: Plant Cell and Tissue Culture (3) II Principles and theory of plant tissue culture. Commercial and experimental applications of micropropogation, plant cell/protoplast culture, and plant transformation techniques. 2R, 3L. P, 312, 330, 360 or consent of instructor. May be convened with 430.


550.* Developmental Plant Anatomy (4) II Structure, function and development of vascular plants. 3R, 3L. P, 100 or MCB 181.

560. Current Advances in Plant Physiology (3) I Investigation of the physiological, bio-
Political Science (POL)
Social Sciences Building, Room 315
(520) 621-7600; FAX: (520) 621-5051

Associate Professors Phillip C. Chapman, Jeanne Nienaber Clarke, John E. Crow (Emeritus), Donald R. Hall (Emeritus), Deborah R. Mathieu, Barbara Norrander, Daniel J. O'Neil, Thomas J. Volgy, John P. Willerton
Assistant Professors David Gibbs, Bradford S. Jones, Paulette Kurzer, Cary Nederman, V. Spike Peterson, David E. Sprio, David Wilkins

The department offers programs leading to the Master of Arts and the Doctor of Philosophy degrees with a major in political science. Concentrations are available in political theory, American politics, public policy, international relations, and comparative politics. The Master of Arts degree is designed as a basis for students who plan to continue into a Ph.D. program.

In addition, the department also designs programs for students interested in government careers, community college teaching, or specialization in selected areas such as policy and environment or for self-improvement. In cooperation with the College of Education, the department also offers work leading to the Master of Education degree. For information concerning this degree see Requirements for Master's Degrees/Master of Education elsewhere in this catalog.

Applicants must submit scores on the Graduate Record Examination, three letters of recommendation, and the personal data called for on the department's information form. Applicants also are invited to submit any other evidence, including published materials, which they believe to be relevant to admission.

Programs are planned, in consultation with an advisory committee, around the student's principal area of interest, emphasizing one or more of the areas of concentration listed above.

Degrees
Master of Arts: Each student must specialize in either one or two of the five fields of concentration listed above and complete at least 30 units of course work at the 500 and 600 levels. A supervised research paper is required and, depending upon the student's principal interest, reading knowledge of a foreign language may be required. The final master's examination will be based upon the chosen area or areas of concentration.

Doctor of Philosophy: In addition to an area of concentration, each student must prepare in two additional fields prior to the preliminary examination. Either two foreign languages or one foreign language at high proficiency or advanced training in methodology are required. Finally, each student must complete two supervised original research papers prior to taking the preliminary examination. The department may waive the requirement for a qualifying examination for a student who has received the master's degree at The University of Arizona.

506. Bureaucracy, Politics, and Policy (3) I Description and analysis of the executive branch of government; how federal agencies capture policy-making; why bureaucracy develops; the rules of bureaucratic culture; who controls the administrative branch.

507. Congress and American Politics (3) I II Examination of election politics, personalities, and career patterns of congressional members, the organization and structure of Congress, and the role of Congress in policy leadership and representation of the public.

510. Struggle for the Presidency (3) I (Identical with COMM 510)

512. Local Government and Administration (3) I II Examination and analysis of local decision-making structures and their policy outputs.

527. The Marxist Legacy (3) II A critical survey of the main currents of Marxism from Marx to the present.

528. Problems in Contemporary Political Theory (3) II Intensive examination of selected problems and concepts in political theory.

531. Political Culture and the Dynamics of Change in American Society (3) I II Examination of the manner in which attitudes about politics and political problems are acquired from exposure to music and television, and the manner in which such attitudes lead to political action.

532. Pressure Groups (3) I I Formation, structure, and place of pressure groups in the democratic society; the function of interest groups in the political process; problems of leadership, internal organization, and membership loyalties.

535. Public Opinion and Voting Behavior (3) I II Attitude and opinion formation and socialization; public opinion in the political process; the relationship between attitudes, opinion, and voting behavior in American politics.

536. Socialization, Violent Crime, and Political Order (3) II Description and analysis of how and why people wield, and respond to, authority. Based on presumption that people's reactions to the public order are influenced by the private order—or disorder—of their minds.
and the way they learned to respond to the private authorities of their childhoods.

537. *Democracies, Emerging and Evolving (3) I Causal analysis of conditions of stability and breakdown of democratic regimes with particular emphasis on the developing democracies of the third world. (Identical with LA S 537)

538a-538b. *Philosophy of Law (3-3) (Identical with PHIL 538a-538b)

541. *Arab-Israeli Conflict (3) I II Traces the birth and growth of the Arab-Israeli conflict since 1948 with particular attention to the internal impediments to conflict resolution on both the Arab and Israeli sides. Also surveys the role of the Great Powers in Middle East politics generally.

542. *Transformation of Agrarian Societies in the Middle East (3) II (Identical with NES 542)

543. *Soviet and Post-Soviet Politics (3) I Revolution and contemporary ideology; state, party, and mass organizations; economic and social planning; civil liberties; models of autocracy and pluralism.

544. *East European Politics (3) II Divergent models of Communist development, from East Germany to Yugoslavia; political, economic, social, and cultural reform.

545. *Comparative Political Revolution (3) I Examination of the causes and consequences of 20th-century revolutions and the revolutionary process, with emphasis on contemporary events.

547. *Latin-American Political Development (3) II Presentation of strategies for development in Latin America; examination of case studies from Cuba, Brazil, Chile, Guatemala, and other countries. (Identical with LA S 547)

548. *Government and Politics of Mexico (3) I Description and analysis of Mexico's political economy, its political system, and its foreign policy, with emphasis on Mexican-U.S. relations. (Identical with LA S 548)

549. *The Politics of Cultural Conflict (3) II Comparative examination of the approaches of different types of political systems to domestic conflict of a racial, religious, linguistic, and/or ethnic nature.


551. *Soviet and Post-Soviet Foreign Policy (3) I II Branches of Soviet foreign policy; the decision-making process; Soviet relations with the West and developing nations.

554. *Theories of International Relations (3) I Introduction to theories of international relations on the levels of man, the nation-state, and the international system, with a logical and empirical evaluation of approaches and theories.

555. *American Foreign Policy (3) I Analysis of the Cold War; Congressional-Executive clashes over foreign policy control; approaches to policy analysis.

556. *International Law (3) The international state system; legal-political problems, including territory, environment, seas.

557. *Inter-American Politics (3) I Survey and analysis of the leading political and economic issues at controversy between the United States and Latin America. (Identical with LA S 557)

558. *Civil-Military Relations in the Third World (3) I II For description of course topics, see 458. Graduate-level requirements include an extensive research paper.

560. *Modern Chinese Foreign Relations (3) I II Survey of the developments and trends in Chinese foreign relations in the modern period, focusing mainly on the relationship between the theoretical and actual objectives of China's foreign policies from 1949 to the present. (Identical with CHN 560)

561. *Feminist and IR Theories (3) I II Issues in epistemology; survey and integration of feminist and IR theories; application of feminist theories to IR.

564. *International Relations of East Asia (3) II National interests, issues and conflicts, relations, and influence of domestic politics in interstate relations in East Asia. (Identical with EAS 564)

567. *Population and Development in the Middle East (3) I (Identical with NES 567)


571. *Constitutional Law: Civil Liberties (3) I II Analysis of the constitutional guarantees of civil liberties in the U.S.


574. *Administrative Law (3) I Law governing the organization, powers, and procedures of the executive and administrative establishment, with emphasis on the limitations imposed by the American constitutional system.

576. *Women and the Law (3) I Legal status of women in America, including constitutional protections, marriage and family relationships, educational and vocational opportunities, political rights, criminal law.

578. *American Indians and the Supreme Court (3) I II Examination of the U.S. Supreme court as a policy-making institution; with analysis of major court opinions affecting tribal sovereignty and individual Indian rights in such areas as tribal status and federal relations, treaty law, Indian land title, jurisdiction. (Identical with AINS 578)

579. Research Design (4) I II Introduction to experimental and quasi-experimental research design; survey research; the use of aggregate statistics; historical documents and life-history materials; participant observation; unobtrusive methods.

580. Methods of Political Inquiry (3) I II Systematic examination of problems of scope and methods of inquiry in the discipline of political science; intended to acquaint students with the discipline and to prepare them for scholarly research in the field.

581. *Environmental Policy (3) I II Role of government in management of energy, natural resources and environment; process and policy alternatives; special attention to the South-west. (Identical with HWR 581 and RNR 581)

582. Research and Methodology (4) I Quanitative techniques and computer applications in political science.

583. *Urban Public Policy (3) I II Analysis and discussion of social, economic, and political problems and proposed solutions in changing urban environments.

584a-584b. Development of Federal Indian Policy (3-3) 584a: European colonial precedents through the treaty-making period. End of treaty-making to the present. 584b is not prerequisite to 584a. (Identical with AINS 584a-584b and LAW 584a-584b)

585. *Political Risk and Intelligence Analysis (3) I II Examination of political risk and intelligence analysis with emphasis on forecasting political developments in nations.

586. *Political Systems of India and Pakistan (3) I II (Identical with NES 586)

587a-587b. *Race and Public Policy (3) I Examination of the race issue in the context of American politics, from historical, behavioral, and comparative perspectives. (Identical with AINS 587a-587b)

589. *Public Choice (3) I II (Identical with ECON 589)

590. Teaching Political Science (3) I II Methods and problems involved with college teaching in general, and specifically in Political Science. Students are required to take this course as early as possible in their curriculum. Students must teach in the classroom under the supervision of a faculty member. F graduate student status.

595. Colloquium
   a. American Politics (3) I III
   b. Political Theory (3) I II
   c. Comparative Politics (3) III
   d. International Relations (3) III
   e. Public Policy (3) (Identical with PA 595g)

596. Seminar
   a. American Politics (3) (Rpt./2) I II
   b. Political Behavior (3) (Rpt./2) I II
   c. Political Theory (3) (Rpt./2) I II
   d. Comparative Politics (3) (Rpt./2) I II
   e. International Relations (3) (Rpt./2) I II
   f. Public Policy (3) (Rpt./2) I II (Identical with PA 596g)
   g. American Indian Law and Policy (3) (Rpt./2) I II (Identical with AINS 596h)
   h. Management and Policy for Ecological Sustainability (3) (Rpt./2) I II (Identical with RNR 596i and PA 596i)

597. *Public Choice (3) I II (Identical with ECON 598)

598. *Public Choice (3) I II (Identical with ECON 598)

599. *Public Choice (3) I II (Identical with ECON 599)
### Psychology (PSYC)

Psychology Building, Room 312 (520) 621-7447: FAX (520) 621-9306

Professors Lynn Nadel, Head, Carol Barnes, Neil R. Bartlett (Emeritus), Lee Roy Beach (Management and Policy), Robert B. Bechtel, Judith Becker (Psychiatry), Allan Beigel (Psychiatry), Richard Bootzin, Dipankar Chakravarti (Marketing), William D. Crano (Communication), Terry C. Daniel, George Domino, Kenneth Forster (Cognitive Science), Merrill Garrett (Cognitive Science), Michael Gottfredson (Management and Policy), Jeff Greenberg, Barbara Gutek (Management and Policy), Travis Hirsch (Sociology), Sigmund Hsiao, (Emeritus), William H. Ittelson, Marvin W. Kahn, Alfred Kaszniak, James E. King, Mary P. Kosinski (Family and Community Medicine), Bruce McNaughton, Amnon Rapoport (Management and Policy), Carl A. Ridley (Family and Consumer Resources), Michael Rohrbaugh (Family and Consumer Resources), David Rowe (Family and Consumer Resources), Bruce D. Sales, Gary Schwartz, Lee Seshret, Mary C. Wetzal, David B. Wexler (Law), Robert L. Wrenn

Associate Professors Harold S. Arkowitz, Felice Bedford, Merrie L. Brucks (Marketing), Aurelio J. Figueredo, Laura McCloskey, Irene M. Pepperberg (Ecology and Evolutionary Biology), Mary Peterson, Ronald H. Pool, Christopher Puto (Marketing), Rosemary A. Rosser, Catherine Shisslak (Family and Community Medicine), Varda Shoham, Linda Swisher (Speech and Hearing Sciences), Gary Wenk

Assistant Professors Geoffrey Ahern (Neurology), John Allen, Iris Bell (Psychiatry), Paul Bloom, Elizabeth Glisky, Kerry Green, Elizabeth Krupinski (Radiology), Akiva Liberman, Chad Marsalek, Janet Nicol (Linguistics), Tamra Pearson-d’Estree, Cyma Van Petten, Karen Wynn

The department offers programs designed for students seeking completion of the Doctor of Philosophy degree with a major in psychology. Concentrations are available in clinical psychology (clinical neuropsychology, psychopathology and affective disorders, health psychology and community and family mental health), cognitive psychology (perception, memory, psycholinguistics, cognitive neuropsychology, cognitive development, environmental cognition, and knowledge representation), developmental psychology (cognitive development, language development, and social and emotional development), psychobiology (animal behavior, neurobiology of learning, memory and aging, cognitive and computational neuroscience, neurophysiology, and psychopharmacology), social psychology (the self, motivation, social cognition, intergroup relations) and psychology, policy and law (mental health and health policy, mental health criminal justice interactions, analysis of policies and laws). In addition, there are two areas of concentration in which students may minor: environmental psychology and measurement and field research.

Applicants should contact the department early to obtain departmental application materials since the deadline for receipt of completed materials is December 31. Applicants must submit scores on the aptitude and advanced (psychology) tests of the Graduate Record Examination. Psychology, policy and law concentration applicants interested in concurrently pursuing the J.D. degree must apply separately to the College of Law.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>500a-500b</td>
<td>Current Issues in Psychological Theory and Research (3-3) Intensive examination of a range of content areas addressed in contemporary psychological theory and research. Open to psychology graduate students only.</td>
</tr>
<tr>
<td>501a</td>
<td>Principles of Psychopharmacology (3) Overview of the principles, theory, and applications of psychopharmacology; an introduction to theory and research in major areas of human psychopharmacology with a particular emphasis on psychopharmacological correlates and physiological substrates of cognition, affect, and psychopathology. May be taken alone or concurrently with 501b.</td>
</tr>
<tr>
<td>501b</td>
<td>Principles of Psychopharmacology (3) I Topics in the neuropharmacology of sensation, perception, cognition and behavior illustrating the application of modern research methods to the understanding of higher brain functions.</td>
</tr>
<tr>
<td>502</td>
<td>Principles of Neuroanatomy (4) (Identical with CBA 502)</td>
</tr>
<tr>
<td>503</td>
<td>Principles of Mammalian Systems Neurophysiology (2) (Identical with NRSC 503a)</td>
</tr>
<tr>
<td>503a</td>
<td>Principles of Mammalian Systems Neurophysiology (2) I II Topics in the neurophysiology of sensation, perception, cognition and behavior illustrating the application of modern research methods to the understanding of higher brain functions. Enrollment is restricted to those concurrently enrolled in the lab. (Identical with NRSC 503a)</td>
</tr>
<tr>
<td>503b</td>
<td>Laboratory in Mammalian Systems Neurophysiology (3) I II Neurophysiology laboratory including stereotaxic surgery, microelectrode recording of neural signals, electrical and chemical stimulation, and principles of analog and digital signal processing.</td>
</tr>
<tr>
<td>506</td>
<td>Principles of Mammalian Systems Neurophysiology (3) I II Theoretical principles and biological mechanisms by which information is represented, categorized, stored, and recalled in specific central nervous system (CNS) circuits in the course of adaptive behavior. (Identical with NRSC 506)</td>
</tr>
<tr>
<td>507a</td>
<td>Statistical Methods in Psychological Research (3-3) Statistical research design, methods and metascience. 507a: Bivariate and multiple regression, application of structural equations modeling to manifest variable (path analysis) and latent variable (multivariate) causal analysis. 507b: Application of the general linear model to analysis of variance, covariance and multiple comparisons, exploratory and confirmatory factor analysis, the canonical correlation, discriminant function analysis and multivariate analysis of variance.</td>
</tr>
<tr>
<td>508</td>
<td>Methods for Field Research (3) I II Research problems and methods particularly relevant to field research. The logic of inquiry and approaches to data analysis appropriate to field trials and quasi-experimental research.</td>
</tr>
<tr>
<td>509</td>
<td>History of Psychological Theories and Research (3) I Development of psychology as a science; schools, systems, theories, major advances, famous investigators. Open to psychology graduate students only.</td>
</tr>
<tr>
<td>511</td>
<td>Animal Behavior (3) I Systematic study of animal behavior. Analysis of environmental and genetic determinants of behavior, special behavioral adaptations in animals, and sociobehavioral concepts.</td>
</tr>
<tr>
<td>512</td>
<td>Animal Learning (3) II Animal learning with emphasis on interspecies comparisons.</td>
</tr>
<tr>
<td>513</td>
<td>Drugs, Brain, and Behavior (3) I II Psychological, neurotoxic and behavioral effects of drugs on individual neurotransmitter systems in the brain. Special emphasis will be given to the historical use and political significance of the major drugs of abuse.</td>
</tr>
<tr>
<td>517</td>
<td>Invertebrate Behavior Laboratory (3) I Animal behavior laboratory in behavioral manipulation, observation and data recording with invertebrate animals. 3L, 2R. P, 101, 230 and 290.</td>
</tr>
<tr>
<td>519</td>
<td>Field-Based Human Learning (3) I II Learning principles in terms of behavioral ecology. Naturalistic study with video and computer methods of human services and academic settings.</td>
</tr>
<tr>
<td>524</td>
<td>Gerontology: A Multidisciplinary Perspective (3) I II Biological, psychological, and social issues in aging, including brain changes with age, cognitive change with age, and the social impact of increasingly older population demographics. (Identical with GERO 524 and NRSC 524)</td>
</tr>
<tr>
<td>525</td>
<td>Human Memory Systems (3) I II Examinations of the processing systems that underlie human learning, memory and cognition; emphasizing cognitive, neuroscientific and computational approaches to research and theory.</td>
</tr>
</tbody>
</table>
528. Cognitive Neuroscience (3) [Rpt./1] I II Recent advances in analysis of the neural bases of cognitive functions, such as learning, memory, and thinking.

529. Advanced Perception (3) [Rpt./2] I II Perception of space, theories of object recognition, evolutionary constraints, learning, attention, visual cognition, and theories of perception.

532. Natural Language Processing (3) I (Identical with PHIL 532)

536. Visual Cognition (3) [Rpt./1] I II Recent advances in the areas of perception and attention, with an emphasis on visual process.

536. Computational Linguistics (3) I (Identical with LING 536)

539. Animal-Human Communication (3) II (Identical with ECOL 539)

540. Advanced Cognitive Development (3) II Examination of major theories and research findings in cognitive development, with emphasis on infant cognition and conceptual development in the area of theory and method.

541. Language Acquisition (3) II (Identical with SP H 541)

542. Psycholinguistics (3) [Rpt./1] I II Recent advances in the area of psycholinguistics, with an emphasis on sentence processing and the contribution of linguistic theory to an understanding of psychological mechanisms. May be convened with LING 542.

543. Lexical and Syntactic Development (3) I II Current theory and data on first language acquisition with special focus on research that relates linguistic theory and learnability theory to empirical studies of children's linguistic abilities. (Identical with LING 543)

545. Neural Network Modeling: What and Why (3) I II Handbook for the development of basic neural modeling. Examination of the process in which modeling is and is not relevant to understanding the architecture of cognitive systems. P. 350 or 355 or 356 or graduate standing, college-level algebra skills, familiarity with either Macintosh or PIC compatible microcomputers. (Identical with PHIL 545)

547. Cognitive and Affective Bases of Behavior (3) [Rpt./1] I II Variable content (consult schedule): learning, cognition, perception, psycholinguistics, emotion, others.

548. Topics in Language and Cognition (3) [Rpt./1] I II Variable content, including language acquisition, the relation between language and spatial cognition, and the evolution of mind. P. graduate majors in linguistics and psychology; others consult with department before enrolling. (Identical with LING 548)

550. Psychological Assessment and Testing (3) III Evaluation of assessment processes and of measurements of intelligence, aptitudes, personality, and interests; test theory; social implications.

552. Advanced Personality (3) I II In-depth consideration of topics, issues and research in personality.

555. Philosophy and Artificial Intelligence (3) (Identical with PHIL 555)

556. Psychology of Death and Loss (3) I II Basic concepts in a psychology of death and loss, with emphasis on both the adjustment to death and loss, and the underlying phenomina, humanistic and current social considerations.

559. Adult Development and Aging (3) I Change and continuity in cognition, personality, and adjustment during adulthood, with emphasis on aging processes and late life. (Identical with GERO 559)

560. Advanced Social Psychology (3) I II Social psychology, with emphasis on theory and method.

561. Social Cognition (3) [Rpt./6 units] I II Analysis of social phenomena from a cognitive perspective: perception, memory, thought and language concerning self, others, and social situations.

562. Mental Health Law and Policy (3) [Rpt./3] I II Theory, research and practice in health psychology, with emphasis on the delivery of mental health services. (Identical with LAW 562)

563. Forensic Assessment: Intervention and Treatment (3-3) III Theory, research and practice in the assessment and treatment of, and intervention with, persons involved with the legal process who have clinical problems. P. permission of the instructor.

564. Methods for Psychosocial Research (3) I Logic of inquiry and issues of philosophy of science as they apply to psychosocial research. Problems encountered by researchers in personal and social psychology, and methodological approaches to their data analysis and methodological design resolutions.

567. Experimental Phonetics: Physiology (3) (Identical with SP H 567)

568. Speech Perception (3) II (Identical with SP H 568)

574. Field Methods in Environmental Psychology (3) II Behavior in man-made or managed environments, with emphasis on objective methods; designed for students having a professional interest in environmental design or management. P. 374. (Identical with ARCH 574 and L AR 574)

576. Environmental Cognition (3) [Rpt./1] I II Recent advances in the area of environmental cognition, with an emphasis on cognitive aspects of environmental psychology.

577. Psychology, Law and Social Policy (3) [Rpt./1] I Critical review of theory and methods, and research in environmental psychology, law and social policy interface.

578. Sleep and Sleep Disorders (3) I II Topics include sleepwake rhythms, sleep deprivation, dreams, and the diagnosis and treatment of sleep disorders.

580. Clinical Neuropsychology (3) I Cognitive and affective sequelae of human central nervous system disease/damage, with emphasis on clinical evaluation, management and rehabilitation.

581. Psychopathology (3) II In-depth study of current theoretical and research formulations in psychological disorders; various approaches to behavior change. P. 290, 381.

582. Advanced Psychopathology (3) [Rpt./1] I II Advanced survey of current theory and research in symptoms, causes and treatment of the major psychological disorders.

584. Advanced Health Psychology (3) [Rpt./1] I II Current research and theory concerning psychological contributions to health maintenance, illness prevention and treatment, and the organization of health services.

585. Contemporary Issues in Psychology (3) [Rpt./1] I II Variable content (consult schedule): major topical problems in psychological research, theory, and applications.

586. Ethical Issues in Psychology (3) I II A consideration of issues in the derivation of ethical criteria, selection of the appropriate subset of criteria to guide ethical decision-making, and utilization of the criteria when making a decision in psychological research or practice.

589. History of Psychology (3) I Growth of psychology as a science; major schools and; theories; contributions of famous investigators and major advances; psychology as an aid and a science today.

596. Seminar I Social Psychology (3) [Rpt./4] I II c. Developmental Psychology (3) [Rpt./1] I II e. Biopsychology (3) [Rpt./1] I II f. Cognitive Psychology (3) [Rpt./1] I II g. Clinical Psychology (3) [Rpt./4] I II h. Law, Psychology, and Policy (3) [Rpt./4] I II i. Quantitative Methods (3) [Rpt./1] I II k. Psychopolitics (2) [Rpt./4 units] I II l. Interdisciplinary Environment-Behavior-Design (3) [Rpt./1] I II (Identical with ARCH 596u, GEOG 596u, L AR 596u, and PLNG 596u)


621. Clinical Assessment Methods (3) II Theory and practice in interview techniques and cognitive and personality assessment. Open to majors only.

622. Principles of Behavior Therapy (3) II Systematic review of the major theories of behavior modification, with emphasis on application to clinical problems. Open to graduate psychology majors only.

626. Family Therapy (3) I II Theoretical bases underlying different methods of family therapy and their clinical applications. Includes system theory, the family as a system, therapeutic principles, and process and outcome research.

628. Systems of Psychotherapy (3) [Rpt./2] I II Current research and theory on psychotherapy.

635. Issues in Rural Health Care (3) II (Identical with NURS 635)
Public Administration and Policy (PA)
McClelland Hall, Room 405
(520) 621-7965

Professors H. Brinton Milward, Director, Michael Gottfredson (Management and Policy), Helen Ingram (Political Science), Theodore Koff, John Schwarz (Political Science), Arthur Silvers, Ronald Vogel

Assistant Professors Susan Gonzalez Baker (Mexican American Studies), Chris Demchak, Howard Frant, Michael Polakowski, Edella Schlager

The School of Public Administration and Policy offers the Master of Public Administration, which is designed to prepare men and women for positions of leadership in public sector and nonprofit organizations, as well as private organizations dealing with the public sector. Graduates may expect to pursue management or policy-making concerns in a wide variety of settings within organizations at local, state, national, and international levels.

For admission and degree requirements, please see Master of Public Administration elsewhere in this catalog.

501. Public Organization Theory (3) I Course focuses on understanding and analyzing interactions, effectiveness and complexities of organization structures

502. Organization Theory and Behavioral Relations (3) II (Identical with MAP 502)

503. Politics and the Policy Process (3) I Various theories of how public policy is formulated.

504. Public and Policy Economics (3) II Applications of economics to the analysis of public policy and planning problems. P, ECON 500 or permission of instructor. Identical with GEC 504 and PLNG 504

505. Methods for Policy Analysis and Program Evaluation (3) II Techniques for analyzing the effects of public policies and programs. P, MKTG 552 or permission of instructor.


513. Government and the Nonprofit Sector (3) II Governments have drastically altered the way they deliver public services. While government spending on services has grown, nonprofit organizations under contract to government increasingly deliver public services in health, welfare and many other areas. This course will map the dimensions of this new relationship; discuss the consequences of third party management of public services; and develop skills in contracting, monitoring and measuring performance.

514. Analytic Methods in Planning and Management (3) II Methods and models for program planning and policy analysis; forecasting, service demand, facility location in capital investment programming, task sequencing, program analysis and evaluation. P, MKTG 552, GEOG 357, or permission of instructor (Identical with PLNG 514)

521. Social Policy (3) II Design, implementation and outcomes of social policy initiatives in the U.S. and abroad. Themes include historical overview of antipoverty policy in the U.S., competing explanations for conditions of inequality, and examination of policy solutions. (Identical with SOC 521)

522. Analysis of Health Systems (3) I Introduces the student to the scope and nature of public and private health systems in the U.S.; examines roles of government and private enterprise in the development and operation of health institutions.

523. Health and Public Policy (3) II Examines public policy issues in health, including recent developments in health policy and planning at the national, state and local levels, and their impact on administrative behavior. P, 522 (Identical with PLNG 523)

524.* Management of Long Term Care Facilities and Programs (3) I Problems and principles of management of facilities and community based programs providing health and social services to the chronically impaired. (Identical with GERO 524)

525. Comparative Management in Health Administration (3) II Assists students in applying general management principles to particular types of health agencies. Models of organizational behavior are used to develop a paradigm for comparative analysis. P, 522

526. Health Economics (3) I Applies microeconomic theory, industrial organization and public finance to efficiency and equity problems in the acute and chronic health-care sectors. Explores solutions to these problems. P, 522, ECON 500, or permission of instructor. (Identical with ECON 526)

527.* Aging and Public Policy (3) II Policy framework for administration of programs, plans, priorities, and legislation related to the needs of the aging in modern society (Identical with GERO 527 and PLNG 527)

528. Topics in Public and Nonprofit Financial Management (3) II Advanced issues in public-sector financial management. P, 508 or FIN 511 (Identical with FIN 528)

535.* International Management (3) II (Identical with MAP 535)

540. Theories of Crime and Public Policy (3) II Theories of crime applied to public policy issues. The relationship between scientific analysis of crime and formation of public policy. (Identical with LAW 540 and SOC 540)

541. Deviance and Social Control (3) (Identical with SOC 541)

550. Social Stratification (3) I II (Identical with SOC 550)

557.* Law of the Elderly (2) II (Identical with GERO 457)

573.* Government and Economic Well-being (3) I II (Identical with POL 473)

593. Internship (1-6)

595. Colloquium

695. Colloquium

96. Seminar

f. Linguistic Investigations and Applications (3) I II (Identical with LING 696, which is home)
527. Psychology of Sport and Exercise (3) I (Identical with PHPR 512)
512. Advanced Pharmacy Management (3) II (Identical with PHPR 511)
511. Advanced Pharmaceutical Care Systems (3) I (Identical with PHPR 511)
512. Advanced Pharmacy Management (3) II (Identical with PHPR 512)
527. Psychology of Sport and Exercise (3) I (Identical with EXSS 527)

530. Methods in Nursing Research (3) II (Identical with NURS 530)
548. Perspectives in Geriatrics (2) II (Identical with PHPR 548)
554. Industrial Toxicology and Chemical Exposures (2-4) I (Identical with OSH 554)
570. Issues and Trends in Public Health (3) II S (Identical with FCM 570)
571. International Comparison of Health Care Systems (3) I II S (Identical with FCM 571)
572. Population Dynamics and Family Planning (3) I II S (Identical with FCM 572)
573. Health Issues of Women and Children (3) I II S (Identical with FCM 573)
574. Health Administration and Policy (3) I II S (Identical with FCM 574)
575. Environmental and Occupational Health (3) I II S (Identical with FCM 575)
576. Biostatistics in Public Health (3) I II S (Identical with FCM 576)
577. Social and Behavioral Basis of Public Health (3) I II S (Identical with FCM 577)
578. Public Health Nutrition (3) I II S (Identical with FCM 578)
579. Clinical Pharmacotherapy of Mental Disorders (3) I II S (Identical with FCM 579)
593. Internship
   a. Public Health (1-12) [Rpt./12 units] (Identical with FCM 593a)
   b. Community-Oriented Medicine (1-12) (Identical with FCM 593b)
596. Seminar
   a. Basic Principles of Epidemiology (3) [Rpt./1] (Identical with EPI 596a)
   b. Occupational Safety and Health (3) [Rpt./1] (Identical with FCM 596b)
597. Public Health (3) II (Identical with FCM 578)
598. Poverty and Health (3) II (Identical with NURS 587)
599. Clinical Pharmacotherapy of Mental Disorders (3) I II S (Identical with FCM 579)
611. Pharmaceutical Education Research (3) I II S (Identical with PHPR 511)
620. Communication Theory II (3) I II (Identical with COMM 620)
621. Pharmaceutical Marketing (3) I II (Identical with PHPR 548)
622. Nurse Educator Role (3) I II (Identical with NURS 622)
624. The Administrative Process (3) I II (Identical with NURS 624)
633. Evaluation Research (3) I II (Identical with NURS 633)
635. Issues in Rural Health (3) (3) I II S (Identical with NURS 635)
660. Infectious Disease Epidemiology (3) II (Identical with EPI 660)
815. Subspecialty
    a. Principles and Practice of Home Health (3) I II S (Identical with FCM 815a)
    b. Trends in Gerontology (3) [Rpt./1] (Identical with FCM 815b)
    c. Social and Behavioral Basis of Public Health (3) I II S (Identical with FCM 896a)
    d. The Dying Patient (3) [Rpt./1] (Identical with FCM 896b)
    e. Principles and Practice of Home Health (3) I II S (Identical with FCM 896c)
    f. Prevention and Control of Disease (1-2) [Rpt./1] (Identical with FCM 896d)
    g. Practice of Community-Oriented Medicine (1-12) [Rpt./1] (Identical with FCM 896e)
    h. Managed Health Care (3) I II S (Identical with ANES 596a)
    i. Pharmaceutical Marketing (3) I II S (Identical with ANES 596b)
    j. Managed Health Care (3) I II S (Identical with FCM 596a)
    k. Managed Health Care (3) I II S (Identical with FCM 596b)
    l. Managed Health Care (3) I II S (Identical with FCM 596c)
    m. Managed Health Care (3) I II S (Identical with FCM 596d)
    n. Managed Health Care (3) I II S (Identical with FCM 596e)

*Available as both 596 and 896.

Range Management
(See Renewable Natural Resources)

Reliability Engineering
(See Systems and Industrial Engineering)

Remote Sensing (REM)
845 N. Park Ave.
Tucson, AZ 85719
(520) 621-7896; FAX: (520) 621-3816
Graduate Interdisciplinary Program in Remote Sensing
Committee:
Professors Victor R. Baker (Geosciences), Robert E. Dickinson (Atmospheric Sciences), Lloyd W. Gay (Renewable Natural Resources), Benjamin M. Herman (Atmospheric Sciences), Donald E. Myers (Mathematics), John W. Olsen (Anthropology), John A. Reagan (Electrical and Computer Engineering), Richard W. Reeves (Geography and Regional Development), William J. Shuttleworth (Hydrology and Water Resources), Philip N. Slater (Optical Sciences), Soroosh Sorooshian (Hydrology and Water Resources), Spencer R. Tiley (Geosciences)
Remote Sensing—Renewable Natural Resources 153

Associate Professors Charles F. Hutchinson (Arid Lands Resource Sciences), Chair, Charles E. Glass (Mining and Geological Engineering), Alfredo R. Huete (Soil and Water Science), Stuart E. Marsh (Arid Lands Resource Sciences), Robert A. Schowengardt (Electrical and Computer Engineering, Arid Lands Resources Sciences), Robert B. Singer (Lunar and Planetary Laboratory, Geosciences), Assistant Professor Kurtis J. Thome (Optical Sciences)

Remote sensing concerns the collection of information related in some way to the Earth's natural resources or environment. Data are primarily collected by satellite and aircraft systems in conjunction with localized ground-based surveys and measurements. The data are processed by digital computer or optical techniques to extract information of value to earth scientists and resource and environment managers at the local, state, and federal levels.

The Program in Remote Sensing offers no graduate major at the present time but minor programs are available for doctoral students with majors in disciplines within the Colleges of Agriculture, Business and Public Administration, Engineering and Mines, Arts and Sciences, and in the Office of Arid Lands Studies and the Optical Sciences Center. Emphases are available in applied remote sensing or in remote sensing techniques.

Students electing the emphasis in applied remote sensing are required to complete at least twelve graduate units or GEOG 330 (without graduate credit and described in the General Catalog only) and ten graduate units. The program must include OPTI 550 and ECE 531 and either GEOG 330, G EN 507 or WS M 520. The remaining units may be selected from WS M 522, GEOG 583, or G EN 507.

Students electing the emphasis in techniques of remote sensing must complete twelve graduate units including OPTI 550 and ECE 531. The remaining units may be selected from OPTI 524, 539, 558, 559; ATMO 590, 591; ATMOS 890, or SW M 590.

Students are urged to discuss the program with members of the Program in Remote Sensing before selecting the courses to be taken. The program selected must be approved in advance by the committee.

950. Remote Sensing for the Study of Planet Earth (3) I 1995-96 A multidisciplinary course delineating the physical basis of electromagnetic remote sensing, the concepts of information extraction, and applications pertinent to earth systems science. (Identical with AR L 590, ATM 590, G EN 590, GEOS 590, HWR 590, MNE 590, OPTI 590, RNR 590, SW M 590).


Renewable Natural Resources (RNR/L AR/RA M/WS M/WFSC)

Biological Sciences East, Room 325 (520) 621-7255; FAX: (520) 621-8801


Assistant Professors Vicente L. Lopes, Cecil R. Schwalbe

The School of Renewable Natural Resources is concerned with the management and conservation of natural ecosystems with emphasis on the desert, range, and forest ecosystems of arid and semi-arid environments. Graduate programs leading toward the degrees of Master of Science and Doctor of Philosophy prepare students for (1) research and teaching in the area of natural resource management and planning, and (2) positions in land management that require specialization that can be acquired through one of the available majors. All students are urged to gain a broad understanding of the social and political institutions as they affect fundamental relations of humans and their environment, particularly those involving plants, animals, soil and water resources, and climate.

Students pursuing the M.S. or Ph.D. degree may elect to major in renewable natural resources studies, range management, watershed management, or wildlife and fisheries science. Applicants for the Master of Science degree are required to submit three letters of recommendation and scores on the Graduate Record Examination. For information concerning the Ph.D. degree see Requirements for Doctor's Degrees/Doctor of Philosophy elsewhere in this catalog.

The school also offers a program leading to the Master of Landscape Architecture degree. For information concerning this degree see Requirements for Master's Degree/Master of Landscape Architecture elsewhere in this catalog.

Majors

Landscape Architecture: Within the Master of Landscape Architecture degree, areas of specialization in sustainable landscape design, planning, policy, and computer applications are: landscape history; theory and criticism; natural resources; arid lands; tourism and recreation.

Watershed Management or Range Management: Concentrations are available in watershed hydrology, watershed management, dryland forestry, and range science. Applicants would normally have completed an undergraduate major in watershed management, range management, natural resource recreation, or forestry with training in the biological, physical, and social sciences equivalent to that required for the bachelor's degree at The University of Arizona. Applicants lacking these prerequisites will be required to complete additional units in established watershed management or range management courses.

Students working toward the Master of Science degree shall complete at least 30 units including a thesis for which as many as five units may be earned.

Wildlife and Fisheries Science: This major includes specializations in wildlife ecology and fisheries science. Both programs require the completion of at least 30 units including a minimum of 20 units of course work and an acceptable thesis focusing on original research that addresses a wildlife and fisheries management topic for the master's degree.

Renewable Natural Resources Studies: Graduate work in this major provides training and research opportunities in natural resources in combination with studies in areas such as planning, policy, administration, economics, and behavioral science. This interdisciplinary program is appropriate for continuing students and mid-career professionals interested in careers in natural resources policy administration, planning, management, and research. Students should have academic training in one of the resource disciplines within the school or a related area. The master's degree requires at least 36 units including a thesis for which six units may be earned.
Renewable Natural Resources (RNR)

506.* Conservation Biology (3) II 1996-97 (Identical with ECOL 506)

517.* Introduction to Geographic Information Systems (3) I Computer techniques for capture, processing, analysis, and display of geographic information, with emphasis on applications in land resources management and planning. 2R, 3L. P, basic knowledge of computer operations. (Identical with GEOG 517 and S W 517)

518.* Advanced Geographic Information Systems (3) II Advanced techniques in geographic information systems database development, manipulation, and analysis, emphasizing renewable natural resource applications. Experience with advanced raster and vector-based GIS packages on workstation platforms. 2R, 3L. P, 517. (Identical with GEOG 518)

522.* Photointerpretation (2) II Reading and interpretation of aerial photographs; natural resource inventory from aerial photographs; remote sensing techniques. 1R, 3L.

527. Artificial Intelligence in Resource Management (3) I 1995-96 Use of artificial intelligence as it applies to natural resources, including knowledge representation, problem solving, expert systems, feature recognition, neural networks, and genetic algorithms. Examples will be derived from current applications using various techniques to address management problems. P, computer programming skills.


538.* Fire Ecology (3) II Ecological role and use of prescribed fire in forest and range ecosystems; fire history; concepts and specific fire effects on vegetation, wildlife, soils, and watersheds. P, basic ecology course, 316 or RA M 382.

546. Principles of Research (3) I Philosophy of science and the principles of conducting research, including formulation of problems, problem analysis, study plans, and preparation of manuscripts for publication.

555. Advanced Applied Plant Ecology (3) II Discussion of advanced topics in plant ecology, with emphasis on applied ecology of terrestrial ecosystems. P, basic ecology and statistics.

575. Economics of Natural Resource Policy (3) II (Identical with AREC 575)

576. Advanced Natural Resource Economics (3) II (Identical with AREC 576)

578.* Global Change (3) II (Identical with ECOG 578)

580.* Natural Resources—Policy and Administration (3) II Resource policy formation; ethics of resource use; administration and organization for resource management; analysis of present policy and trends. P, 200, AREC 375.

581.* Environmental Policy (3) II (Identical with POL 581)

586a-586b.* Natural Resources—Management and Economics (3-3) Introduction to decision-making techniques in natural resources management, including planning, GIS, modeling, applied economics, and systems analysis techniques. 2R, 3L. P, AREC 375, RNR 271, 384.

589a-589b.* Advanced Environmental Interpretation (2-2) Advanced training and experience in communication of natural history and environmental principles to the public. Students must be available for some weekend field work. 589a is part of a two-semester sequence. Credit and grade for 589a will be awarded only upon completion of 589b. Field trips. P, 12 units in biology or renewable natural resources.

590.* Remote Sensing for the Study of the Planet Earth (3) II 1995-96 (Identical with REM 590)

595. Colloquium

a. Public Natural Resource Management (2) II 1996-97

b. Human Dimensions in Renewable Natural Resources (3) I 1995-96

c. Heritage Resources Planning and Management (2) I 1995-96

596. Seminar

i. Management and Policy for Ecological Sustainability (3) [Rpt.] II (Identical with POL 596i, which is home)

m. Conservation Biology (1) [Rpt./6 units] II (Identical with ECOL 596m, which is home)

597. Workshop

a. Natural Resource Conservation Workshop (1) [Rpt./2] S Field trips.

b. Desert Ecosystems (1) [Rpt./3] II

w. Advanced Cadastral Survey (1-4) II (Identical with C E 597w) P, prior training and work experience in cadastral surveying.

*May be conditioned with 400-level course.

694. Practicum

a. Teaching in Renewable Natural Resource Studies (1-3) [Rpt./4 units] I II

b. Teaching in Range Management (1-3) [Rpt./4 units] II

c. Teaching in Watershed Management (1-3) [Rpt./4 units] II

d. Teaching in Wildlife and Fisheries Science (1-3) [Rpt./4 units] II

696. Seminar

a. Renewable Natural Resources (1-2) [Rpt.] I II

b. Integrating Advanced Technology in RNR (3) 1995-96

c. Ecosystem Management (1) II

697. Workshop

a. Interdisciplinary Problem Solving in Natural Resources I (2) II P, 697a. (Identical with HWR 697, which is home.) Note: 697b is part of a two-semester sequence. Credit and grade for 697a will be awarded only upon completion of 697b.

b. Interdisciplinary Problem Solving in Natural Resources II (2) II P, 697a. (Identical with HWR 697b, which is home.) Note: 697b is part of a two-semester sequence. Credit and grade for 697a will be awarded only upon completion of 697b.

Landscape Architecture (L AR)

501.* Site Planning and Design (4) I Planning and design problems at site scale with particular concern for conservation and energy utilization. 1R, 8S. P, 302.

502.* Regional Landscape Planning and Design (5) II Planning and design problems of regional scope and emphasis. 2R, 8S, P, 501.

503. Advanced Landscape Design (3) I Issues and problems in landscape design. Relationships with architects, engineers, planners, and natural resource scientists are stressed. 1R, 6L. Field trips.

504. Advanced Landscape Planning (3) II Advanced techniques in landscape planning and problem analysis including visual simulation, computer map overlay, video applications, research in perception and behavior. 1R, 6L.

507.* The American Landscape (3) II (Identical with GEOG 507)

533. Landscape Planning (3) I Theories and models in landscape planning, planning issues, methods, and case studies. Two, 2-day field trips.

538.* Planting Design (3) II Application of plant materials in landscape design; principles of xeriscape and energy-conserving design. Open to majors only. 2R, 25, P, 335 and 530.

542.* History and Theory of Landscape Architecture (3) II Examination of the historical background and theoretical bases of landscape architecture.

543.* Contemporary Landscape Architecture (3) I Examination of modern and post-modern design in landscape architecture. P, 542.

550. Landscape Ecology (3) II Principles and theories of spatial ecology presented in the context of land management problems in Southern Arizona. Practical application of productivity theory emphasized. Field trips. 2R, 3L.


552.* Landscape Construction (4) II Introduction to construction materials and methods, working drawings and specifications related to the profession of landscape architecture. 2R, 5L. P, 551.

553.* Irrigation Design (3) I Principles of irrigation system design; introduction to system components and applications; construction responsibilities and design liabilities. 2R. Open to majors only.

560.* Professional Practice (3) II Professional services, contract documents, contract administration, office organization, ethics, professional registration, roles of the landscape architect, the practice of landscape architecture. P, 502.
574. Field Methods in Environmental Psychology (3) II (Identical with PSYC 574)

582. Professional Practice Studio (5) II Synthesis studio in landscape architecture. Complex problems in regional, site, and urban planning and design. Emphasis upon "real world" problems and professional practice. Open to majors only. 2R, 7S. P, 502.

595. Colloquium
d. Landscape Architecture Research (3) I e. Professional Leadership (1) [Rpt./4 units] I II

596. Seminar
u. Interdisciplinary Environment-Behavior-Design (3) II (Identical with PSYC 596u, which is home)

597. Workshop
i.* Interdisciplinary Studio for Community Design (3-6) I Field trips. Open to non-majors only. (Identical with ARCH 597i, which is home)

*May be convened with 400-level course.

694. Practicum
a. Landscape Architecture Teaching (1-2) I II

696. Seminar
a. Landscape Architecture (1) [Rpt.] I II

Range Management (RA M)

536. Grazing Ecology and Management (3) I Application of animal diet and nutrition, grazing behavior, and vegetation-soil-herbivore interactions in management of grazing animals for improved livestock production, wildlife habitat, watershed protection, forest reproduction, or other land use objectives. Includes design of water developments, fences, and other structural range improvements.

546. Range Vegetation Improvement (3) I Rangeland habitat manipulation through vegetation control and establishment including mechanical, chemical, and burning treatments. Revegetation techniques for rangeland and drastically disturbed semiarid lands. 2R, 3L. P, MCB 181, ECOL 182, S W 200.

556. Rangeland Inventory and Monitoring (3) I Techniques of mapping and measuring attributes of vegetation and soils for inventory and monitoring of rangelands. Interpretation of data with respect to range condition and trend, watershed protection, value for livestock and wildlife habitat. P, RNR 202, 321.


587. Rangeland Management Plan (2) II Conduct a field inventory, develop management alternatives, and provide environmental and economic analyses of alternative management proposals in a written plan. 6L. All-day field trips. P, 556.

595. Colloquium
a. Rangeland Policy (3) [Rpt.] II 1996-97
b. Topics in Range Research (2) I 1996-97
c. Diet Selection of Free-ranging Ruminants (2) I 1995-96

*May be convened with 400-level course.

696. Seminar
a. Rangeland Management (1) [Rpt.] I II

Watershed Management (WS M)

508. Wildland Fire Management (3) I Principles of fire behavior in forest, range and other vegetation types; interrelationships of fuels, weather, and topography; pyrolysis and combustion processes; effects of fire; fuels inventory; prevention, detection, and control techniques; fire danger rating and fire behavior modeling.

510. Silviculture (3) II Principles and technical procedures for reproducing and growing stands of woody plants for a variety of uses; ecologically-based forest management. Weekend field trips. P, RNR 316.


531. Dryland Forest Management (3) II 1996-97 Utilization and management of forest resources in dry environments; biophysical and socio-economic issues related to the development of forest commodities and amenities. P, 6 units of upper-division WS M.

532. Agroforestry (3) I 1995-96 Ecological and socioeconomic factors related to the planning and implementation of agroforestry systems. P, 6 units of upper-division WS M.

534. Tree Nursery Management (3) I 1996-97 Tree nursery establishment and management, with emphasis on dryland ecosystems. P, 6 units of upper-division WS M.

535. Water Management in Dryland Ecosystems (3) I 1996-97 Hydrologic principles as applied to arid and semiarid ecosystems with water management applications in dryland resources management. For non-majors only. P, STAT 509, S W 201. (Identical with AR L 535)

560. Watershed Hydrology (4) I Application of fundamental principles to quantifying the basic hydrologic processes occurring on watersheds. P, GEOS 101, S W 200, 201, STAT 160 or 263. (Identical with HWR 560)


562. Watershed Management (4) II Evaluating hydrologic impacts of management activities on watersheds to include silviculture, range, mining, and recreation use. 2R, 3L. P, 460 or one course in hydrology.

563. Plant-Water Relations (3) II (Identical with PL S 563)

564. Introduction to Dendrochronology (4) (Identical with GEOS 564)


568. Wildland Water Quality (3) II Introduction to water quality and its influences in natural environments. Interactions with land management and relationships to the larger issues of environmental quality. Field trips.

577. Advanced Topics in the Economics of Environmental Regulation (3) II (Identical with AREC 577)

595. Colloquium
e. Dendrochronology: Physical Applications (3) [Rpt./2] I II. (Identical with GEOS 595e, which is home)

596. Seminar
c. Dendrochronology: Chronometric Applications (3) [Rpt./2] I II (Identical with GEOS 595g, which is home)

597. Workshop
c. Dendrochronology (2) I (Identical with GEOS 597e, which is home)

*May be convened with 400-level course.


605. Watershed Modeling (3) I Distributed modeling of hydrological and sedimentation processes at the watershed scale; emphasis on current concepts and applications. P, 560 and computer programming.

696. Seminar
a. Watershed Management (1-2) [Rpt.] I II

Wildlife and Fisheries Science (WFSC)

505. Aquatic Entomology (3) II 1996-97 (Identical with ENTO 505)

541. Limnology (4) I Study of lakes and streams; biological characteristics as related to physical, chemical, geological, and historical processes operating on fresh waters. 2R, 6L. Weekend field trips. P, six units of biology and 3 units of chemistry. (Identical with ECOL 541)

544. Wildlife Management/Mammalian Species (4) I Management of wildlife as a resource; characteristics of wildlife species; principles of population dynamics in wildlife populations; techniques used in studying wildlife. 3R, 3L and field work. Weekend field trips. P, RNR 384.

546. Wildlife Management/Avia Species (4) II Field and laboratory methods used in avian species management; evaluation of avian habitats; census, productivity, diagnosis, and control of avian populations. 3R, 3L and field work. Weekend field trips. P, RNR 384.

549. Diseases of Wildlife (3) II (Identical with V SC 549)

555R. Fishery Management (3) II Methods and concepts pertaining to fishery investigations and management; application of principles for enhancement of fisheries and aquatic habitats. P, 541 or 544.

555L. Fishery Management Laboratory (1) I II Field and laboratory methods pertaining to fishery investigations and management. P, CR, 555R, 582.

575. * Freshwater Algae (4) II 1995-96 (Identical with ECOL 575)


582. * Ichthyology (4) I 1995-96 (Identical with ECOL 582)

583. Herpetology (4) II (Identical with ECOL 583)

584. * Ornithology (4) II (Identical with ECOL 584)

585. * Mammalogy (4) II (Identical with ECOL 585)

589. * Selected Studies of Birds (2) I [Rpt.] (Identical with ECOL 589)

595. Colloquium
   a. Advanced Issues in Fisheries and Wildlife Science (2) [Rpt./3] II

596. Seminar (1-3)
   a. Fish and Wildlife Ecology (1) [Rpt./3] II

---

**Russian and Slavic Languages**

Modern Languages Building, Room 340
(520) 621-7341; FAX: (520) 621-7341

Professors George Gutsche, Head, John Garrard, Joe Malik, Jr. (Emeritus)

Associate Professors Alexander Dunkel, Grace Fielder, Margaret Gibson (Emerita), Delbert Phillips, Boriss Roberts (Emeritus)

Assistant Professors Galina De Roeck, Teresa Polowy

The Department of Russian and Slavic Languages offers a diversified and balanced program of study including courses in literature, grammar, conversation, linguistics, and culture. All literature courses are conducted in Russian by native or near-native speakers. The emphasis is on the acquisition of practical skills as preparation for continued study, research, teaching, government service, and business careers. The program leads to a Master of Arts degree with a major in Russian. In the College of Education, the Master of Education degree with a major in teaching and teacher education provides an option for 15 hours of study in Russian. For information concerning this degree see "Requirements for Master's Degrees/Master of Education elsewhere in this catalog."

---

585. * Linguistic and Computer-assisted Approaches to Literature (3) [Rpt./6 units] II (Identical with GER 585)

587. Testing and Evaluation in Foreign/Second Language Programs (3) (Identical with GER 587)

*May be convened with 400-level course.


606. Russian Drama (3) Examination of the major dramatic works of nineteenth- and twentieth-century Russian playwrights. P, 405b.

---

**Second Language Acquisition and Teaching (SLAT)**

Modern Languages Building
Room 347
(520) 621-7391

Graduate Interdisciplinary Program in Second Language Acquisition and Teaching

Committee:
Professors Renate A. Schulz, Chair (German Studies), Robert Ariew (French and Italian), Richard Demers (Linguistics), Ruthian Ian Forster (Psychology), Roseann Duenas Gonzalez (English), Kenneth Goodman (Language, Reading and Culture), Yetta M. Goodman (Language, Reading and Culture), Jane Hill (Anthropology), D. Terence Langendoen (Linguistics), Adrienne Lehrer (Linguistics), Judy Nichols Mitchell (English), Hamid Qafisheh (Near Eastern Studies), Muriel Saville-Troike (English), Rudolph C. Troike (English)

Associate Professors H. Douglas Adamson (English), Shirin Antia (Special Education and Rehabilitation), Donna M. Johnson (English), Luis C. Moll (Language, Reading and Culture), Richard Ruiz (Language, Reading and Culture), Karen L. Smith (Spanish and Por-
The Interdisciplinary Ph.D. Program in Second Language Acquisition and Teaching provides an instructional program to prepare researchers, teachers, curriculum specialists, and administrators at all levels of instruction who are concerned with aspects of second language acquisition, learning, and teaching. The cooperating departments include Anthropology; Classics; East Asian Studies; Educational Psychology; English; French and Italian; German Studies; Language, Reading and Culture; Linguistics; Near Eastern Studies; Psychology; Russian and Slavic Languages; Spanish and Portuguese; and Speech and Hearing Sciences. Students may choose from specializations in (1) second language analysis (grammar, contrastive linguistics/interlanguage studies), (2) second language use (discourse analysis, sociolinguistics, language policy/planning, rhetoric, pragmatics), (3) second language processes and learning (second/foreign language acquisition: theory and research), or (4) second language pedagogical theory and program administration (ESL/FL methods; curriculum development, testing and evaluation, reading and writing, educational technology).

Admission to the program is based on the following kinds of evidence: (1) excellent prior academic performance in a related field as indicated by a transcript; (2) three letters of recommendation from persons familiar with the student's performance; (3) an example of the student's scholarly writing on a topic related to the proposed area of study, or a critical review of a book which is relevant; and (4) GRE Aptitude test. In addition, the TOEFL examination is required of foreign students.

All students must demonstrate a thorough knowledge of one language other than English before advancement to candidacy, judged according to criteria and procedures established by the committee. Evidence of such second language proficiency including (but not limited to) a tape recording of speech production in that language will be required prior to admission for all students applying for a graduate teaching assistantship.

Candidates for the Ph.D. will be required to complete a minimum of 81 units beyond the B.A./B.S. degree including 33 units of required courses, 18 units in one of the four areas of specialization, 12 units in a minor area of specialization, and 18 units of dissertation. It is anticipated that most students entering this degree program will hold the master's degree or its equivalent. Prior graduate-level coursework which is judged by the committee to be comparable to required courses in this program may be counted toward the 81 total units. Core course requirements include linguistics, psycholinguistics, sociolinguistics, and research methodology, as well as second language acquisition theory and teaching practice. A detailed listing of courses and alternatives is available from the program office.

Prospective Ph.D. candidates must pass a qualifying examination no later than one year after entry into the program. Before formal admittance to candidacy all students must pass a preliminary examination in both the major and minor field of study. A final examination is required following completion of the dissertation.

Secondary Education
(See Teaching and Teacher Education)

Sociology (SOC)
Social Sciences Building, Room 400
(520) 621-3531; FAX (520) 621-9875


Associate Professors James T. Borhek (Emeritus), Courtney B. Cleland (Emeritus), Patricia L. MacCorquodale, Jerry L.L. Miller (Emeritus), Calvin K. Morrill, Kathleen S. Schwartzman, James W. Shockey

Assistant Professors Sun-Ki Chai, Susan Gonzalez Baker (Public Administration and Policy), Elisabeth S. Clemens, Hector Delgado, Donald S. Grant, Alfonso Morales, Michael Polakowski (Public Administration and Policy), James Ranger-Moore, Marc Schneberg

The department offers programs leading to the Master of Arts and the Doctor of Philosophy degrees. Most fields of sociology are represented in the department, with special concentrations in the areas of crime and deviance, culture, gender, organizations, social psychology, stratification, and political sociology (including political institutions, social movements and collective action, and world-systems analysis).

Degrees

Master of Arts: The M.A. degree requires a total of 30 units of credit for 500-level courses in sociology, including six required courses: SOC 500a-500b, 570a-570b, 575 and 595a (a 1-credit colloquium). Students must write and successfully defend, in a final oral examination, a research paper that is suitable for publication in a professional sociology journal. No formal master's thesis is required. The master's program is designed for students who intend to continue work toward the Ph.D.

Doctor of Philosophy: The Ph.D. degree requires a total of 69 units of graduate credit, including credits taken during the master's program. These credit hours must include 18 hours of dissertation credit, and at least 42 hours of credit must be courses in sociology, the major subject. In addition to completion of the required courses for the M.A. degree, students must complete (1) two courses from each of two preliminary examination areas, and (2) one course in advanced methods or statistics. Students must also pass written preliminary examinations in each of two areas and an oral examination over both areas. Finally, they must write and successfully defend, in a final oral examination, a doctoral dissertation. There is no language requirement and no requirement for a minor, although students have the option of minoring in another department.

Admission requirements: Admission to the graduate program is offered to a limited number of students demonstrating academic excellence and professional promise. To receive consideration for fall admission with financial aid, completed applications must be received by January 15. In addition to application materials required by the Graduate College, applicants must submit to the department a completed departmental application form, GRE general aptitude scores taken within the last three years, three letters of recommendation, a statement of purpose, and a sample of written work.
Sociology—Soil and Water Science


505. World-System Theory and Research (3) Theory and research on the modern world-system.

508. Sociology of Culture (3) Theory and research on the nature of cultural systems, cultural production and consumption, and strategies of interpretative analysis. P, consult with department before enrolling.

509. Objects and Methods of Cultural Analysis (3) From content analysis to statistical analysis, means of gathering and analyzing data on cultural objects.

510. Political Sociology (3) Basic approaches in political sociology, with emphasis on the relationship of economic and political processes.

511. Rational Choice Sociology (3) Survey of the rapidly growing literature that applies the basic principles of rational choice theory to classic sociological problems such as the emergence of effective norms, the causes of marriage and divorce, the attainment of group solidarity, the causes of collective action, and the effects of institutions on social order.

514. The State and Social Policy (3) Examination of the historical development of the state, processes of policy formation, and the political economy of modern welfare and regulatory regimes.

515. Social Movements and Collective Action (3) A sociological examination of the emergence and development of social movements/collective action at both the societal and individual levels. Major theoretical perspectives on social movements/collective action will be reviewed as well as recent and classical empirical works in the area. P, admission to graduate program or departmental approval.

520. Communication and the Legal Process (3) (Identical with COMM 520)

521. Social Policy (3) (Identical with PA 521)

524. Organization Ecology (3) Survey of theory and research in organizational ecology, focusing on the organizational population as the level of analysis. Topics include population boundaries, selection vs. adaption, evolutionary dynamics.

525. Organization Theory (3) Basic review of classic and contemporary approaches to the study of complex organizations; formation, development, and internal processes.

527. Social Networks (3) [Rpt./1] The logic and methods of social network analysis. Emphasis on theoretical underpinnings and applications to sociological research. Open to Sociology graduate students.

530. Theories and Research in Social Psychology (3) A comprehensive introduction to the major theoretical perspectives, methodologies, research areas, and issues in contemporary social psychology.

532. Role, Self, and Identity (3) An examination of the concepts of role, self, and identity in relation to social action and social psychological functioning. Alternative approaches are presented, but the symbolic interactionist perspective is highlighted. P, 530, or consult department before enrolling.

533. Social Relations, Groups, and Networks (3) An analysis of social interaction in relations, groups, and networks, emphasizing the reciprocal influences of social structure and social process. Theories of exchange, power, status, and justice are considered. P, 530, or consult department before enrolling.

537. Social Cognition, Affect and Emotion (3) Theories and research that describe how we perceive and react emotionally to the social world. Topics include social attribution, stereotyping, attitude-behavior relations, social accounts, emotion culture and emotion management.

540. Theories of Crime and Public Policy (3) (Identical with PA 540)

541. Deviance and Social Control (3) Theory and research on the origins of various forms of deviant behavior, and on the consequences of efforts to control them. P, 201, 341 or 342. (Identical with PA 541)

542. Criminology (3) A comprehensive review of classic and contemporary approaches to crime, its nature, causes and consequences.

543. White Collar and Organizational Crime (3) I (Identical with MAP 543)

551. Stratification and Class (3) Basic examination of concepts and research in the area of stratification, with emphasis on the classic statements and contemporary research.

552. Advanced Topics in Stratification (3) [Rpt./1] In-depth study of one contemporary area of research in stratification. Topics will vary.

556. Gender Issues in Organizational Behavior (3) (Identical with MAP 556)

557. Gender and Labor (3) Sources and consequences of gender differentiation and inequality, with attention to occupations, earnings, labor markets, household work, and the family. P, 3 graduate credits in sociology, psychology, or economics; or undergraduate major in one of these three fields.

558. Gender Identities and Interactions (3) Examination of the interface of gender, race, class, and ethnicity in the context of social structures and institutions. Focuses upon identities and social interaction as keys to understanding how gender inequality is created, perpetuated, or altered in families, schools, peer groups, work settings, and cultural symbols. P, 3 graduate credits in sociology, psychology, or women's studies. (Identical with WS 558)

560. Race and Ethnicity (3) Analysis of recent research on the relations among racial and ethnic groups in society, with special attention to current empirical and theoretical issues.

569. Basic Quantitative Methods (3) An introduction to basic quantitative methods for professional sociologists, including computer, mathematical, and statistical concepts.

570a-570b. Social Statistics (3-3) 570a: Probability, distributions, estimation and hypothesis testing. 570b: Ordinary least squares regression, generalized least squares regression, structural equation models (path analysis and non-recursive systems).


576. Field and Observational Methods (3) Comprehensive and critical examination of the collection, coding, analysis, and presentation of ethnographic/qualitative field data. Original field research required. P, admission to graduate program or departmental approval. (Identical with COMM 576)

577. Experimental Methods (3) The logic, design and analysis of experiments in social science research. Topics include the relation of experimentation to theory, experimental design, and practical issues. P, 575 or consult department before enrolling.

580. Population Studies (3) Theory and research in the fields of fertility, mortality, and migration, with emphasis on their relationships to social structure. An original research project is required.

585. Constructing Social Theories (3) The nature and fundamental types of social theories. Formulating theories to guide research across a range of substantive areas. Criteria for choosing among alternative theories.

590. Colloquium

a. Introduction to Graduate Study (1)

596. Seminar

a. Advanced Problems in Research (1-3) [Rpt.]

b. Graduate Teaching (3)

c. Teaching Practicum (1-3)

d. Social Organization (3) [Rpt./6 units] P, completion of first-year graduate program curriculum in sociology. [Note: This is a two-semester course beginning in fall that receives a "K" grade at end of first semester.]

r. Research and Publication (3) [Rpt./1] [Note: This is a two-semester course beginning in fall that receives a "K" grade at end of first semester.]

Soil and Water Science (SW)

Shantz Building, Room 429
(520) 621-1646; FAX: (520) 621-1647


Associate Professors Mark L. Brussseau, David M. Hendrickis, Alfredo R. Huete, Allan D. Matthias

Assistant Professors Joan D. Curry, Raina M. Miller, Thomas L. Thompson

Extension Specialist Jeffrey C. Silvertough

The department offers opportunities for study toward the Master of Science and Doctor of Philosophy degrees with a...
major in soil and water science. Areas of emphasis are available in environmental science, soil science, and soil-plant-water relations. Areas of concentration in environmental science include environmental chemistry; environmental microbiology; contaminant transport; pollution management and remediation; water quality; and remote sensing of terrestrial ecosystems. Areas of concentration in soil science include soil physics, soil chemistry; soil biology; soil genesis, morphology and classification; and soil mineralogy. Soil-plant-water relations include soil-water management, soil fertility and plant nutrition.

Outstanding students with undergraduate preparation in physical sciences, biological sciences, earth sciences, and engineering will be considered for admission to an appropriate degree program. A thesis is normally required for the M.S. degree, but may be waived for a student who is a senior honor of a manuscript published or accepted for publication in a refereed professional journal. A non-thesis option is also available to qualified students in the environmental science area of emphasis with approval of the department head.

A minor is available with a minimum of 12 units of soil science courses required which includes three of the following courses: W 511, 525, 531, 570, or 602.

501. Management of Arid Lands and Salt-Affected Soils (3) II Principles and practices of soil, water and crop management under arid and semiarid conditions, the use of diagnostic procedures for evaluating soils and waters, reclamation, and economics of irrigation project development. 2R, 3L. Field Trips. Silvertooth/Watson

504. Irrigation Principles and Management (3) 1995-96 (Identical with ABE 504)

505. Environmental and Soil Analysis (3) I Principles and methods of chemical analysis of soils, water, and biological materials emphasizing properties of agricultural and environmental significance. 1R, 6L. P, CHEM 322, 323; PHYS 102b, 180b. Artiola/Hendricks

511. Soil Chemistry (3) I Soil chemical interactions with water, air; plants and pollutants. 2R, 3L. P, 200, CHEM 103b, 104b. Hendricks

517. Introduction to Geographic Information Systems (3) I (Identical with RNR 517)

520. Physics of Plant Environments (3) I 1995-96 Principles of energy, momentum, and gaseous exchanges within the environments of agricultural land surfaces, emphasis on models and measurements of potential and actual evaporation of water. P, MATH 125b, PHYS 102b. Matthais


526. Environmental Microbiology Laboratory (2) I Basic techniques for isolation and characterization of environmental soil and water microflora including methods for enumeration and measurement of physiological activity. P, 425. (Identical with MBIM 526)

530. Environmental Monitoring (3) I Theory and application of environmental measurements to the sampling and monitoring of groundwater, soil, surface water, and near-surface atmospheric systems. 1R, 6L. P, HWR 450 or HWR 517 or SW 511 or equivalent. Artiola/Brusseau/Matthais

531. Soil Morphology, Classification and Interpretations (3) I Theory and practice of describing characteristics of soils; principles of soil classification and the classification systems; making soil interpretations for selected land uses. 2R, 3L. Field trips. P, 200, 201. Post


541. Soil Genesis (3) II 1996-97 Physical and chemical processes and mineralogy of weathering and soil formation; quantitative pedology; the soil as part of the ecosystem. Field trips. P, GEOS 101 and CHEM 103b. (Identical with GEOS 541) Hendricks

544. Applied Environmental Law (3) II A guided journey through real world environmental law; U.S. legal system, major environmental laws—criminal and civil; common marketplace problems and solutions; high profile cases; essential professional skills.

546. Environmental Biotechnology (2) II Molecular methods for detection of microorganisms in the environment. Fate and survival of introduced organisms in the environment. Molecular mechanisms of microbial inactivation in waste treatment systems and microbial risk assessment. P, 525 (Identical with MBIM 546) Pepper/Gerba

550. Anticipating the Future: Focus on Environment (3) II Techniques to understand broad issues about the future with focus on environmental topics. Uses computer conferencing and significant student discussion with opportunities for team approaches and reporting. Caldwell

553. Remote Sensing of the Environment (3) II Remote sensing techniques and applications for improved natural resource utilization of soils, water, grasslands, and forest. Fundamental energy-matter interactions that influence the spectral characteristics of vegetation, soil, and water. 2R, 3L. Field trips. P, 330 or PHYS 102b. Huete

554. Remote Sensing for the Study of the Planet Earth (3) II 1995-96 (Identical with REM 590)

570. Soil Physics (3) II Soil structure and physical constitution of soils; the physical properties of soil-water systems, movement and exchange of gases in the soil, and physical laws governing the movement and availability of soil water. 2R, 3L. P, 200, PHYS 102b, CR, MATH 125a. Warrick

573. Monitoring Biosphere Processes (2) I 1996-97 Global-scale interactions of soils with their plant cover and climate. The spatial distributions and dynamics of soil-plant-water processes with emphasis on measurements from space. P, 200; 330 or 453. Huete

590. Remote Sensing for the Study of the Planet Earth (3) II 1995-96 (Identical with REM 590)

591. Soil and Water Conservation (3) II 1995-96 Methods for remediating contaminated soil and groundwater; factors influencing efficacy of remediation systems. Emphasis on scientific basis of restoration. (Identical with HWR 566) Brusseau

595. Environmental Water Quality Management (3) I 1996-97 Global-scale interactions of soils with their plant cover and climate. The spatial distributions and dynamics of soil-plant-water processes with emphasis on measurements from space. P, 200; 330 or 453. Huete

599. May be convened with 400-level course.

602. Soil-Plant Relationships (3) I Principles of soil solution and colloid chemistry, soil-water relationships, soil microbiology, and plant physiology and metabolism will be discussed. These principles will be applied to processes of soil nutrient cycling, nutrient availability, and plant growth. P, 200. Thompson


694. Practicum

696. Seminar
a. Topics in Soil, Water and Environmental Science (1) [Rpt./4] II

Southwest Studies

1052 North Highland Avenue
(520) 621-2484

The Southwest Center

Director Joseph C. Wilder

Southwest Studies are designed to bring new perspectives to regional subjects through an interdisciplinary approach. Courses on the Southwest are taught through many university departments and programs, including American Indian
Studies, anthropology, English, geography, history, Latin American studies, linguistics, Mexican American studies, political science, sociology, Spanish and Portuguese, and women's studies. For information, contact the Southwest Center.

Spanish and Portuguese (SPAN/PORT)

Modern Languages Building,
Room 545
(520) 621-3123; FAX: (520) 621-6104

Professors A. Dolores Brown (Emerita),
Jack Emory Davis (Emeritus), John J. Gilbert, Lanin A. Gyurko, Richard P. Kinkade, Miguel Méndez, Judith Nantell, Dana A. Nelson, José Promis, Eliana S. Rivero
Associate Professors Gilbert E. Evans (Emeritus), Karl C. Gregg, Karen L. Smith, H. Reynolds Stone (Emeritus), Amy R. Williamsen
Assistant Professors Maria José Barbosa, June Jaramillo, Mary Zampini

The department offers programs leading to the Master of Arts and the Doctor of Philosophy degrees with a major in Spanish. In cooperation with the College of Education, the department also offers a master's degree in Educational Administration for those students in other departments, the Department of Spanish and Portuguese offers a doctoral minor in Spanish.

Admission to all graduate programs requires the completion of a bachelor's degree with a major in Spanish; for information concerning this degree see Requirements for Master's Degrees/Master of Education elsewhere in this catalog. For those students in other departments, the Department of Spanish and Portuguese offers a doctoral minor in Spanish.

Requirements for Master's Degrees/Master of Education

Graduate Studies, the student selects one primary field of study from the following areas: (1) medieval, renaissance, and golden age Spanish literature; (2) eighteenth, nineteenth, and twentieth-century Spanish literature; (3) Spanish American literature from the Pre-Columbian period to independence; and (4) nineteenth and twentieth-century Spanish American literature. In addition, the student selects two secondary areas of study outside the primary field from the following areas of study: (1) thirteenth-century through eighteenth-century Spanish literature; (2) nineteenth and twentieth-century Spanish literature; (3) Pre-Columbian through eighteenth-century Spanish American literature; (4) nineteenth and twentieth-century Spanish American literature; (5) Mexican and Mexican American literature; (6) Hispanic linguistics; (7) Lusobrazilian literature; and (8) literary theory.

At least 18 units must be taken in the primary field of study and 6 units in each of the two secondary areas of study. The remaining 6 units are electives. A student whose major field is in Spanish American literature must choose one secondary field in Spanish peninsular literature and vice versa.

Spanish (SPAN)

501. Introduction to Hispanic Studies (1) I II Broad view of fields of research, faculty and courses to familiarize students with some practical aspects of graduate studies, issues that pertain to specific fields of research and questions currently being debated across the profession.

510. Development of Spanish Medieval, Renaissance, and Golden Age Literature (3) Spanish medieval, renaissance, and golden age literature (short fiction, poetry, novel and drama) from the twelfth through the seventeenth century.

511. Topics in Medieval Literature, Renaissance, and Golden Age Literature (3) [Rpt./3 when topic varies] Representative topics include the development of lyric verse; Mester de Clerecia, art of the Juglar; the Romancero; the development of prose; baroque prose or verse; Cervantes; Golden Age drama; picaresque novel.

521. Topics in Eighteenth, Nineteenth and Twentieth-Century Spanish Literature (3) [Rpt./3 when topic varies] Representative topics include Spanish romanticism; nineteenth century realist and naturalist Spanish prose; the generation of '98; modern Spanish prose fiction; modern Spanish poetry; the contemporary novel of the post-Franco era; contemporary Spanish poetry; modern and contemporary Spanish theater.

530. Development of Spanish-American Literature from the Pre-Columbian Period to Independence (3) Spanish-American literature from the Pre-Columbian period to independence (prose, poetry and drama). (Identical with LAS 530)

531. Topics in Spanish American Literature from the Pre-Columbian Period to Independence (3) [Rpt./3 when topic varies] Representative topics include pre-Columbian Aztec, Mayan, and Maya-Quiche literature; the chronicle; Renaissance and Baroque poetry.

540. Development of Spanish American Nineteenth and Twentieth-Century Literature (3) Spanish American nineteenth and twentieth-century literature (short fiction, poetry, novel and drama). (Identical with LAS 540)

541. Topics in Spanish American Nineteenth and Twentieth Century Literature (3) [Rpt./3 when topic varies] Representative topics include: nineteenth-century Spanish-American prose fiction; modernismo; modern Spanish-American prose fiction; modern Spanish-American poetry; contemporary Spanish-American prose fiction; contemporary Spanish-American poetry; modern and contemporary Spanish-American theater; trends in the Spanish-American short story.


551. Topics in Mexican and Mexican-American Literature (3) [Rpt./3 when topic varies] Representative topics include: novel of the Mexican revolution; trends in Mexican and Mexican-American films; trends in contemporary Mexican literature; Mexican-American prose fiction since 1965; trends in Mexican-American theater; major movements and authors of Mexican-American literature.

561. Topics in Hispanic Literature (3) [Rpt./3 when topic varies] Representative topics include Hispanic women writers; U. S. Hispanic literature; trends in modern and contemporary Spanish film; trends in modern and contemporary Spanish and Hispanic American film.

571. Topics in Literary Theory and Criticism (3) [Rpt./3 when topic varies] Topics include historical overview of major developments in literary theory and criticism with theoretical and critical analysis of Hispanic texts.

574. Linguistic Perspectives on Mexican-American Spanish and Bilingualism (3) I II Focuses principally on descriptive linguistic analyses of Chicano language phenomena examined in sociolinguistic and psycholinguistic contexts. Analysis will include phonological and morphological levels, although the primary emphasis will be on morphosyntactic and lexical realizations. Macro-sociolinguistic tools of languages in contact/conflict, language shift, language choice/preference, and language attitudes as well as specific linguistic behaviors associated with Chicano bilingualism will also be treated in depth. P, 310 (Identical with LING 574 and MAS 574)

580. Introduction to Hispanic Linguistics (3) May be taken up to four times and will rotate between the following four topics. Introduction to Hispanic Sociolinguistics: Current sociolinguistic perspective on the Spanish Language (Fall 1995); Introduction to Spanish in the Americas: Diachronic and synchronic perspectives on the evolution and development of the Spanish-American Dialectology (Spring 1996); Introduction to Spanish Phonology: Theoretical perspectives on the phonology of Spanish phonology (Fall 1996); Introduction to Spanish Morpho-Syntax: Current theoretical perspective on major issues of Spanish Morpho-Syntax (Spring 1997).

581. Topics in Second Language Theories and Applications (3) May be taken up to four times and will rotate between the following four topics. Theories of Second Language Acquisition: Analysis of the current theories of second language acquisition including theories from linguistics, psychology and education (Fall 1995); Curriculum and Materials Development: Development of curricula and materials that reflect the impact of current research in the field of second language acquisition (Spring 1996); Theories and Techniques of Teaching Spanish: Study and analysis of theories of language instruction and learning with an emphasis on proficiency-oriented approaches that stress development of skills and accuracy (Fall 1996); Applied Linguistics: Application of current linguistic theories to language analysis for the purpose of teaching forms and functions teaching based on patterns of use as well as similarities and contrasts with English (Spring 1997).

582. Topics in Hispanic Linguistic Theories and Applications (3) May be taken up to four times and will rotate between the following four topics. Morphological Theory: Theoretical perspectives on the major morphosyntactic and morphophonological issues of Spanish Morphology (Fall 1995); Linguistic Perspectives on Mexican American Spanish and Analyses of (socio)linguistic phenomena encountered in the Spanish of the Southwest (Spring 1996); History of the Spanish Language: Diachronic and synchronic perspectives on the evolution and development of peninsular Spanish (Fall 1996); Theoretical Perspectives in Spanish Phonology: Further nonlinear theoretical analyses of selected problems in Spanish Phonology (Spring 1997).

586. Gender, Difference and Power (3) I (Identical with W S 586).

587. Testing and Evaluation in Foreign/Second Language Programs (3) (Identical with GER 587).

596. Seminar a. Spanish Peninsular Literature (3) [Rpt./3] b. Spanish American Literature (3) [Rpt./3] c. Mexican and Mexican American Literature (3) [Rpt./3] d. Hispanic Linguistics (3) [Rpt./3]
The department is committed to scholarship and leadership in the development of theory and practice related to the empowerment of individuals with disabilities and special abilities. The department's research, teaching and service address current issues in special education, rehabilitation and sign language studies. The department offers professional preparation of special education teachers and specialists, teachers of the gifted and talented, rehabilitation counselors and psychologists, and administrators, researchers and teacher educators.

The department offers programs leading to the Master of Arts, Educational Specialist, Doctor of Education and Doctor of Philosophy degrees with a major in special education and rehabilitation. Educational Specialist and doctoral programs focus on leadership in research, administration and teacher education in special education and rehabilitation.

Concentrations focus on rehabilitation counseling: rehabilitation counseling for the deaf; rehabilitation psychology; teachers/specialists in the areas of deaf/hard-of-hearing, early childhood, emotional/behavioral disorders, gifted and talented, bilingual special education, learning disabilities, mental retardation and severe/multiple disabilities and visually impaired. Rehabilitation psychology students pursue a Doctor of Philosophy degree and must meet admission and course study requirements specific to that degree.

An undergraduate grade-point average of at least 3.00 is required for admission to full standing in a graduate degree program. However, applicants with undergraduate grade-point averages of 2.50 to 2.99 may be admitted on a provisional basis. A master's degree is a prerequisite for admission to a specialist or doctoral program. Beyond these minimal requirements, applicants must also meet the specific admission requirements for all majors offered in the department.

500.* Foundations of Special Education and Rehabilitation (3) I II General characteristics of exceptional/disabled persons in interrelated human service delivery systems.

501a.* Assessment and Instruction for Students with Learning Problems (3) I II Procedures, methods, strategies for informal diagnosis and remediation of students with learning problems in the areas of reading, spelling, handwriting, written expression, mathematics and socialization. Strategies and adaptations appropriate for use in the regular elementary or the special classroom.

502.* Behavior Principles and Disability (3) I II Use of behavior principles to positively support individuals with disabilities, especially those with moderate and severe disabilities. 3R, IL, P. 400.

503.* The Special Services in the Schools (3) I I II Information to aid teachers in dealing with responsibilities and concerns in school settings with regard to P.L. 94-142. Education for All Handicapped Children Act Section 504 of the Rehabilitation Act, Family Education Rights and Privacy Act, and other legal issues.

504.* Cultural and Linguistic Diversity in Exceptional Learners (3) I Provides a theoretical base and practical approach to the study of special needs of students with language and cultural differences; basic premises of bilingual special education and the interface of the two fields.

505.* Introduction to Learning Disabilities (3) I II Theories and history of programs for the learning-disabled—definition, characteristics, etiology. Degree candidates must complete 500 prior to taking 505.

507a-507b. Methods for Diagnosing Specific Learning Disabilities (3-1) I Educational and psychological assessment of academic areas and learning processes involving perception, integration, and expression, with emphasis on informal and formal assessment and diagnostic teaching. P, 405/505 or department permission; CR, 593.

508. Teaching Elementary Students with Learning Disabilities (3) I II Remediation of academic areas and cognitive processes involving perception, integration, and expression, with emphasis on strategies for planning and implementing instructional programs at the elementary level. P, 405/505 or permission of department; CR, 593.

510.* Introduction to Mental Retardation and Severe Disabilities (3) I History and philosophy of educational programs for persons with mental retardation and other developmental disabilities; etiology, classification, and characteristics, with emphasis on educational, social, and psychological needs. P, 400 or CR.


513. Educating Students with Mental Retardation and Severe Disabilities (3) I II Methods of developing age-appropriate, functional and inclusive programming, community-based instruction, and integrative source delivery for students who have moderate to profound retardation and other physical, sensory, and behavior disorders.

515.* Physical and Multiple Disabilities (3) I II Physical and multiple impairments, etiology, intervention practices, adaptations, transferring and handling skills, and integration into typical environments. Field trips.

518. Nonoral Communication (3) R.P./R. II Techniques for assessment and intervention of alternative communication skills other than speech for students with severe disabilities. Nonsymbolic communication skills development for all ages; social interaction skills; augmentative communication aids.

520. Low Vision and Visual Functioning (3) I An anatomy and physiology of the eye; implications of visual disorders including visual field losses; introduction to optics; use of optical and nonoptical aids in classroom settings; clinical and functional low vision assessments, including assessing children with multiple impairments; and report writing. P, 521.

521.* Introduction to Visual Impairments and Deaf-Blindness (3) I An overview of educational services for the student with visual impairments and multiple sensory impairments. An emphasis is placed on the impact of visual impairments on the individual and means of compensating for this impact.

522a. Orientation and Mobility for Teachers of Individuals with Visual Impairment (3) II Methods of teaching orientation and mobility skills to visually impaired and blind students. Emphasis on the school-aged child, with particular attention to concept development, orientation skills, pre-cane skills, personal safety, and independent ambulation, including an introduction to long-cane techniques.


524. Methods of Teaching the Visually Handicapped (3) I II Curriculum development and adaptation in various educational programs; adaptation of classroom materials and procedures for use with blind and partially sighted children and youth; emphasis on methods of teaching academic and nonacademic skills and on educating students with nonhandicapped peers. P, 521; CR, 593.

525.* Strategies of Vocational Development and Supported Employment (3) I II Systematic study of the strategies used to place and retain individuals with disabilities in paid, community employment. Topics to include job development, consumer assessment, job placement, job-site training, and follow-up. P, 400.

526. Principles and Assessment of O & M (3) I II In-depth study of the principles supporting orientation and mobility instruction, assessment principles and strategies specific to O & M. P, 522a, 520 or equivalent from other universities.

527. Advanced O & M Practice and Procedures (4) I Prepares orientation and mobility (O & M) specialists in methods, techniques and approaches using the long cane and other mobility devices essential in the development of travel skills of persons with visual impairments. 3R, 8L. P, 522a, 520 or equivalent from other universities.

530.* Education and Rehabilitation of Deaf and Hard of Hearing Individuals (3) I Current and historical perspectives; educational and rehabilitative services; etiology; impact on families, psychosocial, cognitive and intellectual development and functioning of deaf and hard of hearing individuals.

531a-531b.* American Sign Language (4-4) I II Designed to develop intermediate ASL conversational skills in a variety of settings, topics, and functions. P, 370b or department permission. Must be taken in sequence.

532. Oral/Aural Development and Assessment: Deaf and Hard of Hearing (3) II Development of speech and speech reception skills;
534. Language Development for the Exceptional Child (3) I Pragmatic, semantic and syntactic aspects of pre-linguistic and linguistic development in exceptional children and youth; cognitive and social bases of language development.

535. Assessment of Bilingual Exceptional Learners (2) II Educational and psychological assessment of bilingual students with emphasis on informal and formal evaluation methods and procedures for purposes of identification and educational planning. P, 507.

536. Teaching Bilingual Exceptional Learners (2) I Instructional models and program development for exceptional students from culturally and linguistically diverse backgrounds. Emphasis on current intervention methods and practices. P, 508.


539a-539b-539c. * Special Topics in Sign Language Studies (3-3-3) I II Classes will be offered on a rotating basis in the following sequence—539a: ASL Acquisition and Bilingualism; 539b: Language Policy, Planning and Intervention; 539c: Methods and Materials of ASL Instruction. Courses need not be taken in sequence. P, 431b or permission of department.


541. Teaching the Gifted: Questioning Strategies (3) I Mastery of skills involved in developing abstract thinking abilities in gifted children by using the Hilda Taba Teaching Strategies. Emphasis on using these sequential questioning methods in all content areas and at all grade levels. P, 440/540.

542. Teaching the Gifted: Productive Thinking Models (3) I Mastery of skills involved in developing productive thinking abilities in gifted children by using teaching-learning models developed by Farnes, Williams, Taylor, Guilford, Renzulli. Emphasis at all grade levels and in all content areas. P, 440/540.

543. Teaching the Gifted: Hierarchical Models (3) I 1990-91 Introduction to general principles involved in providing a curriculum for the gifted. Overview of ten teaching-learning models commonly used with the gifted. Mastery of skills involved in using the hierarchical models with gifted students. P, 440/540.

544a-544b-544c. * ASL Discourse Processes (3 to 6 -3 to 6 -3 to 6 ) S 544a: Intensive ASL 544b: Introduction to Interpreting. 544c: Classroom instruction in ASL. Courses need not be taken in sequence. P, 431b or permission of department.

550. * Introduction to Emotional or Behavioral Disorders (3) I Issues in education of the emotionally or behaviorally disordered: discussion of history, current issues, definitions, characteristics, and theoretical perspectives. P, 490.

551. Teaching Children with Emotional or Behavioral Disorders (3) II Assessment techniques, academic and behavioral intervention strategies, and classroom management with emotionally or behaviorally disordered children and youth.

555. * Rehabilitation and Aging (3) II Emphasis on aging from the viewpoint of the aging person and those working with the aged.

560. * Introduction to Early Childhood Special Education (3) I Focuses on the disabling conditions impacting on preschool children, programs available to serve them and critical issues in this rapidly evolving field. P, 400/500.


562. Methods of Assessment for Preschool Children with Disabilities (3) I Norm-referenced and criterion-referenced instruments for screening, diagnosis and assessment of infants, toddlers, and preschool children will be reviewed. Emphasis will be placed on teacher involvement. In the assessment process. P, 400/500, 575.

563. Client Assessment in Rehabilitation (3) II Exploration of the world of work; critical review of vocational choice theories; experiences in the use and interpretation of individual assessment techniques. P, 565 or CR; ED P 458. Open to majors only.

565. Principles of Rehabilitation (3) I Principles underlying rehabilitation programs and interdisciplinary relationships of agencies engaged in rehabilitation services. Open to majors only.

568. * Transition Methods (3) II Provides an understanding of effective strategies for promoting the smooth transition of students with disabilities from school to work and adult living.

570. Administration of Special Education Programs (3) I Practical aspects of organizing and development of special education programs, including philosophy, issue resolution, public relations, personnel, case finding, evaluation, placement and records systems. P, consult director before enrolling.

571. Supervision of Special Education (3) I Practical aspects of supervising special education programs and services; curriculum development, service delivery models, staff development, program development, and legal issues and requirements.

572. Policy and Program Analysis in Special Education (3) I Practical aspects of policy analysis and program development/evaluation in schools and other social agencies that serve youth with disability and/or giftedness.

575. Observation and Participation in Special Education Programs (1-3) I II Practical experiences with individuals having special needs with focus on psychological, educational and service-related implications and practices. Field trips, class observations and seminars. P, 400/500.

578. * Prevention of Addictions (3) I Analysis of addictive behaviors (e.g., drug addictions, eating disorders, compulsive gambling) from a psychosocial and biological perspective and the implications of this analysis for primary, secondary, and tertiary prevention of addictions.

580. Medical Aspects of Disability (3) I Etiology, therapy, and prognosis of the major disabilities, including drug and alcohol; assessment of physical capacities and limitations; typical restorative techniques. Open to majors only.

581. Psychosocial and Cultural Aspects of Disability (3) I Exploration of the psychosocial, sociocultural and cultural aspects of disability; analysis of somatopsychology, psychosomatics, and social psychology. Open to majors only.

582. Principles and Practices of Vocational Evaluation (3) I Understanding work skills and labor market conditions; process of vocational evaluation of rehabilitation clientele; collecting and synthesizing evaluation data and writing meaningful reports.

583. Counseling Theories and Practices in Rehabilitation Settings (3) I Professional rehabilitation counseling practices with varied ethnic, age, disability, and dependency populations. 3R, 1L. Open to majors only.

584. * Problems of Drug Abuse (3) I II Survey course for teachers, counselors, and agency workers dealing with drug abuse; examination of community, cultural, and educational approaches to drug use and abuse.

585. Vocational Planning and Placement (3) II Problems of physical, mental, social, and emotional disability, as they relate to the formulation of a rehabilitation plan; exploration of the various sources of occupational and career choice information, case management, job placement and development. P, 565, 580, 563 or CR.

586. Psychosocial Assessment and Deafness (3) I II Selection, administration, and interpretation of various psychosocial evaluation instruments used with persons who are deaf. P, ED P 673, 674a.

588. Professional Problems and Ethical Concerns in Rehabilitation Psychology (3) I I Introduction to the field of rehabilitation psychology including an examination of ethical and legal considerations in the practice of rehabilitative psychology, foundational material in professional psychology and an overview of the rules and functions of rehabilitation psychology. Open to majors only.
Speech and Hearing Sciences (SP H)

Speech Building, Room 104
(520) 621-1644; FAX: (520) 621-9901

Professors Audrey L. Holland, Head, Kathryn A. Bayles, Daniel R. Boone (Emeritus), Richard F. Curlée, Theodore J. Glattke, Thomas J. Hixon, William R. Hodgson (Emeritus), Noel D. Matkin, Ralph L. Shelton

Associate Professor Linda Swisher
Assistant Professors Jeannette D. Hoit, Yingyong Qi
Director of the Speech Pathology Clinic
Anthony De Feo

The department offers programs leading to the Master of Science and the Doctor of Philosophy degrees with a major in speech and hearing sciences.

A minimum of 24 undergraduate units in speech and hearing sciences is required for admission without deficiencies. Such coursework must include six units in normal communication development and processes, six in speech-language pathology and six in audiology. Applicants must complete departmental application forms and submit three letters of recommendation. Scores on the aptitude test of the Graduate Record Examination are required of all applicants to the graduate programs, and doctoral applicants must also submit a sample of their scholarly writing.

The Master of Science program requires the completion of 36 units of coursework plus any additional coursework assigned as deficiencies. Submission of a thesis as a part of the program is optional.

The Doctor of Philosophy degree is designed to provide the tools, knowledge, and experience in research and not to provide specialization in clinical pursuits.

500. Introduction to Quantitative Methods and Research in Speech and Hearing Sciences (2) Study of measurement and research design and their application in research and professional practice.

501. Professional Issues in Speech-Language Pathology and Audiology (1) Professional practice issues including certification, licensure, supervision, quality control, ethics, federal and state legislation.

502. Principles of Neuroanatomy (4) (Identical with CBA 502)

510. Counseling Techniques in Communication Disorders (3) Introduction to counseling the communication handicapped and their families.

541. Language Acquisition (3) Principles and processes of first language acquisition described in relation to children's social and cognitive development; first language acquisition processes compared and contrasted to child and adult second language acquisition and language disorders. (Identical with LING 541, PSYC 541)

552. Language Disorders in School Age Children (3) The nature and treatment of language disorders in children from grades K-12; relationships between language and learning disorders; assessment and treatment strategies.

553. Developmental Language Impairments (3) Topics include: language and nonlanguage characteristics and clinical management of children with developmental language impairment, acquired aphasia, bilingualism and auditory disorders.

554. Developmental Language Disorders (3) Research and clinical perspectives on etiology, changing symptomatology, and management; attention to related deficits, syndromes, learning disabilities, and multicultural issues. Case study focus. P, 451 or 551.


558. Clinical Studies: Speech-Language Pathology (1-3) [Rpt./9 units] P Under supervision, students carry out prescribed intervention programs and conduct evaluation of children and adults. Students participate in weekly staffings and clinical problem solving. Open to majors only. P, 451 or 571.

560. Speech and Hearing Science Instrumentation (2) Consideration of some common and specific instruments and methods employed in speech and hearing laboratories and clinics. P, 260, 280 or CR.

560R. Speech and Hearing Science Instrumentation Laboratory (1) CR, 560R.

562. Psychophysical Acoustics (3) Experimental procedures and instrumentation; study of psychoacoustics; stimulus integration, pitch and loudness limens and scales, masking, and auditory fatigue; binaural hearing; theory of signal detection. P, 280, 460.

563. Microcomputer Applications (2) Basic understanding of microcomputer operations and its multiple functions; emphasis on computer literacy, administrative/commercial applications and hands-on instruction.

567. Experimental Phonetics: Physiology (3) Systematic examination of current experimentation and research in speech as motor behavior, with emphasis on physiological investigations of normal respiration, phonation, resonance, and articulation; critical evaluation of research design. P, 260. (Identical with PSYC 567)

568. Speech Perception (3) General overview of the field of speech perception. Topics include role of contextual factors in the processing of speech, developmental issues in speech perception, perception of foreign language speech sounds, the recognition of speech by computers and animals, implications for hearing-impaired populations and models of speech perception. P, 260. (Identical with LING 568 and PSYC 568)

570R. Evaluation Process (2) Study of principles, methods and selected procedures involved in the assessment of individuals with communication disorders; attention to skills in interviewing and preparation of reports. P, 370, 371, 483; CR or subsequent registration in 570L (for majors).
570L Laboratory in Evaluation Process (1) II Open to majors only. P, 570R or CR.

571R Articulation Disorders and Therapies (2) I S Etiology, diagnosis, prognosis, and therapy for the articulatory aspects of communication problems. P, 350; 371; 367; CR or subsequent registration in 571L (for majors).

571L Laboratory in Articulation Disorders (1) S Open to majors only. P, 571R or CR.

572 Voice Disorders (3) I Etiology, diagnosis, prognosis, and therapy for disorders of voice; speech for the laryngectomized. P, 567.


574 Cleft Palate, Other Craniofacial Disorders, and Communication (2) II Communication disorders associated with cleft palate and other craniofacial defects. Speech assessment, evaluation and treatment; survey of dental and surgical services. P, 471R/L or 571R/L.


576 Communicative Aspects of Aging (1) I Hearing, speech, voice, and language changes in the elderly caused by aging and disease. Emphasis on management of these problems. (Identical with GER0 576)

577 Communication Disorders in Traumatic Brain Injury (3) II 5 Communication consequences of traumatic brain injury with special reference to the evaluation and management of persons with such injury. P, consult department before enrolling.


580 Community and Industrial Audiology (2) II Hearing conservation in industry, schools, and the community; auditory and non-auditory effects of noise, noise assessment, control, and protective procedures.

581 Evaluation and Selection of Hearing Aids (3) I Development of hearing aid evaluations; circuitry of hearing aids and their physical characteristics; speech intelligibility and the electroacoustics of low-fidelity circuitry; patient evaluation and counseling. P, 483.

582 Hearing Disorders and Special Tests (3) II Pathologies of the hearing mechanism, and their auditory manifestations. Special audiological procedures to differentiate site of lesion. P, 280, 483.

583 Principles of Audiology (3) I II Basic principles and techniques of audiological testing, etiologies of hearing impairment, and intervention strategies. P, 280 or graduate standing.

584 Audiologic Rehabilitation: Adults (3) II Speech reading; auditory training; problems encountered with amplification units; social, psychological, educational, speech, and language difficulties encountered by the hearing handicapped. P, 280, 483.

585 Audiologic Habilitation: Children (3) I Amplification, room acoustics, auditory and visual processing, evaluation and remedial programming for children with mild to moderate hearing impairment. P, 483 or 589.

586 Child Audiology (3) III Study of the development and disorders of the auditory system; audiometric evaluation and differential diagnosis in infants and children; psychological, auditory, and educational aspects of the habilitation of aurally handicapped children. P, 280, 483.

588 Electrophysiologic Evaluation of the Auditory and Vestibular Systems (3) II Techniques, normative data, and clinical interpretation of auditory-evoked potential and electrystagnomography tests.

589 Advanced Audiology Evaluation (3) I Principles and techniques of administering and interpreting the comprehensive audiological evaluation. P, 280, 483.

595 Colloquium a. Current Problems in Speech and Hearing Sciences (1) [Rpt./5] I II

596 Seminar a. Experimental Phonetics (1-3) [Rpt./2 or 9 units] I II
b. Clinical Audiology (1-3) [Rpt./2 or 9 units] I II
c. Hearing—Physiology and Psychophysics (1-3) [Rpt./2 or 9 units] I II
d. Language and Language Disorders (1-3) [Rpt./2 or 9 units] I II
e. Speech Pathology (1-3) [Rpt./2 or 9 units] I II

*May be convened with 400-level course.

600 Research Methods in Communication Sciences and Disorders (3) II Design and execution of descriptive and experimental research in communication sciences and disorders.

658 Advanced Clinical Studies: Speech-Language Pathology (1-3) [Rpt./9 units] I II With faculty consultation and supervision, students assume responsibility for all aspects of case management of children and adults. Exposure to clinical research methods and interdisciplinary staffings. P, 598.

659 Advanced Clinical Studies: Audiology (1-3) [Rpt./9 units] I II With faculty consultation and supervision, students assume responsibility for all aspects of case management of adults and children. Exposure to clinical research methods and interdisciplinary staffings. Open to majors only. P, 589 or CR.


665R Aerodynamic Evaluation and Management of the Speech Mechanism (2) II Principles and clinical methods of aerodynamic evaluation and management of the disordered speech mechanism, with practical experience provided through case studies and class experiments. P, 260, 460R/L, 567.


695 Colloquium a. Motor Control (2) [Rpt./8 units] II (Identical with EXSS 695a)

Statistics (STAT)

Economics Building, Room 200 (520) 621-4158

Professors Yashaswini Mittal, Head, Dan Bailey (Emeritus), Jean E. Weber Associate Professor A. Larry Wright

The department offers programs leading to the Master of Science and the Doctor of Philosophy degrees with a major in statistics. Since statistics is an interdisciplinary field, students are encouraged to take courses in other areas. A student is expected to get a broad view of both theoretical and applied statistics.

To be admitted, an applicant must have completed the equivalent of an undergraduate degree in a quantitative field from a recognized institution, at least nine semester units of calculus and at least 6 semester units of upper division mathematics, and must carry a minimum grade point average of 3.00. Applicants are asked to submit scores on the Graduate Record Examination.

All graduate students are required to take 560a, 566a-566b, 551, 552, 548, 595 (at least two units), 597 (at least one unit), and 641. The Master's degree requires a minimum of 33 units. A Master's examination based on the first five of the required courses is offered every summer. A student must pass this exam within two years of admission.

To be admitted to the doctoral program, a student must pass the Master's examination at the Ph.D. qualifying level. The doctoral degree requires a minimum of 39 units beyond the requirements for the minor and dissertation. These 39 units must include all required courses for the Master's degree plus 667, 668 and MATH 563a or equivalent. A minimum of 18 units of dissertation credit is required.

Ph.D. candidates with other majors who wish to minor in Statistics are required to take 19 units of approved courses which must include 551, 552, 566a and 566b and at least one unit of 597.

Areas of specialty for the faculty include clinical trials, extreme value theory, image analysis, inference and probability.

509 Statistics for Research (4) II Statistical concepts and methods applied to research in other scientific disciplines. Principles of estimation and hypothesis testing for standard one and two-sample procedures. Correlation,

548. Introduction to Statistical Packages (3) I Basic structure of general purpose statistical software. Data formats, storage and transmission. Relation between hardware and software. Use of major statistical packages: SAS, BMDP, and SPSS on both personal and mainframe computers. Open to graduate students in all disciplines.


560a-560b. Probability and Random Processes (3-3) 560a, I First part of the sequence will deal with probability. Sample space, basic axioms of probability, combinatorial methods, conditional probability and distributions, independence. Random variables, discrete and continuous distributions. Binomial, Poisson, geometric, normal, exponential and gamma distributions. Transformations of random variables and Jacobians, expectation, variance and other moments, laws of large numbers, central limit theorem. Characteristic and generating functions. Fundamental probability concepts without the use of measure theory. P, two years of calculus, e.g. MATH 125a-125b and MATH 223. 560b, II Second part of the sequence will cover elementary random processes. Markov and stationary processes, random walk, renewal theory, queuing networks, branching processes, Poisson processes, martingales. Theory as well as some applications. No measure theory requirement. P, 560a.


564. Theory of Probability (3) I II (Identical with MATH 564)


568. Applied Stochastic Processes (3) II (Identical with MATH 568)


595. Colloquium a. Statistics (1) [Rpt./3 units] I II Open to majors only.

596. Seminar a. Research Methods (1-4) [Rpt./6 units] II

597. Workshop a. Data Analysis (1) [Rpt./3 units] I II Open to majors only or with permission of instructor. P, 451, 509 or equivalent.

*May be convened with 400-level course.

641. Statistical Consulting (3) I II For statistics graduate students, providing experience in statistical consulting. Client and statistician relationships, communication skills, computing and graphical analysis resources, approaches to problems with measurement error and missing data. Consulting practice with client research problems under faculty supervision. 1R, 6L P, advanced standing in the Masters program.

660. Linear Models (3) I Multivariate normal distribution, distribution of quadratic forms. Generalized inverses. Theory of estimation and hypothesis tests for full rank linear models and less than full rank models applied to regression models. Analysis of variance models, variance component and mixed models and unbalanced data models. Theoretical foundation course for linear model analysis techniques. P, 566a, linear algebra, e.g., MATH 413.


---

**Systems and Industrial Engineering (SIE)**

Engineering Building, Room 111 (520) 621-6551; FAX: (520) 621-6555


Associate Professors Robert L. Baker, Emelie Fernandez, Kenneth L. Head, Sanjay Jagdale, Fei-Yue Wang

The department offers programs leading to the Master of Science degree with majors in systems engineering, industrial engineering, and reliability and quality engineering, and leading to the Doctor of Philosophy degree with a major in systems and industrial engineering.

Normally, the graduate student has a background in engineering, mathematics, or physics. In addition, a special program is available to students with bachelor's degrees in areas other than engineering or the physical sciences. Programs vary in length from one to two-and-one-half years, depending upon background.

The Master of Science degree consists of either 30 or 33 units. At least 18 units must be taken within the department. Options in the 30-unit program include a 6-unit thesis, a 6-unit paper, or a 3-unit report, each of which requires an oral examination. The 33 unit program requires only course work, subject to the stipulations above, with the further requirement of one 600-level course within the department and an oral final examination. Additional details concerning the requirements of the
507. Advanced Quality Engineering (3) II Advanced techniques for statistical quality assurance, including multivariate control charts, principal components analysis, economic design of acceptance sampling plans and control charts, inspection errors, and select papers from the recent literature. P, 530.

508. *Reliability Engineering (3) I Time-to-time failure, failure-rate, and reliability determination for early, used, and wear-out lives; equipment reliability prediction; spare parts provisioning; reliability growth; reliability allocation. Credit for this course or A ME 572. P, S, MATH 223.


511. *Human Interaction with Computers and Software (4) II The interaction of technical requirements with the characteristics of computer users and programmers as they affect the design of software, and the physical and cognitive interfaces between people and computers.

513. Environmental Risk Analysis (3) 11996-97 (Identical with HWR 513)

518. Reliability Testing (3) II Mean-time-between-failure and reliability confidence limits; sequential testing; sampling; accelerated, sudden-death, and suspended-items; nonparametric, and Bayesian testing. Credit for this course or A ME 575. P, 408, 530.


521a-521b. Systems Modeling and Simulation (3-3) (Identical with MIS 521a-521b)

522. *Engineering Decision Making Under Uncertainty (3) I Application of principles of probability and statistics to the design and control of engineering systems in a random or uncertain environment. Emphasis is placed on Bayesian decision analysis. P, 330R-330L.


528. Maintainability Engineering (3) II Complex systems reliability; maintainability engineering; reliability and availability of maintained systems; operational readiness; system effectiveness; maintainability demonstration. Credit for this course or A ME 577, but not for both. P, 408, 530.


532. Statistical Models in Engineering (3) Statistical distributions applicable in engineering, with emphasis on quality and reliability problems. Topics include model selection, parameter estimation, and approximations for large-scale systems. P, 530.

536. Experiment Design and Regression (3) II Planning and designing experiments with an emphasis on factorial layouts and response surface methodology. Also, includes analysis of experimental and observational data with multiple linear regression and analysis of variance. P, 530.

537. Advanced Experiment Design (3) I Robust product and process design through planned experiments, emphasizing the integration of loss functions, parameter design and tolerance design. P, 536.


545. Nonlinear Programming (3) I Unconstrained and constrained optimization problems from a numerical standpoint. Topics include variable metric methods, optimality conditions, quadratic programming, penalty and barrier function methods, interior point methods, successive quadratic programming methods. P, 340.

546. Algorithms for Graphs and Networks (3) I Model formulation and solution of problems on graphs and networks. Topics include heuristics and optimization algorithms on shortest paths, min-cost flow, matching and traveling salesman problems. Credit is allowed for this course or MIS 546. P, 544.

550. Theory of Linear Systems (3) II An intensive study of continuous and discrete linear systems from the state-space viewpoint, including criteria for observability, controllability, and minimal realizations; and optionally, aspects of optimal control, state feedback, and observer theory. P, 350.

551. Modeling Physiological Systems (3) Development and validation of models, sensitivity analysis, and applications of systems engineering techniques to physiological systems.


554. Concurrent Engineering and Systems Design (3) I Process and tools for systems engineering of large-scale, complex systems: requirements, performance measures, concept exploration, life cycle, function decomposition, system configuration, function deployment, multi-objective trade-off analysis, system modeling, design for X, teamwork, project management, ISO 9000 and documentation.

558. Fuzzy Sets in Systems Analysis and Decision Making (3) I Fuzzy numbers' definition, operations; fuzzy regression, interpolation and reliability, fuzzy logic, optimization and control; fuzzy events and decision-making applications in areas such as systems, civil, industrial, electrical, computer engineering and financial management.

559. Multi-Objective Analysis of Engineering Systems (3) II 1996-97 Systems design versus operation; multi-objective programming distance-based and out-ranking techniques; multi-attribute utility; techniques with qualitative criteria; interactive, quasi-interactive and dynamic approaches; model choice; resource and industrial engineering applications. CR, 540 or 544.

562. Advanced Production Control (3) I Quantitative models in the planning, analysis and control of production systems. Topics include aggregate planning, multi-level production systems, inventory control, capacitated and uncapacitated lot-sizing, Just-in-time systems and scheduling.


574. Decision Support Systems (3) I Building, testing and evaluating expert systems, computer systems that emulate the human and draw conclusions based on incomplete or inaccurate data. Each student will build an
expert system using commercially available expert system shells. P, familiarity with computers.

575.* Computational Methods for Games, Decisions, and Artificial Intelligence (3) II An introduction to automata, computer representation and optimal solution of games and decision problems. Principles of heuristic programming and machine learning. A programming project is to be selected from areas such as game strategies, graphics, recreational mathematics, and manufacturing simulation. Microcomputer experience is emphasized.

576.* Numerical Analysis (3) I 1996-97 An intermediate-level introduction to numerical methods and error analysis for function approximation and interpolation, integration, solution of linear and nonlinear equations, and differential equations. P, ENGR 102, MATH 254 or equivalent skill in PASCAL or FORTRAN.

583. Computer Integrated Manufacturing Systems (3) I Modern manufacturing systems with emphasis on information requirements and data management. Includes CAD, CAM, CAPP, real time scheduling, networking and system justification.

584. Manufacturing Automation (3) II Current topics in hardware for automation, selecting and implementing robots, part orientation, computer vision, automated warehousing and material handling, programmable controllers, NC machinery, on-line computer control. Laboratory projects.

585.* Introduction to Robotics (3) I Methods of design and operation of general purpose and industrial manipulation systems. Kinematic and dynamic models of mechanical manipulators, trajectory planning, manipulator control, robotic vision and other sensing techniques. P, 350 or equivalent.


*May be considered with 400-level course.

608. Selected Topics in Reliability (3) I 1995-96 In-depth analysis of selected advanced topics in reliability engineering from the recent archival literature. Project required. P, 530, A ME 577.


631. Digital Systems Simulation (3) Emphasis on current research problems including random variate generation, modeling, language development and statistical analysis of output. P, 431 or M SIS 521a or 521b.

640. Topics of Optimization (3) Convexity, optimality conditions, duality, and topics related to the instructor's research interests; e.g., stochastic programming, nonsmooth optimization, interior point methods. P, 544 or 540.

645. Large-Scale Optimization (3) I 1996-97 Decomposition-coordination algorithms for large-scale mathematical programming. Methods include generalized Benders decomposition, resource and price directive methods, subgradient optimization, and descent methods of nondifferentiable optimization. Application of these methods to stochastic programming will be emphasized. P, 544.

646. Integer and Combinatorial Optimization (3) II 1995-96 Modeling and solving problems where the decisions form a discrete set. Topics include model development, branch and bound methods, cutting plane methods, relaxations, computational complexity, and solving well-structured problems. P, 544.


685. Advanced Topics in Robotics (3) II Selected topics covering recent advances in robotics, to be chosen from a list including applications, kinematics, dynamics, and vision. P, 485.

686. Advanced Manufacturing System Modeling (3) I 1995-96 Current topics in design and analysis of manufacturing systems. Topics include serial processing lines, queueing networks, and FMS. Student projects. P, 562 or 586.

695. Colloquium a. Doctoral (1-3) [Rpt./12 units] II I Consult department before enrolling.

696. Seminar i. Interstate Conflict Resolution (3) [Rpt. II 1995-96 (Identical with AREC 658g and HWR 658g)

Teaching and Teacher Education (TTE)

Education Building, Room 735 (520) 621-1602


The department offers programs leading to the Master of Arts, the Doctor of Education, and Doctor of Philosophy degrees with a major in teaching and teacher education; the Master of Education and Educational Specialist degrees with a major in educational media; the Master of Teaching with majors in elementary education and in secondary education. Specialties and endorsements are available in environmental education, early childhood education, and middle level education. For information concerning these programs, see Requirements for Master's Degree/Master of Education elsewhere in this catalog.

An undergraduate grade-point average of at least 3.00 is required for admission to full standing in a graduate degree program. However, applicants with undergraduate grade-point averages of 2.50 to 2.99 may be admitted on a provisional basis. A master's degree (in education or a related discipline) is a prerequisite for admission to a doctoral program. Beyond these minimal requirements, applicants must also meet the specific admission requirements for all majors offered in the department.

503. Teacher Leadership and School Change (3) II S Teacher leadership and involvement as it applies to change process, school improvement, collaborative decision-making, school assessment, strategic planning, and school restructuring.

504. Trends/Issues in Elementary Schools (3) I Investigation of the rationale, implementation and consequences of recent trends/issues in elementary school organization, curriculum and methodology.

505. Trends/Issues in Secondary Education (3) I II Examination of purposes and functions of middle level and high schools, investigation of trends and issues and organization of curriculum and programs.

515. Observation and Supervision of Student and Inservice Teachers (3) I II A research-based strategies to supervise and critique teaching events, and determine positive ways of thinking and acting in classroom.

520. The School Curriculum: Science (3) I II S Elementary and secondary science curricula in terms of their aims content/processes, instructional methods and assessment. These science curricula are placed within a historical perspective and are examined from a theoretical and research base. P, 324 or 338h.
521. Elementary and Middle School Mathematics Curriculum (3) I II S Elementary and middle school mathematics curricula in terms of their aims, content, processes, instructional methods, and assessment. These mathematics curricula are placed within a historical perspective and are examined from a theoretical and research base. P, 326 or 338y.

522. The School Curriculum: Social Studies (3) I II S Elementary and secondary social studies curricula in terms of their aims, content, processes, instructional methods, and assessment. These social studies curricula are placed within a historical perspective and are examined from a theoretical and research base. P, 327 or 338u.


526. Investigations in Early Childhood Education (3) I II S Critical study and evaluation of research findings and learning theories with emphasis upon pedagogical implications related to early childhood education.

527. Developing Programs for Young Children (3) I II S Contemporary early educational programs with an emphasis on the child's changing needs in the home, school, and society. Criteria unique to particular ECE programs are analyzed to establish guidelines for program development.

528. Classroom Organization and Management (3) I II S An analysis of concepts, research findings, and effective practices for organizing and managing classrooms. Experiences in solving management problems provided. P, 539 or CR, and EDUC 500.


532. Mathematics Diagnosis and Remediation (3) I II S The nature and causes of students' difficulties in mathematics, diagnostic techniques, and the development of prescriptive principles of remedial instruction in mathematics. P, 326.

536. Alternatives in the Secondary Classroom (3) I II S Theoretical bases, methods and strategies for delivering instruction in secondary classrooms are examined, discussed and applied.

537. Equity in Schools and Society (3) I II S Implicit and explicit ways in which values are introduced into the classroom and school. Research on the hidden curriculum, ethnic/racial and sex equity and prejudice and methods for combating inequities.

539. Recent Research on Teaching and Schooling (3) I II S An overview of the concepts, methodologies and findings of recent research on teaching and schooling practices.

542. The Middle School/Junior High (3) I II S History, purposes, curriculum, instructional organization, and classroom processes for middle schools/junior high schools.

545. Curriculum Theory and Policy (3) I II S A survey of theoretical frameworks in curriculum; the processes of content representation and enactment; planning evaluation, and change; analysis of curriculum policy.

593. Internship (3) S Action Research Internship (1-3) I II S P, 597r.

595. Colloquium (3) S Master's Colloquium (1-3) II S P, 593r, 597r

597. Workshop (3) S Learning Through Play (3) I III S
m. Middle Level School Development (3) S
p. Parents as Partners in Education (3) I III S
r. Action Research Workshop (3) S
w. Elementary Science Demonstrations (3) II S P, 324 or 338H

610. Applied Curriculum Theory (3) I II S Theories, techniques, and organization of curriculum construction are discussed, evaluated and applied. P, 545.

612. Staff Development (3) I II S The concept, context, content, processes and evaluation models of staff development as enacted in school settings. P, EDUC 500.


635. Policy Analysis in Teaching and Teacher Education (3) I II S Examination of policy development and enactment related to teaching and teacher education at local, state, and national levels, as well as methods and approaches to policy analysis. P, 539 and 540.

640. Teacher/Student Cognition and Instruction (3) I II S An examination of cognitive models related to teacher comprehension, planning, and decision making; and to students' cognitive change and their interpretation of classroom events. P, 539 and 696b; and EDUC 500.

642. Middle-Level Curricular Process (3) I II S Examination of procedures for curriculum/instructional development, implementation, improvement, and evaluation at the middle-school level. P, 542.

696. Seminar (3) S Research on Teacher Education (3) I II S P, 539, 545, EDUC 500.

793. Internship (3) S Classroom Research (3) I II [Rpt./1] P, EDUC 600 or 601.

b. Teacher Education Research (3) I II [Rpt./1] P, EDUC 600 or 601.

Theatre Arts (TAR)

University Fine Arts Complex,
Room 237
(520) 621-7008; FAX: (520) 621-2412

Professor Albert D. Tucci, Head, Robert C. Burroughs (Emeritus), Irene F. Comer (Emerita), Harold W. Dixon, Robert A. Keyworth (Emeritus), Frank K. La Ban, Mary Z. Maher

Associate Professors Peter Beudert, Richard T. Hanson, Peggy Kellner (Emerita), William A. Lang, Jeffrey L. Warburton, Dianne J. Winslow

Assistant Professors Jerry R. Dickey, Douglas Finlayson, Brett Gibbs, Karen K. Husted, Julie A. Mack, Daniel Yurgaitis Technical Director Jon Jensen

The Department of Theatre Arts is committed to providing professional training at the undergraduate and graduate levels in the theatre arts through a program of performance-centered activities and creative studies, the object of which is to ensure that each student acquires a thorough understanding and appreciation of the theatre arts through classroom study, studio-laboratory training, and university theatre production. The programs of study are designed for those who intend to pursue a professional theatre career, as well as those who may enter other fields where theatre skills are desirable. The program is designed to instill in the student the highest academic standards and professional skills required to initiate a career in educational or professional theatre.

The Department of Theatre Arts offers programs leading to the Master of Arts and the Master of Fine Arts degrees with a major in theatre arts. The Master of Arts in Theatre Arts is an initial graduate degree for those students who wish to complete graduate work in performance studies or in theatre education. Requirements for the performance studies concentration include thirty (30) units of course work, twenty-one (21) of which must be in the Department of Theatre Arts. The program culminates in master's degree exams, an M.A. thesis and an oral defense of that thesis.

The Master of Arts concentration in theatre education requires thirty (30) units in the Department of Theatre Arts, twelve (12) of which must be graduate theatre education courses. The program culminates in master's degree exams, an M.A. thesis, and an oral defense of that thesis. Students may opt to certify them-
selves for teaching in the State of Arizona; such an option requires a number of course work units in addition to the thirty cited above.

Students in both concentrations of the Master of Arts degree are required to complete the departmental graduate core curriculum consisting of T AR 600, 3 units of a departmentally-approved 600-level course in theatre history; and 3 units of a departmentally-approved 600-level course in dramatic theory or criticism. Candidates must complete all requirements within a six-year period.

Students who elect to take an M.A. in one of the above concentrations have normally completed an undergraduate degree in theatre arts. Those who have not done so may need to take additional units to make up for deficiencies in the area of theatre. Only six (6) transfer units of graduate courses in theatre arts may be applied toward the degree, and these must be documented evidence of equivalency.

The Master of Fine Arts degree is a professional training program emphasizing artistic achievement. Admission and retention are competitive and based on an evaluation of the applicant's professional potential, trainability, and talent. The program encompasses a rigorous regime of studio training, classroom study, and University Theatre production.

In cooperation with the Department of Theatre Arts, the Committee on Dance offers a program of advanced study which leads to a Master of Arts or a Master of Fine Arts in theatre arts with a dance concentration. For a listing of graduate courses, see Dance.

501.* Advanced Stagecraft I (3) II 1996-97 Advanced studies in scenic construction methods and techniques. P. 111.

502.* Combat for the Stage (1) [Rpt./1] I II Basic study in the execution of staged combat, training in the use of theatrical weapons and hand-to-hand combat required in playscripts. Extensive physical training as well as work in relaxation and focus. Open to majors only.

503.* Musical Theatre (3) I Intensive text and score analysis in relation to the process of characterization for the actor, singer, dancer in musical theatre. Audition materials and techniques for a professional career in theatre. Individual and group performance. Open to majors only. 2L, 2S. P. 205 and audition.

504.* Musical Theatre III (3) II Intensive scene study and exploration of the major historical styles and genres of the American musical theatre. 2R, 2S. Open to majors only. P. 205 and audition.

510.* Methods of Teaching Creative Drama (3) I Principles and procedures of improvisation, role-playing, creative playwriting techniques, and program development in creative dramatics applicable to the elementary and secondary school levels. P. 12 units of theatre arts and education.

514.* Advanced Make-up (2) [Rpt./2] History and practical application of theatrical make-up. Design and construct such items as masks, prosthetic pieces, wigs and beards. P. 115.

515.* Advanced Scenic Drafting (3) I Advanced mechanical drawing for the theatre. Includes computer-aided drafting instruction. P. 224.

516.* Advanced Rendering (3) [Rpt./3] II Advanced practical color theory in pigment and illustration, rendering mediums and techniques. P. 224.

519.* Sound Design (3) II Advanced study in theatrical sound production and design. P. 215 or consult department before enrolling.

520.* Advanced Lighting Design I (3) II Special problems, practice and trends in designed light for theatrical productions. P. 220.

521.* Special Effects for Theatre (3) II Applied theory and techniques associated with sound system and visual effects in theatre. 2R, 3L.

522.* Theatrical Properties (3) [Rpt./2] II 1995-96 Construction and collection of stage properties. Experimentation with the use of materials and techniques.

523.* Scene Painting (3) I 1996-97 Techniques and methods of scenic painting.

524.* Advanced Scenic Design (3) II Advanced techniques and methods of scenic design. P. 223.


529.* Advanced Stage Costume Construction I (3) I Advanced techniques in costumes design. P. 116.

530.* Stage Management (3) I Principles and techniques of stage management, practical applications, problems and analysis of stage management. P. 111, 151.

531.* Audience Development (3) I Publicity, press releases, sales, advertising, display techniques, subscription procedures. P. 12 units of theatre arts or related arts fields.

532.* Theatre Management (3) II Amateur, educational and professional theatre organization and management; theatrical contracts, professional unions and representative organizations. P. 12 units of theatre arts or related arts fields.


541. Scenography (3) The integration of scenery, costume, make-up, light and sound into a total production design.

542.* Advanced Stage Lighting II (3) I An advanced study of lighting design dance; theoretical (light plots) and practical (light lab) projects. P. 420/520.

546. Careers in Dance (3) I 1996-97 (Identical with DNC 546)

549.* Acting V (3) Intensive study of classical acting styles with emphasis on Shake-
research in theatre and drama; introduction to the bibliography of these fields; organization and form of thesis.


606. Advanced Voice and Movement for the Actor II (3) [Rpt./1] II Continued advanced study and exercise in voice and movement for the actor: standard stage speech, stage dialects, period customs, manners and movement. 65. P, audition.

656. Shakespeare Production (3) Advanced readings and discussion in theory and criticism, analysis of filmed and video Shakespeare, and directorial approaches to Shakespeare production in performance history.

640. Dramatic Criticism: Tragedy (3) I Comparative analysis of tragedy and theories of tragedy from antiquity to the present for stage and screen; writing of critical papers.

641. Dramatic Criticism: Comedy (3) II Comparative analysis of comedy and comic theory from antiquity to the present for stage and screen; writing of critical papers.

642. Advanced Studies in Theatre History (3) [Rpt./1] I II Concentrated study in theatre history, with major emphasis on the physical theatre, standard scholarly works, and source materials.

644. History of the American Theatre (3) II Studies in the American theatre and drama. Directed and individual projects will be assigned.

646a-646b. Theories of the Theatre I-II (3-3) 646a: I 1996-97 A year-long study of theories of theatrical performance and dramatic presentation. The first semester covers select theories from the Greeks through Neoclassicism. The second semester treats theories from Romanticism to the present.


655. Advanced Directing I (3) I Techniques of stage direction including play analysis, director-actor communication, director-designer communication, blocking, movement, composition; use of directorial style and the adaptation of directorial philosophies. 2R, 2S.

656. Advanced Directing II (3) II Techniques of analyzing and staging classical texts for a contemporary audience; use of directorial style and the adaptation of directorial philosophies with an emphasis on staging the plays of Shakespeare. 2R, 2S. P, 449, 655.

696. ** Seminar  
   a. Contemporary Trends (1-3) [Rpt./6 units] I I  
   b. Special Topics in Acting (1-3) [Rpt./6 units] II  
   c. Special Topics in Directing (1-3) [Rpt./6 units] II  
   d. Musical Theatre Production (1-3) [Rpt./6 units] II  
   e. Special Topics in Playwriting (3) [Rpt./6 units] P, permission of instructor.  
   f. Special Topics in Stage Costume Construction (1-3) [Rpt./6 units] I  
   i. Period Design Style (1-3) [Rpt./6 units] II  
   l. Special Topics in Costume Design (2-3) [Rpt./6 units] P, 429.  
   m. Special Topics in Design (2) [Rpt./6 units] I P, 401/501.  

** Students may earn a maximum of 9 units in T AR 696, with a maximum of 6 units in any one area.

Toxicology  
(See Pharmacology and Toxicology,  
College of Pharmacy)

Veterinary Science (VSC)  
Pharmacy-Microbiology Building,  
Room 203  
(520) 621-2355  
Professors Charles R. Sterling, Head, Robert B. Chiasson (Emeritus), Leonard W. Dewhirst (Emeritus), Donald Lightner, Lynn A. Joens, C. John Mare, Raymond E. Reed (Emeritus), Jose M. Ribeiro (Entomology), James N. Shively (Emeritus), J. Glenn Songer  
Associate Professors Rodney Adam (Medicine), Ronald W. Hillwig, Robert J. Janssen (Emeritus), David W. Sammons  
Assistant Professor Michael W. Riggs  

The department offers programs leading to the Master of Science and Doctor of Philosophy degrees in pathobiology. The program offers an integrative approach to the basic animal and comparative health sciences with areas of study in immunology/pathology of disease; microbial pathogenesis; epidemiology, diagnosis and prevention of disease.

Applicants for admission shall hold an undergraduate or higher degree in the basic sciences. In addition to the application materials submitted to the Graduate College, applicants must submit to the department scores from the General Test of the Graduate Record Examination. The department recommends that scores in the advanced biology section be submitted if available. Foreign students must demonstrate English proficiency by earning a score of greater than 550 on the TOEFL or by completing two academic years or a bachelor's degree at an institution where English is the medium of instruction, as prescribed by the Graduate College. The department requires that three letters of recommendation and a statement of intent, written by the applicant, declaring career objectives and research experience be submitted.

Master of Science: Degree requirements include at least 30 units of graduate credit: 18 units of core courses in pathology, microbiology, immunology, biochemistry, and cell biology; 6 units of thesis; seminar units; an overall GPA of 3.0; an acceptable thesis; a manuscript in a form suitable for publication; and a final oral examination.

Doctor of Philosophy: Doctoral students must complete 69 units of graduate credit including the M.S. core, 36 units in the major and 18 units of dissertation. At least 6 semesters of essentially full-time graduate study is required with 30 units of graduate credit in the major field completed at The University of Arizona. Degree requirements of the student include passage of a doctoral preliminary examination, an acceptable dissertation, one or more manuscripts suitable for publication, and a doctoral oral defense.

Minor: At least one minor is required by the graduate college and may be chosen from any graduate program, including pathobiology, as approved by the graduate committee.

500a-500b.* Animal Anatomy and Physiology (3-3) Physiology, gross and comparative anatomy. 500a: Nervous, musculoskeletal, immune, hemolympathic, circulatory, and renal systems. 500b: Respiratory, digestive, endocrine and reproductive systems. 500a is not prerequisite to 500b. P. ECOL 181, 182; CHEM 243a; MATH 1717R/S.

503R. * Biology of Animal Parasites (3) I Biologic of host-parasite relationships with emphasis on parasites of veterinary and human importance. Parasite morphology and physiology, life cycles, epidemiology, pathogenesis and zoonotic potential. P, 8 units of biology or microbiology. (Identical with ECOL 503R, ENTO 503R, INSC 503R and MBIM 503R)

503L. * Parasitology Laboratory (1) I Parasite morphology and diagnostic laboratory techniques. P, 9 units of ecology or microbiology, CR, 503R. (Identical with ECOL 503L, ENTO 503L, INSC 503L and MBIM 503L)


505. * Animal Diseases (3) I Survey of selected diseases of domestic animals.

519. * General Immunological Concepts (3) I (Identical with MBIM 519)

520. * Pathogenic Bacteriology (3) II (Identical with MBIM 520R)

523. * Mechanisms of Disease (5) II General pathologic of animal and selected human diseases with emphasis on pathogenesis, pathophysiology, and morphologic changes at the macroscopic, microscopic and molecular levels. Recitation will stress general mechanisms of disease. Laboratory will enforce recitation and stress recognition of disease in organs and tissues at the gross and microscopic levels. 3R, 1L, P, 400A-400B, 459 or CR, MIC 205, MIC 419
527. * Insect Chemical Ecology (4) I 1995-96 (Identical with ENTO 527)

529. * General Virology (3) II (Identical with MBIM 529)


538. * Ecology of Infectious Disease (3) II Ecology of the major infectious diseases of humans and other animals. P, 419 or 420. (Identical with MBIM 538)

543. * Research Animal Methods (3) I Regulations, care, and techniques involving common laboratory animals used in research and teaching programs. (Identical with AN S 543, BIOC 543, MBIM 543)

549. * Diseases of Wildlife (3) I Important diseases of wildlife. Disease mechanisms, infectious agents, diagnostic procedures, and post-mortem techniques as well as a survey of selected but generally well-recognized diseases of wildlife. (Identical with WPSC 549)

550L. Medical Mycology (2) II (Identical with MBIM 550L)

552. * Medical-Veterinary Entomology (4) I (Rpt./3) II (Identical with ENTO 552)

554. * Host- Microbial Interactions (3) II Review of bacterial-host interactions with emphasis on mucosal immunity following bacterial infection. Important issues such as molecular mechanisms of virulence factors, bacterial resistance to host factors, immune modulation, and regulation of the host response to bacterial assault will be discussed. P, 419 and 420, or instructor approval. (Identical with MBIM 554)

556. * Aquaculture (3) II 1991-92 (Identical with WPSC 556)

559. * Comparative Vertebrate Histology (4) II Identification, phylogenies, and function of normal vertebrate tissues. 2R, 6L. P, 12 units of animal biology. A vertebrate anatomy and/or systematics course is strongly recommended. (Identical with ECOL 559)

565. * Shrimp Pathology (3) [Rpt./1] S Comprehensive lectures and practical laboratory training on the current methods used to diagnose, prevent and treat the principal diseases of cultured penaeid shrimp. Field trip. Fee. P, B.S., M.S., and/or D.V.M. in biological and/or medically oriented fields.

566. * Physiology Laboratory (2) II (Identical with ECOL 566)

568. * Comparative Physiology (3) II (Identical with ECOL 568)

570. * Animal Behavior (3) II (Identical with ECOL 570)

601. Experimental Surgery (2) II 1993-94 Exercises in the surgical procedures commonly necessary in animal experimentation, including aseptic technique, anesthesia, and surgical operations, and care of the postsurgical patient. 1R, 3L. P, 3 units of mammalian anatomy.

612. Biological Electron Microscopy (4) I (Identical with MCB 612)

630. Experimental Methods for Research (4) II (Identical with MBIM 630)

649. Fishery-Water Quality and Toxicology (3) I (Identical with WPSC 649)

660. Infectious Disease Epidemiology (3) I (Identical with MBIM 660)

660. Infectious Disease Epidemiology (3) II 1996-97 Principles of systemic disease processes. Physical, chemical, or cellular events which alter body functions or produce disease. P, 400a-400b/ 500a-500b, 405/405 and 423R/523R or equivalent. (Identical with MBIM 660)

695. Colloquium
   a. Veterinary Laboratory (1-3) [Rpt./9 units] II

696. Seminar
   a. Research Seminar (1) [Rpt./3] II

Water Resources
(See Hydrology and Water Resources)

Watershed Management
(See Renewable Natural Resources)

Wildlife and Fisheries Science
(See Renewable Natural Resources)

Women's Studies (WS)
Douglass Building, Room 102
(520) 621-7338; FAX: (520) 621-1533

Committee on Women's Studies

Chair, Department of Women's Studies

Professor Barbara C. Aiken (English), Assistant Professor Kathleen Aiken (English), Associate Professor Sallie Marston (Women's Studies and English), Assistant Professor Susan White (Women's Studies and Religious Studies), Kimberly Jones (East Asian Studies), V. Spike Peterson (Political Science), Jane Rice (German Studies), Abby Van Slyck (Architecture)

The Committee on Women's Studies is an interdisciplinary program that offers the Master of Arts with a major in women's studies. The program draws its courses and faculty from many different perspectives. The graduate program offers its students a choice of one of two tracks—the academic option or the applied option. The academic option prepares students for doctoral work in their chosen field by providing a background in women's issues and feminist theories. The applied option is for students intending to follow a career in women's issues or one that can be enhanced by the study of women's issues. Students applying to the Master of Arts program should hold the baccalaureate degree or its equivalent by the date of entry into the program. An undergraduate major or minor in women's studies or a strong background in feminist theory within the undergraduate major is strongly encouraged. Students must submit GRE scores to the women's studies program. The Master of Arts requires 36 graduate credits, 18 of which must be in women's studies, including the four women's studies core courses of 3 units of credit each. Students must consult with a women's studies faculty advisor to select the remaining 12 units of electives and receive approval for a course of study. Students following either option must engage in a final project of 6 credit hours. Students following the academic option must, in consultation with their advisor, write an extended research paper of publishable quality. Those following the applied option may write such a research paper or engage in a internship which culminates in a report. Oral and written examinations, which evaluate the student's understanding of the theoretical and empirical dimensions of feminist scholarship, will be taken after all other work is finished.

Please note: The graduate program was not given final approval until after the Catalog deadline. Please contact Women's Studies for details.

502. Gender and Language in Japan (3) II (Identical with JPN 502)


530. * Lesbian/Bisexual Women's Theories/Lives/Activisms (3) I Exploration of the relationships between lesbian and bisexual women's lives and activism, and the theoretical understandings which concurrently both arise out of and construct those lives and activism. P, 3 units of women's studies, preferably 305, or consent of instructor.
539. History of Feminist Theory (3) I Historical grounding in woman-centered theory characteristic of Western discourse. Each reading will be placed in context with other contemporaneous relevant thinking of the human condition, including attention to race, class and difference.

544. Women and the Body (3) II Exploration of the ways that women have defined their bodies; how the representation of woman as body permeates the culture and affects women's sense of self and self-esteem. Examination of feminist theoretical analyses of women's power and the control of women's bodies. P, 6 units in women's studies.

550. Modern Theories of Cultural Studies (3) (Identical with CCLS 550)

554. Contemporary Feminist Theories (3) II Introduction to contemporary feminist theories, posing and analyzing the questions that propel theorizing about women's relationships to processes of gender differentiation. By examining the assumptions about gender relations that ground theoretical positions from various disciplines, analytic traditions, and subject areas, students will be enabled to read, synthesize and critique across the spectrum of feminist theorizing. P, consult the committee before enrolling (Identical with ENGL 554)

555. History of Women in Europe (3) (Identical with HIST 555)

558. Gender Identities and Interactions (3) (Identical with SOC 558)

561. Feminist and IR Theories (3) (Identical with POL 561)

564. Women in American Architecture (3) I (Identical with ARCH 564)

571. Counseling Women (3) II (Identical with FS 571)

581. Work, Motherhood and Female Identity in America: 1945 to the Present (3) I History of women in the U.S. since 1945. Will explore a variety of topics including employment, sexuality, motherhood, abortion, reproductive technologies, and feminism, and explore how changes in these areas have affected diverse groups of women. Prior course work in women's studies or history helpful. P, two women's studies courses or one women's history course. (Identical with HIST 581)

583. Gender and African History (3) I II S (Identical with HIST 583)

584. Feminist Research Methodologies (3) II Considers some epistemological assumptions underlying research and theoretical projects of traditional disciplines; explores feminist adaptations and critiques of these assumptions.

585. Mexicana/Chicana Women's History (3) I (Identical with MAS 585)

586. Gender, Difference and Power (3) I Focuses on gender as it has intersected in varied ways with other cultural distinctions of differences based on class, race, sexual identity and religion. (Identical with PORT 586, SPAN 586)

596. Seminar w. Women's Studies (3) [Rpt.] I II (Identical with ENGL 596w)

*May be convened with 400-level course.

606. Women's Health in the United States (3) II (Identical with ANTH 606)

695. Colloquium e. Advanced Studies in the History of Women (3) [Rpt./5] I II (Identical with HIST 695e)

696. Seminar n. Comparative Women's History (3) [Rpt./4] P, consult committee before enrolling. (Identical with HIST 696n)
UNIVERSITY LIBRARIES, RESEARCH, AND SERVICE FACILITIES

The University Libraries

The University Library system contains almost 7,000,000 items, including books, periodicals, microforms, maps, government publications, manuscripts, and nonbook media. Basic holdings cover all fields of instruction, and there are especially strong collections in anthropology, geology, arid lands, Spanish and Latin American language and literature, American agriculture, Southwestern Americana, Arizoniana, 20th century photography, history of science, science fiction, and 18th- and 19th-century British and American literature. Through the library the University is a member of the Center for Research Libraries and the Association of Research Libraries. The library is also a member of the AMIGOS Bibliographic Network and through that and other agencies can borrow materials for student and faculty research on interlibrary loan. The library offers reference services, online searching of computerized databases, and bibliographic course-related instruction. SABIO, the library's information system includes an on-line catalog, commercial databases and access to the Internet.

The University Library system consists of the Main Library, which houses the Central Reference Department, the Media Center, the Map Collection, the Current Periodicals and the Reserve Book Room, Newspapers and Microforms Collection; the Science-Engineering Library; and the following branch libraries: the Oriental Studies Collection, Special Collections, and the Architecture Library. Three large but separate library facilities are the College of Law Library, the Arizona Health Sciences Center Library, and the Arizona State Museum Library. In addition, several other departmental libraries, such as the Division of Economics and Business Research Library, the Steward Observatory Library, the Herbarium, and the Lunar and Planetary Sciences Library, have been established to serve special research needs.

MAIN REFERENCE—Houses reference materials for the social sciences, fine arts, humanities, business and government documents. Several SABIO terminals, CD-ROM stations and image stations are available. General reference questions can be answered.

MEDIA CENTER—Houses all the library's nonbook materials except microforms and music tapes and records. The Film Department was added in 1988.

MAP COLLECTION—A depository for federal government maps, houses a fully cataloged collection of nearly 300,000 maps on every subject.

CURRENT PERIODICALS/RESERVE BOOK ROOM—Displays current issues of the 4,000-plus periodicals received in the Main Library, and manages the reading materials put on reserve for class use.

NEWSPAPERS AND MICROFORMS COLLECTION—Displays current issues of more than 150 newspapers to which the library has a collection of microforms which numbers nearly 2 million.

SCIENCE-ENGINEERING LIBRARY—Houses all materials on science and technology; has more than 500,000 volumes, 1,500,000 microforms, and displays current issues of its 4,000-plus periodicals.

MUSIC LIBRARY—Maintains the library's collection of approximately 50,000 music-related books, 230 periodicals, 70,000 scores, 15,000 pieces of sheet music and 25,000 recordings. Music material from the Arizona and Sonora geographical area is represented. Other significant items include: The Hill & Phillips collection containing over 125,000 titles of historical popular sheet music dating back to the early 1800's.

CENTER FOR CREATIVE PHOTOGRAPHY—The center is a world-class museum and research center devoted to photography as an art form. The research center features nearly 150 photographer's archives including personal papers, negatives, contact sheets, and artifacts, which are available to researchers by appointment. In addition to 17,000 books, the library has over 80 current periodicals and 500 videotapes.

SOUTHWEST FOLKLORE CENTER—Houses musical tapes and manuscript archives of Southwest music and folklore.

SPECIAL COLLECTIONS—Houses the library's collections of Arizoniana and Southwestern Americana, special subject collections, rare books, fine printing, manuscripts and The University of Arizona archives.

ORIENTAL STUDIES COLLECTION—Houses materials in the Chinese, Japanese, Arabic, Persian, Turkish and other oriental languages; has over 160,000 items.

LAW LIBRARY—Houses over 340,000 volumes and volume equivalents. It provides a research collection of all state and federal jurisdictions in the United States, as well as extensive holdings of legal periodicals, treatises and loose-leaf services. The library recently became a selective depository for United States government publications related to law. There is a large collection of English and British Commonwealth materials, and a growing collection of foreign and international legal materials, with a special emphasis on Mexican and Latin American law.

HEALTH SCIENCES LIBRARY—This specialized library, which serves the University Hospital as well as the colleges of Medicine, Nursing and Pharmacy, contains almost 190,000 volumes and receives approximately 3,000 serial titles. The collection includes books, journals, and nonprint materials in the health sciences.

ARCHITECTURE LIBRARY—Houses a collection with emphasis on the topics of design, architectural history and theory, building technology, desert architecture, and design communications. Includes over 10,000 monograph titles and 300 serial titles.

Research and Special Public Service Units

The following divisions are a part of or are affiliated with the University. Additional information regarding their organization and services may be obtained upon inquiry to the director concerned.

THE AGRICULTURAL EXPERIMENT STATION (1890) is responsible for the basic and applied research programs in the schools, departments, and other units within the College of Agriculture. It is administered by the Director of the Experiment Station. Modern facilities for laboratory and field research and extension, as well as graduate and undergraduate teaching, are available on the university campus and at agricultural centers throughout the state of Arizona, including the Santa Rita Experimental Range. Research is also conducted on farms, orchards, ranches, rangelands, and forests in cooperation with farmers, ranchers, and officials of various state and federal agencies.

THE ARIZONA ARTHRITIS CENTER (1977) is a multidisciplinary organization which is University-wide and contains physicists, basic scientists, allied health personnel, and a variety of other health professionals interested in research, education, and comprehensive care of patients with arthritis, rheumatic, and related diseases. The center's activities cover both basic and clinical research. Multiple programs in the area of basic mechanisms of disease in rheumatoid arthritis, systemic lupus erythematosus, metabolic bone disease, scleroderma, inflammatory muscle disease, spondyloarthropathies, and various autoimmune diseases are actively being pursued.
There is a large clinical pharmacology study unit within the center. Basic work on the immunology of inflammatory cell function and the immunology of bone formation and destruction is being studied. There is a large area of research and the development of artificial joint prostheses and biomaterials. Basic educational and health sciences research in rheumatic diseases are also carried on at the center. Educational activities are carried on at the level of medical student, postgraduate trainees in primary care medicine, specialists in the area of orthopedics, rheumatology, joint replacement surgery as well as physical and occupational therapy and podiatry. There are extensive programs in patient education and postgraduate and continuing educational programs in the state, region, and nation. The patient care model of interdisciplinary team care is emphasized. There are large programs in both adult and pediatric rheumatic disease care that provide for statewide consultative programs.

The Arizona Arthritis Center is a division of the College of Medicine, reporting to the Dean of the College. This program, however, includes faculty and staff in the college as well as on main campus and is linked to staff and university physicians in University Physicians, Inc. and University Medical Center.

THE ARIZONA CANCER CENTER (1976) is a comprehensive cancer center officially designated by the National Cancer Institute. The center has as its mission to significantly contribute to research related to the understanding, diagnosis, treatment, and prevention of cancer. To attain its goal, the Arizona Cancer Center pursues the following objectives:

1. Serve as a major geographic resource which is comprehensive in the scope of its activities
2. Promote excellence in basic and clinical cancer research, patient care, and professional training and education
3. Facilitate and coordinate cancer-related programs at The University of Arizona
4. Develop an outreach program to serve the State of Arizona

The Arizona Cancer Center plans educational, clinical, and scientific activities. The center offers educational opportunities for medical and graduate students as well as organizing local and national continuing medical education programs for physicians and other health professionals. Graduate degree programs in cancer biology were opened at The University of Arizona in 1988 with the support of faculty from the Arizona Cancer Center. Medical students and life sciences graduate students are able to work in cancer-related research projects with faculty throughout the College of Medicine. The monthly Tumor Board at the Arizona Cancer Center is open to all interested persons; presentations cover aspects of cancer patient management, cancer research, and cancer prevention. As part of the required curricula of medical students, cancer-related lectures are presented in the Departments of Biochemistry, Molecular and Cellular Biology, Microbiology and Immunology, Cell Biology and Anatomy, and Pharmacology.

The clinical oncology research programs of the Arizona Cancer Center continue to bring cancer patients to the Arizona Health Sciences Center, which is the leading resource for cancer care in the state.

Multidisciplinary cancer research expertise is continually developed and expanded in numerous clinical and laboratory programs that include basic research studies on oncogenes and on carcinogenesis; the study of gene therapy, heat, radiation, biological modifiers, bone marrow transplantation, and targeted drugs in cancer therapy; the interaction of vitamins A and E and their synthetic derivatives with pre-neoplastic and neoplastic states; the definition of the pathophysiology of clonal growth of human tumors; clinical pharmacology of anticancer drugs; tissue kinetics; tumor virology; cellular and molecular biology; medical imaging of cancer; tumor immunology; cancer prevention; effectiveness of Vitamins A, E, and C, Selenium, wheat fiber, and fruits and vegetables; cytogenetics; and clinical trials of promising approaches to cancer prevention, diagnosis, and treatment.

THE ARIZONA CENTER ON AGING (1991) in the University of Arizona College of Medicine has these primary goals: 1) Development of multidisciplinary education and clinical training programs regarding the elderly that involve university faculty, allied health professionals, scientists, and health administrators; 2) development of a more effective, humane, and comprehensive system for delivering medical, health, and social services to elderly persons; and 3) engagement in research programs addressing the processes of aging and the delivery of services to elderly in the context of our society. The center has three major programmatic emphases: geriatrics, long-term care, and gerontological studies.

The center's activities are diverse and comprehensive. It has established a statewide network for education in gerontology/geriatrics. Internships, postgraduate training in geriatrics, as well as an accredited geriatric fellowship are major features of the center's education program. A Master of Science in gerontology, a doctoral minor in gerontology, and a graduate certificate in gerontology are also offered through the center. Maintenance of geriatric clinical settings, including specialty clinics, a home visitation program, academic nursing home, a geriatric hospital unit, and inpatient consultation program within the College of Medicine allow for direct involvement of students from medicine, nursing, pharmacy, and allied health professions in direct service experiences. Expanding research activities include investigations of basic mechanisms of the aging process; psychosocial issues, including dementia's, depression, cognition, and quality of life; influence of aging on function, including falls, incontinence, and appropriate rehabilitation practices; government policy formulation, and models for quality service delivery to older people and their families. All programs are designed to contribute to the increased well being of the elderly.

THE ARIZONA CENTER FOR MATHEMATICAL SCIENCES (1988) provides an interdisciplinary environment for research and learning in the mathematical sciences. Its basic research themes are the modeling, understanding and applicability of nonlinear processes in optics, fluids, ocean waves, plasma physics, and neural networks with continuing investigations into pattern dynamics, chaos and turbulence, and, in particular, their manifestation in optical contexts. The center supports graduate students, postdoctoral fellows, long- and short-term visitors, and sponsors various workshops throughout the year. These activities serve to provide a rich environment for student and faculty interaction. The Arizona Center for Mathematical Sciences (ACMS) received funding as a University Research Initiative of the Air Force Office of Scientific Research (AFOSR) for six years, 1986-1992, and is currently supported by continued funding from AFOSR as well as by funds from the National Science Foundation and the Office of Naval Research.

THE ARIZONA COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT (1951) engages in graduate education, research, and extension. The unit is supported by the University of Arizona, the Arizona Game and Fish Department, the National Biological survey, and the Wildlife Management Institute. The facilities and personnel of the unit are available to graduate students who wish to pursue both class work and research programs leading to advanced degrees in fisheries science and wildlife biology. The unit is housed in the School of Renewable Natural Resources.

THE ARIZONA COOPERATIVE NATIONAL PARK RESOURCES STUDIES UNIT (1973), located in the School of Renewable Natural Resources, is engaged in research to support the natural science program of the National Park Service. In cooperation with The University of Arizona, the unit provides graduate research opportunities and instructional support in a broad array of natural resource problem areas.
THE ARIZONA EMERGENCY MEDICINE RESEARCH CENTER (1990) was established by the Arizona Board of Regents as a center of excellence to enhance and expand research, education, and training in Emergency Medical and Emergency Health Services (EMS). It is one of only four such units in the U. S. and the only one in the entire Southwest region. AEMRC activities (by division) include:

Research: (1) epidemiology of acute medical and traumatic injuries; (2) clinical research into the pathophysiology of acute illness and injury; (3) research in operations, quality improvement, and policies of emergency health services.

Training: (1) evaluation and enhancement of prehospital EMS through prehospital provider training at all levels; (2) continuing medical education and technologies update in EMS.

Education: (1) development of educational pathways for physicians, nurses, administrators, and researchers dedicated to careers in EMS; (2) education of medical students, housestaff officers, postgraduate fellows, and practicing physicians in emergency medicine and emergency medical services systems. The AEMRC participates in the M.P.A. and M.P.H. programs at The University of Arizona.

Emergency Health Informatics and Information Systems: (1) development, implementation, and evaluation of data dictionaries and data sets; (2) provision of telecommunication and computing support services for research projects involving data collection and analysis; (3) development of methods and modalities for prehospital data collection, transmission, storage, retrieval, and evaluation; (4) facilitation and support efforts as the National Emergency Health Services Information and Injury Control Clearinghouse.

THE ARIZONA INSTITUTE FOR NEUROGENIC COMMUNICATION DISORDERS (1986) is a multidisciplinary academic unit designed to promote, coordinate, and administer research programs and a clinical center for speech and language disorders caused by diseases of the nervous system. Initiated by the Department of Speech and Hearing Sciences and the Department of Neurology, this unit includes the participation of cognitive science, exercise and sport sciences, linguistics, neuroscience, pediatrics, physiology, psychology, radiology, surgery, and systems and industrial engineering. In addition to its major thrusts involving research programs and a clinical center, the institute's mission includes fostering doctoral and postdoctoral education, state-of-the-art conferences, continuing education, and public service through advocacy for individuals with neurogenic communication disorders.

THE ARIZONA POISON AND DRUG INFORMATION CENTER (1980) is operated by the College of Pharmacy and is located in the Arizona Health Sciences Center Library. The center provides comprehensive poison information and advice on treatment of poisoning to the public on a statewide basis. It also provides drug information and therapeutic consultations to health professionals. The center has a toll-free telephone number (1-800-362-0101) and can be reached 24 hours a day, seven days a week. Full-time clinical pharmacists staff the center and serve as poison and drug information specialists. Serving as consultants are medical toxicologists and specialists in plant and animal poisons, drugs, and environmental and industrial poisons. The Arizona Poison and Drug Information Center also provides for clinical training of pharmacy and medical students in the areas of clinical toxicology, drug, and poison information. The Arizona Poison and Drug Information Center is a component of the Arizona Poison Control System which was established at The University of Arizona by the Arizona State Legislature in 1980. The Arizona Poison Control System is certified as a regional poison control program by the American Association of Poison Control Centers.

THE ARIZONA REMOTE SENSING CENTER (1972), located in the Office of Arid Lands Studies, serves as a focus of remote sensing research in the College of Agriculture. The staff of the center is involved in interdisciplinary remote sensing and computer mapping projects related to agriculture and natural resource management. The center contains equipment for manual analysis of satellite and aircraft imagery and computer systems for digital processing and display of images and maps. These facilities are available to faculty, students, and cooperators from outside the University.

THE ARIZONA RESEARCH LABORATORIES (ARL) (1979) is a multidisciplinary unit established to promote and support interdisciplinary collaborations which initiate new research and educational programs of high priority to the scientific community. ARL provides an important mechanism for fostering and administering programs which bridge disciplines embraced by departments from more than one collegiate unit. It presently consists of nine divisions: Arizona Fullerton Consortium; Biotechnology Division; Center for Insect Science; Institute for the Study of Planet Earth; Microcirculation Division; Division of Neural Systems, Memory and Aging; Division of Neurobiology; Committee on Neuroscience; and Surface Science Division.

THE ARIZONA STATE MUSEUM (1893) houses one of the finest collections of prehistoric, historic, and contemporary Southwestern Indian material in the world. The Paths of Life exhibit explores the cultures, beliefs, and histories of ten Native American groups in Arizona and northern Mexico. Library, research facilities, gift shop. Guided tours for school groups by appointment. Exhibits occupy two buildings. Free admission.

THE ARIZONA TRANSPORTATION AND TRAFFIC INSTITUTE (1959) is engaged in broad research aimed at developing advanced methods of analysis and obtaining answers to the transportation problems in Arizona. Topics considered include the planning, design, and operation of transportation facilities, including pavement design and highway materials, as well as maintenance of these systems. The institute acts as a technical information center, and its activities are closely tied to those of the Department of Civil Engineering and Engineering Mechanics.

THE ARIZONA VETERINARY DIAGNOSTIC LABORATORY (1983) is a service unit of the Department of Veterinary Science which provides consultation and diagnostic assistance in animal health to veterinarians; livestock and companion animal owners; wildlife managers; zoos; and federal, state, and municipal agencies. The services provided include pathology, toxicology, virology, parasitology, bacteriology, and applied research and field investigation of livestock problems. Diagnostic faculty members support research and teaching programs of the department.

THE BIOTECHNOLOGY DIVISION (1986) of the Arizona Research Laboratories exists to provide core facilities necessary to support on-going research and educational programs. It provides access to state-of-the-art technology and instrumentation to all units within the University, state agencies, and the private sector. The division presently consists of six facilities: Biophysical Magnetic Resonance Facility; Cell Sorting; Biotechnology Computing Facility; Electron Microscopy; Laboratory for Molecular Systematics and Evolution; and Macromolecular Structures Facility. The facilities offer workshops and other educational opportunities as a means to educate students and researchers in the application of the most modern technologies.

THE BOYCE THOMPSON SOUTHWESTERN ARBORETUM (1927) is operated cooperatively by The University of Arizona (College of Agriculture), Arizona State Parks Board, and the Boyce Thompson Southwestern Arboretum Board. This public botanic garden has facilities for teaching and research. Situated on the edge of the low desert near Superior, Arizona, the arboretum is a two-hour drive from the campus. Thirty acres of native...
and introduced plants from arid and semiarid regions, together with about 1,000 additional acres of undisturbed fauna and flora, are under arboretum control. Additionally, large tracts of relatively undisturbed habitats in a variety of biomes lie in the surrounding Tonto National Forest. Laboratory facilities and housing are available. The arboretum is open daily except for Christmas Day.

THE BUREAU OF APPLIED RESEARCH IN ANTHROPOLOGY (BARA) (1952), a division of the Department of Anthropology, is a regional and international center for basic and applied research relating to the resolution of critical problems in human society: culture change, urban and rural living, technological innovation, cross-cultural and multicultural learning, health, disease and diet, ecological transformation, social and cultural impact assessment, agricultural and institutional development, educational innovation, and research methods. As part of the University, BARA promotes interdisciplinary research efforts. Also, BARA actively involves students of anthropology in its on-going research projects.

THE BUREAU OF MINERAL TECHNOLOGY (1915), formerly the Bureau of Geology and Mineral Technology, was reorganized by the state legislature, effective July 1, 1988, to form the Arizona Geological Survey as an independent state agency. The Arizona Geological Survey replaces the former Geologic Survey Branch of the bureau and continues to serve as the primary source of geologic information in the state. The mission of the Mineral Technology Branch is maintained through the College of Engineering and Mines. Dissemination of information relating to mining, including health and mine safety and geological engineering, is accomplished by the Department of Mining and Geological Engineering. Information about mineral processing and extractive metallurgy can be obtained from the Department of Materials Science and Engineering.

THE CENTER FOR COMPUTING AND INFORMATION TECHNOLOGY (CCIT) (1985) provides campus-wide services in support of the instructional, research, and administrative computing needs of the University. The University’s network of shared computers includes a VAXcluster comprised of two 3100s and a 4000. Other mainframes include a Prime 6350, an IBM 3090-300E, and three CONVEX C240 minicomputers. CCIT also provides access to nearly 200 IBM PC, PC-compatible, and Apple Macintosh microcomputers in labs available to faculty, staff, and students.

CCIT provides a campuswide data communications network which supports both central and distributed processes. Access to facilities is available twenty-four hours a day. Additionally, CCIT provides access to external networks such as BITnet and the National Internet which provides access to academic institutions and supercomputer centers across the country. The University is a member of Cornell National Supercomputing Facility’s Smart-Node Program and has a local allocation of service units.

Interactive access to CCIT’s central computers comes through the IDX-3000, or the campus ethernet (UANet) providing a campus-wide data communications network. Users may access these systems via terminal service centers at various campus locations. Remote access is also provided through the following dial-up number 621-9600.

CCIT offers many services to assist users in taking advantage of available computing resources. Services include mainframe and microcomputer open access facilities; Computing and Technology Store (CATS) for microcomputers, workstations, peripherals, and software; Courseware Library for Instructional Computing (CLIC); a wide variety of training; consulting on the use of the University’s computers and various microcomputers; communications and networking between user-owned equipment and the University’s systems; computing facility planning and preparation; mainframe and microcomputer training facilities; programming and applications support; dissemination of information through user publications, manuals, and program library documentation; and assistance in user acquisition of computing facilities.

The primary source for information and assistance on computing services and facilities is the CCIT Help Desk (621-HELP). The Help desk is located in Room 218 of the Computer Center Building. Computer users can keep informed of changes in and additions to CCIT services by reading the Computing & Communications News.

THE CENTER FOR ECONOMIC PACKAGING RESEARCH (CEPR) (1991) performs research in the areas of electrical and thermal characteristics of electronic device packages and interconnected devices. The main activity is in modeling and simulation of electrical and thermal characteristics of Level 1 and Level 2 packaging, and experimental verification of the modeling results. The work in high-speed interconnected systems is being extended to on-chip interconnects. Faculty members from Electrical and Computer Engineering and Aerospace and Mechanical Engineering are currently contributing to CEPR projects.

The long-term goal of the Center for Economic Packaging Research is to develop an integrated package and Multi-chip Module (MCM) design/simulation/manufacturing system. This system will permit tradeoffs between performance, cost, reliability, and manufacturability to be performed in the design phase. The simulation capability will assure first-pass achievement of packaging requirements, rather than require successive iterations. The CEPR is committed to expeditious transfer of basic research results to research sponsors, the electronic packaging community, and the U.S. industry community through reports, publications, workshops, education of students, and cooperative efforts which involve member industry personnel as both researchers and mentors.

THE CENTER FOR INSECT SCIENCE (1989) of the Arizona Research Laboratories is a multidisciplinary program fostering collaborative research and education on a broad array of topics dealing with insect science. The research goal of the center is to investigate fundamental questions about the biology of insects. Another goal of the center is to produce well-trained, interactive, independent scientists who are capable of working in a variety of areas in the biological sciences and excelling in university, industrial, or governmental laboratories. Finally, through the Educational Outreach Program, the center strives to improve the quality of science taught at the elementary school level, and to arouse a child’s interest in science that will continue throughout his or her formal education. To foster interactions among its members, the center also sponsors several scientific meetings including the HexaPodium series, guest seminar series, distinguished professor series, weekly group insect meetings, and an international symposium on insect science.

THE CENTER FOR MICROCONTAMINATION CONTROL (1984) is located in the Department of Electrical and Computer Engineering. The center conducts funda-
ment and applied research that will lead to better control of defects in high density logic and memory technology. It is one of 50 centers throughout the country initiated by the National Science Foundation to increase the rate of technology interchange between the academic community and the scientists and engineers of industry. The center sponsors interdisciplinary research in more than six departments in several colleges. In addition, the center maintains a class-10 cleanroom, an equipment test-tower, and equipment for measuring low levels of airborne and surface contamination.

THE CENTER FOR MIDDLE EASTERN STUDIES (1975) is one of several federally-funded programs in the United States devoted exclusively to the comprehensive study of this key region of the world. The area of the center's concern ranges from North Africa and the Fertile Crescent to Israel, Turkey, Iran, Afghanistan, and Islamic Central Asia. As a U.S. Department of Education National Resource Center, CMES disseminates information about Middle East studies nationally and internationally. The center includes more than sixty faculty members representing over thirty different departments and seven colleges throughout the University and also houses the Middle East Studies Association (MESA), which is the primary professional organization of scholars of the Middle East.

THE CENTER FOR PHARMACEUTICAL ECONOMICS (1989) is an interdisciplinary research and service unit of the College of Pharmacy. The center was established to provide national and international leadership in the application of the economic and administrative sciences in health care and pharmaceutical research, education, and service. The center integrates clinical and economic research to achieve a framework for the economic evaluation of new therapies. Services include economic/clinical analyses for individual client needs; training programs for industry representatives, researchers, and practitioners; consultation on the design of studies to analyze cost and benefits of drugs; and the dissemination of information about pharmaceutical issues in managed health care systems.

THE CENTER FOR THE MANAGEMENT OF INFORMATION (CMI) (1985), partially funded by grants from IBM, the National Science Foundation, the U.S. Army, and a consortium of industrial companies, supports interdepartmental research in economic, political, social, and technological aspects of information management. CMI is one of the world's leading research centers looking at Electronic Meeting Systems and Groupware research. The center has three facilities which host classes and corporate groups as part of an extensive research program into a variety of group processes such as planning, problem-solving, process re-engineering, and decision making.

THE CENTER FOR THE STUDY OF COMPLEX SYSTEMS, a multidisciplinary unit bringing together local and external researchers, is designed to identify and explore new concepts and features of complex nonlinear systems in various areas of science. Recent advances in the understanding of fundamental aspects of nonlinear systems, coupled with progress in computer technology, permit new approaches to heretofore intractable scientific problems in diverse fields: climate; cognitive science; computational theory; elementary particle physics; evolutionary biology; materials and condensed matter science; motor control, robotics and prosthetics; neurobiology; vascular physiology; turbulence; and others. The center sponsors research, visiting scientists, workshops, and colloquia, all aimed at encouraging the development of new approaches to complexity at the interfaces between traditional scientific disciplines such as biology, chemistry, mathematics, and physics.

THE CENTER FOR THE STUDY OF HIGHER EDUCATION (1978) in the College of Education conducts research studies and provides related service activities to meet state and institutional needs, as well as those of national, international, and regional governmental units and other organizations. It develops and disseminates information about higher education policy and operation and facilitates the research of faculty members and students. Special research and service projects are provided through outside support.

THE CENTER FOR TOXICOLOGY (1988) is an interdisciplinary organization that operates as a unit of the College of Pharmacy. Its mission is to strengthen and expand university and statewide efforts in toxicology. The goals of the center are to develop new research programs in toxicology, to insure that these and present programs have an interdisciplinary approach; to participate in graduate training at the master's, doctoral, and postdoctoral levels; and to interact with local, state, and federal agencies as well as with the private sector, to predict and prevent problems associated with exposure to toxic chemicals present in the home, workplace, and environment. The underlying theme of the research activities of the center is elucidation of mechanisms by which chemicals produce adverse biological reactions.

In 1994, the Southwest Environmental Health Sciences Center (SWEHSC) was established by a major grant from the National Institute of Environmental Health Sciences. Besides fostering the interdisciplinary research activities of the Center for Toxicology, the SWEHSC has developed a community outreach and education program.

THE COOPERATIVE EXTENSION SYSTEM (1914) has made knowledge useful for the people of Arizona through community education programs for more than eighty years. The agenda focuses on three main areas: environmental stewardship; strengthening youth, families, and communities; and economic vitality. Extension faculty, also known as county faculty or agents, deliver these programs through offices in each of Arizona's fifteen counties, on Indian reservations, and in satellite centers throughout the state.

Using nonformal teaching methods, extension professionals, often assisted by volunteers, present the latest research on agriculture, family living, nutrition, youth development, horticulture, management of natural resources, and community and economic development. Their agenda has expanded from a traditional emphasis on production agriculture and home economics to a broader approach based on needs identified in both rural and urban communities.

Delivery methods include workshops, demonstrations, field days, short courses, publications, videotapes, telephone consultations and personal visits—whatever method best suits the needs of the audience and the nature of the subject matter. These outreach programs serve people of all ages and all walks of life.

THE DIVISION OF ECONOMIC AND BUSINESS RESEARCH (DEBR) (1949) is a research and service organization within the College of Business and Public Administration. Its broad objectives are to conduct research relating to business, economics, and public policy in Arizona; to complement the formal education of students with research experience; and to disseminate information. To achieve its objectives, DEBR builds and maintains regional economic models for applications in forecasting and impact simulation, conducts research on state and local market conditions, and analyzes the effects of public policy alternatives. It publishes the quarterly Arizona's Economy, the semi-annual chart book Arizona Economic Indicators, and the Arizona Statistical Abstract. It also produces forums and seminars for the public. In addition, DEBR answers requests from business, government, and the general public for tabular information and maps showing local demographic and business patterns and, as a member of the State Data Center, for computerized census information.

THE DIVISION OF NEURAL SYSTEMS, MEMORY AND AGING (1990) of the Ari-
Research Laboratories is an interdisciplinary research unit whose main focus is memory, studied from a variety of perspectives. There is a particular focus on spatial cognition and memory, and the neural mechanisms involved in carrying out this important function. Most members of the unit work on the hippocampal formation and related structures thought to be involved in this capacity. Particular faculty have special interests in development, aging, plasticity at the cellular and molecular level, computational aspects of memory and neurochemical aspects of memory and aging. Postdoctoral fellows and graduate and undergraduate students work in all these areas, and receive a broad training in behavioral and computational neuroscience.

THE DIVISION OF NEUROBIOLOGY (1985) of the Arizona Research Laboratories is an interdisciplinary research unit devoted to the neurobiology and behavior of insects. Investigations under way in the division, probing experimentally favorable insect neural preparations at the cellular, developmental, molecular, and systems levels, seek to reveal fundamental neurobiological processes and mechanisms common to many animal species including human beings. These studies also promise to advance our understanding of agriculturally and medically harmful insects.

THE DIVISION OF SOCIAL PERSPECTIVES IN MEDICINE (1968) was established within the College of Medicine in recognition of the increasingly complicated cultural, social, economic, legal and ethical influences affecting the institution of medicine in American society. The efforts of this division are aimed at expanding and exciting the thinking of medical students and faculty in the area of human values and the role of medicine in contemporary society.

The activities of the division include symposia, seminars and workshops on such topics as cultural and economic factors in health and disease, ethical issues in medicine, medical jurisprudence, health needs of the elderly, care for the terminally ill, holistic medicine, innovations in medical education and other current issues. Local and national authorities are invited to participate in these programs from such fields as psychology, law, politics, sociology, anthropology, economics, theology and philosophy in addition to medicine.

THE ECONOMIC SCIENCE LABORATORY (ESL) (1985) is a research unit of the College of Business and Public Administration. Its purpose is to support innovative research and instruction through the use of laboratory economics experiments. Recent areas of investigation include the performance of asset markets, comparative behavior of different auctions and forms of market organization, game theory and behavior, comparative evaluation of processes for the provision of public goods, and the design of new computer-assisted exchange institutions to meet the information and technological demands of a wide variety of environments. ESL operates two computer laboratories dedicated to conducting economic, political, and business and government policy experiments. Other programs include lectures by visiting scholars, seed money for faculty and graduate student research, and the organization of internationally attented conferences.

THE ENGINEERING EXPERIMENT STATION (1941) administers the funds of sponsored grants and contracts of the faculty of the College of Engineering and Mines. Using state-appropriated funds, the station promotes, initiates, and conducts engineering research of potential benefit to the State of Arizona.

THE ENVIRONMENTAL RESEARCH LABORATORY (ERL) (1967) conducts research in controlled-environment agriculture (CEA) warm water aquaculture, in sea water crop irrigation, bioreactors, environmental control systems, water quality, and solar heating and cooling. ERL has designed CEA vegetable systems which produce crops in the desert sands of the United States, Mexico and the Middle East, and it has developed systems for the intensive culture of marine shrimp. ERL is developing halophytic crops for livestock feeds, soil and water remediation, and other uses. ERL consults on many environmental projects such as the EPCOT Center at Walt Disney World in Florida. ERL has also developed a series of demonstration solar homes at Tucson International Airport, where the laboratory is located. The work in biophysics research is reflected in the development of Biosphere 2, a private venture of Space Biosphere Ventures, and in global studies of the greenhouse effect.

FLANDRAU SCIENCE CENTER AND PLANETARIUM (1975), a part of the College of Arts and Sciences, was built as a result of a gift to the University by Grace H. Flandrau. It houses a 50-foot projection dome, a Minolta Series IV planetarium projector, and a hemispheric 35mm motion picture projector. It is used as a teaching facility for university classes in astronomy, and 25,000 Tucson public school children attend its special educational programs each year. The planetarium presents dramatic public programs on astronomy and general science that take audiences on cosmic journeys through time and space. The science exhibit halls and 16-inch telescope are open free to the public. Open daily except Mondays.

THE INSTITUTE FOR THE STUDY OF PLANET EARTH (1994) of the Arizona Research Laboratories is a multidisciplinary research unit designed to promote research, education, policy formulation, and information exchange on global environmental issues. The global change research is concentrated in five major areas: biophysical aspects of arid regions, study of past global change, remote sensing; global climate modeling; and human dimensions of global change. Funding from federal agencies has enhanced the development of undergraduate courses in global change by providing access to state-of-the-art computer lab facilities for both science and non-science majors. Graduate students can minor in Global Change while pursuing studies within a traditional discipline or within one of several interdisciplinary degree programs. The institute facilitates campus-wide communication through a seminar series and a visiting scholar program that brings leading researchers to campus.

THE INSTITUTE OF ATMOSPHERIC PHYSICS (1954) conducts research on fundamental aspects of climate and global change, mesoscale meteorology, atmospheric dynamics, radiative transfer, remote sensing, atmospheric aerosols, atmospheric chemistry, cloud and precipitation physics, lightning, and atmospheric electricity.

THE JEFFREY M. GOLDING CLINICAL RESEARCH UNIT (1984) is a specially equipped facility located in the College of Pharmacy. Its primary objective is to provide clinical scientists at The University of Arizona with the opportunity to study the action of drugs in humans with the ultimate goal of developing improved methods of treatment. The research unit has three rooms: a patient waiting room, a private office for conducting interview sessions and preliminary examinations, and the main room which houses two hospital beds and is equipped with specialized medical equipment.

THE KARL ELLER CENTER FOR THE STUDY OF THE PRIVATE MARKET ECONOMY (1983) is a research and education organization within the College of Business and Public Administration. It has three broad objectives: (1) to promote research in basic market processes, (2) to sponsor an Entrepreneurial Studies Program, and (3) to provide for business/academic exchange. Research is supported through limited faculty research fellowships and chaired professorships awarded to the center. The Entrepreneurial Studies Program offers both academic courses for students interested in entrepreneurship and practical courses on the development of business plans. Approximately 50 students are included in the program annually.
logical controls. Along with the world's
logical variables, and the documentation
hydrologic, paleoclimatic, and paleoeco-
of basic tree growth and environmental
throughout the world, the understanding
efforts are directed toward the quantifica-
able to qualified students. Current research
graduate research assistantships are avail-
departments, and a limited number of
is offered through cooperating academic
drochronology. Graduate-level instruction
College of Arts and Sciences, the Labora-
toried tree-ring studies initiated by
Andrew Ellicott Douglass at The Univer-
are affiliated with the Public Broadcasting
satellite reception and recording and a
Sierra Vista. The department also provides
ITFS transmission to Ft. Huachuca and
through the TEDS system, microwave and
production capability includes a color studio.
Professional production facilities are
maintained in the Modern Languages
building and the Harvill Building. Pro-
duction of public and commercial radio.
The VideoServices department produces
and distributes University of Arizona
credit and noncredit courses to business
and industry in the Tucson area through
an 8-channel ITFS system called the Tuc-
on Education Delivery System (TEDS),
and across the nation by videotape and
live satellite transmission. The University is
a member of the National Technological
University (NTU) consortium.
The VideoServices department provides
production and engineering support for the
campus including: pre-production and
post-production consultation, video produ-
tion, television distribution nationwide
via KU Band uplink facilities, locally
through the TEDS system, microwave and
ITFS transmission to Ft. Huachuca and
Sierra Vista. The department also provides
satellite reception and recording and a
2-way video teleconference origination
facilities.

THE LABORATORY OF TREE-RING RE-
SEARCH (1937) is an outgrowth of the pio-
neering tree-ring studies initiated by
Andrew Ellicott Douglass at The Univer-
sity of Arizona in 1906. A division of the
College of Arts and Sciences, the Labora-
tory conducts a unique program of teaching
and research in all aspects of dendrochronology. Graduate-level instruction
is offered through cooperating academic
departments, and a limited number of
graduate research assistantships are available to qualified students. Current research
efforts are directed toward the quantifica-
tion of new tree-ring chronologies, the establish-
ment of new tree-ring chronologies
worldwide, the understanding of basic tree growth and environmental
relationships, the reconstruction of paleo-
hydrologic, paleoclimatic, and paleoeco-
logical variables, and the documentation
and development of prehistoric chronologi-
ical controls. Along with the world's
largest collection of tree-ring specimens
from living trees and ancient timbers, the
laboratory maintains a variety of special-
ized equipment and data files containing
processed tree-ring chronologies, relevant
climatic and hydrologic records, and
archaeological tree-ring dates and site
information.

THE LATIN AMERICAN AREA CENTER
(1974) is a unit of the Faculty of Social and
Behavioral Sciences that fosters opportuni-
ties for students and researchers in Latin
American Studies. In addition to offering
undergraduate and graduate programs through its Committee on Latin American
Studies, the center is a focal point of Latin
American related research undertaken by
scholars from every college of the University
and whose interests range from medici-
to law, from anthropology to ecology,
from agriculture to history, and from politi-
sce to international business. Each year
the center engages in a variety of outreach
activities: editing and publishing, tele-
vision and radio programming, cur-
culum development for the public
schools, conferences, lecture and film
series, and government funded training
programs for Latin American profession-
als. The center also works with students
to arrange internship and study abroad pro-
grams designed to enhance career oppor-
tunities.

THE LUNAR AND PLANETARY LAB-
ATORY (1960) is the research unit con-
nected with the Department of Planetary
Sciences. Planetary Sciences faculty also
hold appointments in the laboratory, which
in addition, has a large research staff
to conduct vigorous investigations
which span a wide range of planetary
and related astrophysical and space science.
Laboratory staff participate closely in the
graduate research instruction of the
department. Close relationships and coop-
erative programs are maintained with a
number of other units on the campus,
including the departments of Astronomy,
Geosciences, Optical Sciences, Physics, and
the Steward Observatory.

Together, the Department of Planetary
Sciences and the Lunar and Planetary Lab-
atory form an institute uncommonly
broad and complete in its approach to
planetary science education research.
The department and laboratory participate in
many NASA space science missions.
Among the current missions in which the
faculty are participating are the Voyager
Mission, the Near Earth Asteroid Ren-
dezvous, the Galileo Mission to Jupiter, the
Cassini/Huygens Mission to Saturn, the
Mars-Pathfinder, the Discovery Missions,
NASA space shuttle missions and the
Ulysses Heliospheric Probe. In addition
LPL scientists make use of Earth orbiting
observatories, including the Hubble Space
Telescope and the Ultraviolet Explorer. The
Laboratory's Space Imagery Center con-
tains one of the most extensive collections
of planetary images in the world, begin-
ing with those obtained from the earliest
space projects and continuing to most cur-
rent missions. LPL's Planetary Imaging
Research Laboratory is a modern image
processing facility for the analysis of
planetary and astronomical data. Also available
for student research are cosmochemistry
and geochemistry laboratories, including a
scanning electron microscope and micro-
probe facility, an experimental petrology
laboratory, a radiochemistry separation
and neutron activation laboratory, and a
noble gas mass spectrometry laboratory.
The numerous telescopes of The Univer-
sity of Arizona observatories are available
for research projects, including instru-
ments on Kitt Peak and in the Santa
Catalina Mountains, as well as the Multi-
ple Mirror Telescope on Mt. Hopkins; all
are within easy reach of the University
campus.

Laboratory staff and students also make
use of major observatories around the
world, including the NASA Infrared Tele-
scope Facility on Mauna Kea, Hawaii,
and conduct a regular program of planetary,
solar, and stellar infrared spectroscopy
using the NASA Kuiper Airborne Obser-
atory. The University is developing a new
observatory site on Mt. Graham, northeast
of Tucson. The laboratory participates in
interdepartmental programs in theoretical
astrophysics and in applied mathematics.
The laboratory is housed in the Gerard P.
Kuiper Space Sciences Building, with addi-
tional facilities in the Gould-Simpson
Building.

THE MEXICAN AMERICAN STUDIES &
RESEARCH CENTER (1983) engages in
research, publication, public service, and
undergraduate and graduate educational
activities which enhance the study of the
Mexican American experience and related
issues. Major objectives of interdisciplinary
research and publication include such areas
as expressive culture, adaptations of the
Mexican-born into U.S. society, educational
practices and policies, minority entrepre-
neurship, and health care behavior and
intervention strategies. Special research
and service projects are provided through uni-
versity funds and outside support. Funds of
sponsored grants support training of stu-
dents in a variety of disciplines. The center
disseminates information of concern to the
Hispanic community, sponsors lectures and
forums and provides assistance to and link-
age with the University and the greater
Mexican American community, as well as
regional, national and international private
and public sectors.

THE MINERAL MUSEUM (1902) is oper-
ated by the Department of Geosciences,
and housed in the lower level of the Flan-
The museum has more than 15,000 mineral specimens representing more than 1,000 different mineral species. On display is a wide collection of material from around the world, including meteorites, cut gem stones, and mining artifacts from Arizona's past. The museum operates a series of education programs for both university students and the community at large. The Mineral Museum is open to the public whenever Flandrau Science Center is open.

THE OFFICE OF ARID LAND STUDIES (1964), administratively located within the College of Agriculture, is active in international studies, natural resources development and management, environmental studies, economic botany, new crop development, water and energy conservation, farming systems research, information services, remote sensing, geographic information systems, publications and education. Activities are conducted within the framework of the arid environment. The office provides interdisciplinary project management and works closely with local and campus communities as well as with local, state, federal, and international government agencies. The office administers the interdisciplinary Doctor of Philosophy degree with a major in arid lands resource sciences.

THE OPTICAL SCIENCES CENTER (1967) is a graduate center for research in experimental and theoretical optics. Areas in which research is currently being conducted include optical systems design, interferometry and optical testing, infrared technology, radiometry, remote sensing, optical detector systems, thin film deposition, image processing, scanning tunneling microscopy, nuclear, x-ray and MRI medical imaging, optical data storage, optical computing components, diffractive and binary optics, novel optical materials, adaptive optics, nonlinear optics, optical trapping and cooling of atoms, semiconductor and solid state laser physics. Interdisciplinary programs in progress involve the departments of Materials Science and Engineering, Mathematics, Astronomy, Chemistry, Electrical and Computer Engineering, Ophthalmology, Physics, and Radiology, as well as Steward Observatory, the Arizona Research Laboratory, the Optical Circuity Cooperative and the Optical Data Storage Center. Special facilities of the Optical Sciences Center include optics shops for fabrication and testing of both small and large (up to 2.5 meters) optics, optical detector testing facilities, an instrument shop, an optomechanical design facility, a molecular beam epitaxy machine, clean rooms, numerous laser systems including ultra fast femtosecond lasers, a thin film deposition lab and a multitude of networked computing facilities.

THE RESPIRATORY SCIENCES CENTER (1975) has members from many different academic departments. It is responsible for interdisciplinary pulmonary-allergy programs in research, training and clinical services. It coordinates activities of the Adult-Pediatric Chest-Allergy Clinic as well as University Medical Center's Adult and Pediatric Pulmonary Function Laboratories, Blood Gas Laboratory and Respiratory Care Service. It is also responsible for collaborative postdoctoral training programs in Adult and Pediatric Pulmonary Medicine.

A major function of the center is to coordinate multidisciplinary research programs in pulmonary disease with a special emphasis on airways obstructive diseases (asthma, chronic bronchitis and emphysema). It is responsible for the Specialized Center of Research (SCOR) in Airways Obstructive Diseases established at the College of Medicine with funding from the National Institutes of Health. The center is widely known for its epidemiologic studies, including a longitudinal study of a representative sample of the Tucson population (The Tucson Epidemiologic Study of Airways Obstructive Diseases), a longitudinal study of newborns and their families (The Children's Respiratory Study) and studies of the health effects of environmental pollution (The Health and Environment Study). It is now very involved in more basic research, particularly in regard to the immunological, biochemical, pharmacological, neural, and physiological mechanisms which affect airway function and which may be relevant to the pathogenesis of airways obstructive diseases.

THE RUTH E. GOLDING CLINICAL PHARMACOKINETICS LABORATORY (1977) in the College of Pharmacy is primarily an analytical laboratory where new assays are developed to quantify drugs and their metabolites from biological fluids. These assays are used in conjunction with animal and clinical research projects to better define the disposition of and response to drugs. The results of these studies along with the monitoring of drug plasma concentrations in patients are used to optimize therapy by individualizing drug administration.

SEMI TECH CENTER OF EXCELLENCE FOR CONTAMINATION/DEFECT CONTROL AND ASSESSMENT (1988) is a joint effort by industry and the federal government to reverse a decline in U.S. competitiveness in semiconductors, particularly in the production of integrated circuits. Centers of Excellence established at universities represent SEMATECH's external research arm and are selected based on the quality and relevance of the programs proposed. They will bring graduate students into semiconductor manufacturing and will create major academic manufacturing research capability. In May 1988, the UA became one of the first five universities selected to become a center of excellence. Engineers working in the center are developing methods for measuring and removing impurities, contamination, and defects that are a major problem for semiconductor manufacturing.

The Department of Electrical and Computer Engineering, home to the SEMATECH Center of Excellence, provides a direct source to coordinate the efforts of principal investigators from Electrical and Computer Engineering, Materials Science and Engineering, Chemical Engineering, and Systems and Industrial Engineering. Part of the research is being carried out with Sandia National Laboratories in Albuquerque.

The technical objective of the Center are four-fold: (1) to understand and eliminate sources of contamination during wafer surface preparation, (2) to understand and utilize chemical reactions and electric charge effects to develop methods and systems for the removal of impurities and particles from process materials, (3) to understand and develop control techniques for contaminants and defects originating from process equipment, such as oxidation, deposition, dry etch (plasma, RIE etc.) and ion implantation equipment, and (4) to understand through test pattern technology the role of specific contaminants in generating defects and the role of specific defects limiting yield, and to prioritize efforts in contamination/defect reduction. The Center transfers technology through reports, workshops, students, and cooperative research projects. The University of Arizona's Center has been complimented as exemplary in their technology transfer activities.

THE SOCIAL AND BEHAVIORAL SCIENCES RESEARCH INSTITUTE (1984) supports and coordinates organized research efforts within the Faculty of Social and Behavioral Sciences. Through a series of regular competitions, the institute provides support for faculty members and academic professionals undertaking pilot projects or small-scale studies likely to lead to externally-funded research. In addition, funds are available to underwrite small projects designed to involve undergraduates in the research process. The institute encourages both disciplinary and interdisciplinary research and takes initiatives to promote work in new areas of study. SBSRI contains two smaller units, the Data and Software Laboratory (DASL) and the Survey Research Center (SRC). DASL provides support for faculty and their graduate students who are working on research problems requiring any form of data purchase and/or analysis, or who require wordprocessing support; in addition, help
is provided with the purchase of hardware and software for instructional improvement. SRC provides various forms of support for contract-based questionnaire delivery and analysis. SBSRI also liaises with other research units in SBS, including the Southwest Center. Annually, the institute sponsors a competition for the best research monograph and the best research article published by a member of SBS, including graduate students.

**THE SOUTHWEST CENTER (1982)** is a unit of the Faculty of Social and Behavioral Sciences that fosters research, teaching, academic development, publication, and public programming on the history, culture, and development of the Greater Southwest (including southwestern Mexico). Southwest Center initiatives are designed for their multiplier effects on the research and service mission of the University, creating new opportunities for interdisciplinary scholarship. As an agency dedicated to the enhancement of regional scholarship and intellectual service, the Southwest Center acts as a liaison to funding sources; creates and implements interdisciplinary regional research projects; pursues a vigorous publishing program; and engages in a broad range of public outreach and programming: conferences, seminars, lectures, speakers’ bureau, cultural events. The center publishes *Journal of the Southwest*, a scholarly regional quarterly, and sponsors the Southwest Center book series, with the UA Press as well as an imprint with the University of New Mexico Press.

**THE SOUTHWEST INSTITUTE FOR RESEARCH ON WOMEN (SIROW) (1979)** is a regional research and resource center within the Committee on Women’s Studies. The institute develops and conducts research on women in the Southwest (Arizona, Colorado, New Mexico, Utah, and west Texas) or of interest to scholars in the region. SIROW publishes a newsletter and a working paper series, links researchers with community organizations and policy makers through a research clearinghouse, and provides professional development and training for people in education, research, business, and government.

**THE SOUTHWEST RETAIL CENTER (SWRC) (1994),** an arm of the division of Retailing and Consumer Studies, offers students an opportunity to interact with retail executives and personnel by creating partnerships between The University of Arizona and the retail industry. Opportunities provided by the center include: retail internships, a variety of scholarships, the UA Student Retailing Association, retail speaker series, retail workshops, retail industry tour and the retailing resource center. Outstanding students will also have an opportunity to be a member of the SWRC Student Advisory Board to promote the center’s activities and to develop leadership skills.

**STEELE MEMORIAL CHILDREN’S RESEARCH CENTER (1986)** represents a multidisciplinary and interdisciplinary approach to research related to various medical problems facing children. The goals of the center include:

1. Coordinate, focus, facilitate and increase research related to children’s health
2. Foster multidisciplinary research on medical problems related to children
3. Expand research training and education programs, thereby facilitating the training of future researchers
4. Enhance the rapid application of research observations to patient care

Special emphasis will be placed on molecular genetics, immunology, neurology, gastroenterology and nutrition, behavioral sciences and developmental biology.

The center’s research programs are closely tied to the educational and clinical activities of the Department of Pediatrics which include extensive outreach programs in numerous communities throughout the state, and general and subspecialty pediatric clinics and inpatient services at University Medical Center, Tucson Medical Center and Kino Community Hospital.

**THE STEWARD OBSERVATORY (1916)** was established by a generous gift from Lavinia Steward, in honor of her husband, George Steward. For many years, the observatory’s principal telescope was its 36-in. (91-cm) reflector, constructed with the aid of the Steward bequest. Currently, the primary research programs of the observatory include the Multiple Mirror Telescope (MMT), located on the Mt. Hopkins summit in the Santa Rita Mountains, the 90-in. (2.3-m) reflector on Kitt Peak, and the 61-in. (1.55-m) reflector at the Mt. Bigelow station in the Santa Catalina Mountains. The MMT, operated jointly with the Smithsonian Astrophysical Observatory, represents an innovative and highly successful concept for construction of very large optical telescopes.

The Steward Observatory offices and laboratories are located on the northeast part of the university campus adjacent to the original 36-in. dome. The main areas of research include quasars and active galaxies, degenerate stars, infrared sources, radio galaxies, and the formation of stars and galaxies. Observational programs are concentrated in the optical and infrared (using the facilities of the observatory) but outside facilities are also used at radio, ultraviolet, and x-ray wavelengths. The observatory activities are closely integrated with the University’s Theoretical Astro-

**physics Program.** The observatory has recently completed a major new telescope on Mt. Graham for work in the mm- and submm-wave region, in collaboration with the Max Planck Institute for Radioastronomy in Bonn, West Germany. The Mirror Laboratory is developing optics for the next generation of giant optical/infrared telescopes. It will furnish the optics for an upgrade of the MMT, the Carnegie Foundation’s Magellan Project (a 6.5-m telescope in Chile), and for the Columbus project, a collaboration of Steward Observatory with Arcetri Observatory, the Research Corporation, and other partners which will use two 8.4-m mirrors and be placed on Mt. Graham. Two construction efforts for space astronomy are also centered at the observatory: the Near Infrared Camera, which will be mounted in the Hubble Space Telescope to replace one of the existing instruments, and the Multiband Infrared Photometer, which is one of the major instruments for the Space Infrared Telescope Facility, planned for launch early in the next century.

The offices and laboratories of the National Optical Astronomy Observatories are located across Cherry Avenue from Steward Observatory, and a division of the National Radio Astronomy Observatory occupies the top floor of the Steward Observatory building. The three observatories jointly sponsor a weekly series of professional colloquia. Steward Observatory also works closely with the Department of Planetary Sciences, the Optical Sciences Center, the Department of Physics, the Vatican Observatory, and the Planetary Science Center and Planetarium, as well as with the astronomy departments of the other Arizona state universities.

**THE USDA FOREST SERVICE COOPERATIVE RESEARCH UNIT (1993)** is a research component of the Rocky Mountain Forest and Range Experiment Station (RMS) located in the School of Renewable Natural Resources. The unit promotes and supports cooperative research efforts among the RMS, the Coronado National Forest and The University of Arizona. The unit provides graduate research opportunities and scientist assistance in a broad range of natural resource problem areas. The unit is committed to a long-term systematic program of basic and applied research and monitoring on the physical, biological, and social issues associated with managing the borders area of southeastern Arizona, southwestern New Mexico, and northern Mexico.

**UNIVERSITY ANIMAL CARE (1987)** oversees the Animal Care and Use Program of the University and provides services for care and use of all University-owned animals. The unit reports to the Office of the Vice President for research.
Animal care facilities may be found at several locations on the University campus, and each facility is operated and controlled by UAC. The entire Animal Care and Use Program, which includes both laboratory and farm animals, is fully accredited by the prestigious American Association for Accreditation of Laboratory Animal Care. The program also meets and exceeds all federal laws and policies which regulate the use of animals in research and education.

Six veterinarians and a staff of specially trained animal technologists and technicians provide high quality animal care. UAC staff and faculty are available to train and assist investigators, research technicians and students on proper methods of animal handling and use. Expertise in the choice and selection of specific animal models is provided to investigators, thus eliminating unnecessary use of animals. A student manual for animal research is available by contacting the UAC office (520) 626-6702.

Federal laws and local policies require that all research, teaching, and/or testing protocols involving the use of animals must be reviewed and approved by the Institutional Animal Care and Use Committee. The IACUC, as well as the staff of UAC, is involved in the assurance that all animals receive humane treatment. Concern for the welfare of animals, plus provision of support for the biomedical and agricultural research and teaching programs of the University are the primary objectives of University Animal Care.

THE UNIVERSITY HEART CENTER (1986) is an interdisciplinary center dedicated to the prevention and cure of heart and vascular disease through research, patient care and education. Its one hundred members with Ph.D.'s, M.D.'s, or both, are located throughout the campus. They hold joint appointments and are organized into research focus groups, educational and patient care sections.

The University Heart Center operates as a division of the College of Medicine and reports to the dean of the college. Programs are linked to the faculty and staff in the college, in University Medical Center, and other colleges and units within the University.

THE UNIVERSITY OF ARIZONA MUSEUM OF ART (1942) — With two large gallery floors and 14,000 square feet of exhibition space, the Museum of Art maintains and exhibits one of the finest university collections of Renaissance and later European and American art in the Southwest. Works by Rembrandt, Piranesi, Picasso, O'Keeffe and Rothko are part of a permanent collection of more than 4,000 paintings, sculptures, drawings and prints. The museum is home to masterpieces of the Samuel H. Kress Collection, which include 26 panels of the 15th century Spanish altarpiece of the Cathedral of Ciudad Rodrigo. Part of the first floor is occupied by the "Jacques Lipchitz: Sketches and Models" gallery, featuring 61 clay and plaster models and sketches by this leading 20th century sculptor. Contemporary international painting and sculpture are well-represented in the Edward Joseph Gallagher III Memorial Collection, while the C. Leonard Pfeiffer Collection includes American paintings from the 1930's. The Gallagher Acquisition Fund, plus donations, allow the collection to selectively grow each year. An active program of temporary exhibitions complements the permanent collection, part of which is always on display. The museum also schedules lectures, seminars and informal lunch time "Art Breaks." Guided tours can be arranged two weeks in advance. Art publications and art-related gifts are on sale in the museum shop. There is no admission fee. Call 621-7567 for hours and for more information.

THE WATER RESOURCES RESEARCH CENTER (1965) is Arizona's state water resources research institute, established under the Water Resources Research Act of 1964 to promote interdisciplinary research at the three state universities and enhance their contribution to the solution of critical water problems within the state.

To accomplish this mission, the WRRC administers a federal water resources research grant program that provides funds for research on water-related issues. Research findings are brought to the attention of potential users and disseminated throughout the state. As Arizona's water information center, the WRRC provides access to water data and publications; produces informational directories and monographs, newsletters, and presentations; and sponsors conferences, symposia, and workshops. In addition, the center promotes and facilitates interdisciplinary research and carries out a policy analysis research program on water issues requiring examination from multidisciplinary perspectives.

Cooperating Organizations
Certain other independent agencies, not administratively a part of The University of Arizona, cooperate closely with the University and provide opportunity for study and research for faculty and qualified graduate students. Several of these are actually located on the university campus, and certain staff members of some also hold university staff appointments.

ARIZONA-SONORA DESERT MUSEUM is a self-supporting, nonprofit institution situated fourteen miles west of the city of Tucson in a saguaro and palo verde landscape of the Sonoran desert. This living indoor and outdoor museum of natural history enables one to gain in a few hours a knowledge of the flora and fauna of the Southwest that would otherwise require many years. Unique habitat groups and other displays of desert animals and plants have been developed at this unusual museum. The museum cooperates with educational institutions at all levels as an outdoor education center and provides laboratory and field space for research in the natural history of Arizona and Sonora, Mexico, with special emphasis on the Sonoran desert common to both states.

ARIZONA HISTORICAL SOCIETY—Organized in 1894 for "the collection and preservation of materials illustrative of the history of Arizona in particular and of the West generally," the Society receives support from the Arizona State, and maintains both a historical museum and a research library. The museum and library are located in the university campus and contain 50,000 books, 2,000 manuscript collections, and 250,000 photographs, as well as film and oral history interviews. The manuscript collections are especially rich, with letters, diaries, journals, business records and other documents, many of which are still partially or completely
unpublished. State and federal historical records are on microfilm, as are records from Spanish colonial archives. Membership is open to everyone. Museum collections of historical artifacts are available by appointment for study and research.

THE MUSEUM OF NORTHERN ARIZONA and its Research Center, located at Flagstaff, Arizona, provide unusually fine training and research facilities in many areas of anthropology, art, biological sciences, and geology. A close association is maintained between the staff of the Museum and Research Center and certain teaching and research departments of The University of Arizona. Field work and independent research for a limited number of graduate students can be undertaken at the Museum’s Research Center with the approval of the departments concerned, the Director of the Museum, and the Dean of the Graduate College. Registration may be arranged by the procedure commonly used for work done in absentia for credit in 920 Research to apply toward requirements for an advanced degree, for 910 Thesis, and for 920 Dissertation.

THE SOUTHWESTERN RESEARCH STATION of the American Museum of Natural History, New York, is located within a few hours of the university campus in the Chiricahua Mountains of southeastern Arizona. The station proper is located at an elevation of 5,400 feet in a moderate evergreen woodland climate, midway between the desert floor and the coniferous forest above. A wide variety of life zones is represented within a few miles of the station between the desert floor and the fir-covered peaks at 9,800 feet. This unspoiled area within the Coronado National Forest includes many protected wilderness areas accessible only on foot or horseback.

Station living facilities and equipment are available, and the laboratory is well equipped for many kinds of modern field and laboratory research in ecology and physiology. The station is a field base for almost any kind of field work in biology, geology, paleontology, resource management, and wildlife management.

UNITED STATES GOVERNMENT AGENCIES—A number of agencies of the United States Government, including several divisions of the Agricultural Research Service and the Soil Conservation Service of the United States Department of Agriculture, the United States Bureau of Mines, and the United States Geological Survey, are located on or near the campus of the University. These research organizations work closely with the University, and a number of their personnel also hold university staff appointments.

THE UNIVERSITY OF ARIZONA FOUNDATION

Every institution of higher learning, whether supported by public or private funds, needs a group of friends who has a special interest in its welfare. The need is great and the opportunities are many for contributions of private funds to improve and develop educational, research, and public service programs outside the scope of state funds and tuition income.

In Arizona and elsewhere, many people aware of the importance of private funding are assisting The University of Arizona. In order to unite these efforts, The University of Arizona Foundation was established in 1958 as a nonprofit corporation to ensure academic excellence at the University through the development of private support. The foundation is governed by a 33-member volunteer board of directors.

The Foundation’s principal objectives are met in three basic ways: Fund Raising, Asset Management, and Facilitations.

Fund raising: By virtue of a development services contract, all fund development at The University of Arizona is managed by the UA Foundation. University administrators and faculty work with the foundation to determine fund-raising priorities and goals. The foundation works to ensure that gifts are spent according to donors’ wishes and in ways that are consistent with the mission of the University.

Asset management: The foundation’s fiduciary responsibility is outlined in a formal investment policy. Specifically, the policy calls for the foundation to protect the value of its assets against inflation and obtain maximum income. By maintaining a balanced package of investments, including stocks, corporate and government bonds, and real estate, the foundation attempts to balance the University’s needs for current income with estimated future needs. The foundation is exempt from state income taxes. It is also exempt from federal income taxes under Section 501 (c)(3) of the Internal Revenue Code.

Facilitation: The UA Foundation facilitates the accomplishments of countless university objectives by providing services such as bridge loans to donor pledges, construction and finance assistance, and funding and development of educational programs. The foundation is also a grant-making institution. Its annual grants and awards program recognizes the achievements of faculty, researchers, undergraduates, and graduate students.

This united effort of friends of the University is helping to meet the changing requirements of education and to enrich higher education to the ultimate benefit of the people of Arizona.

Officers
James F. Morrow Chair of the Board
Helen S. Schaefer Vice Chair
Richard F. Imwalle President
Burton J. Kinerk Treasurer
C. Donald Hatfield Secretary
Gary N. Scribner Vice President, Finance and Administration
S. James Manilla Vice President, Development Operations
Ken R. Dildine Office of Planned Giving

Board of Directors
Harold W. Ashton
Nicholas S. Balich
Donald A. Bliss
Carmen Canchola
Ray Clarke
Gerrit Corman
Mark DeMichele
Ken R. Dildine
Darryl B. Dobras
Stevie Eller
Robert A. Elliott
Robert H. Friesen
Jack Gumbin
Donald C. Hatfield
Richard F. Imwalle
Burton J. Kinerk
Eddie Lynch
James S. Manilla
Frances H. McClelland
David A. McEvoy
John E. Miller, Jr.
James F. Morrow
Robert L. Mueller
Kathryn L. Munro
Manuel T. Pacheco
Jim Patterson
Mary Levy Peachin
James M. Sakson
Michael J. Sarikas
Helen S. Schaefer
Gary Scribner
Ralph Silberschlag
Louis J. Slavin
Lester L. Smith
Louise Thomas
Cherie Walden

Directors Emeritus
Fred Boice
Jack D. Davis
Luther J. Davis
Roy P. Drachman
Douglas Holsclaw
Peter Kiewit, Jr.
Mary Margaret Raymond
Donald N. Soldwedel

Malcolm J. Rathbun, President
The University of Arizona is managed by the Board of Regents of the University of Arizona. The President acts as chief executive officer of the University Libraries, Research, and Service Facilities.
ARIZONA BOARD OF REGENTS

Ex Officio
Fife Symington .................. Governor of Arizona
Lisa Graham .................. State Superintendent of Public Instruction

Appointed
David Tung .................. June 1995
Andrew D. Hurwitz .................. January 1996
Douglas J. Wall .................. January 1996
Art Chapa, J.D .................. January 1998
Eddie Busha .................. January 1998
John F. Munger, J.D .................. January 2000
Rudy Campbell .................. January 2000
George Amos .................. January 2002
Judy Gignac .................. January 2002

Administrative Officers
The following is a partial list of administrative officers at The University of Arizona. The list includes senior academic officers and others with academic-related responsibilities.

(Year of first University appointment in parentheses after each name)


Henry Koffler (1982-91) President Emeritus of the University; B.S., 1943, University of Arizona; M.S., 1944, Ph.D., 1947, University of Wisconsin; D.Sc., 1977, Purdue University; LL.D., 1981, Amherst College; D.Sc., 1981, University of Arizona.

John P. Schaefer (1960-85) President Emeritus of the University; B.S., 1955, Polytechnic Institute of Brooklyn; Ph.D., 1958, University of Illinois.


Martha W. Gilliland (1990), Vice Provost for Academic Affairs and Human Resources; B.A., 1964, Catawba College; M.A., 1968, Rice University; Ph.D., 1973, University of Florida.


Robert L. Hull (1964), Dean Emeritus, College of Fine Arts; B.Mus., 1939, M.Mus., 1941, University of Rochester; Ph.D., 1945, Cornell University.

José G. Falvey (1984), Associate Vice President for Faculty; B.S., 1966, University of Michigan; M.D., 1970, University of Chicago; M.S., 1972, University of Arizona.

Graduate College Officers
Michael A. Cusonovich (1969), Vice President for Research and Graduate Studies

Thomas J. Hixon (1976) Dean of the Graduate College

Herbert Dawson Rhodes (1943) Dean Emeritus of the Graduate College

Graduate Council
The Graduate Council consists of members representing all colleges at the University. The Council works with the Graduate College to review and establish policies affecting graduate education.
Committee on Graduate Study

Members of the Committee on Graduate Study represent the Dean of the Graduate College at all doctoral preliminary oral examinations and oral defense examinations and in the event of a second master's oral examination. The Committee on Graduate Study representative certifies that these examinations are conducted in a manner consistent with the expectations and standards of the Graduate College.

(Date in parentheses after each name denotes expiration of term.)

Lawrence M. Aleamoni (1999), Professor of Education Psychology
Jay B. Angervine, Professor of Anatomy
Boyd B. Baker (1999), Associate Professor of Exercise and Sport Sciences
H. Bradford Barber (1999), Research Associate Professor of Radiology
Kathryn A. Bayles (1999), Associate Professor of Speech and Hearing Sciences
Hinrich L. Bohn (1999), Professor of Soil and Water Science
G. Tim Bowden (1999), Professor of Radiation Oncology, Pharmacology and Toxicology and Molecular and Cellular Biology
Michael D. Bradley (1999), Associate Professor of Hydrology and Water Resources
Charles J. Brainerd (1999), Professor of Educational Psychology
Elidon J. Braun (1999), Professor of Physiology
John R. Browe (1999), Professor of Electrical and Computer Engineering
John T. Brobeck (1999), Assistant Professor of Music
Meg Lota Brown (1999), Assistant Professor of German
Nathan Buras (1999), Professor of Hydrology and Water Resources
Michael F. Burke (1999), Associate Professor of Chemistry
Janis M. Burt (1999), Associate Professor of Surgery and of Physiology
Andreas Cangelaris (1999), Associate Professor of Electrical and Computer Engineering
William T. Carleton (1999), Professor of Finance and Real Estate
Francois E. Cellier (1999), Associate Professor of Electrical and Computer Engineering
Dipankar Chakravarti (1999), Professor of Marketing
Anoop Chandola (1997), Professor of East Asian Studies
Robert B. Chlason (1999), Professor of Veterinary Science
Peter J. Coney (1999), Professor of Geosciences
Gary Cook (1999), Professor of Music
Terry C. Daniel (1999), Professor of Psychology and of Renewable Natural Resources
Owen K. Davis (1999), Associate Professor of Geosciences
Thomas Davis (1999), Professor of Pharmacology
Jeffrey S. Dean (1999), Professor in the Tree Ring Laboratory
Dominick Deluca (1999), Associate Professor of Microbiology and Immunology
Eustachia Dzieniak (1997), Professor of Optical Sciences
Galina L. De Roeck (1999), Assistant Professor of Russian and Slavic Languages
Donald G. Dickinson (1999), Professor of Library Science
Robert P. Erickson (1999), Professor of Pediatrics and of Molecular and Cellular Biology
Thomas R. Ervin (1999), Professor of Music
Celma D. Estekholm (1999), Research Professor of Surgery
Kenneth A. Feldmann (1999), Assistant Professor of Plant Sciences
Aurelie J. Figaredo (1999), Associate Professor of Psychology
Karl W. Flessa (1999), Professor of Geosciences
Kenneth Foster (1997), Professor of Arid Lands
Edward D. French (1999), Associate Professor of French
Richard L. Friedman (1999), Associate Professor of Microbiology and Immunology
Lynn Galbraith (1999), Assistant Professor of Art
Add. C. Gamal (1999), Professor of Near Eastern Studies
Rose M. Gerber (1999), Associate Professor of Nursing
John Gilabert, Professor of Spanish and Portuguese
Richard S. Glass (1999), Professor of Chemistry
Yetta M. Goodman (1999), Professor of Language, Reading and Culture
Elle C. Green (1999), Professor of Architecture
W. Dwaine Greer (1999), Professor of Art
Michael Hammond (1999), Associate Professor of Linguistics
Sathy Harpalani (1999), Associate Professor of Mining and Geological Engineering
David T. Harris (1999), Associate Professor of Microbiology and Immunology
Donald Heckerman (1999), Associate Professor of Economics
Paul E. Heckman (1999), Assistant Professor of Educational Administration
David M. Hendricks (1999), Associate Professor of Soil and Water Science
Julia L. Higle (1999), Associate Professor of Systems and Industrial Engineering
Frederick J. Hill (1999), Professor of Electrical and Computer Engineering
Joseph J. Lemann (1999), Associate Professor of Arid Lands
Jeanette D. Heil (1997), Assistant Professor of Speech and Hearing Sciences
Willis J. Horak (1999), Associate Professor of Teaching and Teacher Education
John T. Hubbard (1999), Professor of Animal Sciences
Alfredo R. Huete (1999), Associate Professor of Soil and Water Science
Bobby R. Hunt (1999), Professor of Electrical and Computer Engineering
Charlie D. Hurt (1999), Professor of Library Science
Christopher D. Impy (1999), Associate Professor of Astronomy
Simon Ince (1999), Professor of Hydrology and Water Resources
Kenneth A. Jackson (1999), Professor of Materials Science and Engineering
Sanjay J. Jagdale (1999), Assistant Professor of Systems and Industrial Engineering
Keith M. Johnson (1997), Associate Professor of Music
Kenneth A. Jordan (1999), Professor of Agricultural and Biosystems Engineering
Kurt Just (1999), Professor of Physics
Dimitri Kecicicoglou (1999), Professor of Aerospace and Mechanical Engineering
James E. King (1999), Professor of Psychology
Sigurd D. Kohler (1999), Professor of Physics
Otakar Koldovsky (1999), Professor of Pediatrics
Barbara Kosta (1999), Assistant Professor of German Studies
Paul Kruusmaa (1999), Professor of Wildlife and Fisheries Science
Elizabeth Krupinski (1999), Research Assistant Professor of Radiology
Pinnaduwa H.S.W. Kulatilaka (1999), Associate Professor of Mining and Geological Engineering
Frank K. La Ban (1999), Professor of Theatre Arts
D. Terence Langendoen (1999), Professor of Linguistics
R. Clark Lantz (1999), Associate Professor of Cell Biology
Gordon Lehman, Associate Professor of Watershed Management
Lise H. Leibacher (1999), Associate Professor of French and Italian
Eveleen A. Leopold, Jr. (1999), Professor of Geosciences
John Little, Professor of Molecular and Cellular Biology
Ahmed Louri (1999), Professor of Electrical and Computer Engineering
David C. Lynch (1999), Professor of Materials Sciences and Engineering
Neil MacKenzie (1999), Associate Professor of Pharmaceutical Sciences
Angus Macleod (1997), Professor of Optical Sciences
C. June Maker (1999), Associate Professor of Special Education and Rehabilitation
Lawrence D. Mann (1999), Professor of Geography and Regional Development
Richard W. Mann (1999), Associate Professor of Wildlife and Fisheries Science
Avind S. Marathy (1999), Professor of Optical Sciences
John A. Mars (1999), Professor of Animal Sciences and of Nutrition and Food Science
C. John Mare (1999), Professor of Veterinary Science
Stuart E. Marsh (1999), Associate Professor of Arid Lands
Fred S. Matter (1999), Professor of Architecture
William J. Matter (1999), Associate Professor of Wildlife and Fisheries Science
D. Keith McElroy (1999), Associate Professor of Art
Donald J. McNamara (1997), Professor of Nutritional Sciences
Neil M. Mendelson (1999), Professor of Molecular and Cellular Biology
Lula C. Moll (1999), Associate Professor of Language, Reading and Culture
Eric A. Monke (1999), Professor of Agricultural and Resource Economics
Gerald Monsman (1999), Professor of English
Gordon F. Mulligan (1999), Professor of Geography and Regional Development
Kamakshi P. Murti (1999), Associate Professor of German Studies
Kenneth Mylrea (1999), Professor of Electrical and Computer Engineering
Bartholomew Nagy (1999), Professor of Geosciences
Richard T. Oehrle (1999), Associate Professor of Linguistics
A.G. Pacholczyk (1997), Associate Professor of Computer Science
Olgafer A. Palusinski (1999), Professor of Electrical and Computer Engineering
Daniel R. Papaj (1999), Associate Professor of Ecology and Evolutionary Biology
Jonathan D. Penner (1999), Professor of English
Elizabeth A. Pierson (1999), Research Assistant Professor of Plant Pathology
Leland J. Pierson III (1999), Assistant Professor of Plant Pathology
Stanley Pogrow (1999), Associate Professor of Educational Administration
Titus D. M. Purdlin (1999), Assistant Professor of Management Information Systems
Radhakrishna Rao (1999), Research Assistant Professor of Pediatrics
William O. Rasmussen (1999), Associate Professor of Agricultural and Biosystems Engineering
Dennis T. Ray (1999), Associate Professor of Plant Sciences
Donald E. Ray (1999), Professor of Animal Sciences
Thomas R. Rehm (1999), Professor of Chemical Engineering
Richard W. Rice (1999), Professor of Animal Sciences
Carl A. Ridley (1999), Professor of Family and Consumer Resources
Teaching and Research Faculty

This list identifies tenured and tenure-track faculty members appointed for the 1994-95 academic years, as well as emeritus faculty. For a list which includes all faculty appointed for the 1994-95 academic years, including their dates of appointment and degrees, consult The University of Arizona General Catalog.

Aamot, Agnes M., Professor Emerita, Nursing
Abrams, Herbert K., Professor Emeritus, Family and Community Medicine
Adam, Rodney D., Associate Professor, Medicine; Assistant Professor, Microbiology and Immunology
Adamec, Ludwig Warran, Professor, Near Eastern Studies
Adamowicz, Rudwik, Associate Professor, Chemistry
Adams, Alison E., Assistant Professor, Molecular and Cellular Biology
Adams, Charles, Research Associate Professor, Anthropology
Adams, William G., Associate Professor, Art
Adams, H. Douglas, Associate Professor, English
Ahern, Geoffrey L., Assistant Professor, Microbiology; Assistant Professor, Physiology
Ahmad, Nafees, Assistant Professor, Microbiology and Immunology
Ahn, N. S., Associate Professor, English
Aiken, Susan H., Assistant Professor, Medicine
Alkporaye, Emmanuel, Associate Professor, Microbiology and Immunology
Albanese, Charles A., Professor, Architecture
Alberts, David S., Professor, Medicine; Professor, Pharmacology
Alican, Stanley, Professor Emeritus, Plant Pathology
Aleman, Lawrence M., Professor, Educational Psychology
Alepa, Francis P., Professor, Medicine; Associate Professor, Pediatrics
All, Ashish, Associate Professor, Accounting
Allen, Rupert C., Jr., Professor Emeritus, Spanish and Portuguese
Allen, Adela A., Associate Professor, Language, Reading and Culture
Allen, John J., Assistant Professor, Psychology
Allen, Paul M., Professor Emeritus, Secondary Education
Allen, R. Van, Professor Emeritus, Elementary Education
Allen, Ronald E., Professor, Animal Sciences
Alonso, Ana M., Assistant Professor, Anthropology
Altschul, D. Robert, Associate Professor, Geography
Alvarez, Leticia, Assistant Professor, Ecology and Evolutionary Biology
Am, Roy L., Professor, Animal Sciences; Professor, Obstetrics and Gynecology
Amy, Harry W., Professor, Agricultural and Resource Economics; Adjunct Professor, Agricultural and Resource Economics
Babcock, Barbara A., Professor, English
Badger, Terry A., Associate Professor, Nursing
Badger, Boyd Byron, Associate Professor, Exercise and Sport Sciences
Bagnara, Joseph T., Professor Emeritus, Anatomy
Baker, William B., Professor, Accounting
Barnes, Andrew, Assistant Professor, Linguistics
Bartels, Paul G., Professor Emeritus, Plant Sciences
Bartels, Peter H., Professor, Optical Sciences; Professor, Pathology
Bartlett, Nicholas, Professor Emeritus, Psychology
Bartos, Leslie L., Professor, Pediatrics
Bartos, Mark D., Professor, Geosciences
Bay, Mark, Assistant Professor, Physics
Bassett, Randy L., Professor, Hydrology and Water Resources
Bassford, Tamsen L., Assistant Professor, Clinical Family and Community Medicine
Basso, Ellen B., Professor, Anthropology
Batemann, Herman E., Professor Emeritus, History
Bates, Robert B., Professor, Chemistry
Bauwens, Eleanor E., Professor Emeritus, Nursing
Baygents, James C., Assistant Professor, Chemical Engineering
Beck, Ethlyn A., Professor, Speech and Hearing Sciences
Belay, Bruce J., Professor, Mathematics
Beach, Lee R., Professor, Management and Policy
Beattie, Bruce R., Professor, Agricultural and Resource Economics
Bechtel, Robert B., Professor, Psychology
Beckford, J. Ill, Assistant Professor, Astronomy
Beck, Jonathan, Professor, French and Italian
Bek, Suzanne L., Assistant Professor, Geosciences
Becker, Judith V., Professor, Psychology
Becker, Stewart, Professor Emeritus, Electrical Engineering
Bedford, Bruce L., Associate Professor, Psychology
Beekman, Ralph, Associate Professor, Teaching and Teacher Education
Beigel, Allan, Professor, Psychiatry; Professor, Psychology
Bell, Iris R., Assistant Professor, Psychiatry; Assistant Professor, Psychology
Bellamy, William T., Assistant Professor, Pathology
Benjamin, James B., Associate Professor, Surgery
Benson, Brenda, Professor, Anatomy
Benson, Clark T., Professor, Mathematics
Benz, Willy, Professor, Astronomy; Associate Professor in the Arizona Research Laboratories; Associate Professor, Planetary Science
Berg, Robert A., Associate Professor, Pediatrics
Bergan, John R., Professor, Educational Psychology
Bergesen, Albert J., Professor, Sociology
Berkhout, Carl T., Associate Professor, English
Bernhard, M. Roseann T., Associate Professor, Art
Bernays, Elizabeth A., Professor, Entomology
Bernstein, Alan E., Professor, History
Bernstein, Carol, Research Associate Professor, Microbiology and Immunology
Bernstein, Galia, Professor, History
Bernstein, Harris, Professor, Microbiology and Immunology
Berry, James W., Professor Emeritus, Nutrition and Food Science
Berry, Laura C., Assistant Professor, English
Bessey, Paul M., Associate Professor Emeritus, Plant Sciences
Bettin, M. C., Associate Professor, Atmospheric Sciences
Beudert, Peter M., Associate Professor, Theatre Arts
Bickel, William S., Professor, Physics
Biegler, John W., Assistant Professor, Astronomy
Bier, Joan, Professor Emeritus, Engineering
Bignoli, Brunella, Assistant Professor, French and Italian
Binder, Rudolf, Assistant Professor, Optical Sciences
Birkby, Walter H., Adjunct Research Professor, Anthropology
Birnie, Duane P., III, Associate Professor, Materials Science and Engineering
Bishop, Jerold, Associate Professor, Art
Black, John H., Professor, Astronomy
Blanchard, James, Professor, Pharmaceutical Sciences
Blecha, Milo K., Professor Emeritus, Elementary Education
Bleck, Erich K., Associate Professor Emeritus, Finance and Real Estate
Bleibtreu, Hermann K., Professor, Anthropology
Blitzer, Leonard, Professor Emeritus, Physics
Christensen, Harley D., Associate Professor Emeritus, Educational Psychology
Christopherson, Victor A., Professor Emeritus, Family and Consumer Resources
Church, Edna E., Professor Emeritus, Music
Clarricoate, Frank W., Associate Professor, Systems and Industrial Engineering
Civil, Marta, Assistant Professor, Mathematics
Clancy-Smith, Julia A., Associate Professor, Near Eastern Studies
Clark, Donald C., Professor, Teaching and Teacher Education
Clark, Kenneth N., Professor, Architecture
Clark, Lisa, Professor Emeritus, English
Clark, Larry C., Associate Professor, Family and Community Medicine
Clark, Robert Emmet, Professor Emeritus, Law
Clark, James W., Professor, Political Science
Clave, Jeanne Nienaber, Associate Professor, Political Science
Clasen, Albrecht, Professor, German Studies
Clausen, M. Richard, Professor Emeritus, Physical Education
Clay, James Ray, Professor, Mathematics
Clayton, J. Wesley, Professor Emeritus, Pharmacology and Toxicology
Cleland, Courtney B., Associate Professor Emeritus, Sociology
Clemens, Elisabeth S., Assistant Professor, Sociology
Coan, Richard W., Professor Emeritus, Psychology
Coates, Wayne E., Professor, Arid Lands Studies
Coen, William J., Associate Professor, Astronomy
Cockrum, E. Lendell, Professor Emeritus, Ecology and Evolutionary Biology
Cohen, Andrew S., Associate Professor, Geosciences; Associate Professor, Ecology and Evolutionary Biology
Colby, Bonnie G., Associate Professor, Agricultural and Resource Economics; Associate Professor, Hydrology and Water Resources
Cole, Jack R., Professor Emeritus, Medicinal Chemistry
Colescott, Robert H., Professor, Art
Connie, Andrew C., Assistant Professor, Geography and Regional Development
Conroy, Peter J., Professor, Geosciences
Conry, Ponnola, Associate Professor, Obstetrics and Gynecology
Conklin, Martha H., Assistant Professor, Hydrology and Water Resources
Connolly, Terence, Professor and Policy Congress, Paul F., Professor, Pharmacology and Toxicology
Contractor, Dinshaw, Professor, Civil Engineering and Engineering Mechanics
Conway, William E., Associate Professor, Mathematics
Cook, Gary D., Professor, Music
Cook, Mary J., Professor Emerita, English
Coons, Stephen J., Associate Professor, Pharmacy Practice
Cooper, Alarcon, Daniel F., Associate Professor, English
Copeland, Jack G., Professor, Surgery
Copple, Peggy J., Professor, Pediatrics; Professor, Neurology
Cortner, Hannaj M., Professor, Renewable Natural Resources; Professor, Political Science
Cortner, Richard C., Professor, Political Science
Cory, Dennis C., Professor, Agricultural and Resource Development
Cosart, William P., Associate Professor, Chemical Engineering
Cosgrove, Richard A., Professor, History
Coulter, Pearl P., Professor Emerita, Nursing
Cowen, Joseph L., Professor Emeritus, Philosophy
Cox, David E., Associate Professor, Agricultural Education
Cox, James C., Professor, Economics
Cox, Vivian E., Associate Professor, Teaching and Teacher Education
Crano, William D., Professor, Communication
Crow, John E., Associate Professor Emeritus, Political Science
Crow, Steven C., Professor, Aerospace and Mechanical Engineering
Crutchfield, Clifton D., Clinical Assistant Professor, Family and Community Medicine
Cuello, Joel L., Assistant Professor, Agricultural and Biosystems Engineering
Culbert, T. Patrick, Professor, Anthropology
Cummins, Robert C., Professor, Philosophy
Cuneo, Pia F., Assistant Professor, Art
Cunniff, Christopher M., Associate Professor, Pediatrics
Curlee, Richard F., Professor, Speech and Hearing Science
Curtis, Richard E., Professor Emeritus, Sociology
Cusanovich, Michael A., Professor, Biochemistry
Cushing, Jim M., Professor, Mathematics
Cutietta, Robert A., Professor, Music
Dabney, Donald L., Professor, Civil Engineering and Engineering Mechanics
Dalhagen, Roger A., Associate Professor, Agricultural and Resource Economics
Daloz, Roger, Professor, English
Dalrymple, Roger J., Professor Emeritus, Family and Consumer Resources
Dalen, James E., Professor, Medicine
Dalvin, Bruce L., Assistant Professor, Surgery
Dallal, James L., Professor, Radiology; Professor, Optical Sciences; Professor, Electrical and Computer Engineering
Dalmeida, Irene S., Assistant Professor, French and Italian
Dallin, William S., Professor, Medicine
Damon, Paul E., Professor Emeritus, Geosciences
Daniel, Terry C., Professor, Psychology; Professor, Renewable Natural Resources
Danielson, Paul J., Professor Emeritus, Counseling and Guidance
Dantzler, William H., Professor, Physiology
Darling, Linda T., Assistant Professor, History
Datta, Anindita, Assistant Professor, Management Information Systems
Davenport, William G., Professor, Materials Science and Engineering
Davis, Charles E., Associate Professor, English
Davis, Donald R., Professor, Hydrology and Water Resources
Davis, George H., Professor, Geosciences
Davis, Jack Emory, Professor Emeritus, Romance Languages
Davis, James W., Associate Professor Emeritus, Art
Davis, James W., Associate Professor Emeritus, Communication
Davis, John Robert, Professor, Pathology; Professor, Obstetrics and Gynecology
Davis, Owen K., Professor, Geosciences
Davis, Russell, Associate Professor Emeritus, Ecology and Evolutionary Biology
Davis, Stanley N., Professor Emeritus, Hydrology and Water Resources
Davis, Thomas P., Professor, Pharmacology
Dawson, George A., Professor Emeritus, Atmospheric Sciences and in the Institute of Atmospheric Physics; Professor Emeritus, Dendrochronology; Professor, Hydrology and Water Resources
Day, Arden D., Professor Emeritus, Plant Sciences
Day, Larry J., Professor, Music
Dayan, Joan, Professor, English
Dean, Jeffrey S., Professor, Dendrochronology
Debrah, Sounya K., Associate Professor, Computer Science
Decelles, Peter C., Associate Professor, Geosciences
Decker, Jan, Research Associate Professor, Veterinary Immunology
De Felio, Anthony, Director, Speech Pathology Clinic
De Laix, Roger A., Associate Professor Emeritus, History
Delaney, Pamela, Assistant Professor, Electrical and Computer Engineering
Delaplane, Walter H., Professor Emeritus, Economics
Delforge, Gary D., Associate Professor, Exercise and Sport Sciences
Delgado, Hector L., Assistant Professor, Sociology
Delgado, Pedro L., Associate Professor, Psychiatry
Della Penna, Dean, Assistant Professor, Plant Sciences; Associate Professor, Biochemistry
Deluca, Dominick, Associate Professor, Microbiology and Immunology
Demchak, Chris C., Assistant Professor, Public Administration and Policy
Demer, Louis J., Professor Emeritus, Materials Science and Engineering
Demers, Richard A., Professor, Linguistics
Dennis, John W., Professor Emeritus, Media Arts
Dempster, Judith S., Associate Professor, Nursing
Denise, Ronise K., Associate Professor, Animal Sciences
Dennis, Robert E., Professor Emeritus, Plant Sciences
Dent, Douglas G., Professor Emeritus, Mathematics
Denny, John L. Jr., Professor Emeritus, Mathematics
Denney, William E, Professor, Medicine
Denton, M. Bonner, Professor, Chemistry; Professor, Geosciences
Derenjak, Eustace L., Professor, Optical Sciences; Professor, Electrical and Computer Engineering
DeReus, Willem J., Assistant Professor, Anthropology; Assistant Professor, Linguistics
DeRoeck, Galina L., Assistant Professor, Russian and Slavic Languages
de Bghosian, Harry D., Associate Professor, Architecture
Desai, Chandrakant, Professor, Civil Engineering and Engineering Mechanics
Dessler, Alexander J., Research Scientist, Lunar and Planetary Laboratory
Dever, William G., Professor, Near Eastern Studies
Devito, Carl L., Associate Professor, Mathematics
Dewalt, Evelyn M., Associate Professor Emerita, Nursing
Dewhurst, Leonard W., Professor Emeritus, Veterinary Science
Deymier, Peter A., Associate Professor, Materials Science and Engineering
Dhalil, Dan S., Professor, Accounting
Dickey, Jerry R., Assistant Professor, Theatre Arts
Dixson, Donald Charles, Professor, Library Science
Dixson, Robert E., Professor, Atmospheric Sciences; Professor in the Institute of Atmospheric Physics; Professor, Dendrochronology; Professor, Hydrology and Water Resources
Dixson, William R., Professor Emeritus, Geosciences
Djebold, A. Richard, Jr, Professor Emeritus, Anthropology
Dieckmann, Carol L., Associate Professor, Biochemistry; Associate Professor, Molecular and Cellular Biology
Dieke, Ikenna, Associate Professor, African American Studies
Dietrich, Duane L., Associate Professor, Systems and Industrial Engineering
Dietz, William D., Associate Professor, Music
Dinham, Sarah M., Professor, Educational Psychology
Dinnerstein, Leonard, Professor, History
Dixon, Harold W., Professor, Theatre Arts
Dixon, William J., Professor, Political Science; Associate Professor, Sociology
Dobbs, Dan B., Rosenstiel Distinguished Professor, Law
Dodd, Mark S., Assistant Professor, Biochemistry
Domino, George, Professor, Psychology
Donahue, Douglas J., Professor, Physics
Donnerstein, Richard L., Associate Professor, Pediatrics
Doolan, Margaret B., Professor, Teacher Education
Doogah, Nathan, Associate Professor, Pharmacology
Doty, Jay C., Professor Emeritus, Emgineering and Geologic Engineering
Downey, Peter J., Assistant Professor, Computer Science
Doxtater, Dennis C., Associate Professor, Architecture
Doyne, Walter, Professor, Teaching and Teacher Education
Drabicki, John Z., Associate Professor, Economics
Drach, George W., Professor, Surgery
Gegenheimer, Albert E., Professor Emeritus, English
Gehman, Anton J., Tom, Professor, Lunar and Planetary Laboratory
Gehrels, George E., Associate Professor, Geosciences
Gehrt, Kenneth C., Associate Professor, Family and Consumer Resources
Gelenberg, Alan J., Professor, Psychiatry
Gelety, Timothy J., Assistant Professor, Obstetrics and Gynecology
Gensler, Helen Lynch, Associate Professor, Radiation Oncology
Gensler, William G., Associate Professor Emeritus, Electrical and Computer Engineering
Girard, Maria M., Professor, Art
Gerba, Charles P., Professor, Soil and Water Science; Professor, Microbiology and Immunology
Gerber, Joseph S., Associate Professor Emeritus, Finance and Real Estate
Gerber, Rose M., Associate Professor, Nursing
Gerhard, Glen C., Professor, Electrical and Computer Engineering
Gens, Eugene W., Professor, Radiation Oncology; Professor, Biochemistry
Gervay, Jacquelyn, Assistant Professor, Chemistry
Gething, Mary, Assistant Professor, Economics
Gibbs, Brent T., Assistant Professor, Theatre Arts
Gibbs, David Neil, Assistant Professor, Political Science
Gibbs, David M., Professor, Optical Sciences
Gibson, Josephine R., Associate Professor Emerita, Nursing
Gibson, Lay J., Professor, Geography and Regional Development
Gibson, Margaret I., Associate Professor Emerita, Russian and Slavic Languages
Gifford, Gilbert L., Professor Emeritus, Economics
Gillet, John J., Professor, Spanish and Portuguese
Gilbertson, Robert Lee, Professor, Plant Pathology
Gillette, Michael, Professor, Media Arts
Gillies, Robert J., Associate Professor, Biochemistry; Associate Professor, Radiology
Gillman, Margaret, Associate Professor, Hydrology and Water Resources; Professor, Renewable Natural Resources; Professor, Civil Engineering and Engineering Mechanics
Ginbrett, Howard R., Associate Professor, Landscape Architecture; Associate Professor, Renewable Natural Resources
Gimbel, Robert M., Professor, East Asian Studies; Professor in the Committee On Religious Studies
Gipson, Rosemary, Associate Professor Emerita, Drama
Glass, Charles E., Associate Professor, Mining and Geological Engineering
Glass, Richard Steven, Professor, Chemistry
Glattke, Theodore J., Professor, Speech and Hearing Sciences; Professor, Audiology
Glennon, Robert J., Jr., Professor, Law
Glisky, Elizabeth L., Assistant Professor, Psychology
Glittenberg, JoAnn E., Professor, Nursing
Gnitro, Arthur F., Associate Professor, Radiology; Associate Professor, Optical Sciences
Goldberg, Jeffrey B., Associate Professor, Systems and Industrial Engineering
Goldberg, Stanley J., Professor, Pediatrics
Golden, Judith, Professor, Art
Goldman, Alvin I., Professor, Philosophy
Goldman, Steven, Professor, Medicine
Goldshel, Ellen, Associate Professor, Family and Consumer Resources
Goll, Darrel E., Professor, Animal Sciences; Professor, Biochemistry
Golove, David M., Associate Professor, Law
Gonzalez, Maria V., Assistant Professor, Educational Psychology
Gonzalez-Rosado, Duenas, Professor, English
Gonzalez-Baker, Susan, Assistant Professor, Public Administration and Policy; Assistant Professor, Sociology
Good, Thomas L., Professor, Educational Psychology
Goodman, Kenneth S., Professor, Language, Reading and Culture
Goodman, Seymour E., Professor, Management and Information Systems
Goodman, Yetta M., Professor, Language, Reading and Culture
Gordon, Herman, Assistant Professor, Anatomy; Assistant Professor, Molecular and Cellular Biology
Gordon, Paul R., Assistant Professor, Family and Community Medicine
Gore, Robert W., Professor, Physiology; Professor, Anatomy
Gornick, Vivian, Professor, English
Gosner, Kevin M., Associate Professor, History
Gothberg, Helen M., Associate Professor Emerita, Library Science
Gottfried, Michael R., Professor, Public Administration and Policy; Professor, Management and Policy; Professor, Sociology; Professor, Law
Gould, Laurence M., Professor Emeritus, Geosciences
Gourley, Ronald, Professor Emeritus, Architecture
Graham, Anna R., Professor, Pathology
Graham, Gordon J., Professor Emeritus, Agricultural Education
Graham, Lee A., Assistant Professor, Wildlife and Fisheries Science; Assistant Professor, Arid Lands Studies
Grant, Don S., II, Assistant Professor, Sociology
Grant, Arthur T., Professor Emeritus, Higher Education
Grant, Kathryn L., Associate Professor, Pharmacy Practice
Graumlich, Lisa J., Associate Professor, Dendrochronology; Assistant Professor, Renewable Natural Resources; Associate Professor, Ecology and Evolutionary Biology
Green, Ellery C., Professor, Architecture
Green, Jerrold D., Professor, Political Science; Professor, Policy
Green, Perry F., Assistant Professor, Psychology; Assistant Professor, Speech and Hearing Sciences; Assistant Professor, Linguistics
Green, Richard, Adjunct Astronomer, Steward Observatory
Greenberg, Jeff L., Professor, Psychology
Greenberg, Richard J., Professor, Planetary Sciences; Professor, Teaching and Teacher Education
Greeley, Dennis L., Associate Professor Emeritus, German Studies
Greenlee, Wilfred M., Professor, Mathematics
Greer, Wesley D., Professor, Art
Greer, William F., Associate Professor, Journalism
Gregg, Karl Curtis, Associate Professor, Spanish and Portuguese
Gregg, R. Frank, Professor Emeritus, Renewable Natural Resources
Greivenskamp, John E., Jr., Associate Professor, Optical Sciences; Associate Professor, Ophthalmology
Griffin, Gary A., Professor, Teaching and Teacher Education
Griffith, Terri L., Assistant Professor, Management and Policy
Grimes, William J., Professor, Biochemistry; Professor, Molecular and Cellular Biology
Grissell, Ralph E., Professor, Computer Science
Groemer, Helmut, Professor, Mathematics
Grogan, Thomas Malcolm, Professor, Pathology
Gross, Eugene J., Assistant Professor, Radiation Oncology
Gross, Joseph F., Professor Emeritus, Chemical Engineering
Grossman, Maurice K., Professor Emeritus, Art
Grove, Larry C., Professor, Mathematics
Gruene, Raphael P., Professor, Physiology
Guerrero, Vincent, Jr., Assistant Professor, Animal Sciences
Guerin, D. Phillip, Associate Professor, Watershed Management
Guilbert, John M., Professor Emeritus, Geosciences
Gullo, Joseph D., Associate Professor Emeritus, Educational Psychology
Gum, Russell L., Specialist, Agricultural and Resource Economics; Adjunct Professor, Agricultural and Resource Economics
Gutek, Barbara A., Professor, Management and Policy
Gutierrez, George J., Professor, Russian and Slavic Languages
Guy, Donna J., Professor, History
Guzman, Roberto Zamudio, Assistant Professor, Chemical and Environmental Engineering
Gyorko, Lainia A., Professor, Spanish and Portuguese
Haas, Joan E., Assistant Professor, Nursing
Hadley, Mac E., Professor, Anatomy
Hagedorn, Henry H., Professor, Entomology
Haldar, Achintiya, Professor, Civil Engineering and Engineering Mechanics
Hale, William H., Professor Emeritus, Animal Sciences
Hall, David J., Professor Emeritus, Civil Engineering
Hall, Donald R., Associate Professor Emeritus, Political Science
Hall, Henry K., Jr., Professor, Chemistry
Hall, Jennifer D., Associate Professor, Molecular and Cellular Biology; Associate Professor, Biochemistry
Hallik, Richard B., Professor, Biochemistry; Professor, Molecular and Cellular Biology
Halonen, Marilyn J., Professor, Pharmacology; Professor, Microbiology and Immunology
Halpert, James R., Professor, Pharmacology and Toxicology
Hamara, Oma, Associate Professor, Mathematics
Hamblin, Robert L., Professor Emeritus, Sociology
Hamernik, Debora L., Assistant Professor, Physiology; Assistant Professor, Obstetrics and Gynecology
Hamlen, Stuart R., Associate Professor, Anesthesiology
Hamm, Allan J., Assistant Professor, Surgery; Clinical Assistant Professor, Radiation Oncology
Hammond, Douglas J., Professor Emeritus, Electrical and Computer Engineering
Hammond, Keith C., Professor Emeritus, Plant Sciences
Hammer, Michael E., Assistant Research Scientist in the Arizona Research Laboratories; Assistant Research Scientist in Ecology and Evolutionary Biology
Hammond, Harmony, Professor, Art
Hammond, Michael, Associate Professor, Linguistics
Hampton, Jean E., Professor, Philosophy
Hancox, Jory L., Professor, Dance
Hancock, Melissa Lowe, Associate Professor, Dance in the School of Music
Hansen, Ronald C., Professor, Medicine; Professor, Pediatrics
Hanson, Gregg L., Professor, Music
Hanson, Richard T., Associate Professor, Theatre Arts
Haralovich, Mary Beth, Associate Professor, Media Arts
Harclerode, Fred F., Professor Emeritus, Higher Education
Harish, Robert M., Professor, Philosophy; Professor, Linguistics
Harpalani, Satya, Associate Professor, Mining and Geological Engineering
Harper, Donald J., Assistant Professor, East Asian Studies
Harris, David T., Associate Professor, Microbiology and Immunology
Harris, De Verle P., Professor, Geosciences; Professor, Mining and Geological Engineering
Harris, Robert M., Professor Emeritus, General Biology
Harrison, Elizabeth G., Assistant Professor, East Asian Studies
Harshman, Gordon A., Associate Professor Emeritus, Counseling Psychology
Hardman, John H., Professor, Computer Science
Hartell, Onnie M., Professor Emeritus, Music
Hartshorne, David J., Professor, Animal Sciences; Professor, Biochemistry
Haskell, Jeffrey R., Professor, Music
Haskin, Donald M., Professor Emeritus, Art
Hatch, Kathryn L., Professor, Family and Consumer Resources
Hatch, Kenneth D., Professor, Obstetrics and Gynecology
Hathorn, Scott J., Professor Emeritus, Agricultural Economics
Hausen, Charles B., Professor Emeritus, Electrical and Computer Engineering
Hausler, Mark R., Professor, Biochemistry
Havens, William H., Professor, Landscape Architecture
Pajor, Ana M., Associate Professor, Astronomy
Palmer, James A., Associate Research Professor, Optical Sciences
Palmer, John D., Professor, Pharmacology; Assistant Professor, Medicine
Palmer, John N., Associate Professor, Mathematics
Palmer, Milcent L., Assistant Professor, Ophthalmology
Palusinski, Olgierd A., Professor, Electrical and Computer Engineering
Pao-Tao, Chia-Lin, Associate Professor, East Asian Studies
Papaj, Daniel R., Assistant Professor, Ecology and Evolutionary Biology
Papenfuss, Richard L., Associate Professor, Health Education; Associate Professor, Family and Community Medicine
Paplanus, Samuel H., Professor Emeritus, Pathology
Park, Thomas K., Associate Professor, Anthropology
Parker, Roy R., Assistant Professor, Molecular and Cellular Biology; Assistant Professor, Biochemistry
Parks, Harold G., Associate Professor, Electrical and Computer Engineering
Parmenter, Robert H., Professor, Physics; Professor, Arizona Research Laboratories
Parish, Judith T., Professor, Geosciences
Parvinzadeh, Ali, III, Professor, Art
Parsons, L. Claire, Professor, Nursing; Associate Professor, Physiology
Partch, P. Jonathan, Professor, Geosciences; Professor, Arizona Research Laboratories
Patel, Glenn S., Associate Professor, Teaching and Teacher Education
Patrascioul, Adrian N., Professor, Physics
Patten, Jimmy D., Associate Professor, Journalism
Patterson, K. Thomas, Associate Professor, Music
Patterson, Richard B., Associate Professor, Molecular and Cellular Biology
Pattson, Dennis D., Professor, Radiology; Professor, Optical Sciences
Paul, Arleen, Associate Professor, Teaching and Teacher Education
Paulson, Leonard A., Professor Emeritus, Music
Pearson, C. Derick, Professor Emeritus, Higher Education
Pederson, Leland R., Professor, Geography and Regional Development
Pellegrin, Mary E., Assistant Professor, Spanish and Portuguese
Peirin, Jessie V., Associate Professor Emerita, Nursing
Perkins, Henry C., Jr., Professor, Aerospace and Mechanical Engineering
Perry, Catherine S., Associate Professor, Pathology
Peterson, Richard E., Professor Emeritus, Music
Peterson, Williams C., Professor Emeritus, Mining and Geological Engineering
Peterson, Eskild A., Professor, Medicine
Peterson, Margaret S., Associate Professor Emerita, Civil Engineering and Engineering Mechanics
Peterson, Russell E., Professor Emeritus, Aerospace and Mechanical Engineering
Peterson, Larry L., Associate Professor, Computer Science
Peterson, Mary A., Associate Professor, Psychology
Peterson, Thomas W., Professor, Chemical and Environmental Engineering
Peterson, V. Spike, Assistant Professor, Political Science
Peygaharian, Nasser N., Professor, Optical Sciences
Phillips, Anthony F., Professor, Pediatrics
Phillips, Susan U., Professor, Anthropology
Phillips, Delbert D., Associate Professor, Russian and Slavic Languages
Phillips, Linda R., Professor, Nursing
Pialorsi, Frank P., Professor, English
Picchioni, Albert L., Professor Emeritus, Pharmacology and Toxicology
Pickens, Peter E., Professor Emeritus, Molecular and Cellular Biology
Pickrell, Douglas M., Associate Professor, Mathematics
Pierso, Leland S., III, Assistant Professor, Plant Pathology
Pilakowski, Michael P., Associate Professor, Public Administration and Policy; Assistant Professor, Sociology
Pilkington, Michael J., Assistant Professor, Russian and Slavic Languages
Pilmale, Horace H., Associate Professor, Anthropology
Pinnock, Kay E., Associate Professor, Administration and Policy; Assistant Professor, Sociology
Pinti, Philip A., Assistant Professor, Astronomy
Pitt, Sheila B., Assistant Professor, Art
Plane, David, Professor, Geography and Regional Development
Plax, Julie A., Assistant Professor, Art
Pogrow, Stanley, Associate Professor, Teaching and Teacher Education
Poirier, David R., Professor, Materials Science and Engineering
Polakowski, Michael P., Assistant Professor, Public Administration and Policy; Assistant Professor, Sociology
Polt, Andrew W., Associate Professor, Art
Pollock, John L., Professor, Philosophy
Polowy, Teresa L., Assistant Professor, Russian and Slavic Languages
Polakowski, Michael P., Associate Professor, Chemistry
Polzer, Charles W., Curator of Ethnobiology, Arizona State Museum
Pomeau, Yves, Professor, Mathematics
Pond, Gerald D., Professor, Radiology
Pool, Ronald H., Associate Professor Emeritus, Psychology
Porco, Carolyn C., Associate Professor, Lunar and Planetary Laboratory; Associate Professor, Planetary Sciences
Porreca, Frank, Professor, Pharmacology
Post, Donald Francis, Professor, Soil and Water Science
Post, Roy G., Professor Emeritus, Nuclear and Energy Engineering
Post, Charles M., Associate Professor, Architecture
Poulton, Mary M., Assistant Professor, Mining and Geological Engineering
Povman, Charles E., Professor, English
Powell, Lawrence C., Professor Emeritus, Residence
Powell, Richard C., Professor, Optical Sciences; Professor, Materials Science and Engineering
Powell, Walter W., Professor, Sociology
Powis, Garth, Professor, Pathology; Professor, Pharmacology
Price, Ralph L., Associate Professor, Nutritional Sciences
Prince, John L., III, Professor, Electrical and Computer Engineering
Pritchard, Earl H., Professor Emeritus, Oriental Studies
Pritchard, Wallace, Professor Emeritus, Music
Prosser, Daniel L., Professor, Computer Science
Pruitt, Arlene M., Professor Emeritus, Nursing
Purcell, Ronald E., Professor, Family and Community Medicine
Putnam, Charles W., Professor, Surgery; Professor, Pharmacology
Puto, Christopher P., Associate Professor, Marketing
Purdy, Arlene M., Associate Professor, Sociology
Qafisheh, Hamdi A., Professor, Near Eastern Studies
Qi, Yingyong, Assistant Professor, Speech and Hearing Science
Quade, Jay, Assistant Professor, Geosciences
Quan, Stuart F., Professor, Medicine; Professor, Anesthesiology
Quinn, Robert M., Professor Emeritus, Art
Quiroz, Alfred J., Associate Professor, Art
Rabasa, Carlos V., Professor Emeritus, Philosophy
Racowsky, Catherine, Associate Professor, Obstetrics and Gynecology; Associate Professor, Physiology
Racy, John C., Professor, Psychiatry
Raffalski, Johann, Professor, Physics
Baghavatula, Professor, Materials Science and Engineering
Ragula, Lyndal J., Professor, Political Science
Ram, Sudha, Associate Professor, Management Information Systems
Ramawatani, Mani, Assistant Professor, Molecular and Cellular Biology
Ramberg, John S., Professor, Systems and Industrial Engineering
Ramohalli, Kumar N., Professor, Aerospace and Mechanical Engineering
Rance, Naomi E., Assistant Professor, Pathology; Assistant Professor, Neurology; Assistant Professor, Anatomy
Rankin, James R., Associate Professor, Teaching and Teacher Education
Ranniger, Bill J., Professor Emeritus, Teaching and Teacher Education
Rao, Anbar G., Professor, Marketing
Rao, Radha Krishna, Research Assistant Professor, Psychological and Brain Sciences
Rapske, Steven Z., Assistant Professor, Neurology; Assistant Professor, Psychology
Rappoport, Amnon, Professor, Management and Policy
Reed, Raymond E., Professor Emeritus, Veterinary Medicine
Rees, Richard W., Professor, Geography and Regional Development
Reagan, John A., Professor, Electrical and Computer Engineering; Professor, Optical Sciences
Reich, Naomi A., Professor Emerita, Family and Consumer Resources
Reid, James D., Professor Emeritus, Art
Reid, James J., Professor, Anthropology
Reid, Charles P., Professor, Renewable Natural Resources
Reiman, Eirin M., Associate Professor, Psychiatry
Reimer, Margaret, Assistant Professor, Philosophy
Reiter, Jocelyn S., Professor, Music
Remers, William A., Professor, Pharmaceutical Sciences
Resnick, Sol D., Professor Emeritus, Hydrology
Restifo, Linda L., Assistant Professor, Neurobiology Division, Arizona Research Laboratories; Assistant Professor, Neurology
Reyna, Valerie E., Associate Professor, Educational Psychology
Reynolds, Stanley S., Professor, Economics
Rhoades, Gary D., Associate Professor, Higher Education Administration and Policy
Rhodes, Herbert D., Professor Emeritus, Chemistry
Ribeiro, Jose M., Professor, Entomology; Professor, Biochemistry
Rice, C. Jane, Assistant Professor, German Studies
Rice, Richard W., Professor, Animal Sciences
Rice, Robert R., Professor, Architecture
Richard, Ralph M., Professor Emeritus, Civil Engineering and Engineering Mechanics
Richardson, Randall, Associate Professor, Geosciences
Richardson, Virginia, Professor, Teaching and Teacher Education
Richter, Roland, Associate Professor Emeritus, Germanic Studies
Rider, Evelyn D., Assistant Professor, Pediatrics
Ridge, George W., Jr., Professor Emeritus, Journalism
Ridley, Carl A., Professor, Family and Consumer Resources; Professor, Psychology
Rieber, Michael, Professor, Economics; Professor, Mining and Geological Engineering
Rieke, George H., Professor, Astronomy; Professor, Planetary Sciences; Professor, Lunar and Planetary Laboratory
Rieke, Marcia J., Professor, Astronomy
Riggs, Carol A., Assistant Professor, Veterinary Science; Assistant Professor, Pathology
Riker, Adelaida E., Associate Professor Emerita, Microbiology and Medical Technology
Rindfleisch, Thomas, Assistant Professor, Law
Rittenbaugh, Cheryl, Associate Professor, Family and Community Medicine
Rivero, Eliesa S., Professor, Spanish and Portuguese
Roberts, Bois, Associate Professor Emeritus, Russian and Slavic Languages
Robichaux, Robert H., Associate Professor, Ecology and Evolutionary Biology
Robins, Harry E., Professor Emeritus, English
Robinson, D. Paul, Assistant Professor, Teaching and Teacher Education
Robinson, Faye L., Associate Professor, Music
Robinson, William J., Professor Emeritus, Dentrodentistry
Robson, John W., Professor Emeritus, Physics
Rober, Frederick B., Professor Emeritus, Exercise and Sport Sciences
Roby, Mary M., Professor Emerita, Exercise and Sport Sciences
Rodney, D. Ross, Professor Emeritus, Plant Sciences
Roghia, Jeffrey J., Assistant Professor, Electrical and Computer Engineering
Roe, Charles R., Professor, Music
Roe, Denise, Assistant Professor, Family and Community Medicine
Rohrig, Hans, Research Professor, Radiology
Romm, Elizabeth R., Professor, Astronomy; Professor, Lunar and Planetary Laboratory
Rosens, William R., Professor, Medicine; Professor, Pharmacology
Rogers, Barbara J., Professor, Art
Rohmhaug, Michael J., Professor, Psychology; Professor, Family and Consumer Resources
Rollins, Franklin D., Professor Emeritus, Nutrition and Food Science
Romer, Frank E., Assistant Professor, Classics
Ros, Nestor R., Professor Emeritus, Finance and Real Estate
Roo-Leger, Luis J., Assistant Professor, Surgery
Rosenblatt, Paul, Professor, English
Rosenblum, Sandra, Professor, Architecture
Rosenzweig, Michael L., Professor, Ecology and Evolutionary Biology
Rosen, Roseanne E., Associate Professor, Psychology
Roth, Robert, Superintendent, Maricopa Agricultural Center
Rovere, David C., Professor, Family and Consumer Resources; Associate Professor, Psychology
Rovinbli, Jerzy W., Associate Professor, Electrical and Computer Engineering
Rubens, Alan B., Professor, Neurology
Rubis, David D., Professor Emeritus, Plant Sciences
Ruiz, Jocquins, Professor, Geosciences
Ruiz, Richard, Associate Professor, Language, Reading and Culture
Rund, Hanno, Professor Emeritus, Mathematics
Rund, John V., Associate Professor, Chemistry
Runyan, Raymond B., Associate Professor, Anatomy
Rupley, John A., Professor, Biochemistry
Rush, Jean C., Professor Emeritus, Art
Rush, Mark, Assistant Professor, Music
Rush, Jerald G., Professor, Political Science
Russell, Kenneth E., Associate Professor, Exercise and Sport Sciences
Russell, Stephen M., Associate Professor Emeritus, Ecology and Evolutionary Biology
Ruthterford, John R., Professor, Physics
Rutledge, Kenneth A., Professor, Pathology; Professor, Microbiology and Immunology
Rychlik, Marek J., Associate Professor, Mathematics
Rykowski, Mary Cecilia, Assistant Professor, Anatomy; Assistant Professor, Molecular and Cellular Biology
Saadatmanesh, Hamid, Associate Professor, Civil Engineering and Engineering Mechanics
Saezner, Thomas E., Professor Emeritus, Geography and Regional Development
Saavedra, Steven S., Assistant Professor, Chemistry
Saban, David, Assistant Professor, Latin American Studies
Sabat, Robert J., Associate Professor, Media Arts
Saber, Darrell L., Professor, Educational Psychology
Sacamone, Charles M., Professor Emeritus, Plant Sciences
Salsche, Stuart J., Associate Professor, Medicine
Saldata, Macario, IV, Professor, Educational Foundations and Administration
Sales, Amos P., Professor, Special Education and Rehabilitation
Sales, Bruce D., Professor, Psychology; Professor, Psychiatry; Professor, Law
Salmon, Sydney E., Professor, Medicine
Saltus, Elinor C., Professor Emerita, Library Science
Salzman, William R., Professor, Chemistry
Sammarco, Anita, Professor Emerita, Music
Samsong, David W., Associate Professor, Veterinary Science
Samplin, Richard E., Professor, Medicine
Samson, Riccardo A., Assistant Professor, Pediatrics
Sandel, Bill R., Senior Research Scientist, Lunar and Planetary Laboratory
Sander, Eugene, Professor Emeritus, Biochemistry
Sanders, Arthur B., Professor, Surgery; Associate Professor, Family and Community Medicine
Sanders, Linda W., Professor, Architecture
Sanders, William H., Associate Professor, Electrical and Computer Engineering
Sanderson, Richard M., Professor, Economics
Sankey, Robert W., Associate Professor, Communication
Sanosi, Si J., Assistant Professor, French and Italian
Sarcevic, Ina, Associate Professor, Physics
Sargent, Murray III, Professor, Optical Sciences
Sarid, D. Ross, Professor, Optical Sciences; Professor, Arizona Research Laboratories
Sarnoff, Joshua D., Assistant Professor, Law
Saunders, Joyan, Assistant Professor, Art
Saunders, T. Frank, Professor Emeritus, Education
Saville-Trouke, M. R., Professor, English
Schaedler, Michael, Professor, Physics
Schafer, John Paul, President Emeritus, the University of Arizona
Schafer, William M., Professor, Ecology and Evolutionary Biology
Schaller, Michael, Professor, History
Schatzberg, Jeffrey W., Associate Professor, Accounting
Schiff, Michael B., Professor, Anthropology
Schiffman, Ronald B., Associate Professor, Pathology
Schlagel, Edella, Assistant Professor, Public Administration and Policy
Schlegel, Alice E., Professor, Anthropology
Schlichting, Richard D., Professor, Computer Science
Schmidt, Gary D., Professor, Astronomy
Schmutz, Erwin M., Professor Emeritus, Range Management
Schaudorf, Herbert N., Professor, English
Schweik, Theodore J., Professor, Law
Schonhorst, Melvin H., Professor Emeritus, Plant Sciences
Scholz, Lutz C., Associate Professor, Electrical and Computer Engineering
Schottland, Richard M., Professor, Atmospheric Sciences; Professor, Institute of Atmospheric Physics
Schowengerdt, Robert, Associate Professor, Electrical and Computer Engineering; Associate Professor, Optical Sciences; Associate Professor, Arid Lands Studies
Schram, Karl H., Professor, Pharmaceutical Sciences
Schreiber, Joseph F. Jr., Professor Emeritus, Geosciences
Schrumpf, Ronald D., Assistant Professor, Electrical and Computer Engineering
Schroeder, Lynn R., Professor Emeritus, Art
Schueller, Thomas L., Professor, Law
Schuh, James D., Professor Emeritus, Animal Sciences
Schultz, Donald G., Professor Emeritus, Systems and Industrial Engineering
Schultz, William R., Professor Emeritus, Oriental Studies
For Copies of Other University Catalogs:

General Catalog
Write: ASUA Bookstore, send a check for $4.00

College of Law Catalog
Write: The College of Law

College of Medicine Catalog
Write: The College of Medicine

Extended University Schedule or
Sierra Vista Campus Schedule
Write: Extended University

Summer Session Schedule
Write: Summer Session

For Further Information on:

Applications to the Graduate College
Write: Graduate College Admissions

Degree Programs
Write: Head of particular department

Financial Assistance
Write: Director of Financial Aid

Housing Facilities
Write: Director of Residence Life

Medical Facilities
Write: Director of Student Health Service

Certification for Teachers
Write: Dean of College of Education

Part-Time Employment
Write: Career Services

Transcripts
Write: Office of the Registrar