BOT 300, 360 (or ZOL 360); MIC 205 (or 220), 206; ZOL 350. The remaining 12 hours are selected so that the total major hours reflect a balance between the two departments. Required supplementary courses are as follows: CHM 113 and 115 and 231 *or* CHM 331 and 332 and 335 and 336; CSE 181 or 183; MAT 210 or any calculus; PHY 101 (or 111 or 112 or 113 or 114).

Bachelor of Science Degree in Wildlife Conservation Biology

Two options are available: the terrestrial and the aquatic option. Both options consist of 62 hours in the major and supplementary courses, plus mathematics proficiency. Courses required for both options are as follows: BIO 181, 182, 217, 320, 340, 415; CHM 113 and 115 and 231 *or* CHM 331 and 332 and 335 and 336; ENG 301; MAT 210 or any calculus; ZOL 360, 410, 411, 413.

Terrestrial Option. Additional required courses for this option are as follows: BOT 370; ERA 370 or 360, ZOL 471 or 472.

Aquatic Option. Additional required courses for this option are as follows: BIO 426; ZOL 370 (or 350), 473.

These requirements meet the minimum for eligibility for the Federal Register. Students planning to enter graduate school from either option should take CHM 331, 332, 335, and 336 instead of CHM 231 and should take PHY 111, 112, 113, and 114

Bachelor of Science Degree in Zoology

The major in Zoology consists of 34 hours in major courses and 27 hours in required supplementary courses, plus math proficiency. Required courses are as follows: BIO 181, 182, 320, 340, 445; CHM 113, 115; CHM 331 and 332 and 335 and 336 *or* CHM 231 and 361, CSE 181 or 183; MAT 210 or any calculus; PHY 111, 112, 113, 114; ZOL 280, 330, 331, 360, 370 (or 350 or 354).

Minor in Zoology

The Zoology minor consists of 24 semester hours in BIO and ZOL courses, including BIO 181 and 182, and 16 hours selected with approval of an advisor in the Department of Zoology; at least 12 hours must be in the upper division. Courses not available for credit in the Zoology major cannot be used for the minor (e.g., BIO 100, ZOL 201).

Bachelor of Arts in Education Degree in Secondary Education

See page 118 for information on the academic specialization in biological sciences.

Graduate Program

The Department of Zoology offers programs leading to the degrees of Master of Natural Science, Master of Science, and Doctor of Philosophy. Consult the *Graduate Catalog* for requirements.

BIOLOGY

For courses in biology see Biological Sciences, pages 118–119

ZOOLOGY

ZOL 113 Contemporary Zoology. 4 F S
Topics emphasizing society relevant problems Cannot be used for major credit in the biological sciences 3 hours lecture, 3 hours lab. *[Satisfies General Studies Requirement S2]*

120 Human Physiology. 4 F, S
Basic concepts of general science will be discussed using current issues and basic concepts of human physiology as a focus Cannot be used for major credit in biological sciences 3 hours lecture, 3 hours lab *[Satisfies General Studies Requirement S2]*

201 Human Anatomy and Physiology I. (4) F S SS
Structure and dynamics of the human mechanism. Cannot be used for major credit in the Department of Zoology 3 hours lecture 3 hours lab *[Satisfies General Studies Requirement. S2]*

202 Human Anatomy and Physiology II. (4) F S SS
Continuation of ZOL 201 Cannot be used for major credit in the Department of Zoology. 3 hours lecture, 3 hours lab Prerequisite ZOL 201 or instructor approval.

241 Human Genetics. (3 F S
Introduction to human heredity and variation. Cannot be used for major credit in the Department of Zoology. Prerequisite a course in the fe sciences

280 Animal Behavior. 3) F
Evolutionary genetic, physiological and ecological bases of animal behavior Prerequisite: 4 hours of BIO or ZOL or instructor approval

300 Biogenetics of Man. (4 S
Concepts of ecology, heredity evolution, and their relation to human affairs Cannot be used for major credit in fe sciences

311 Animal Microtechnique. 2 N
Zoological microtechnique including the preparation for microscopic examination of animal structures tissues cells and whole mounts 6 hours lab. Prerequisite. BIO 182.

316 History of Biology: Conflicts and Controversies. 3 N
Focuses on 19th and 20th centuries considering biology as a discipline, evolution, and problems of heredity development and cell theory. Crosslisted as HPS 330. *[Satisfies General Studies Requirement H]*

318 History of Medicine. 3 N
Sc ent fic study of the human body, chang ng theories of d sease evo ution of pract ca op n ons on treatment, and the emerg ng inst tut ona zat on of medical pract ce Cross sted as HPS 331 *Satisfies Genera Studies Requirements SB, H]*

330 Developmental Anatomy. (3) F
Genera developmental b o ogy (embryo ogy and com parat ve structure of organ systems, ustrated ma n y by vertebrate examp es Prerequisite· BIO 182.

331 Laboratory in Vertebrate Developmental Anatomy. (2) F S
Morpho ogy of representat ve embryon c and adult verte brates Two 3 hour abs ZOL 330 recommended Pre requ s te B O 182.

350 Comparative Invertebrate Zoology. 4) F
Character st cs, fe cyc es adaptat ons and evo ut on of nvertebrate an mals 3 hours ecture 3 hours lab Pre requisite. BIO 182 or nstructor approval

354 General Entomology. 4) S 92
Form activit es and c ass f cat on of nsects. 3 hours ec ture 3 hours lab Prerequ s te BIO 182

360 Basic Physiology. (4) F S
Phys o og ca mechan sms of the h gher vertebrates. 3 hours ecture 3 hours lab Prerequis tes BIO 182 CHM 115; MAT 117

370 Vertebrate Zoology. 4) S
Characterist cs, c assif cation evolut on, and natura his tory of the major groups of vertebrate an mals 3 hours lecture, 3 hours ab Prerequ s te B O 182.

380 Sociobiology. (3) S
Survey of an ma and human soc a behav or exam ned from an evo ut onary perspect ve. Su table for nonmajors. ZOL 280 is recommended

394 Special Topics (Nonmajors). (2 3 N
Top cs of current or spec'al nterest in one or more as pects of an mal b o ogy Top cs vary Cannot be used for major cred't n fe sc ences. Prerequis te. jun or stand ng

410 Techniques in Natural Resource Management. 3) F
F e d and analyt'cal techn ques used n eva uat ng popula tion structure, v ab ity and env ronmental mpacts. Lec ture, lab. Prerequ s tes· B O 217 and 320 *or* nstructor approval *[Satisfies General Studies Requirement. L2]*

411 Biology and Management of Terrestrial Wildlife. (3) S
Prncip es, theor es, and pract ces of manag ng terrestria wi d fe from hab tat and popula ton perspect ves. Pre-requis tes· BIO 217 and 320 and ZOL 471 and 472 *or* n structor approva

413 Biology and Management of Aquatic Resources. (3) F
Princ p es, theor es, and pract ces of manag ng aquat c resources. Prerequ s tes. B O 217 and 320 and ZOL 473 *or* nstructor approva

420 Field Zoology. (3) N
Experience n zoo og cal f e d techn ques. Requ res week end or longer f eld tr ps Prerequ s te nstructor approval

423 Population and Community Ecology 3) N
Organ zat on and dynam cs of popu at on and commun t es emphasizing anima s Theoret cal and emp r ca ap proaches Prerequ s te: B O 320 or nstructor approva

425 Animal Ecology. (3) N
Physio og'ca and behav oral adaptat'ons of nd v dual an ma s to both ab ot c and b ot c env ronment. Prerequis te: BIO 320.

433 Animal Histology. (4) S
M croscop c study of an mal t ssues 3 hours ecture, 3 hours ab. Prerequ s te: B O 182 or instructor approva

440 The Nucleus. 3 N
Exper menta stud es in chromatin and chromosome struc ture. Molecu ar mechan sms of chromosome movement and mechan cs cel popula ton k net cs the nuc eolus, and the nuclear enve ope. Prerequ s tes: B O 340 CHM 261, 335 or 361).

441 Principles of Human Genetics. (3) N
Genetics n human populations nclud ng med cal as pects. Prerequ s te BIO 340.

454 Aquatic Insects. (3) N
Systemat cs and eco ogy of aquat c insects. Prerequ site: ZOL 354.

465 Neurophysiology. (3) S 92
Deta ed treatment of ce lular and organ smal neurophysi ology and nervous system funct on Prerequ s te: ZOL 360

466 Neurophysiology Laboratory. (2) S 92
ntrace u ar and extrace u ar e ectrophys olog ca record ing techniques h sto og cal preparations and dye fi ng techn ques. 6 hours ab Pre- or corequ s te ZOL 465

470 Systematic Zoology. (3 S 93
Ph osophy, theory, and pract ce in nterpret ng patterns of an ma d vers ty nc ud ng spec es concepts and spec a t on, nomenclature and taxonomy and evo ut onary and phy ogenet c c assification. Prerequisites jun or standing 18 hours n l fe sc ence.

471 Ornithology. (3) S
The b ology of birds 2 hours ecture, 3 hours ab week end f e d tr ps Prerequis te. ZOL 370 or instructor ap prova

472 Mammalogy. (4 F '92
Class f cat on, structure habits, eco ogy and d str but on of mammals emphasizing North Amer can forms. 3 hours lecture, 3 hours ab or f e d trip, weekend field tr ps. Pre-requ s te. ZOL 370 or nstructor approva

473 Ichthyology. (3) S '93
Systemat cs and bio ogy of recent and ext nct fishes 2 hours ecture, 3 hours ab or f eld tr p weekend f e d trips required. Prerequis'tes ZOL 370 and 425 *or* nstructor approva

474 Herpetology. (3) S 92
Systemat cs and b o ogy of recent and extinct rept es and amph'b ans 2 hours ecture 3 hours ab or f eld tr p Pre requ s te ZOL 370

481 Research Techniques in Animal Behavior. (3) S '92
Exper menta and f e d stud es of an mal behavior, de scr pt on and quant ficat on of anima behavior and nter pretat on of behavior w thin an evo utionary framework 1 hour ecture 6 hours ab Prerequ s te ZOL 280

508 Scientific Data Presentation. 2) F
Techn ques necessary for presentation of sc ent fic data used in journa pub cat ons grant proposals and v sua presentations Lecture ab. Prerequ s tes: nstructor ap prova

515 Populations: Evolutionary Genetics. (3) F
Mathematical models in the description and analysis of the genetics of populations. Prerequisites: BIO 320 and 415 and 445 *or* instructor approval.

516 Populations: Evolutionary Ecology. (3) S
Principles of population biology and community ecology within an evolutionary framework. 2 hours lecture, 2 hours recitation. Prerequisites: BIO 320, 415 (or MAT 210); ZOL 515.

517 Techniques in Evolutionary Genetics. (4) S
Practical experience in modern techniques for the study of evolution. Lecture, lab. Prerequisites: BIO 340, 445; instructor approval.

532 Developmental Genetics. (3) S '92
Genetic approaches to the analysis of development during the life cycle of eukaryotic organisms, and the role of genes in the unfolding of the differentiated phenotype. Prerequisite: BIO 443.

560 Comparative Physiology. (3) S '93
The analysis of function in invertebrates and vertebrates, emphasizing evolutionary trends in physiological systems. Prerequisite: ZOL 360 or equivalent.

566 Environmental Physiology. (3) S '92
Physiological responses and adaptations of animals to various aspects of the physical environment. Prerequisites: BIO 320; ZOL 360.

568 Mammalian Physiology. (3) F '91
Detailed treatment of mammalian organ system functions emphasizing integrative mechanisms. Prerequisite: ZOL 360 or equivalent.

569 Cellular Physiology. (3) F '92
Emphasizing the molecular basis for cell structure and function. Prerequisites: ZOL 360; organic chemistry.

591 Seminar. (1–3) F, S
Topics such as the following will be offered:

(a) Behavior	(e) Physiology
(b) Cell Biology	(f) Evolution
(c) Ecology	(g) Adaptations
(d) Genetics	(h) Genetic Engineering

May be repeated for credit.

Omnibus Courses: See pages 50–51 for omnibus courses that may be offered.



College of Architecture and Environmental Design

John Meunier, M.Arch.
Dean

Purpose

The practice of architecture and environmental design is the culturally responsible shaping of our environment from the scale of the cities we live in, to the buildings and interiors we inhabit, to the artifacts and products we use. What we design must be durable, useful, beautiful, appropriate to its context, and must not be a waste of resources, energy, and materials. Designing our environment is an art, a technology, and a social science that has a history as long as human culture. The goals of the faculty include offering students an education that becomes the basis for life long growth and improvement as professionals, advancing the discipline in both theory and practice, and improving the quality of the environment by making the expertise and knowledge of the faculty available to other professionals and to the public.

Organization

Academic Organization. The college is composed of three academic units: the School of Architecture, the School of Design, and the Department of Planning. Administration of the college is the responsibility of the dean, who in turn is responsible to the president of the university through the provost.

College Facilities. With the opening of an award winning 100,000 square foot expansion to the existing building in 1989, all the college's programs are now housed in a single complex. Facilities include: the Architecture and Environmental Design Library; computer laboratories; design studios; the Gallery of Design; lecture and seminar rooms; the Media Center; offices for faculty, administration, and student organizations; the shop; the slide collection; and technology laboratories. The bridge between the original building and the expansion places the college's review and display space at the heart of the complex.

The Architecture and Environmental Design Library. As a branch of the University Library, the Architecture and Environmental Design Library provides easy access to books, periodicals, and reference materials for students, faculty and the professional community. The collection includes the Howe Architecture Library, with more than 26,000 volumes, and special research collections on the work of Paolo Soleri and Frank Lloyd Wright.

Gallery of Design. The Gallery of Design is one of eight university galleries and museums. It provides space for traveling exhibitions and exhibitions of student and faculty work

Special Facilities. College programs are supplemented by several kinds of special laboratories. New spaces include: the computer aided design and graphics lab, the high bay research lab, the lighting lab, the solar research lab, the solar roofdeck work area, an extensive shop equipped to handle wood, plastic, and metal, the Material Resource Library, and space for the college's community outreach activities and programs of the Center for Design Excellence. The college's photographic lab and darkroom provide high quality equipment and space for research projects. The Media Center includes traditional graphics and audiovisual equipment as well as portable gear The slide collection, with more than 75,000 images, is available for instructional use, and the college maintains an array of materials testing equipment The college is also home to a computer site managed by Computing and Network Consulting Services.

Admission

Lower-Division Programs. A new or transfer student who has been admitted to the university and has selected a college major is admitted to the lower division program of his or her choice. A separate application procedure is required for entry to upper division programs and graduate programs. Acceptance into lower-division programs does not guarantee acceptance to upper division programs.

Transfer Credits. While the university accepts credits transferred from other accredited institutions, transfer credits are not applied to specific degree programs until reviewed and accepted by the appropriate academic units. Transfer course work must be equivalent in both content and level of offering. In addition, a review of samples of work (portfolio of work) from previous studio classes is required. Change of major transfers into the College of Architecture and Environmental Design, or one of its program areas, requires a minimum 2.50 cumulative GPA.

Upper-Division Programs. Admission to upper-division programs is competitive. Consult requirements for each major for details. Students applying to more than one program must make a separate application to each and must submit separate portfolios. Students not enrolled at ASU when they apply to upper division programs must also make a separate application to the university. Students not admitted to the upper division are not dismissed from the university and may reapply or may transfer to other programs. Students who plan to reapply should contact the college academic advisor. Transfers into upper division programs are considered only if vacancies occur, and such transfers are limited to students with equivalent course work who are competitive with continuing students. Acceptance into upper division programs requires a TOEPL score of 550 or higher for international students.

Graduate Programs. For admission to the graduate programs in the College of Architecture and Environmental Design, see requirements and procedures under the respective academic units in this catalog and in the *Graduate Catalog*. Students must make separate applications and be admitted by both the Graduate College and the academic unit administering the degree program selected.

Advisement

While the college and its academic units provide academic advising, *it is ultimately the responsibility of each student to fulfill academic and program requirements.* Advising and recordkeeping for lower division programs are the responsibility of the college academic advisor. Records for upper division program students are kept in the appropriate academic units, and advising is by the faculty and the head of the academic unit. General career advising is available from all faculty members. Administration of program requirements is the responsibility of the head of the academic unit and the dean.

Appeals Procedures. Academic appeals and requests for variances are typically made first to the student's advisor and then, if necessary, to the head of the appropriate academic unit, the College Standards Committee, and, finally, the dean. A student who feels he or she has been unjustly treated in academic or other matters relating to his or her career as a student may contact the college academic advisor or may take the grievance to the college ombudsperson.

Degrees

Undergraduate. The college offers curricula leading to four- or five-year undergraduate degrees: the Bachelor of Science in Design and the Bachelor of Science in Planning. A student selects one of the following majors within the respective academic units.

MAJOR FIELD	DEGREE	SCHOOL/DEPARTMENT
Architectural Studies	B.S.D.	Architecture
Design Science	B.S.D.	Design
Housing and Urban Development	B.S.D.	Planning
Industrial Design	B.S.D.	Design
Interior Design	B.S D.	Design
Urban Planning	B.S.P	Planning

Each undergraduate program is divided into a lower division and an upper division program. Completion of a lower-division program does not guarantee advancement to an upper-division pro gram.

Graduate. The Graduate College awards the master's degree to candidates who have success fully completed graduate programs offered in this college. Four degrees are offered: the profes sional degree Master of Architecture (M.Arch.), the professional degree Master of Environmental Planning (M.E.P.), the Master of Science (M.S.) degree with a major in Building Design, and the Master of Science in Design with majors in In dustrial Design and Interior Design.

Degree Requirements

Students seeking the Bachelor of Science in De sign degree must satisfactorily complete a cur riculum of a minimum of 132 to 153 semester hours, depending on the major. The Bachelor of Science in Planning requires 131 or 134 semester hours, depending on the concentration These re quirements include six semester hours for English proficiency and meet or exceed the University General Studies requirements.

Major in:	*Seme ter H urs*
Architectural Studies	134 or 135
Design Science	132 or 153
Housing and Urban Development	134
Industrial Design	132
Interior Design	153
Urban Planning	131 or 134

Dean's List. Undergraduate students who earn 12 or more graded semester hours ("A," "B," "C," "D," or "E") during a semester in residence at ASU with a GPA of 3.50 or better are eligible for the Dean's List. A notation of achieving the distinction of being listed on the Dean's List ap pears on the final grade report for that semester.

Special Honors at Graduation. At the time of graduation, students with academic distinction are awarded the respective designation *cum laude, magna cum laude,* or *summa cum laude.* Also see university requirements for graduation with academic recognition, pages 90–91.

General Studies Requirements

Each curriculum offered by the college meets or exceeds the University General Studies require ments. Courses are regularly reviewed to deter mine whether they meet one or more General Studies requirements. See the listing of courses, pages 62 88.

The following key to General Studies credit abbreviations applies to each curriculum offered in the college:

Key to General Studies Credit Abbreviations

L1	Literacy and Critical Inquiry Core Courses Intermediate level
L2	Literacy and Critical Inquiry Core Courses (Upper division)
N1	Numeracy Core Courses Mathematics)
N2	Numeracy Core Courses (Statistics and Quantitative Reasoning
N3	Numeracy Core Courses (Computer Applications
HU	Humanities and Fine Arts Core Courses
SB	Social and Behavioral Sciences Core Courses
S1	Natural Sciences Core Courses (Introductory)
S2	Natural Sciences Core Courses (Additional Courses
G	Global Awareness Courses
H	Historical Awareness Courses

Graduation Requirements

In addition to completing departmental degree re quirements, students must fulfill university gradu at'on requirements. Students must apply and pa a fee for a graduation requirements review.

Academic Standards

Lower-Division Retention Standards. A student in one of the college's lower division pro grams is placed on probation when he or she fails to maintain a cumulative GPA of 2.00. Students on probation must observe rules or limitations the college Standards Committee imposes on their probation as a condition of retention. If, after one semester on probation, the overall GPA is not a least a 2 00 and the conditions of probation have not been met, the student is disqualified for a minimum of two full academic semesters. Ap peals may be made to the college Standards Com mittee. Also see university retention standards pages 55 56.

Upper-Division Retention Standards. Stu dents in upper division programs are placed on probation when they fail to meet *any* of the fol lowing requirements:

1. failure, incomplete, or withdrawal from any required course;
2. a semester GPA below 3.00;

3. a grade of "D" or "E" in a design studio or a design laboratory; or
4. violation of the college *Code of Student Responsibilities* or any admission agreement.

Students on probation must observe rules or limitations that the Standards Committees or an academic unit places on their probation as a condition of continuation. Students are removed from a program if:

1. after one semester on probation, the requirements imposed are not met, the probationary semester GPA is below 3.00, or the cumulative GPA is not above 2.00;
2. failures or withdrawals in required courses are not resolved at the next offering of the course;
3. failures or withdrawals from required sequential courses are not resolved; or
4. incompletes in required sequential courses are not completed before the first day of class of the next semester.

A student removed from a program is not guaranteed reinstatement in the program even if probation requirements or requirements placed on readmission are fulfilled. Appeals may be made first to the appropriate academic unit and, if necessary, to the college Standards and Appeals Committee. Also see university retention standards, pages 55-56.

Incompletes. It is the student's responsibility to contact the instructor regarding the process of requesting and fulfilling an incomplete. Tardiness in contacting the instructor may result in a failing grade. Students must obtain an official "Request for Grade of Incomplete" form from their academic units. The completed form must include a justification, a listing of requirements that have not been fulfilled, and a proposed schedule of completion. The instructor reviews the request, proposes modifications if necessary, and submits a copy of the request to the appropriate program head (for upper-division students) or the college academic advisor (for lower division students). An incomplete in an upper-division course that is a prerequisite for sequential courses automatically places the student on probation and denies enrollment in subsequent courses. Also see university requirements on incompletes, pages 52-53.

Withdrawals. University withdrawal regulations apply to lower division courses. In addition, because the college's upper-division curricula are modular and sequential and space in the programs is limited, a student is expected to progress through the curriculum with his or her class. Withdrawal from a required upper division course automatically places a student on probation. Withdrawal from a required upper division course in a required sequence automatically removes the student from the program beginning the subsequent semester. Also see university requirements on withdrawals, pages 53-54.

Credit/No Credit. The only courses accepted toward graduation with a grade of pass/fail or credit/no credit are transfer freshman composition courses, internships, and field studies.

Foreign Study. The College of Architecture and Environmental Design maintains active communications with several foreign institutions offering professional course work similar to the programs of the college. This opportunity is available for students who wish to pursue professional studies at a foreign institution in lieu of resident course work for up to a maximum of one academic year. Any interested student is encouraged to inform the head of his or her academic unit at the earliest possible date of any intentions for foreign study.

Exchange programs currently exist with the Universitat Stuttgart, Germany, and the Universidad Autónoma de Guadalajara, Mexico. A foreign study program in London and summer off-campus courses are offered by the School of Architecture. The Department of Planning offers a summer landscape planning course in Europe.

Students are also encouraged to consider foreign travel for either a semester or an entire academic year. A leave of absence must be requested for foreign study and foreign travel. Each academic unit reserves the right to evaluate the content and the student's competency in each of the courses completed at foreign institutions.

Internships. Upper-division students in the college are required to complete an internship program during the summer, normally between the third and fourth year of study.

Student Responsibilities

Code of Student Responsibility. The purpose of this code is to promulgate standards of conduct for students of the College of Architecture and Environmental Design and to establish procedures for reviewing violations. Students are expected to support and maintain the highest professional standards with regard to their individual conduct and their personal and common environ

ments in the college. Copies of the *Code of Student Responsibilities* are available from the Office of the Dean and the college academic advisor.

Attendance. Attendance is expected at all classes, laboratories, and seminars and is a criterion for evaluating performance. Absences and missing work due to absences may result in failure of a course or academic probation. A student may not be excused from attending a class except for medical reasons or other serious personal conditions beyond his or her control. Requests for special consideration must be submitted in writing to the instructor. If accepted, a student may be allowed to take a late or special examination or submit missing work. Tardiness in contacting the instructor is cause for denying acceptance. Also see university policy regarding religious holidays, page 3.

Employment. It is difficult for students in professional programs to carry part-time employment while in school. Acceptance to any of the college's upper division programs presumes a commitment of a minimum of eight hours a day for professional studies. Prior work experience is not a requirement for admission to upper-division programs.

Retention of Student Work. The college reserves the right to retain any or all projects or work submitted to meet course requirements for the college's future instructional, publication, and exhibition use.

Student Leave of Absence. Upper-division students who withdraw from classes or do not continue sequentially in enrollment must request both a leave of absence and readmission in writing from the head of the appropriate academic unit. Leaves of absence are for one year increments and may be approved for personal reasons, travel, work, or additional study in other disciplines. Students on leave must make their written request for readmission before May 1 for the fall semester of the year of return or before November 1 for the spring semester so that a space may be reserved. Failure to request a leave of absence may result in removal from the program.

Special Programs

The college and its academic units regularly sponsor lecture series symposia and exhibits. In addition, there are regional and national meetings of educators and professionals that students and faculty attend. Academic units sponsor student awards programs and regularly invite professionals and critics to student reviews of student projects. The college also participates with the University Honors College and offers courses accepted in that college.

General Information

Accreditation. The program in architecture leads to the Master of Architecture degree, which is accredited by the National Architecture Accrediting Board The Bachelor of Science in Design with a major in Interior Design is accredited by the Foundation of Interior Design Education and Research. The following programs maintain affiliations with the following accrediting agencies: Planning—American Planning Association, American Society of Landscape Architects; Industrial Design Industrial Design Society of America.

College of Architecture and Environmental Design Alumni Association. The College Alumni Association encourages graduates to contribute to the college by acting as liaisons among the college community, students, and practicing professionals. The college also calls on the members of the Architecture Guild of Arizona State, the Arizona Design Institute, the Council for Design Excellence, and the Planning Advisory Committee for advice and to promote the goals of the college.

Council for Design Excellence. The Council for Design Excellence has been created to consolidate a partnership between the College of Architecture and Environmental Design and key community leaders who share a vital interest in the development of high quality in the built environment of the Phoenix metropolitan area. By joining together professionals, business and civic leaders, students, and faculty in a common pursuit of design excellence, the council seeks to make a profound difference in the quality of life.

Affiliations. The College of Architecture and Environmental Design maintains active affiliations with the following organizations:

Architecture—Arizona Society of Architects, the Central Arizona and the Rio Salado Chapters of the American Institute of Architects, and the Association of Collegiate Schools of Architecture;

Industrial Design the Industrial Designers Society of America;

Interior Design the American Society of Interior Designers, the Institute of Business Designers, and the Interior Design Educators Council;

Planning the American Planning Association, the American Society of Landscape Architects,

the Association of Collegiate Schools of Planning, and the Council of Educators in Landscape Architecture.

Student Professional Associations. The purpose of the student associations is to assist students with the transition into professional life and to acquaint them with the profession relating to their program of study. These include the following associations.

- American Institute of Architecture Students
- College of Architecture and Environmental Design Pre Studies Organization
- Student Association of Interior Designers
- Student Chapter American Planning Association
- Student Chapter American Society of Landscape Architects
- Student Chapter/Industrial Designers Society of America

Application to Upper-Division Programs

Upper-Division Application Procedures. Students should write to the college academic advisor for the application form well in advance of the application deadline. For additional information on portfolios, ask for a copy of the *Portfolio Seminar* brochure from the college academic advisor.

Upper-Division Application Deadlines. *April 15, 1992.* Portfolio and application documents are due in the school or department office by 4:00 P.M.

June 12, 1992. If the spring 1992 semester includes transfer course work (i.e., course work taken at an institution other than ASU), a student must submit his or her transcripts to the school or department no later than June 12. These transcripts may be unofficial copies. A second set of official transcripts must be sent to the university Office of Undergraduate Admissions. Application is not complete until the university receives official transcripts for transfer course work. For those transfer students whose academic term ends in June rather than May, this deadline may be extended upon the written request of the applicant.

July 1, 1992. Acceptance notices are mailed no later than July 1.

Return of Letter of Acceptance. A signed receipt of acceptance of admission must be received by the school or department by the date indicated on the Notice of Acceptance. Alternates may be accepted at a later date if space becomes available.

Matriculation. An accepted student is expected to begin his or her upper-division professional program at the beginning of the immediate fall term. There is no spring admission to the upper division.

Portfolio Format Requirements. Each applicant is responsible for obtaining the following documents and including them in the portfolio. Application materials are submitted at one time in a presentation binder (portfolio) with plastic sleeves (8.5 x 11 format only). The student's name is to be affixed to the outside. Items must appear in the following order:

Page One. The application form should be completely filled out with the first page visible. Application forms are available from the college academic advising office.

Page Two. The second page of the application should be visible.

Page Three. All high school transcripts should be put into one sleeve.

Page Four. All college transcripts for both ASU and transfer work should be included through the fall 1991 semester. Copies are acceptable. The academic advisor forwards 1992 ASU transcripts. (Those wishing to transfer spring semester 1992 work are responsible for submitting these transcripts by June 12 so that they may be added to their portfolios. The student is also responsible for getting an official transfer transcript sent directly to the Office of Undergraduate Admissions.)

Page Five. Evidence of admission (or readmission) to ASU. This may be a copy of the ASU Certificate of Admission or a Student Information System printout showing enrollment status, obtained at a registrar's site.

Following Pages (usually 10–20 sheets). Sufficient examples of studio and laboratory work to show the depth of the student's design and drawing skills should be included. The student should also include freehand and hardline drawings and examples of two- and three-dimensional design and graphics, a concise caption for each item that explains the work, and a list of other pertinent information as applicable and the names of other team members, the length of the project, and course and project descriptions.

Students are encouraged to include additional materials, written or pictorial, that provide additional evidence of skills and abilities and of the aptitude and commitment to the major. When any work submitted is not completely original,

the source must be given. When work is of a team nature, the applicant's role should be clearly indicated. Original examples or slides must not be submitted. All examples must be photographs or other reproduction graphic media

Return of Portfolios. Application documents (pages one through five remain the property of the College of Architecture and Environmental Design However, the remaining portfolio is returned after the admissions review, provided the applicant encloses a self addressed return mailer with sufficient prepaid postage Portfolios may be claimed in person after July 1, 1991. If the applicant provides written permission, another person may claim the portfolio. After one year, unclaimed portfolios are discarded. While care is taken in handling the portfolios, no liability for lost or damaged materials is assumed by the college, school, or department.

School of Architecture

Michael J. Underhill, M.Arch., Director

REGENTS' PROFESSOR:
COOK
PROFESSORS:
UNDERHILL AED 162D BOYLE ER BES, McSHEFFREY, MEUNIER, PETERSON RAPP SCHLUNTZ
ASSOCIATE PROFESSORS:
CHR STENSEN, EL D ASTY, LOOPE, McG NTY Mc NTOSH, SCHEATZLE, SHEYDAYI, ZYGAS
ASSISTANT PROFESSORS:
BERTELSEN BUR AN F FIELD, F NDLEY, HARDIN, UNDERWOOD WOOLSEY
PROFESSORS EMERITI:
ELLNER H NSHAW JAKOB OL VER RUMMEL STRAUB, WH FFEN

Purpose

The architecture program at Arizona State University offers an integrated curriculum of professional courses and focuses on the design laboratory. The program reflects an awareness of the complex factors affecting the quality of the built environment It seeks through scholarship, teaching, research, design, and community service to develop the discipline and the knowledge necessary to address the important environmental and design issues faced by society.

In addition to developing knowledge and skills in architectural design, building technology, and professional practice, students are expected to select electives to achieve an emphasis in one of several areas, including solar and energy-conscious design, computer aided architectural design, architectural administration, urban design, and building technology.

Organization

The School of Architecture's program is organized by the faculty under the direction and administration of the director and standing committees of the faculty.

Degrees and Majors

The faculty of the School of Architecture offer three degrees: the Bachelor of Science in Design with a major in Architectural Studies, the Master of Architecture, and the Master of Science with a major in Building Design.

The six year program in architecture culminates with the professional degree Master of Architecture, which is accredited by the National Architectural Accrediting Board.

The professional level program in architecture consists of the final four years of course work, i.e , the final two years of the Bachelor of Science in Design degree and the two years required to complete the Master of Architecture degree

In cooperation with the College of Business, a dual degree program, Master of Architecture/Master of Business Administration, has been established. Students contemplating dual matriculation are advised to select electives appropriate to this program at the undergraduate level.

The Master of Science degree with a major in Building Design provides opportunities for advanced and specialized studies and research in building science. Concentrations include computer aided design, energy performance of buildings, and facilities development and management. Students entering this program typically have the professional Bachelor of Architecture or Master of Architecture degrees or undergraduate degrees in areas such as physics, engineering, or design. For particulars, see the *Graduate Catalog*

Admission

Lower-Division Program. New and transfer students who have been admitted to the university and who have selected Architectural Studies are admitted to the lower division architecture program without separate application to the School

of Architecture. Completion of lower division requirements does not assure acceptance to the upper division professional program.

Transfer credits for the lower division program are reviewed by the college faculty. To be admissible to this curriculum, transfer courses must be equivalent in both content and level of offering. A review of samples of work is required for studio classes. Consult the college academic advisor for an appointment.

Entering lower-division students who are not prepared to enroll in some of the required courses are required to complete additional university course work. These additional prerequisite courses do not apply to the Bachelor of Science in Design degree requirements.

Upper-Division Professional Program. Admission to the upper-division, professional level program is competitive and limited by available resources. Admission is awarded to those applicants demonstrating the highest promise for professional success, including evidence of ability and prospect for future significant public service.

Transfer students who have completed the equivalent required lower division course work may apply to the upper division program. Prior attendance at ASU is not required for application to the upper division program. Applicants who already hold a bachelor's degree in another field may be accepted to the upper division program if they have accomplished the lower division requirements.

To be eligible for application to the upper-division program, the following is required:

1. admission to ASU (note that application and admission to ASU is separate from application and admission to the upper-division program);
2. completion of lower division requirements (a minimum of 63 hours) or equivalents as approved by the college academic advisor and the faculty of the school;
3. a minimum university cumulative GPA of 3.00 as well as a 3.00 GPA based only on the required lower-division courses or equivalents; and
4. submission of a portfolio (for detailed information about this requirement, see pages 209 210).

In an unusual circumstance, when the admission standard deficiency is slight, written evidence of extenuating circumstances is convincing, and promise for success is evident, a student may be granted admission to the upper division on a *provisional* basis.

Students not admitted to the upper division program are not dismissed from the school and may reapply or may transfer to other programs. Students who intend to reapply should meet with the college academic advisor.

Applications for transfer into the upper-division professional program are considered only if vacancies occur Transfer applicants must demonstrate that equivalent course work has been completed, and applicants must be academically competitive with continuing students.

Students with the four year Bachelor of Science in Design degree (with a major in Architectural Studies or equivalent degree from another school that offers an accredited professional degree in architecture) should apply directly to the graduate program.

See "Application to Upper Division Programs," page 209.

Advisement

Advising for the lower division curriculum is through the college academic advisor. Advising for upper division students is by assigned faculty advisors.

Degree Requirements

The Bachelor of Science in Design degree with a major in Architectural Studies requires a minimum of 134 hours of course work. Most lower division students pursue option A; however, those who intend eventually to seek an advanced degree in either engineering or building science are encouraged to fulfill the requirements outlined in option B.

The accredited professional degree Master of Architecture requires an additional 56 hours of approved graduate level course work. For detailed information, consult the *Graduate Catalog*.

Bachelor of Science in Design
Major in Architectural Studies
Lower-Division Requirements
Option A

		Semester Hours
English (6)		
ENG 101	First Year Composition or ENG 105 if qualified	3
ENG 102	First Year Composition or HU elective if ENG 105	3
Literacy and Critical Inquiry (3)		
COM 225	Public Speaking or approved communication substitute	3

Numeracy (12

CSE	181	Applied Problem Solving with BASIC[1]	3
		or CSE 183	
MAT	119	Finite Mathematics[2]	3
		or CSE 180	
MAT	210	Brief Calculus[2]	3
		or advanced calculus substitute	
STP	226	Elements of Statistics[2]	3
		or PSY 230, QBA 221, SOC 390	

Humanities/Fine Arts (13)

APH	100	Introduction to Environmental Design I[1]	2
APH	101	Introduction to Environmental Design II[2]	2
Approved Humanities/Fine Arts Electives[1]			9

Social Behavioral Sciences 9

ECN	112	Microeconomic Principles[1]	3
		or ECN 111 Macroeconomic Principles	
Approved Social/Behavioral Science Electives[1]			6

Natural Sciences 8

PHY	111	General Physics[2]	3
PHY	112	General Physics[2]	3
PHY	113	General Physics Laboratory[1]	1
PHY	114	General Physics Laboratory[2]	1

Studio Courses[3] 12

ADE	221	Design Fundamentals I	3
ADE	222	Design Fundamentals II	3
AVC	141	Design Graphics	2
AVC	160	Freehand Perspective Drawing I	2
AVC	161	Freehand Perspective Drawing II	2
		Lower Division Minimum Total	63

[1] Transfer credits are reviewed by the college and evaluated for admissibility to this curriculum. To be admissible, transfer courses must be equivalent in both content and level of offering.

[2] This course satisfies a General Studies requirement. See the course description for specific requirement(s) the course fulfills.

[3] Portfolio review is required for transfer studio work. See the college academic advisor for an appointment.

Bachelor of Science in Design
Major in Architectural Studies
Lower-Division Requirements
Option B

			Semester Hours
English (6			
ENG	101	First Year Composition	3
		or ENG 105 if qualified	
ENG	102	First Year Composition	3
		or Humanities/Fine Arts elective if ENG 105	

Literacy and Critical Inquiry 3)

COM	225	Public Speaking[2]	3
		or approved communication substitute	

Numeracy 19

ECE	105	Introduction to Languages of Engineering[3]	3
ECE	106	Introduction to Computer Aided Engineering[2]	3
MAT	274	Elementary Differential Equations	3
MAT	29	Calculus I[2]	5
MAT	291	Calculus II	5

Option B Engineering Requirements 3 in lower division

ECE	210	Engineering Mechanics I: Statics	3
ECE	312	Engineering Mechanics II: Dynamics[4]	3
ECE	313	Introduction to Deformable Solids[4]	3
ECE	383	Probability and Statistics for Engineers[4]	2

Humanities/Fine Arts 7

APH	100	Introduction to Environmental Design I	2
APH	101	Introduction to Environmental Design II[1]	2
Approved Humanities and Fine Arts Electives[1]			3

Social Behavioral Sciences (6)

ECN	112	Microeconomic Principles[2]	3
		or ECN 111 Macroeconomic Principles (3 or approved business course	
Approved Social and Behavioral Sciences Elective[2]			3

Natural Sciences 8

PHY	121	University Physics I: Mechanics[2]	3
PHY	122	University Physics Laboratory I[2]	1
PHY	131	University Physics II. Electricity and Magnetism[1]	3
PHY	132	University Physics Laboratory II[2]	1

Studio Courses 12

ADE	221	Design Fundamentals I	3
ADE	222	Design Fundamentals II	3
AVC	141	Design Graphics	2
AVC	160	Freehand Perspective Drawing I	2
AVC	161	Freehand Perspective Drawing II	2
		Lower Division Minimum Total	66

Transfer credits are reviewed by the college and evaluated for admissibility to this curriculum. To be admissible, transfer courses must be equivalent in both content and level of offering.

This course satisfies a General Studies requirement. See the course description for specific requirement(s) the course fulfills.

[3] See prerequisites for ECE 105. These may be completed in high school

These courses may be taken at the upper division level as approved electives and are not required before admission to the upper-division program. However, conflicts in course time can be avoided by taking them before applying to the upper division.

[3] Portfolio review is required for transfer studio work. See the college academic advisor for an appointment

Bachelor of Science in Design
Major in Architectural Studies
Upper-Division
Professional Program Requirements

Junior Year

			Semester Hours
Fall (17)			
ADE	321	Architectural Design/Process Determinants	3
ANP	331	Environmental Analysis	3
APH	313	History of Western Architecture I[1, 2]	3
ATE	353	Architectural Construction I	3
ATE	361	Building Structures I[3]	3
AVC	301	Architectural Communication I	2
Spring (17)			
ADE	322	Architectural Design/Environmental Determinants	5
ANP	431	Architectural Programming Methods[2]	3
APH	314	History of Western Architecture II[1, 2]	3
ATE	351	Environmental Control Systems I	3
ATE	362	Building Structures II[3]	3
Summer 3			
ARP	484	Clinical Internship	3

Senior Year

Fall (17)			
ADE	421	Architectural Design/Human and Behavioral Determinants	5
APH	446	20th Century Architecture I[2]	3
ATE	452	Environmental Control Systems II	3
ATE	461	Building Structures III[3]	3
Approved Professional Emphasis Elective			3
Spring (17)			
ADE	422	Architectural Design Societal Determinants	5
APH	447	20th Century Architecture II	3
ATE	451	Architectural Construction II	3
ATE	462	Building Structures IV[3]	3
Approved Professional Emphasis Elective			3
Upper Division Total			71
B.S.D. Minimum Total			134

[1] These courses may be completed before admission to the upper division. If already completed, a student may substitute an approved professional emphasis elective.

[2] This course satisfies a General Studies requirement. See the course description for specific requirement(s) the course fulfills.

[3] Approved substitute courses are accepted from the College of Engineering and Applied Sciences for option B students

General Information

Professional Emphasis Electives. A student, with the approval of his or her advisor, selects required upper division professional emphasis electives from the following areas:

1. architectural office management (also courses in the College of Business);
2. construction technology and administration (also courses in the Department of Construction);
3. landscape architecture (also courses in the Departments of Planning, Botany, and the School of Agribusiness and Environmental Resources);
4. structural systems design (also courses in the College of Engineering and Applied Sciences);
5. architectural history, theory, or preservation (also courses in art history in the College of Fine Arts or philosophy in the College of Liberal Arts and Sciences);
6. environmental research, analysis, and programming (also courses in the Departments of Sociology and Psychology);
7. solar design and technology (also courses in the College of Engineering and Applied Sciences);
8. energy conservation and adaptive reuse (also courses in the Department of Planning);
9. urban and regional planning, environmental psychology, and sociology; interior architecture (also courses in the School of Design);
10. computer aided design also courses in the Department of Computer Science and Engineering), and
11. advanced architectural communication

General Studies Requirements

The architecture curriculum exceeds the General Studies requirements of the university. For more information about University General Studies requirements, see pages 58–61. Specific courses in the curriculum that fulfill the required General Studies distribution requirements are indicated with a letter and number code. See page 61 for the key

Courses

Subject matter within the school is categorized in the following instructional areas.

Architectural Administration and Management. AAD courses focus on the organizational and management aspects of architectural practice, including management coordination, administrative procedures, ethics, legal constraints, and the economics of practice.

Architectural Design and Technology Studios. ADE courses require the synthesis of knowledge and understanding gained from other course work and develop an understanding of design theory and design skill through a series of comprehensive design projects. Students apply analytical methods, compare alternative solutions, and develop sophisticated technical and conceptual results.

Architectural Philosophy and History. APH courses develop an understanding of architecture as both a determinant and a consequence of culture, technology, needs, and behavior in the past and present. Studies are concerned with the theory as well as the rationale behind methods and results of design and construction. Case studies are both American and international.

Architectural Technology. ATE courses develop knowledge of the technical determinants, resources, and processes of architecture. These studies focus on the science and technology of design and construction, including materials, building systems, acoustics, lighting, structural systems, environmental control systems, computer applications to design and technology, and both passive and active solar systems. Emphasis is on measurable and quantifiable aspects.

Environmental Analysis and Programming. ANP courses develop the ability to analyze and program environmental and human factors as preconditions for architectural design using existing and emerging methods of evaluation and analysis.

Architectural Communication. AVC courses develop the student's understanding of communication theory as it applies to architectural design and practice as well as skills in drawing, graphics, photography, presentation design, and the design process.

Architecture Professional Studies. ARP courses provide students with residency and off campus opportunities, educational experience in group and individual studies relative to specific student interests, and faculty expertise, including summer internships and field trips.

Those courses that are required in the upper division and graduate levels of the professional program are not open to nonmajors or those not admitted to the upper division program

ARCHITECTURAL ADMINISTRATION AND MANAGEMENT

AAD 551 Architectural Management I. (3 F
Organizational human performance and market influences on the architecture firm and its projects. Readings case studies and analysis of managerial problems and solutions Lecture discussion. Prerequisite AAD 560 or instructor approval

552 Architectural Management II. 3 S
Elements of project and financial management in architectural firms Decision modeling, resource planning and control Readings and case studies Lecture discussion Prerequisite AAD 560 or instructor approval

553 Construction Contract Administration I. 2 F
Construction contract administration, including budget control, scheduling cash flow, changes and claims, and monitoring systems for traditional fast track and design-build methods 2 hours lecture 3 hours abincluding field trips Prerequisite AAD 560

554 Construction Contract Administration II. (3 S
Advanced topics and problems in construction contract administration Prerequisite AAD 553 or instructor approval

555 Architect as Developer. 3 F S
Development building real estate construction funding and acquisition and the sources for capital. Prerequisite instructor approval.

558 Specifications and Cost Analysis. (3 S
Coordination of working drawings construction specifications, and cost estimates Emphasis on methods office procedures contract conditions bonds and bidding procedures Prerequisite graduate evening standing or instructor approval

560 Professional Practice I. 3 F
Professional practice issues including legal requirements ethics financial and marketing mechanisms management concentrations and new developments in practice Prerequisite admission to M Arch program or instructor approval.

Omnibus Courses: See pages 50 51 for omnibus courses that may be offered

ARCHITECTURAL DESIGN AND TECHNOLOGY STUDIOS

ADE 221 Design Fundamentals I. 3) F
Exercises in basic visual organization: includes design vocabulary principles of 2 and 3 dimensional composition color and aesthetic reactions to design 1 hour lecture 6 hours studio Prerequisite major in college

222 Design Fundamentals II. 3) S
Application of design fundamentals to environmental design problems introduces human scale performance criteria, functional and aesthetic spatial organization, and movement. 1 hour lecture 6 hours studio Prerequisites ADE 221 AVC 141, 160 major in college

321 Architectural Design Process Determinants. 3 F
Fundamentals of architectural design problem solving techniques and the design process. Investigation analysis, synthesis and development of design projects. Lecture, studio and field trips. Prerequisite. Instructor approval

322 Architectural Design Environmental Determinants. 5 S
Building and site design in response to site climate, and other environmental determinants. Housing and other building types. Lecture studio and field trips. Prerequisite: ADE 321.

421 Architectural Design Human and Behavioral Determinants. 5) F
Emphasis on the design of community facilities user needs, and activities. People and their behavior as a primary architectural determinant. Lecture, studio, and field trips. Prerequisites: ADE 322, ARP 484

422 Architectural Design Societal Determinants. 5 S
Comprehensive development of multibuilding complexes relating to community cultural and urban services. Emphasis on societal needs and expectations. Lecture studio and field trips. Prerequisite ADE 421

521 Advanced Architectural Design I. 5 F
Building design within an urban context. Lecture, studio, and field trips. Prerequisite ADE 422 or approved equivalent

522 Advanced Architectural Design II. 5 S
Building design that integrates major building systems in large structures and complexes. Lecture studio and field trips. Prerequisite ADE 521

621 Advanced Architectural Design III. 5 F
Selected topics in complex buildings. Lecture studio and field trips. Prerequisites ADE 522. Instructor approval.

622 Advanced Architectural Design IV. 5 S
Individual student-initiated final studio project emphasizing a final synthesis of major architectural design determinants. Studio. Prerequisites ADE 621 or equivalent. Instructor approval

661 Climatic and Solar Design. 4 F
Laboratory and field experience in architectural synthesis emphasizing climatic criteria and analysis with emphasis on appropriate technology and passive thermal systems. Prerequisite first professional degree or instructor approval.

662 Energy Efficient Design and Planning. 4 S
Laboratory and field experience in energy efficient design emphasizing solar energy and related renewables in urban and institutional complexes for comfort prototypes. Prerequisite ADE 661.

Omnibus Courses: See pages 50 51 for omnibus courses that may be offered

ENVIRONMENTAL ANALYSIS AND PROGRAMMING

ANP 331 Environmental Analysis. 3 F
Analysis of natural and human environmental determinants as the basis of the programming and design of the built environment. Emphasis on site and climate analysis and landscape space theory. Prerequisite professional level standing.

431 Architectural Programming Methods. 3 S
Theory and methods of architectural programming including determinants of architecture information gathering techniques, program preparation, and methods of evaluation. Prerequisite professional level standing *[Satisfies General Studies Requirement L2]*

433 Building Codes and Ordinances. 3 N
Analysis of national state, and local building codes and ordinances relative to their impact on architectural programming design and construction documentation

442 Site Planning Principles and Analysis. 3 S
Effects of topography, climate energy, zoning, and landscaping upon design development of external spaces. Programming and analysis and integration of architectural design to the site and site to the region.

475 Computer Programming in Architecture. 3) F, S
Computer programming for architectural problems and applications. Lecture lab. Prerequisite CSE 183 or equivalent

477 Computer Applications to Design Problems. 3) F
Examination of general microcomputer software in solving architectural design problems. Emphasis on the logic of problem formulation. Lecture, lab. Prerequisite. Instructor approval

530 Computer Graphics in Architecture. 3 N
Fundamentals of computer graphics programming in architecture including graphics hardware device independent packages 2 and 3 dimensional transformations and data structures. 2 hours lecture, 3 hours lab. Prerequisite ANP 475 or instructor approval

561 Architectural Information Processing Systems. 3 S
Applications of information processing systems to architectural problems. Analysis of computing tools with respect to assumptions and theories. Lecture lab. Prerequisites: graduate standing. Instructor approval

562 Information Systems for Facilities Management. 3 F
Introduction to database design and implementation. Assessment of facility management problems from information system points of view. Seminar lab. Prerequisites: ANP 477 or 561 graduate standing

576 Community Housing. 3 F
History practices trends, and forms of housing; includes growth of public programs national and local programs zoning law housing distribution planning principles and policies design review standards, and private development practice

577 Housing Environments. 3 S
Contemporary housing environments housing types and lifestyles as determined by user preference density, development and property standards, cost, community and privacy security identity movement, and the need for open space.

581 Urban Structure and Design. 3 F
The nature and dynamics of urbanization and its relation ship to architecture and urban design including growth, decay, social organization planning processes and visual perception. Case studies Prerequisite professional level standing.

681 Professional Seminar: Societal Influences on Architectural Practice. 2 F S
Examination of societal issues confronting the practice of architecture. Seminar. Prerequisite graduate standing or instructor approval

Omnibus Courses: See pages 50 51 for omnibus courses that may be offered

ARCHITECTURAL PHILOSOPHY AND HISTORY

APH 100 Introduction to Environmental Design I. 2 F S
Survey of environmenta des gn: nc udes histor c ex amples and the theoret ca soc a techn ca and env ron menta forces that shape them *[Sat sfies Genera Stud es Requirements HU G H]*

101 Introduction to Environmental Design II. 2 F S
Survey of env ronmenta des gn ssues respons b t es and d rect ons. *[Satisf es Genera Stud es Requ rements HU, H]*

300 World Architecture I/Western Cultures. 3 F
H stor ca and contemporary bu t env ronments of West ern c v zat ons Med terranean Europe, and the Amer cas as man festat ons of cu tura h story and responses to env ronmenta determ nants Non Arch tecture majors on y *[Sat sf es Genera Stud es Requ rements G H]*

301 World Architecture II Eastern Cultures. 3 S
H stor ca and contemporary bu t env ronments of Eastern c v zat ons M d East, Centra As a Far East and South Pac f c as man festat ons of cu tura h story and responses to env ronmenta determ nants. *[Sat sf es Genera Stud es Requ rements G H]*

304 American Architecture. 3) N
Arch tecture n the Un ted States from earl est co on a t mes to present Non Arch tecture ma ors on y *[Sat sfies General Stud es Requ rements. HU, H]*

305 Contemporary Architecture. 3 N
Europe and America from the foundat ons of the modern movement to the present. Non Arch tecture majors on y *[Satisf es Genera Studies Requirements HU G H]*

313 History of Western Architecture I. 3) F
Representat ve bu d ngs and s tes w th emphas s on the r phys ca and soc a sett ngs from ant qu ty through the Midd e Ages Prerequ s te jun or stand ng or nstructor approva *[Satisf es General Stud es Requirements HU, H]*

314 History of Western Architecture II. 3 S
Representat ve examp es of arch tecture and urban de s gn w th emphas s on the r soc a and h stor ca contexts from the M dd e Ages to the present. Prerequ s te jun or stand ng or nstructor approva *[Satisfies General Stud es Requirement H]*

348 Theory of Built Environments. 3 N
Focused study of bu lt env ronmenta forms, the r theoret ca foundat on and the r re at on to soc a processes Pre requ s te sophomore stand ng *[Sat sf es Genera Stud es Requ rement HU]*

411 History of Landscape Architecture. 3 F
The phys ca record of human att tudes toward the and Selected examp es of anc ent through contemporary and scape p ann ng and des gn

414 History of the City. 3) F
The c ty from ts ancient org ns to the present day w th emphas s on c t es of Europe and Amer ca dur ng the ast 5 centur es

441 Ancient Architecture. 3) N
Arch tecture of the anc ent Med terranean wor d w th se ect ve emphas s on major h stor ca comp exes and monumenta sites Prerequis te: APH 313 *[Sat sfies Gen eral Stud es Requ rements HU, H]*

442 Preservation Planning. 3 F
Pr nc p es and pract ces n p ann ng for preservat on con servat on and ne ghborhood redeve opment Emphas s on eva uat on of h stor c resources Off campus f e d prac t cum requ red Prerequis te instructor approva

443 Renaissance Architecture. 3 N
Se ected examp es of Rena ssance arch tecture and ur ban sm w th emphas s on the r h stor ca and cu tura set t ngs Prerequ s te: APH 314 *[Sat sfies Genera Stud es Requ rements. HU, H]*

444 Baroque Architecture. 3) N
Se ected examp es of Baroque arch tecture and urban sm w th emphas s on re at onsh ps between arch tecture and other arts. Prerequ s te: APH 314. *[Satisf es General Stud es Requ rements. HU H]*

445 19th-Century Architecture. 3 N
Arch tecture and urban sm n Europe and North Amer ca from the French Revo ut on to Art Nouveau. Emphas s on the cha enge of new mater a s and techn ques n the con text of rev ved and trad t ona arch tecture. Prerequ s te: APH 314 *[Sat sf es Genera Stud es Requ rements HU, H]*

446 20th-Century Architecture I. 3 F
Arch tecture n Europe and Amer ca from the foundat ons of the modern movement to the c m nat on of the nterna t ona sty e. Prerequ s te: major n co ege *[Satisfies Gen era Stud es Requirements: HU, G, H]*

447 20th-Century Architecture II. 3 S
Deve opments n arch tecture s nce the nternat ona sty e Prerequ s te APH 446 *[Sat sf es Genera Stud es Re qu rements HU G H]*

681 Architectural Theory. 3 N
An exam nat on of arch tectura theory Emphas s on ap p cat on of theory to pract ce Sem nar Prerequ s te n structor approva

682 Architectural Criticism. 3 N
An exam nat on of architectura cr t c sm emphas z ng spec fic methods of cr t c sm and the r app cat on for aes thet c judgment Sem nar Prerequ s te nstructor ap prova .

Omnibus Courses: See pages 50–51 for omn bus courses that may be offered

ARCHITECTURAL TECHNOLOGY

ATE 351 Environmental Control Systems I. 3 F
Arch tectura des gn mp cat ons of so ar rad at on, heat and mo sture transfer Trends n env ronmenta contro and energy consc ous des gn. Pass ve techn ques to heat coo , and ght 2 hours ecture 3 hours ab. Prerequ s te: adm ss on to upper d v s on.

353 Architectural Construction I. 3 F
Bas c mater a s and methods of arch tectura construct on for res dent al sca ed systems Inc udes effects of zon ng and code requirements Lecture ab Prerequ s te: admis s on to upper d v s on

361 Building Structures I. 3 F
Stat cs, dynam cs and strength of materia s. E ast c ty of structura mater a s proper es of sect ons e astic stress ana ys s of determ nate structures computer app cat ons Pre m nary des gn of s mp e structura systems Lecture, lab Prerequ site: adm ss on to upper d v s on

362 Building Structures II. 3 S
Analys s and des'gn of wood and masonry structural sys tems and connect ons. Latera ana ys s and des gn, ut z ng shear wa ls and d aphragms n sma structures Lec ture, ab Prerequis te ATE 361

451 Architectural Construction II. 3) F
Se ect'on and emp oyment of mater a s and systems ac cord ng to the r nature and the techn ques of the r use and bas c construction cost est mat ng procedures for arch tects. Lecture ab. Prerequ site ATE 353

452 Environmental Control Systems II. 3 S
Arch'tectura design mp cat ons of HVAC systems Heat ng and cooling oads, psychrometr cs the refr gerat on cyc e, a r water d str but on contro systems energy per formance standards, and ut ty rates 2 hours ecture, 3 hours ab and f e d tr ps Prerequ s te ATE 351

461 Building Structures III. (3 F
Ana ys s, des gn, and deta ng of stee bu d ngs and frames Latera ana ys s of sma r g d and braced frame systems Lecture, ab. Prerequ s te ATE 362

462 Building Structures IV. 3 S
Ana ys s, des gn and deta ng of concrete systems con s der ng cont nu ty mu t story frames and shear wal s, and atera ana ys s Computer app cat on us ng ex st ng pro grams Prerequ s te ATE 461

501 Introduction to Solar Energy. (3 S
Introduction to theoret ca and pract ca aspects of use of solar rad at on and nocturna coo ng for contro of bu d ng env ronments

511 Energy Environment Theory. 3 F
H storical, contemporary, and pract ca nf uences of so ar and other resource systems on the des gned env ronment architectura andscape urban and reg ona mp cat ons of resource strategies other renewab e resources

521 Solar Energy Technology. 3) F
Ut l zat on of so ar rad at on to meet the therma energy requ rements of bu ld ngs. Prerequ site MAT 290 or equ va ent

522 Desert Habitation Technology. 3) F
Ana ys s of hab tat on approaches n nontechno ogical and techno og ca soc et es ar s ng from the nature of desert areas

541 Solar Collector and Storage Design. 3) F
Fundamenta understand ng and pract ca app cat ons of so ar energy co ectors and storage to bu d ngs s empha s zed Prerequ s te ATE 521

542 Building Thermal System Simulation and Optimization. (3 S
Mathemat ca mode s of bu d ng enve ope and comfort cond t on ng systems w be deve oped to s mu ate bu d ng energy systems, opt m zat on techn ques are a so pre sented Prerequ s te ATE 541.

544 Solar Thermal Subsystem Design. 3) S
Fundamenta understand ng and pract ca app cat ons of so ar subsystems such as contro s, heat exchangers heat transfer f u ds n bui d ngs is emphas zed Prerequ s te ATE 541

550 Passive Cooling in Buildings. 3 N
Theory, c ass f cat on and eva uat on of pass ve and ow energy coo ng systems for therma comfort n bu d ngs. Prerequ s te ATE 452

551 Passive Heating. (3) F
Theory, class f cation and evaluat on of ow energy heat ng systems for therma comfort n bu d ngs Prerequ s tes ATE 452 521

552 Advanced Modeling of Passive Systems. 3) S
Advanced computer a ded eva uat on techn ques to deter m ne env ronmenta nf uence on comfort n pass ve and ow energy heated and coo ed bu d ngs Prerequis te ATE 551 or nstructor approva

553 Building Systems I. 3 F
Pr nc p es of ght ng day ght ng and acoust cs and their app cat on n the des gn of bu d ngs Prerequ s te: adm s s on to upper d v s on or nstructor approva

554 Energy Conservation in Buildings. 3 S
mpact of natura forces on the des gn of bu ld ngs empha s z ng pre des gn dec s ons and post construct'on prac t ces ead ng to m n mum energy consumpt on Invest ga t on of new energy sources Prerequ s te ATE 452.

557 Construction Documents I. 3 F
Product on of arch tectura work ng draw ngs, egal status, organ zat on ayout, s te survey p ans, sections, e eva t ons deta s schedu es and coord nation. Lecture, Lab. Prerequ s te adm ss on to upper d v s on.

558 Bioclimatic and Energy Parameters for Buildings. 3 S
Ana ys s and eva uat on techn ques for des gn synthesis of energy re ated parameters n s te, c mate, human com fort, and bu d ng program. Prerequ s te ATE 521

560 Computer-Aided Energy Analysis. (3) N
Advanced and new algor thms to ana yze environmental prob ems w th emphas s on energy performance Se ected top cs Lecture ab. Prerequ site ANP 475 or 477

562 Energy Efficient Systems Evaluation. (3 N
F e d performance data of act ve and pass ve so ar sys tems and components are compared w th fundamenta pr nc p es and formu at ons Prerequ site: ATE 521

582 Building Systems II. 3 S
Des gn of bu d ng systems nc ud ng e ectrical, plumb'ng secur ty commun cat ons, f re protect on and transporta t on. 2 hours ecture 3 hours ab, and fie d tr ps Prerequ sites ATE 452 553

588 Building Structures V. 3) F
New deve opments n h gh r se structura systems Effects of w nd and se sm c forces. Pre m nary ana ys s, des gn, and deta ng of ta bu d ngs us ng code requ rements, and computer app cat ons Lecture ab Prerequ s te: ATE 462

Omnibus Courses: See pages 50 51 for omn bus courses that may be offered

ARCHITECTURAL COMMUNICATION

AVC 141 Design Graphics. (2 F S SS
Orthograph c, para ne, axonometr c, and perspect ve pro ject on shades and shadows, and bas c descript ve ge ometry for des gners 1 hour ecture 4 hours stud o. Pre requ s te major n co ege

160 Freehand Perspective Drawing I. (2) F S, SS
Freehand perspect ve drawing methods applied to draw ng objects and nter or and exterior env ronments in l ne and tone 1 hour ecture 4 hours studio Prerequ s te ma jor n co ege.

161 Freehand Perspective Drawing II. (2 F S SS
Continuat on of AVC 160 Introduct on of co or med a, and ana yt ca and des gn draw ng exerc ses 4 hours stud o. Prerequ s'tes AVC 160 major in co ege

301 Architectural Communication I. (2) F
Basic graphic skills, drawing conventions, values, graphic symbols and lettering, sketching, and presentation vocabulary. Lecture, 2 afternoons in lab per week, and field trips. Prerequisite: admission to upper division.

410 Architectural Presentation Techniques. (3) F, S
Special techniques of graphic communications as preliminary presentation tools for the design professional. Prerequisite: AVC 301 or instructor approval.

411 Architectural Watercolor Presentation Techniques. (2) N
Introduction of architectural presentation techniques using watercolor as a primary media. Emphasis on color, composition, and technique. Prerequisite: AVC 301 or instructor approval.

444 Architectural Photography. (2–3) N
Use of photography as a means of architectural study, evaluation, and record. Introduction to 35mm camera and darkroom techniques. Lecture, lab. Prerequisite: instructor approval.

Omnibus Courses: See pages 50–51 for omnibus courses that may be offered.

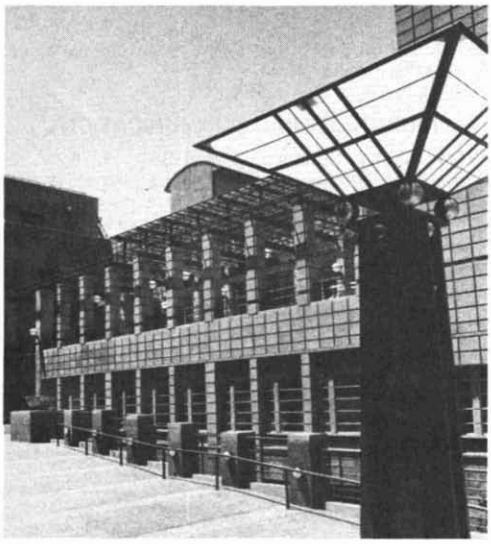
ARCHITECTURE PROFESSIONAL STUDIES

ARP 451 Architecture Field Studies. (1–6) F, S, SS
Organized field study of architecture in specified national and international locations. Credit/no credit. May be repeated with approval of director.

484 Clinical Internship. (3) SS
Full-time internship under the supervision of practitioners in the Phoenix area or other locales. Credit/no credit. Prerequisite: instructor approval.

684 Professional Internship. (2–6) S
Field experience in an architectural firm specializing in an area directly related to the student's advanced study. Integration of theory and state-of-the-art practices. Credit/no credit. Prerequisite: instructor approval.

Omnibus Courses: See pages 50–51 for omnibus courses that may be offered.



School of Design

Robert L. Wolf, M.A., Director

PROFESSORS:
WOLF (AED 154B), BUSH, KROELINGER, REZNIKOFF
ASSOCIATE PROFESSORS:
KNIGHT, NIELSEN, WITT
ASSISTANT PROFESSORS:
BRANDT, DiCICCO, JOHNSON, McDERMOTT, RATNER, SADLER, VERNON
PROFESSORS EMERITI:
BENZINGER, QUESADA, STREUFERT

Purpose

The School of Design educates designers for a professional world that needs informed and developed talent. The curricula emphasize preparation in building bridges between the academic world and the professions. The faculty believe that the designers have a responsibility to the public and the communities that they serve—the student learns not only the history and theory of the professions and their practical application, but an understanding of systems, functions, scientific, and technical data related to public welfare, safety, and human factors. Students integrate aesthetic values into the products and spaces they design and consider the aspirations of the world in which they live. The goal is to create the best design curricula possible and to develop technically accomplished and conceptually sophisticated graduates who continue to evolve as practicing professionals. With the help of an international network and a faculty of active design professionals, the aim is to educate creative individuals who will achieve a comprehensive understanding of both products and interiors as related to the different cultures in which they exist.

Organization

Programs in the School of Design are organized by the faculty of the school under the direction and administration of the director.

Degrees and Majors

The faculty of the School of Design offer the Bachelor of Science in Design degree. Three majors are available: Industrial Design, Interior Design, and Design Science.

Industrial Design. Industrial Design is primarily concerned with how humans perceive and use designed objects. The discipline of industrial design has been defined as the professional service of creating and developing concepts and specifications that optimize the appearance, function, and value of products and systems for the mutual benefit of both the user and the manufacturer. This service is often provided in the context of a cooperative working relationship with other members of a development group. The industrial designer's contribution places special emphasis on human characteristics, needs, and interests that require detailed understanding of visual, tactile, safety, and convenience criteria. Industrial designers combine these considerations with practical concern for technical processes, manufacturing requirements, economics, and marketing, including distribution, sales, and service.

Interior Design. The program in Interior Design is accredited by the national accrediting agency, the Foundation for Interior Design Education Research. The five year curriculum emphasizes design process, technical skill development, problem solving, and the management skills needed to work in collaboration with the allied design professions. The goal is to create high quality environments for human use.

Significant changes in the interior design profession over the last two decades are reflected in the program The school is committed to integrating computer technology into each level of the curriculum. In doing so, the program offers an excellent environment for experimenting with and testing innovative applications of computer aided design and simulation to interior design.

Design Science. The Design Science major is an individualized upper division program of study for students who are academically above average and who have specific academic and professional goals that are not achievable in the department's two other programs. Design Science majors select either an industrial design emphasis (program total of 132 hours) or an interior design emphasis (program total of 153 hours) and do not necessarily take studio or laboratory courses. An internship is a part of each curriculum

Admission

Lower-Division Program. New and transfer students who have been admitted to the university and who have selected Industrial Design or Interior Design as a major are admitted to the appropriate lower-division program. Transfer credits for the lower division program are reviewed by the college and evaluated as admissible to this curriculum. To be admissible, transfer courses must be equivalent in both content and level of offering. A review of samples of work is required for studio classes. Consult the college academic advisor for an appointment.

Entering lower division students who are not ready to take some courses in the curriculum (for example, algebra and trigonometry or a second course in computer programming) are required to take additional courses that do not apply to the Bachelor of Science in Design degree. If these courses are needed, it may take an additional year to complete the lower division program.

Completion of lower division requirements does not assure acceptance to an upper-division professional program.

Upper-Division Program. When students have completed the lower division curriculum requirements, they may apply for acceptance to upper division programs in Industrial Design, Interior Design, or Design Science. The limited spaces available each year are awarded to applicants with the highest promise for professional success. The faculty of the School of Design retain the right to admit any meritorious student who may be deficient in a published departmental criteria. Such admission requires an extraordinary review of the applicant by the department's admissions committee. Should the faculty choose to admit such an applicant, the student is placed automatically on a provisional admission status with stipulations as to what is required to be removed from probation. See "Application to Upper-Division Programs," pages 209 210.

Students not admitted to upper division programs are not dismissed from the university and may reapply or may transfer to other programs. Students who intend to reapply should meet with the college academic advisor.

Applicants for admission to the upper division Design Science program follow the same time table as Interior and Industrial Design students. Application is made directly to the department chair. Applications must include a proposed curriculum developed in conjunction with a faculty advisor that is acceptable to the department faculty. Applicants must fulfill lower division program requirements in either Industrial Design or Interior Design.

Advisement

Advising for the lower division curriculum is through the college academic advisor. Advising for the upper division curriculum is by faculty advisors and the credentials evaluator.

Degree Requirements

The Bachelor of Science in Design degree requires the following minimum number of hours of required and approved courses for its majors:

Bachelor of Science in Design

Major in:	Semester Hours
Design Science	132 or 153
Industrial Design	132
Interior Design	153

The program includes required field trips. Students are responsible for these additional costs. Foreign study opportunities are available for honors students. An internship is a required part of the program.

Industrial Design. The curriculum in Industrial Design is divided into a lower division and an upper division program.

	Semester Hours
Lower Division Program	62
Upper Division Program	70
Total	132

The lower division curriculum balances a foundation in academic subjects such as English, algebra and trigonometry, computers, and physics with departmental courses that include history as well as studio courses in drawing, design fundamentals, human factors, and materials and processes.

The upper division curriculum includes studio and laboratory work in industrial design, graphics, material design, professional practice, and a number of approved program electives. A supervised summer internship is part of the curriculum.

Upper division studios emphasize projects which promote an interdisciplinary approach to solving problems and which develop the student's intellectual understanding of the philosophy and direction of methods and theories related to industrial design. Problems proceed from small consumer products with simple task functions to larger and more complex problems and systems. Studio projects also emphasize the design processes: problem resolution through concept ideation, dialogue with specialists in related areas, and product development, presentation, and marketing.

Graduates of the program accept entry level positions in industry and firms doing product and packaging design. They may focus on consumer products, transportation, electronics, medical devices, health products, recreational products, or materials application. Students may also choose to continue their education with graduate studies to enrich their design skills, to specialize, or to prepare for college-level teaching.

Bachelor of Science in Design
Major in Industrial Design
Lower-Division Requirements

Freshman Year

			Semester Hours
Fall 14			
COM	100	Introduction to Human Communication	3
DSC	100	Introduction to Environmental Design/Theory[2]	2
DSC	160	Visualization for Industrial Design	3
ENG	101	First Year Composition or ENG 105 if qualified	3
MAT	117	College Algebra[3]	3
Spring 18)			
DSC	101	Contemporary International Design/Theory[2]	3
DSC	161	Vocabulary for Industrial Design	3
ECN	112	Microeconomic Principles[2]	3
ENG	102	First Year Composition	3
MAT	118	Precalculus Algebra and Trigonometry[3]	3
PGS	100	Introduction to Psychology[2]	3

Sophomore Year

Fall 16)			
DSC	227	Visual Methods for Problem Solving	3
DSC	242	Materials and Design	3
DSC	260	Industrial Design I	3
DSC	316	20th Century Design I[2]	3
PHY	111	General Physics[2]	3
PHY	113	General Physics Laboratory[2]	1
Spring 15)			
DSC	228	Imaging and Visualization	3
DSC	243	Process and Design	3
DSC	261	Industrial Design II	3
DSC	317	20th Century Design II[2]	3
DSC	344	Human Factors in Design	3
		Lower Division Total	63

[1] Transfer credits for the lower division program must be equivalent in both content and level of offering. Samples of studio work must be provided for evaluation. See the college academic advisor for an appointment.

[2] This course satisfies a General Studies requirement. See the course description for specific requirement(s) the course fulfills.

Bachelor of Science in Design
Major in Industrial Design
Upper-Division Requirements

Junior Year

			Semester Hours
Fall 17)			
COM	207	Introduction to Communication Inquiry[2] ..... or COM 222 3 or COM 225 (3	3
DSC	318	History of Graphic Design[1]	3
DSC	327	Presentation Graphics	3
DSC	354	Principles of Product Design	3
DSC	360	Industrial Design III	5
Spring 16)			
DSC	328	Graphic Design	3
DSC	355	Plastics Design	3
DSC	361	Industrial Design IV	5
DSC	483	Pre Internsh p Seminar	1
Approved Natural Science Elective with Approved Laboratory[1]			4
Summer 3			
DSC	484	Internship	3

Senior Year

Fall 17)			
DSC	460	Design Project I	5
DSC	470	Professional Practice for Industrial Design	3
ENG	301	Writing for the Professions	3
Approved Numeracy Elective[1]			3
Humanities or Social and Behavioral Science Elective[1]			3
Spring 16			
DSC	461	Design Project II	5
DSC	474	Industrial Des gn Seminar Studio	3
Approved Program Elective			2
Humanities or Social and Behavioral Science Elective[1]			6
Upper Division Tota			69
B S D Minimum Total			132

[1] This course satisfies a General Studies requirement See the course description for specific requirement(s the course fulfills

[2] A list of courses that fulfil approved program and technology electives is available from the departmental academic advisor.

Interior Design. The curriculum in Interior Design is divided into a lower division first and second year) and an upper division program (third, fourth, and fifth years):

	Semester Hours
Lower-Division Program	56
Upper Div sion Program	97
Total	153

The lower division curriculum balances a foundation in academic subjects such as English, algebra and trigonometry, computer technology, and physics with departmental courses that include history and theory, as well as studio courses in drawing, design fundamentals, and conceptual design.

The upper division curriculum includes studio work in interior design, furniture design, construction methods/structures, codes as related to materials and finishes, human factors, environmental control systems, as well as lecture courses in the history of interior design, decorative arts, and textiles. An eight week supervised summer internship is a part of the curriculum. The fifth year is an interdisciplinary year in which students address real life environmental problems.

Graduates from the program accept entry level professional positions in a variety of settings, including interior design firms, department of space planning, or interior design in architectural firms, public institutions or industry. Students may also choose to continue their education through graduate studies, which offer greater enrichment in studio disciplines and which contribute to the possibility for postsecondary level academic appointments, giving the recipients highly sought-after academic credentials

Bachelor of Science in Design
Major in Interior Design
Lower-Division Requirements[1]

Freshman Year

			Semester Hours
Fall 14)			
DSC	100	Introduction to Environmental Design	2
DSC	170	V sualizat on for Interior Design	3
ENG	101	F rst Year Composition or ENG 105 if qualified	3
MAT	117	College Algebra[2]	3
Elective			3
Spring 14			
DSC	171	Vocabulary for Interior Design	3
DSC	223	Introduction to Interior Design[2]	2
ENG	102	First Year Composition or HU elective if ENG 105	3
MAT	18	Precalculus Algebra and Trigonometry[2]	3
Social and Behavioral Science Elective[2]			3

Sophomore Year

Fall (13			
CSE	181	Applied Problem Solving with BASIC[2]	3
DSC	220	Media for Design Development	3
DSC	231	Concepts for Interior Design	3

PHY 111 General Physics[2] 3
PHY 113 General Physics Laboratory[2] 1

Spring (16)
ARS 102 Art of the Western World II 3
COM 207 Introduction to Communication Inquiry[2] 3
DSC 235 User Needs and Behavior in Interior Design 3
Approved Humanities or Social and Behavioral Science Elective[2] 3
Natural Science Elective with Laboratory[2] 4

Lower Division Total 57

[1] Transfer credits for the lower division program must be equivalent in both content and level of offering. Samples of studio work must be provided for evaluation See the college academic advisor for an appointment

[2] This course satisfies a General Studies requirement. See the course description for specific requirement(s) the course fulfills.

Bachelor of Science in Design
Major in Interior Design
Upper-Division Requirements

Junior Year

			Semester Hours
Fall (17)			
DSC	310	History of Interior Design I	3
DSC	340	Interior Codes Public Welfare and Safety	3
DSC	364	Interior Design Studio I	5
DSC	494	ST: Construction Methods in Design	3
		Approved Humanities or Social and Behavioral Science Elective[1]	3
Spring (15)			
DSC	311	History of Interior Design II	3
DSC	341	Interior Materials and Finishes	3
DSC	344	Human Factors in Design	3
DSC	365	Interior Design Studio II	5
DSC	483	Pre internship Seminar	1
Summer (3)			
DSC	484	Internship	3

Senior Year

Fall (17)			
DSC	412	History of Decorative Arts in Interiors	3
DSC	442	Specifications and Documents for Interiors	3
DSC	464	Interior Design Studio III	5
ENG	301	Writing for the Professions	3
		Humanities or Social and Behavioral Science Elective[1]	3
Spring (16)			
DSC	413	History of Textiles in Interior Design	3
DSC	458	Lighting for Interior Design	3
DSC	465	Interior Design Studio IV	5
		Social and Behavioral Science Elective	3
		Elective	2

Fifth Year[2]

Fall 14)			
DSC	421	Concept and Style in Presentation Documents	3
DSC	446	Furniture Design and Production	3
DSC	457	Acoustics for Interior Design	3
DSC	466	Interior Design Studio V	5
Spring (14)			
DSC	467	Interior Design Studio VI	5
DSC	472	Professional Practice for Interior Design	3
		Approved Terminal Project Elective	3
		Elective	3
		Upper-Division Total	96
		B.S.D. minimum Total	153

[1] This course satisfies a General Studies requirement See the course description for specific requirement(s) the course fulfills.

[2] During the fifth year, the student concentrates on research related to the development of a comprehensive project This year is self-directed in nature and prepares the student for independent thinking and creative problem solving. The fifth year experience requires high expectations for producing professional work that represents the culmination of the major's academic experience It should be noted that the fifth year studio sequence is designed to draw majors from the upper division programs of industrial design, architecture, and planning, thus furthering a real life interdisciplinary problem solving experience.

General Studies Requirements

The Interior Design and Industrial Design curricula meet the General Studies requirements of the university. For more information about University General Studies requirements, see pages 58–61. For a key to the letters and numbers on each list of degree requirements see page 61.

DESIGN

DSC 100 Introduction to Environmental Design. (2) F S
Survey of environmental design, including historic examples and the theoretical, social technical and environmental forces that shape them. *[Satisfies General Studies Requirements. HU, G, H]*

101 Contemporary International Design/Theory. (3) S
Survey of contemporary European, American, and Asian design in light of historical events economic forces, cultural values and aesthetic deals Prerequisite. DSC 100 *[Satisfies General Studies Requirements: HU, G]*

160 Visualization for Industrial Design. 3) F
Draw ng as re ated to bas c form descr pt'on and co or re at onships 1 hour ecture 2 hours stud o. Prerequ s te major in co ege

161 Vocabulary for Industrial Design. (3) S
Forms n space co or systems and co or schemes Con temporary draw ng med a, 2 and 3 dimens ona mode s 1 hour ecture 2 hours stud o Prerequ s te· DSC 160 or equ valent

170 Visualization for Interior Design. (3 F
Deve opment of an understand ng of draw ng space and product sequent al deve opment of 2 and 3 d mens ona draw ng sk s 1 hour ecture 4 hours ab Prerequ s te major n co ege

171 Vocabulary for Interior Design. 3 S
Projects n the vocabu ary of des gn, nc ud ng co or, com posit on character and form as re ated to des gn 2 and 3 d mens ona graph c representat on. 1 hour ecture 4 hours ab Prerequ s te DSC 170

220 Media for Design Development. 3 F
Graph c representat'on methods used to descr be and ana yze space, emphas s on qu ck presentat'on tech n ques. 6 hours stud o Prerequ s te DSC 171.

223 Introduction to Interior Design. 2) S
Interiors ssues theor es, and phi osoph es Emphas s on subject ve and ob ect ve analys s of problems of des gn and the r solut ons. *[Satisf es Genera Studies Requ re ment: HU]*

226 Color Sketching. (3 N
Felt markers· qu ck representat ona and concept commu n'cat on sketch ng Forms n space, ght, and shade Ma ter al ref ectance propert es 6 hours studio. Prerequ sites DSC 161 or equ valent Industria Des gn major

227 Visual Methods for Problem Solving. (3 F
Introduct on to conceptua des gn activ ty based on the m nd-eye-med a feedback oop. Graph c anguage used to represent conjecture ana ys s synthes s of objects, and the r contexts Sem nar stud o Prerequ s te DSC 161 or equ va ent

228 Imaging and Visualization. (3 S
Des'gn act v t es stress ng graph'c anguage abstract on pract ced for presentat on. Structure of cnt c sm, nc ud ng descnption, nterpretat on and evaluat on are d scussed. Sem nar stud o. Prerequ s te DSC 227

231 Concepts for Interior Design. 3 F
Conceptua des gn deve opment nc ud ng sca e and pro portion ght texture form, vo ume, and spat a h erarchy, passage and repose 1 hour ecture 4 hours ab. Pre requ s te. DSC 171.

235 User Needs and Behavior in Interior Des'gn. 3 S
App icat ons of conceptua des gn to ssues of program ming and space p ann ng user needs, and behav or 1 hour ecture 4 hours ab Prerequ s te. DSC 231

242 Materials and Design. 3 F
Mater als app cat on n des gn ntroduct on to character s t cs and propert es of meta s and organ c mater a s, nc ud ng p astics and norgan c mater a s

243 Process and Design. (3 S
nfluences of industr a process ng on des gn ntroduct on to bas c mater a s process ng and post-form ng processes. Emphas s on appearance enhancement and des gn con stra nts of mater a process ng. Prerequ s te· DSC 242.

260 Industrial Design I. 3 F
Introduct on to the method and process of the industr a des gner Determ nants necessary n sma product de s gn 1 hour ecture 2 hours stud o Prerequis te. DSC 161 or equ va ent

261 Industrial Design II. 3 S
ssues of phys ca form development re ated to product and des gn, form deve opment propert es of paper f bers wood, meta and p ast cs 1 hour ecture 2 hours stud o. Prerequis'te· DSC 260 or equ va ent.

310 History of Interior Design I. 3 F
The des gn of nterior spaces as an express on of cu tura nfluences to 1835. Prerequ's te: ARS 102 or nstructor approval *[Sat sf es Genera Stud es Requ rements· HU, H]*

311 History of Interior Design II. 3 S
Des gn of nter ors as an express on of cu tura nf uences from 1835 to the present. Prerequ s te DSC 310 or n structor approva *[Satisf es Genera Studies Require ments· HU H]*

316 20th-Century Design I. 3 F
Modern European and Amer can des gn from 1900 to 1940 Emphas s on transportat on, product furn ture, exhi b t on and graphic des gn *[Satisf'es Genera Stud es Re qu rements. HU, H]*

317 20th-Century Design II. 3 S
Modern European, As an and American design s nce 1940 Emphas s on transportat on product, furniture exh b t on and graph c des gn. *[Sat sf es General Stud es Re qu rements HU H]*

318 History of Graphic Design. 3 F
Survey of development n the graph c arts, nnovat ve pr nt ng methods aesthet c va ues and soc al and cu tura env ronments that shape them *[Sat sf es General Studies Requirement HU]*

327 Presentation Graphics. (3 F
Methods for portfo o and profess ona product presenta tion us ng graph c med a for nformat on transfer are stud ed Aesthet c judgement organ zat on and craftsman sh p are stressed. Sem nar stud o Prerequ s te: DSC 228

328 Graphic Design. 3 S
Packag ng app cat ons and plann ng are nvest gated and app ied to the deve opment of an dent ty for a product ne structured as a system Lab. Prerequ s te DSC 327.

340 Interior Codes: Public Welfare and Safety. 3) F
Codes and regu at ons as performance cr ter a for nter or des gn

341 Interior Materials and Finishes. 3 F
Genera ana ys s of qua ty control measures re at ng to n ter or des gn matena s, f n shes and performance criteria Prerequ s te DSC 340

344 Human Factors n Design. 3 F
Man mach ne env ronment systems human characteris t cs and behav or app ed to des gn of products systems and the r operat ng env ronment

354 Principles of Product Design. 3 F
nf uences of phys ca and mechan ca concepts n product des gn mechan sms k nemat cs, and fasten ng systems Concepts of ana ys s for product des gn nf uences of concepts on aesthet cs Prerequ s tes: MAT 117· PHY 111

355 Plastics Design. 3 S
Mo d des gn for part requ rements mo ded ho es; threads nserts fasten ng and jo n ng, decorat ng, re nforced p as t cs Prerequ s te· DSC 354

360 Industrial Design III. 5 F
Methods of v sua th nk ng, conceptua zat on and deat on re ated to bu d ng ski evels in profess ona des gn pres entat on techn ques 10 hours studio Prerequ site depart ment approva

361 Industrial Design IV. 5 S
Emphas s on deve op ng ideas nto a comp ete funct ona product, nc ud ng survey and app cation of aesthet cs human factors, mater a s and manufactur ng 10 hours stud o Prerequ s te DSC 360

364 Interior Design Studio I. 5 F
Stud o prob ems n nter or des gn re ated to behav ora re sponse n persona and sma l group spaces. 10 hours stu d o Prerequ site. department approva .

365 Interior Design Studio II. 5) S
Stud o problems n interior design, w th emphas s on is sues of pub c and pr vate use of nter or p aces of assem b y 10 hours stud o Prerequ s te department approval

367 Electronic Packaging. 3 N
Industr al des'gn prob ems n packag ng e ectron c de v ces Emphas s s p aced on packag ng d sp ays and contro s Prerequ s te nstructor approva

412 History of Decorative Arts in Interiors. 3 F
The des gn of decorat ve arts as an express on of cu tura inf uences and as an extens on of nter or spaces Pre- requ s te DSC 311 or nstructor approva *[Sat sf es Gen eral Stud es Requirement HU]*

413 History of Textiles in Interior Design. (3 S
Cu tura and h stor ca express on of text es as re ated to nter ors May nclude f e d tr ps Prerequ s te DSC 412 or instructor approva

421 Concept and Style in Presentation Documents. (3) F
Methods of analyz ng portfo o des gn for nter ors. Form ng presentat on concepts and estab sh ng a commun ca t ons style Prerequ s te sen or stand ng

422 Facilities Planning and Management I. (3 F
The fac ty management process n arge sca e organ za tions P ann ng ong range forecast ng, and product v ty. Project management methodo og es us ng m cro based software programs Prerequ's te· sen or stand ng

423 Facilities Planning and Management II. 3) S
The format on of fac t es po c es procedures and stan dards The fac t es database, space a ocations and management process Evaluat on of programm ng crite r a. Prerequ s tes: DSC 422, sen or stand ng

442 Specifications and Documents for Interiors. (3 F
Contract spec f cations documents schedules, and b d- d ng procedures for nter or des gn. Prerequ s tes DSC 341 365.

446 Furniture Design and Production. 3) F
Des gn construct'on, cost est'mat ng and insta at on in nterior furn ture and mi work. 1 hour ecture 4 hours stu- d o. Prerequisite: DSC 465

455 Environmental Control Systems. 3 F
Methods of spec fy ng and construct ng systems that con- tro the sensory input from the amb ent env ronment Lec ture f e d tr ps Prerequ s tes: MAT 117, 118; PHY 111 113; sen or stand'ng.

457 Acoustics for Interior Design. 3 F
Phys ca propert es of sound Stud es perta n ng to sound absorb ng materia s, construct ons, and room acoust cs. Prerequ s tes MAT 118 PHY 111, 113; sen or stand ng

458 Lighting for Interior Design. 3 S
L ght as an aspect of nter or des gn. Eva uation of ght sources for d str but on co or and cost Prerequis te: sen or stand ng

460 Design Project I. (5) F
Comp ete ana ys s of the product un t as an e ement of mass product on, featur ng market'ng techno ogy human factors and v sua des gn Emphas s on profess ona standards 10 hours stud o. Prerequ s tes· DSC 361 484

461 Design Project II. (5 S
Product des gn w th emphas s n systems nteract on. Cu m nat on of des gn process and techn que Ind v dua proj ect d rect on s encouraged 10 hours stud o Prerequ s'te· DSC 361

464 Interior Design Studio III. 5 F
Stud o prob ems n nter or des gn re ated to commerc al spaces 10 hours stud o. Prerequ s tes· DSC 365 484

465 Interior Design Studio IV. 5) S
Stud o prob ems n nterior des gn re ated to hea th and educat ona fac t es 10 hours stud o. Prerequ's te DSC 464

466 Interior Design Studio V. 5 F
Advanced nter or des gn prob em so v ng des gn theory, and cr t c sm Thes s project development based upon the major s concentrat on 10 hours studio Prerequ s te de partment approva .

467 Interior Design Studio VI. 5 S
Advanced ser es of spec a zed projects or cont nuation of thes s project based upon the major's concentrat on 10 hours stud o Prerequ s te· department approva .

470 Professional Practice for Industrial Design. 3) F
Bus ness procedures management techn ques account ng systems, eth cs and ega respons b t es of the de s gn profess ons. May be repeated for cred t Prerequ s te sen or stand ng.

472 Professional Practice for Interior Design. 3 S
Bus ness procedures project contro fee structures and profess ona product ab t es Prerequ s te· sen or stand ng

474 Industrial Design Seminar Studio. 3 S
Large-sca e nterd sc pl nary c ass project nvo v ng project p ann ng and contro des gn prototype deve opment, fea sib ty study and report ng Sem nar stud o Prerequ sites sen or stand ng nstructor approva

483 Pre-internship Seminar. 1 S
Preparat on of nternsh p mater a s that produce and en hance a successfu nternsh p exper ence Sem nar Pre requ s te 3rd year major n the department.

484 Internship. (3 SS
Fu t me summer nternsh p under superv s on of pract t o ners n the Phoen x area or other oca es Prerequ site nstructor approva

520 Design Forecasting: Methods and Applications. 3 F S
Projected appl cat ons n des gn product on, p ann ng and dec s on-mak ng processes Lecture sem nar. Prerequ - s tes· DSC 310 and 311 *or* equ va ents

524 Illumination and Acoustics. 3 N
Research and laboratory nvest gat on of advanced um nat on and acoust cs ssues of fac ty des gn Emphas s on human factors and performance aspects Prerequ s tes DSC 457 and 458 *or* equ va ent

525 Design Methodologies. (3) F
Practical exercises and studies in problem-solving strategies; problem definition and supporting theory for the designer. Lectures, seminars, lab. Prerequisite: senior or graduate standing.

527 Modern Design Theory. (3) S
Aesthetic, political, economic, and social theories that have shaped modern design; theory as the basis for design philosophies. Lectures, seminars. Prerequisite: DSC 525 or equivalent.

529 Design Criticism. (3) F
Critical methods applied to design as material culture and human expression; evaluation of achievement versus intention. Lecture, seminar. Prerequisite: DSC 527 or equivalent.

544 Human Factors Systems and Documentation. (3) F
Advanced topics associated with theory and methods of human factors in design. Individual projects stressing problem organization, evaluation, and documentation. Lectures, seminars, lab. Prerequisite: DSC 344 or equivalent.

552 Computer Simulation In Design. (3) F
The use of computer graphics as a medium to develop and present images of the environment for analysis and perception. Lecture, lab. Prerequisite: senior or graduate standing.

553 Computer Imaging and Visual Perception. (3) S
Issues and applications of computer simulation as a tool for describing and testing human interface with the environment. Lecture, lab. Prerequisite: senior or graduate standing.

558 Daylighting. (3) N
Daylighting as a design determinant; concepts, techniques, methodology, experiments, and case studies. Lecture, studio. Prerequisite: senior or graduate standing.

580 Practicum: Methods of Teaching Design. (3) F
Background and development of design education theories. Concepts of studio teaching methods. Comprehensive student project development and evaluation methods. Prerequisite: graduate standing.

591 Seminar: Graduate Design. (3) F
Design criticism, human/environment problems, design education, sociology of design, occupational safety and health, and human factors. Participant presentations. Lecture, seminar. Prerequisite: graduate standing.

Omnibus Courses: See pages 50–51 for omnibus courses that may be offered.



Planning

PROFESSORS:
STEINER (AED 158A), LAI
ASSOCIATE PROFESSORS:
KIM, SAN MARTIN, WILLIAMS
ASSISTANT PROFESSORS:
COOK, YABES
PROFESSOR EMERITUS:
ELMORE

Purpose

The faculty of the Department of Planning offer a curriculum that provides an education for careers in urban and regional development, landscape architecture, and urban design. The goal of the faculty is to advance the profession of planning through scholarship, teaching, research, and community service.

Planners work on projects that range in scale from site and landscape development to the design of entire communities and the formulation of policies that shape urban and regional growth. Planning graduates work for both private firms and government agencies. Their work typically involves fields such as land-use planning, housing, natural resource management, urban transportation, development controls, and environmental impact assessment.

Organization

The programs are organized by the faculty of the department under the direction and administration of the chair.

Degrees and Majors

The faculty of the Department of Planning offer the undergraduate degrees Bachelor of Science in Planning and Bachelor of Science in Design and the graduate degree Master of Environmental Planning. The Bachelor of Science in Planning offers the major in Urban Planning with a concentration in landscape architecture or urban planning. The Bachelor of Science in Design offers the major in Housing and Urban Development.

Urban Planning (with Concentrations in Landscape Architecture or Urban Planning). The Bachelor of Science in Planning with a major in Urban Planning requires four years of study. Following two years of preparatory work, students take two years of courses that include

site planning, landscape architecture, urban design, comprehensive planning, socioeconomic and environmental analysis, computer and analytical methods, planning law, and public-policy formulation and administration. An internship is required between the third and fourth years. Many students continue to specialize in planning at the graduate level. Students select from two concentrations: landscape architecture and urban planning.

Students in the landscape architecture concentration explore the reasons for and the techniques involved in the analysis, planning, and design of the environment, both natural and built. Students in the urban planning concentration are exposed to the theories, methods, and interdisciplinary approaches of the profession of urban planning.

Housing and Urban Development. The Bachelor of Science in Design with a major in Housing and Urban Development familiarizes students with housing technology and housing planning and development in both the public and private sectors. Students interested in this upper division program should contact the department chair for more information. The lower-division program is the same for the Bachelor of Science in Planning.

Master of Environmental Planning. The Department of Planning offers a concentration in urban planning with specialization areas in urban and regional development, urban design, landscape ecological planning, and international planning under the Master of Environmental Planning degree (M.E.P.), a professional planning degree. This concentration is a two year program and includes 24 hours of core courses, 15 hours in an area of specialization, an optional three hour internship, five hours of approved electives, and a four hour applied project or thesis, for a total of 51 semester hours or 48 without the internship. For further information, see the *Graduate Catalog*.

Admission

Lower-Division Program. New and transfer students who have been admitted to the university and who have selected a program in the Department of Planning as a major are admitted to the lower-division program. Transfer credits for the lower-division program are reviewed by the college and evaluated for admissibility to this curriculum. To be admissible, transfer courses must be equivalent in both content and level of offering. A review of samples of work is required for studio classes. See the college academic advisor for an appointment.

Completion of lower-division requirements does not assure acceptance to the upper-division professional program. Admission to the upper division is competitive and limited to the space available. Admission requires formal application and acceptance.

Upper-Division Program. Admission to the upper division programs of the Department of Planning is limited to applicants who have completed the lower division program requirements and who are determined by the admissions committee to have the best potential for academic success. Spaces in the program are limited by available facilities, faculty, and qualified applicants. A lower division program GPA of 3.00 may be required. See "Application to Upper Division Programs," pages 209–210.

Students not admitted to upper division programs are not dismissed from the university and may reapply later or may transfer to other programs. Students who plan to reapply should meet with the college academic advisor.

Applications for admission to the upper division Housing and Urban Development program are made directly to the department chair. Applications must include a proposed curriculum developed in conjunction with a faculty advisor and acceptable to the department faculty.

Advisement

Advising for the lower-division curriculum is provided through the college academic advisor. Advising for the upper division curriculum is provided by the department chair and faculty advisors.

Degree Requirements

The Bachelor of Science in Planning degree requires the following minimum number of hours of required and approved courses for its majors.

Bachelor of Science in Planning

	Semester Hours
Lower Division courses	65
Upper Division courses	
Core	60
Approved electives	6
Internship	3
Total	134

Bachelor of Science in Planning
Major in Urban Planning
Lower-Division Requirements

			Semester Hours
English (6			
ENG	101	First Year Composition or ENG 105 if qualified	3
ENG	102	First Year Composition or Humanities/Fine Arts elective if ENG 105	3
Literacy and Critical Inquiry (6			
PUP	301	Introduction to Urban Planning	3
Literacy and Critical Inquiry elective			3
Numeracy (6)			
MAT	117	College Algebra or MAT 118 Precalculus Algebra and Trigonometry*	3
Approved Statistics or Quantitative Reasoning			3
Humanities and Fine Arts 9)			
APH/PUP	100	Introduction to Environmental Design I[1]	2
Approved Humanities and Fine Arts elective			3
Approved Humanities and Fine Arts elective* or Social and Behavioral Sciences elective			2
Social and Behavioral Sciences 6			
ECN	112	Microeconomic Principles[2]	3
Approved Social and Behavioral Sciences elective*			3
Natural Sciences (8			
BIO	100	Living World*	4
GPH	111	Physical Geography*	4
General Studies Electives 6)			
BIO	330	Ecology and Conservation	3
Electives that fulfill Humanities and Fine Arts and Social and Behavioral Sciences requirements*			3
Studio and Planning Courses[3] 23			
First Year			
AVC	141	Design Graphics	2
AVC	160	Freehand Perspective Drawing I	2
AVC	161	Freehand Perspective Drawing II	2
Second Year			
ADE	221	Design Fundamentals I	3
PLA	301	Introduction to Landscape Architecture	3
PUP	264	Planning Communication	3
PUP	322	Planning Methods Using Computers[2]	5
Planning courses to be specified by the department			4
Lower Division Minimum Total			68

[1] Transfer credits are reviewed by the college and evaluated for admissibility to this curriculum. To be admissible, transfer courses must be equivalent in both content and level of offering.

This course satisfies a General Studies requirement. See the course description for specific requirement(s) the course fulfills.

[3] Portfolio review is required for transfer studio work. See the college academic advisor for an appointment.

Bachelor of Science in Planning
Major in Urban Planning
Upper-Division Concentration in Urban Planning
Professional Program Requirements

Junior Year

			Semester Hours
Fall 17			
GCU	36	Urban Geography[1]	3
PUP	361	Planning Design I	5
PLP	412	History of the City	3
PUP	424	Planning Methods I: Planning Research Methods	3
Approved elective[2]			6
Spring 17			
PUP	362	Planning Design II	5
PUP	420	Theory of Urban Design	3
PLP	442	Environmental Planning	3
PLM	405	Urban Transportation	3
Approved elective			3
Summer 3			
PUP	484	Internship or Approved elective*	3

Senior Year

Fall 15			
PUP	420	Theory of Urban Design	3
PUP	432	Planning and Development Control Law	3
PUP	461	Planning Design III	5
PUP	494	Urban Housing Analysis	3
PUP	498	Senior Pro Seminar	1
PUP	642	Land Economics	3
Spring (14)			
PUP	452	Ethics and Professional Practice	3
PLP	462	Planning Design IV	5
PUP	494	Environmental Impact Assessment	3
PUP	499	Independent Study	3
Upper Division Minimum Total			66
BSP Minimum Total			134

This course satisfies a General Studies requirement. See the course description for specific requirement(s) the course fulfills.

Courses that fulfill approved concentration electives for the concentrations should be selected in consultation with departmental advisors.

Bachelor of Science in Planning
Major in Urban Planning
Upper-Division Concentration in
Landscape Architecture
Professional Program Requirements

Junior Year

			Semester Hours
Fall (14)			
BIO	330	Ecology and Conservation	3
PLA	361	Landscape Design I	5
PLA	442	Landscape Construction and Materials	3
PUP	412	History of the City	3
Spring (17)			
BOT	380	Landscape Plants	3
PLA	362	Landscape Design II	5
PLA	420	Theory of Urban Design	3
PLA	444	Landscape Architecture Site Preparation	3
Humanities and Fine Arts or Social and Behavioral Sciences elective			3
Summer (3			
PLA	484	Internship	3
		or approved elective[2]	
PLA	485	International Field Studies (elective credit)	1 12

Senior Year

Fall (15)			
PLA	461	Landscape Design III	5
PLA	494	ST: Planting Design	3
PLA	498	Senior Pro Seminar	1
PUP	432	Planning and Development Control Law	3
Landscape architecture course to be specified by department			3
Spring (14)			
PLA	462	Landscape Design IV	5
PUP	442	Environmental Planning	3
		or PUP 546 Urban Design Policy (3)	
PUP	452	Ethics and Professional Practice	3
Approved elective			3
		Upper Division Minimum Total	63
		B S.P. Minimum Total	132

[1] This course satisfies a General Studies requirement. See the course description for specific requirement(s) the course fulfills.

[2] Courses that fulfill approved concentration electives for the concentrations should be selected in consultation with departmental advisors.

Concentration in Landscape Architecture (PLA)

Students in the landscape architecture concentration explore the reasons for and the techniques involved in the analysis, planning, and design of land and the exterior environment, both natural and built.

Concentration in Urban Planning (PUP)

The concentration in urban planning exposes the student to the theories, methods, and interdisciplinary concerns of the urban planning field.

General Studies Requirements

The curriculum for the major in Urban Planning meets the General Studies requirements of the university. For more information about University General Studies requirements, see pages 58–61. For a key to the letters and numbers on each list of degree requirements, see page 61.

Inquiries

For further information on the lower-division or upper-division programs in planning, contact the college academic advisor, College of Architecture and Environmental Design, Arizona State University, Tempe, Arizona 85287 1605.

URBAN PLANNING

PUP 100 Introduction to Environmental Design I. (2) F S SS
Survey of environmental design including historic examples and the theoretical, social, technical, and environmental forces that shape them. 2 hours lecture. *[Satisfies General Studies Requirements: HU, G, H]*

101 Introduction to Environmental Design II. 2) F, S
Survey of environmental design issues, responsibilities, and directions 2 hours lecture *[Satisfies General Studies Requirements. HU, H]*

264 Planning Communication. (3) S
Communication techniques for urban planning and landscape architecture presentations Prerequisites ADE 221 AVC 141, 160.

300 The Planned Environment. (3) F
Aesthetic, social, economic, political, and other factors influencing urban development in the 20th century

301 Introduction to Urban Planning. (3) F S SS
Theoretical and practical aspects of city planning Interrelationships among physical planning environment, government, and society *[Satisfies General Studies Requirement. L1]*

322 Planning Methods Using Computers. (3) F
Planning methods using database word processors, spreadsheets, CAD, and mapping packages on microcomputers

361 Planning Design I. (5) F
Site planning: analysis of natural and cultural features; site systems and implications on site planning and design. Studio. Prerequisite: department major or instructor approval Cross listed as PLA 361

362 Planning Design II. (5 S
Regional p ann ng. ana ys s of reg ona processes and the development of reg ona plans and designs Stud o. Cross l'sted as PLA 362 Prerequisite PLA/PUP 361 or nstructor approva

412 History of the City. 3 S
The c ty from its anc ent or g ns to the present day. Em phas s on European and Amer can c t es dur ng the ast f've centur es *[Satisf es General Stud es Requirement H]*

420 Theory of Urban Design. 3 F
Analysis of the v sua and cu tura aspects of urban de s gn Theor es and techn ques app ed to se ected study mode s. Cross sted as PLA 420 Prerequ s te jun or standing. *[Sat sfies General Stud es Requirement HU]*

424 Planning Methods I: Planning Research Methods. 3) F
Tools useful for urban p ann'ng research emphas s on re search des gn and survey methods Cross sted as PUP 524 Prerequ s te PUP 301 or nstructor approva

432 Planning and Development Control Law. 3 F
Case studies on po ce power em nent doma n, zon ng Subd vision contro s exc usion preservat on, urban rede velopment and aesthet c and des gn regu at on Cross sted as PUP 531

433 Building Codes, Zoning Ordinances, and Subdivision Regulations. (3 F
Ana ysis of nat ona state and oca bu d ng codes, zon ing ord nances, and subd v s on regu at ons re ative to o ca p ann ng and deve opment

442 Environmental Planning. 3) S
Environmental p anning prob ems inc ud ng f ood p a ns water qua ty and quant ty, sol d and hazardous waste, air quality ands des, and no se Fie d tr ps Prerequ s te PUP 301 or nstructor approva

444 Preservation Planning. (3) S
Pr nc ples and pract ces in plann ng for preservat on con servation, and ne ghborhood redevelopment Emphas s on evaluat on of h stonc resources Off campus f e d prac t cum requ red Prerequ site: nstructor approval.

452 Ethics and Professional Practice. (3) S
Eth ca prob ems and issues 'n p ann ng profess ona pract ce and dec's on making Prerequ s te department major or nstructor approva

461 Planning Design III. 5) F
Urban des gn· analys s of urban form and des gn mp ca t ons w th n an urban context Stud o Cross listed as PLA 461 Prerequ s te PLA/PUP 362 or nstructor ap prova .

462 Planning Design IV. (5 S
Urban plann ng: co ection and app cat on of econom c soc al, and env ronmenta data re evant to urban p ann ng development of and-use p ans Stud o Prerequ s te PLA/PUP 461 or instructor approva .

484 Internship. 3) F, S, SS SS1 on y
Fu t me internsh p under the superv s on of practit oners in the Phoen x area or other oca e Cred t/no cred t. Pre requ s te. department major or nstructor approval

485 International Field Studies in Planning and Landscape Architecture. (1 12) F, S, SS
Organ zed f e d study of p ann ng and andscape architec ture n spec f ed nternational acat ons. May be repeated for cred t with department approval. Study abroad Cross sted as PLA 485.

520 Planning Theories and Processes. 3) S
Rev ew of past and current theoretica deve opments re ated to soc a change perspect ves the ro e and eth cs of p anners Prerequ s te: nstructor approva .

524 Planning Methods I: Planning Research Methods. (3) F
Too s usefu for urban p anning research emphas s on re search des gn and survey methods Cross sted as PUP 424 Prerequ s te PUP 301 or nstructor approva

531 Planning and Development Control Law. 3) F
Case stud es on po ce power em nent doma n, zon ng, subd v s on contro s, exc us on preservat on, urban rede ve opment, and aesthet c and des gn regu at on Cross sted as PUP 432

532 Advanced Urban Planning Law. 3 S
Advanced study on se ected issues n plann ng law, such as urban des gn contro s exc us onary practices compen sable regu at on and tax po cy Prerequ s te PUP 432 or nstructor approva

544 Urban Land Use Planning. 3 F
Theory and methods of urban and use plann ng inc uding the rat ona p ann ng process comprehens ve funct ona , and ne ghborhood p ans Prerequ s te PUP 301 or n structor approva

546 Urban Design Policy. 3 S
Advanced study of oca state, and federa urban design po cy Cross- sted as PLA 546 Prerequ s te. PLA/PUP 420

561 Urban Design Studio. (5 F, S
Current urban form and urban andscape des gn problems w th n the Phoen x-centered reg on. Stud o. Prerequ site: PUP 420 or instructor approva

572 Planning Studio I: Data Inventory and Analysis. (4 F
Comprehens ve p ann ng workshop dea ng with rea com mun ty prob ems. Focus on the data gathering and ana y sis steps of the p ann ng process Prerequ s te Master of Env'ronmenta Plann ng Student or nstructor approva

574 Planning Studio II: Options and Implementation. 4 S
Comprehens ve p ann ng workshop deal ng with rea com mun ty problems Focus on the deve opment of options p an mak ng and p an mplementation Studio. Prerequi s'te: PUP 572 or nstructor approval

584 Internship. 3 F S, SS SS1 on y
Internsh p under the superv sion of pract tioners n the Phoen x area or other oca es. Credit/no cred t

622 Planning Methods II: Quantitative Planning Analysis. (3 S
Methods and mode s used as the bas c quant t ative tech n ques of urban, reg ona and env ronmental p ann ng and pol cy analys s Prerequ sites PUP 424 stat st cs, in structor approva

642 Land Economics. 3 S
Land use and ocat ona mpact of econom c act v ty and the urban rea property market Prerequ s te: nstructor approval.

644 Public Sector Planning. (3 N
Urban f sca problems and pub c goods prov s on n state and oca governments Prerequ s tes. nstructor ap prova one course n m croeconom cs

Omnibus Courses: See pages 50–51 for omn bus courses that may be offered

LANDSCAPE ARCHITECTURE

PLA 301 Introduction to Landscape Architecture. (3) S, SS
The relevance of landscape architecture to the creation of humanized environments, with emphasis on natural factors.

310 History of Landscape Architecture. (3) N
Physical record of human attitudes toward the land. Ancient through contemporary landscape planning and design. *[Satisfies General Studies Requirement: H]*

359 Resort and Recreational Design. (3) F
Interrelationships of social, economic, and physical aspects of total tourist resort design; emphasis on physical development of tourist centers and resort areas.

361 Landscape Design I. (5) F
Site planning: analysis of natural and cultural features; site systems and implications for site planning and design. Studio. Prerequisite: department major or instructor approval. Cross-listed as PUP 361.

362 Landscape Design II. (5) S
Regional planning: analysis of regional processes and the development of regional plans and designs. Studio. Cross-listed as PUP 362. Prerequisite: PLA/PUP 361 or instructor approval.

420 Theory of Urban Design. (3) F
Analysis of the visual and cultural aspects of urban design. Theories and techniques applied to selected study models. Cross-listed as PUP 420. Prerequisite: Junior standing. *[Satisfies General Studies Requirement: HU]*

432 Plant Materials. (3) N
Natural components of landscape design: characteristics, applications, selection, and use. Field trips.

442 Landscape Construction and Materials. (3) F
Characteristics of materials and methods used in landscape architectural construction.

444 Landscape Architecture Site Preparation. (3) S
Landscape construction drawings focusing on site transformations. Topics include grading, earthwork computations, roadway alignments, and layout. Prerequisite: admission to department's professional level or instructor approval.

446 Landscape Structures and Systems. (3) F
Landscape construction drawings for structures and systems, including wood construction, retaining walls, irrigation systems, planting, specifications, cost estimating, contract administration. Prerequisite: PLA 444 or instructor approval.

461 Landscape Design III. (5) F
Urban design: analysis of urban form and design implications within an urban context. Studio. Cross-listed as PUP 461. Prerequisite: PLA/PUP 362 or instructor approval.

462 Landscape Design IV. (5) S
Landscape ecological planning: collection and application of ecological data relevant to planning and design at landscape scale. Studio. Prerequisite: PLA/PUP 461 or instructor approval.

484 Internship. (3) F, S, SS (SS1 only)
Full-time internship under the supervision of practitioners in the Phoenix area or other locales. Credit/no credit. Prerequisite: department major or instructor approval.

485 International Field Studies in Planning and Landscape Architecture. (1–12) F, S, SS
Organized field study of planning and landscape architecture in specified international locations. May be repeated for credit with department approval. Study abroad. Cross-listed as PUP 485.

546 Urban Design Policy. (3) S
Advanced study of local, state, and federal urban design policy. Cross-listed as PUP 546. Prerequisite: PLA/PUP 420

Omnibus Courses: See pages 50–51 for omnibus courses that may be offered.



College of Business

Larry E. Penley, Ph.D.
Interim Dean

Purpose

The primary objective of the College of Business is to prepare students for positions of responsibility in the business community. The undergraduate and graduate degree curricula are designed to provide:

1. a background of general education helpful to informed, thinking citizens;
2. a mastery of basic business tools and skills and an understanding of business procedures; and
3. a specialized and professional knowledge of a selected field of business.

To attain these objectives in the undergraduate program, the curriculum has been devised so that the student completes 50% of work in general education and other non business courses and 45% in courses offered by the College of Business, with the remaining 5% selected from either area by the student in consultation with his or her advisor.

The college is a member of the American Assembly of Collegiate Schools of Business (AACSB), the official accrediting organization in the field of business administration. The undergraduate and graduate programs and the School of Accountancy of the College of Business are accredited by this organization.

The college is host to a chapter of Beta Gamma Sigma, a national society that recognizes high academic achievement in AACSB accredited schools. Election to Beta Gamma Sigma is the highest scholastic honor a student in business administration can earn.

In addition to the regular degree curricula, other programs of study in the college are designed to meet special needs. Evening and continuing education courses are conducted for qualified persons who are regularly employed and who otherwise would be unable to enroll in college courses. Short courses and institutes on a non credit basis are organized in cooperation with various business groups for the furtherance of in service training of employed personnel.

Organization

The courses offered by the College of Business are organized into groups so that a related sequence may be established for the various subject fields. For administrative purposes, these fields are organized into the following academic units: Accountancy, Business Administration, Decision and Information Systems, Economics, Finance, Management, and Marketing.

The School of Health Administration and Policy offers a master's degree program designed to prepare qualified individuals for management careers in hospitals, group practices, health maintenance organizations, consulting firms, long term facilities, and other health services organizations.

The Center for Business Research collects, analyzes, and disseminates information on the economy and business climate of Arizona. Analyses of gross state product, prices, income, employment, real estate activity, and demographic data for Arizona are made available to businesses and the general public. The center coordinates interdisciplinary sponsored research efforts that provide useful information to business and a learning experience for students and faculty researchers.

The Economic Outlook Center serves as the economic forecasting unit of the college and is responsible for the publication of *Arizona Blue Chip* and *Western Blue Chip* monthly newsletters. The center sponsors seminars and workshops on the national and regional economies.

The Center for Advanced Purchasing Studies (CAPS) is the result of an affiliation agreement between the College of Business at ASU and the National Association of Purchasing Management. CAPS conducts in-depth research into the problems facing the purchasing profession today and the requirements of the future.

The Center for Office Automation Research (COAR) provides computer systems and management technology research support to businesses, government agencies, and other organizations. Organizations seeking information on the latest management technology issues such as computer systems development, desktop publishing, presentation graphics, image processing technologies, executive information systems development, white collar productivity, ergonomic office design, and telecommunications may use the center's ergonomically designed research laboratory in the College of Business. In addition to the COAR Research Laboratory, organizations may participate in COAR activities through published reports, electronic database services, electronic mail services, seminars, audio and video teleconferences, and on site training and development programs.

The Center for Financial System Research serves the national financial, policy-making, and academic communities through research, publications, conferences, and educational programs. The focus of such activities is on the changing nature of the domestic and international financial systems. Specific areas such as the interaction between financial markets, deposit insurance reform, the deregulation of financial institutions, the financing of mergers and acquisitions, and the effect of government policy on financial markets have received recent attention.

The Decision Systems Research Center (DSRC) serves as the focal point for research regarding the collection, storage, analysis, and utilization of data in computer based information systems in business and governmental organizations. The DSRC advances and monitors the state of the art in the management of data, information, decision, and planning analysis. The center provides a forum for the discussion and exchange of ideas to its members through discussion groups, technical reports and papers, and technical conferences. Members include academics in the decision sciences and information systems and representatives from leading business and government organizations

The Center for Executive Development serves the needs of the community with continuing education programs designed for business persons and is open to government officials and the general public.

The Joan and David L ncoln Center for Ethics conducts research and offers educational programs on ethical issues in business, government, and the professions.

The First Interstate Center for Services Marketing is North America's leading university based hub for the study of services marketing and management. The center conducts extensive research on service quality, the dynamics of service delivery, the dimensions of service encounters, professional services such as health care, banking, and insurance, service personnel, and so on. Its work advances scholarly understanding and provides marketers with applicable principles, concepts, and tools. The center offers specialized education and training Its annual Services Marketing Institute is the premier executive education program for marketers and managers in service industries and in companies devoted to providing quality service. The center's charter member list is a who's who of service companies, including AT&T, Ernst & Young, Greyhound Dial Corporation, Marriott Corporation, and IBM Canada.

The Hahn Center for Entrepreneurship and Innovation provides hands on experience and interdisciplinary course work for students and applied research and advice and assistance for entrepreneurs.

The Arizona Real Estate Center collects and analyzes data concerning the multifaceted real estate market to provide insight into solutions for problems confronting the real estate industry.

The Dean's Council of 100, a group of 100 distinguished business and professional leaders, provides a liaison between the college and the business community and develops private support for the priority needs of the college.

The Economic Club of Phoenix, a subsidiary of the Dean's Council of 100, provides programs that foster discussion of economic and business issues among the academic, business, labor, and public sectors of Phoenix

The Council of Emeritus Advisers, founded by the ASU College of Business and Dean's Council of 100, is a select group of retired executives who advise the dean and invite nationally known experts to Arizona as visiting scholars, lecturers, and speakers.

Admission

The Preprofessional Program. Each student admitted to the College of Business is designated as a preprofessional business program student. The student follows the freshman and sophomore sequence of courses listed in the four-year curriculum outline and the recommendations of an academic advisor in completing the prescribed background and tool courses in preparation for the subsequent professional program. Completion of lower-division requirements does not assure acceptance to the upper-division professional program. Preprofessional program students are not allowed to register for 300- and 400-level business courses.

The Professional Program. The junior and senior years constitute the professional program of the undergraduate curriculum. Admission to the professional program is competitive and limited by available resources. Admission is awarded to those applicants demonstrating the highest promise for professional success.

To be considered for admission to the professional program, the student must apply at the Undergraduate Programs Office in the College of Business and must have:

1. completed at least 56 semester hours;
2. attained a minimum combined cumulative GPA of 2.50 at ASU and other institutions;
3. attained a minimum cumulative GPA of 2.50 for all courses taken at ASU;
4. completed ACC 211 and 212, CIS 200, ECN 111 and 112, ENG 101 and 102, MAT 119 and 210, and QBA 221 with a grade of "C" or better and a minimum cumulative GPA of 2.50 in these courses, whether taken at ASU or another institution (for computational purposes, the college averages "D" and "E" grades received in these courses);
5. attained a cumulative GPA of 2.50 for all business courses taken at ASU; and
6. completed at least 32 semester hours toward the college's general studies requirement, including COM 100 or 230 or 259, ENG 101 and 102, MAT 119 and 210, and an S1 and an S2 laboratory science class.



Students not admitted to the professional program are ineligible to enroll in 300- and 400-level courses in the College of Business.

To be accepted for credit as part of the professional program in business, all courses transferred from other institutions must carry prerequisites similar to those of the courses they are replacing at ASU.

Non-business Students. A non-business student is permitted to register for selected 300- and 400-level business courses only if, (1) at the time of registration, the student has junior standing (56 semester hours completed) and (2) the student has a minimum cumulative GPA of 2.50 at ASU and a minimum GPA of 2.50 for all business courses completed at ASU.

Non-business majors are limited to a maximum of 15 semester hours of selected upper-division business courses (excluding economics courses).

Nondegree Undergraduate Students. A nondegree undergraduate business student is permitted to enroll in selected 300- and 400-level business courses only during on-line registration and only if (1) the student has an ASU cumulative GPA of at least 2.50 and an ASU cumulative business GPA of at least 2.50 at the time of on-line registration or (2) the student has never attended ASU, in which case he or she is given a one-semester period to register during on-line registration and to establish a GPA at ASU. Students must meet all prerequisites and course requirements as listed in the catalog.

Nondegree undergraduate business students are limited to a maximum of 15 semester hours of selected upper-division business courses (excluding economics courses). Nondegree undergraduate students in other colleges are not permitted to register for 300- and 400-level business courses.

Nondegree Graduate Students. A graduate business student not declaring a degree program is permitted to enroll in selected 300 and 400 level business courses only during on line registration and only if (1) the student has an ASU cumulative GPA of at least 2.50 and an ASU cumulative business GPA of at least 2.50 at the time of on-line registration or 2) the student has never attended ASU, in which case he or she is given a one semester registration to establish a GPA at ASU. Students must meet all prerequisites and course requirements as listed in the catalog.

Nondegree graduate business students are limited to a maximum of 15 semester hours of selected upper division business courses (excluding economics courses). Nondegree graduate students in other colleges are not permitted to register for 300 and 400 level business courses

Advisement

The student should follow the sequence of courses suggested in the four year curriculum outline below and the recommendations of the academic advisor in completing the prescribed background and tool courses in preparation for the subsequent professional program

Each student, upon entering the professional program in the College of Business, is assigned a faculty advisor upon the basis of the subject matter field in which the student is primarily interested The student, in consultation with a faculty advisor, selects the necessary upper division business courses to complete the major.

Four-Year Curriculum Outline

Pre-Professional Business Program

First Semester

			Semester Hours
COM	100	Introduction to Human Communication or COM 230 3 or 259 3)	3
ECN	111	Macroeconomic Principles	3
ENG	101	First Year Composition	3
MAT	119	Finite Mathematics	3
Laboratory Science (S1			4
			16

Second Semester

ECN	112	Microeconom c Principles	3
ENG	102	First Year Composition	3
MAT	210	Brief Calculus	3
Laboratory Science S2			4
PGS or SOC course			3
			16

Third Semester

ACC	211	Introductory Financial Accounting	3
QBA	221	Statistical Analysis	3
General Studies			7
PGS or SOC course			3
			16

Fourth Semester

ACC	212	Introductory Managerial Accounting	3
CIS	200	Computers in Business	3
General Studies			10
			16

Professional Business Program[1]

Fifth Semester

FIN	300	Fundamentals of Finance*	3
GNB	301	Adm nistrative Communicat on	3
MGT	301	Management and Organization Behavior*	3
MKT	300	Principles of Marketing*	3
OPM	301	Operations and Logist cs Management	3
Genera Studies			1
			16

Sixth Semester

BLW	305	Legal Environment of Business	3
Courses for Major			6
General Studies			7
			16

Seventh Semester

Courses for Major			6
Electives			3
General Studies			6
			15

Eighth Semester

MGT	463	Strategic Management[3]	3
Courses for Major			6
Electives			4
General Studies			2
			15
Total			126

Professional program students *only* may register for 300 and 400 level business courses.

[2] This is a prerequisite for the major See the departmental *Advisement Guide*

[3] The prerequisite for this course is the completion of 108 hours, including *all* other business core courses

Transfer Credit. Students planning to take their first two years of work at a community col

lege or another four year college should take only those courses in business and economics that are offered as freshman- or sophomore level courses at any of the three state supported Arizona universities. These lower division courses are numbered 100 through 299 at the three Arizona universities. *A maximum of 30 hours of business and economics courses from community colleges are accepted toward a bachelor's degree in business administration*

Professional business courses taught in the junior or senior year in the three state universities may not be completed at a two-year college for transfer credit in the business core or major. The introductory course in the legal environment of business is accepted as an exception to this policy, but only lower division credit is granted. Such courses may be utilized in the free elective category *subject to the 30 hour limitation*. Courses taught as vocational or career classes at the community colleges that are not taught in the colleges of business at any one of the three state universities are not accepted for credit toward a bachelor's degree. Courses taught in the upper division business core at the three state universities must be completed at the degree-granting institution unless transferred from an accredited four-year school. Normally, upper division transfer credits are accepted only from AACSB accredited schools.

The following general pattern of courses is recommended for students completing their first two years of work in a community college and who plan to transfer to ASU without the loss of credit:

	Semester Hours
Business Courses	30
Accounting Business Core (6)	
Business Communication Other General Studies) 3	
Computers in Business (Business Core (3	
Economics (Business Core (6	
Legal Environment of Business (Business Core 3)	
Quantitative Methods in Business (Math General Studies) (3)	
Statistical Analysis (Business Core) (3	
Lower Division Business Courses Electives (3)	
General Studies and English Proficiency	34
Communication	
English	
Global Awareness	
Humanities and Fine Arts	
Laboratory Science	
Mathematics	
Social and Behavioral Sciences	
Total	64

Consult with an academic advisor in the Undergraduate Programs Office to plan curriculum requirements

Incomplete. A mark of incomplete ("I") is granted only in cases in which the student can complete the course outside the classroom (e.g., final examination or term paper) with the same instructor or an instructor designated by the department chair. See the university section of this catalog for statements regarding university policy on incompletes.

Degrees

The College of Business awards the Bachelor of Science degree upon successful completion of a four year curriculum of 126 semester hours as prescribed above. Students may select one of the following eight majors. Each major is administered by the academic unit indicated.

MAJOR FIELD	DEGREE	SCHOOL/DEPARTMENT
Accountancy	B.S.	Accountancy
Computer Information Systems	B.S.	Decision and Information Systems
Economics	B.S.	Economics
Finance	B.S.	Finance
Management	B.S.	Management
Marketing	B.S.	Marketing
Operations/Production Management*	B.S.	Business Administration
Purchasing and Logistics Management	B.S.	Business Administration
Real Estate	B.S.	Business Administration
Transportation*	B.S.	Business Administration

* Applications are not being accepted to this program.

Master's Degrees

The Master of Business Administration degree, the Master of Health Services Administration degree, the Master of Accountancy degree, the Master of Science degree with a major in Decision and Information Systems, the Master of Taxation, and the Master of Science degree in Economics are awarded upon successful completion of programs detailed in the *Graduate Catalog*

Master of Business Administration. This general program is designed to meet the needs of students who seek broad, integrated graduate course work in the various functional fields of business The program of study emphasizes the managerial responsibility of policy formulation, problem solving, and decision making. Students with undergraduate backgrounds in general education or technical sciences and those with bachelor's degrees in business administration find the program well suited to their needs

The College of Business and the College of Liberal Arts and Sciences have defined a program whereby outstanding students may obtain a Bachelor of Arts or Bachelor of Science within the College of Liberal Arts and Sciences and a Master of Business Administration in five years of study. While obtaining the baccalaureate degree, the capable student also begins the M B.A. degree.

Master of Health Services Administration. This program is designed to prepare qualified individuals seeking careers as administrators of hospitals and health care organizations and as consultants to health management firms, accounting firms, and policy makers in state and federal agencies. This preparation is carried out by providing the students with selected theories, tools and techniques the understanding, analysis, and application that are essential for effective health services administration.

The program consists of a minimum of 51 semester hours 15 hours of business administration, 27 hours of health services administration, and nine hours of electives. Students serve internships and residencies in major organizations throughout the United States and abroad During the course of their training, students act as consultants to major health care organizations throughout the United States. This is accomplished through the program's innovative Graduate Technical Assistance Program (GTAP)

Master of Accountancy. This program is designed to provide professional competency in a variety of fields in accounting In addition to a broadly oriented degree program, the student may choose to specialize in accounting information systems electronic data processing auditing.

Master of Science Degree in Decision and Information Systems. This is a specialized program that stresses the application of decision and information systems to business, economic, governmental, and social issues It includes substantial familiarization with computer-based systems and quantitative methods to facilitate managerial planning, decision analysis, and control. The program of study consists of a minimum of 30 semester hours with six hours in required study and 24 hours in electives to support an area of specialization. The Department of Decision and Information Systems also participates with the Department of Mathematics to allow students to earn the Master of Science degree with a major in Statistics

Master of Science Degree in Economics This is a specialized program for students who desire to teach in community colleges, to prepare for research positions in business and government, or to take additional graduate work in economics. The master's program in Economics requires graduate work in macroeconomic analysis, microeconomic analysis, and quantitative methods.

Master of Taxation. This is a specialized program to equip persons with the highly technical and demanding skills required to administer the tax laws in both the private and public sectors of the economy.

Doctoral Degree in Business Administration

The Doctor of Philosophy degree (Ph D.) in Business Administration prepares individuals to teach and conduct scholarly research in a specialized area of concentration in the field of business administration and prepares individuals for positions in business or government for which the required educational background is doctoral level study. Prerequisites for the Ph.D. degree program include computer skills and mathematical competence through linear algebra and calculus. The program of study includes graduate study in economics, behavioral sciences, and quantitative statistical analysis. The advanced program is composed of an area of concentration and supporting course work that best prepares students for conducting scholarly work in their areas of interest. The degree is granted upon the completion of an approved program of graduate study, the success

ful completion of comprehensive written and oral examinations, and the submission of an acceptable original research project presented in a dissertation.

Doctoral Degree in Economics

The Doctoral of Philosophy degree in Economics is awarded upon the successful completion of the program as described in the *Graduate Catalog*. Primary objectives of this degree program are to prepare persons for research positions in public agencies and private business organizations and for teaching and research in institutions of higher learning. The degree is granted upon the completion of an approved program of graduate study, the successful completion of comprehensive written and oral examinations, and the submission of an acceptable original research project presented in a dissertation.

Graduation Requirements

Bachelor of Science. Students seeking a Bachelor of Science degree in the College of Business must satisfactorily complete a curriculum of 126 semester hours as follows:

	Semester Hours
Business Core Curriculum	39
Major	18–21
General Studies Requirements	62
Electives	4–7
Total	126

Business Core Requirements. To obtain an understanding of the fundamentals of business operation and to develop a broad business background, every student seeking a Bachelor of Science degree in the College of Business must complete the following courses:

			Semester Hours
ACC	211	Introductory Financial Accounting	3
ACC	212	Introductory Managerial Accounting	3
BLW	305	Legal Environment of Business	3
CIS	200	Computers in Business	3
ECN	111	Macroeconomic Principles	3
ECN	112	Microeconomic Principles	3
FIN	300	Fundamentals of Finance	3
GNB	301	Administrative Communication	3
MGT	301	Management and Organization Behavior	3
MGT	463	Strategic Management	3
MKT	300	Principles of Marketing	3
OPM	301	Operations and Logistics Management	3
QBA	221	Statistical Analysis	3
		Total	39

Major Requirements

A major consists of a pattern of 18–21 semester hours in related courses falling primarily within a given subject field. Majors are available in Accountancy, Computer Information Systems, Economics, Finance, Management, Marketing, Purchasing and Logistics Management, and Real Estate.

General Studies Requirements

All students in the College of Business are required to complete a total of 62 hours of general studies course work. A minimum of 35 of these hours must be selected to satisfy the University General Studies requirement. Courses that meet both the 35-hour University General Studies requirement and the total 62 hour general studies requirement of the College of Business are listed in the "Advising Guide" available in the Undergraduate Programs office of the College of Business. Students must select their general studies courses from this "Advising Guide" in consultation with their advisor.

Specific courses from the following areas must be taken:

	Semester Hours
Humanities and Fine Arts	9

At least two courses must be in the same area, one of which must be upper division. (Any foreign language courses must be nonspeaking courses.)

Social and Behavioral Sciences	15

This must include one course with a PGS prefix and one course with a SOC prefix. There must be at least two courses in the same area, one of which must be upper division.

Science and Mathematics	14

This must include two laboratory sciences (eight hours) and MAT 119 and 210 (or a more advanced course). Economics majors must take MAT 270 which may be used in place of MAT 210.

Historical Awareness	2–4

General Studies requirements must include one approved historical awareness course.

Communication	9

All students must complete both ENG 101 and 102 or ENG 105 with a grade of "C" or better. See page 89 for details. Also COM 100 or 230 or 259 must be completed.

Global Awareness	9

Two courses must be in the same area, at least one of which must be upper division.

Other Courses

Additional general courses that provide breadth and cultural background must be taken to bring the student's total credits up to the 62 hour minimum

Total 62

Elective Courses. Sufficient elective courses are to be selected by the student to complete the total of 126 semester hours required for graduation. Free electives by business majors are restricted to a maximum of six semester hours of ASU business courses.

Pass/Fail. Business majors may not include among the credits required for graduation any courses taken at this university on a pass fail basis.

Additional Graduation Requirements

In addition to completion of the pattern of courses outlined above, to be eligible for the Bachelor of Science degree in the College of Business, a student must

1. have completed at least 30 semester hours, including 24 in professional business courses (numbered 300 or above) after admission to the professional program;
2. have attained a cumulative GPA of 2.00 or higher for all business courses taken at this university and for all courses for the major taken at this university; and
3. have earned a minimum of 51 semester hours in traditional courses designed primarily for junior or senior students and completed in an accredited, four-year degree granting institution.

A student may, by formal application to the registrar, request that a grade of "D" or "E" in lower division courses not be included in his or her college GPA after the course has been repeated in residence with a passing grade and before completion of the student's first baccalaureate degree

Exceptions. Any exception to the above requirements must be approved by the Standards Committee of the College of Business.

Application for Graduation. A professional program business student must apply for graduation during the semester in which the student completes 87 semester hours.

Academic Standards

Probation. All students, freshman through senior, must maintain a minimum GPA for all courses completed at ASU of 2.00 and a minimum GPA for all College of Business courses completed at ASU of 2.00 or be placed on probation. During any semester in which the student is on probation, the student is not eligible to register early or to participate in on line registration, nor is the student permitted to enroll in summer sessions courses in this college until the probationary period has expired and the student has been restored to good standing

Disqualification. A student who has not achieved a minimum cumulative GPA of 2.00 in all courses completed at ASU and in all College of Business courses completed at ASU is disqualified if, (1 during any semester in which the student is on probation, the student obtains a semester GPA below 2.50 or receives a grade below "C" in one or more courses or if, (2) at the end of two consecutive semesters on probation, the student has not achieved a minimum cumulative GPA of 2.00 in all courses completed at ASU and a minimum GPA of 2.00 in all College of Business courses completed at ASU.

Students who have been academically disqualified are not permitted to enroll in summer sessions courses in this college until the disqualification period has expired and the students are reinstated.

Reinstatement. The College of Business does not accept an application for reinstatement until the disqualified student has remained out of this college for at least a 12 month period. Merely remaining in a disqualified status for the above period of time does not, in itself, constitute a basis for reinstatement. Evidence of ability to do satisfactory academic work is required.

Academic Dishonesty. The faculty of the College of Business have adopted a policy on academic dishonesty A copy of the policy may be obtained in the Office of the Dean, Undergraduate Programs.

Student Appeal Procedure on Grades. The faculty of the College of Business have adopted a policy on the student appeal procedure on grades. A copy of the policy may be obtained in the Office of the Dean, Undergraduate Programs.

Special Programs

Asian Studies. Students in the College of Business may pursue a program with emphasis in Asian studies. As part of the Bachelor of Science degree requirements in business, at least 30 upper division semester hours of the program must be in Asian studies content courses. Reading

knowledge of an Asian language is required. The Asian studies content program must be approved by the Center for Asian Studies (see page 109). Fulfillment of the requirements is recognized on the transcript as a bachelor's degree with a designation of the Asian studies discipline. It is possible to complete the certificate program in International Business Studies and the Asian studies emphasis concurrently.

Certificate in International Business Studies. See page 252 for the requirements of this certificate.

Honors Program. The College of Business Honors Program provides opportunities for superior students to interact with other such students and faculty both inside and outside the classroom. The program focuses on students in the professional business program. However, freshmen and sophomores are offered honors breakout sections in core courses and may attend selected events such as seminars with top business leaders and special luncheons.

At the professional program level, each academic unit in the college offers a special upper-division course every third semester. In addition, a senior omnibus course featuring lectures by faculty, local and national experts, and business leaders is offered every fall semester Through the omnibus course, students complete a thesis and receive honors credit for HON 493 Honors Thesis and MGT 463 Strategic Management.

To graduate with an honors degree from the College of Business, professional program business students must:

1. take at least one of the department-offered courses;
2. take the senior omnibus course, completing a thesis approved by the director of the Honors Program;
3. have a minimum of six hours of upper division honors credits outside the college; and
4. graduate from the University Honors College.

A special academic advisor within the College of Business is assigned to honors students to assist in course selection, to monitor progress toward the honors degree, and to be actively involved in job placement upon the completion of the degree.

Latin American Studies. Students in the College of Business may pursue a program with emphasis in Latin American area studies. At least 30 upper-division semester hours of the program must be in Latin American content courses, including 15 semester hours of Latin American content courses in the College of Business listed on page 253 under International Business Studies (except ECN 365) and 15 semester hours of Latin American content courses in other disciplines. A reading knowledge of either Spanish or Portuguese is required; a reading knowledge of both is recommended. The Latin American content program must be approved by the Center for Latin American Studies (see page 110). Fulfillment of the requirements is recognized on the transcript as a bachelor's degree with a designation of the Latin American studies discipline. It is possible to complete the certificate program in International Business Studies and the Latin American emphasis concurrently.

Pre-law Studies. Pre-law students may pursue a program of study in the College of Business. Courses in accounting, economics, finance, insurance, labor relations, and statistics are recommended for any student planning to enter the legal profession.

The admission requirements of colleges of law differ considerably. The student should communicate with the dean of the law school he or she hopes to attend to plan a program to meet the requirements of that school. Most law schools, including the ASU College of Law, require a baccalaureate degree for admission, although some permit admission upon completion of three years of college work.

Students who plan to take a bachelor's degree before entering law school may follow any field of specialization in the College of Business. Within the College of Business are faculty members who are lawyers and who serve as advisors for students desiring a pre law background.

Certificate in Quantitative Business Analysis. See page 245 for the requirements of this certificate.

Assessment and Development in Business Communication. The critical business analysis and related oral and written business communication competencies of all professional business majors are assessed. After this assessment of their critical analyses of business situations, business writing, and videotaped oral presentations, students are given a set of prescriptive developmental activities. After completing these activities, students are again assessed to make sure that all business graduates have established appropriate analytical business communication competencies.

School of Accountancy

Richard E. Flaherty, Ph.D., Director

PROFESSORS:
FLAHERTY BA 267A), BOATSMAN, BOYD, FR TZEMEYER, HAR ED, IMDIEKE, JOHNSON, McKENZIE, PANY, RECKERS, RENEAU, SCHULTZ, SM TH, TIDWELL, W LKINSON, WYNDELTS

ASSOCIATE PROFESSORS:
GOLEN, KAPLAN, KNEER, O'DELL SHR VER

ASSISTANT PROFESSORS:
AHN, ANDERSON CHRISTIAN, GRASSO GUPTA, M TTELSTAEDT, MOECKEL PEI, REG ER

SENIOR LECTURERS:
MAGILL, RABY

LECTURER:
JONES

PROFESSORS EMERITI:
HUIZINGH, HUNTINGTON, SANDERS

The major in Accountancy includes the essential academic training for:

1. those wishing to prepare for professional careers in public accounting,
2. those seeking positions as controllers, heads of accounting divisions, cost accountants or internal auditors;
3. those wishing to serve in any of the numer ous accounting positions offered in federal, state, and local governments, and
4. those planning to operate their own busi nesses.

The major in Accountancy consists of the following 21 semester hours:

			Semester Hours
ACC	321	Intermediate Accounting	3
ACC	322	Intermediate Accounting	3
ACC	331	Cost Accounting	3
ACC	347	Accounting Information Systems	3
ACC	351	Income Tax Accounting	3
ACC	481	Auditing Theory and Practice	3
ACC	483	Advanced Accounting	3

As part of the requirements described in the "Advising Guide" of the College of Business, all Accountancy majors must complete the following courses:

			Semester Hours
COM	100	Introduction to Human Communication	3
		or 230 (3	
COM	259	Communication in Business and the Professions	3
ENG	301	Writing for the Professions	3
PHI	103	Principles of Sound Reasoning	3
PHI	306	Applied Ethics	3

Admission. To be considered for admission to the Accountancy major, a student must (1) meet the College of Business admission requirements and (2) have received a grade of "B" or better in both ACC 211 and ACC 212 or their equivalents.

Academic Good Standing. In addition to college and university requirements, Accountancy majors must receive grades of "C" or better in the required upper division Accounting courses to be in good standing. If an Accountancy major re ceives a grade below "C" in any required upper-division accounting course, this course must be repeated before any other upper-division account ing course can be taken. If a second grade below "C" is received in either an upper division accounting course already taken or in a different upper-division accounting course, the student is no longer eligible to take additional upper-division accounting courses.

ACCOUNTANCY

ACC 211 Introductory Financial Accounting. (3) F S, SS
Theory and pract ce of account ng app cable to the accu mu at on externa report ng and externa uses of financ a account ng nformat on. Prerequ s te· sophomore standing

212 Introductory Managerial Accounting. (3 F, S, SS
Se ect on and analys s of accounting nformat on for nter na use by management. Prerequ s tes: ACC 211, sopho more stand ng

315 Financial Accounting and Reporting. 3) F, S
Account ng theory and practice re ated to uses of f nancia statements by externa dec s on makers Prerequisites ACC 212 non Accountancy major.

316 Management Uses of Accounting. 3 F, S
Uses of account'ng nformat on for manageria dec s on mak ng budget ng and contro Prerequ s tes· ACC 212 non Accountancy major

321 Intermediate Accounting. 3) F, S
Account ng theory and pract ce app cab e to determ na t on of asset va ues and re ated prob ems of ncome deter m nat on Prerequ s tes: ACC 212; profess ona program bus ness student major ng n Accountancy

322 Intermediate Accounting. (3) F, S
Account ng theory and pract ce appl cable to 'abi t es and owner s equ ty Spec'a prob em areas related to income determ nat on and f nancia report ng. Prerequ s tes ACC 321 (grade of "C" or h gher ; profess ona program busi ness student majoring n Accountancy.

331 Cost Accounting. 3 F S
Cost accumu at on systems for product cost ng; cost be hav or concepts for p ann ng and contro w th the ntegra t on of quant tat ve methods Prerequ s tes ACC 212 MAT 119 210 QBA 221, profess ona program bus ness student major ng n Accountancy.

347 Accounting Information Systems. (3 F, S
Informat on requirements and transact on process ng pro cedures re evant to ntegrated accounting systems, em phas zing systems ana ys s and des gn contro s and computer process ng. Prerequ s tes C S 200, profess ona program bus ness student major ng n Accountancy

351 Income Tax Accounting. 3 F S
Federa ncome taxat on of nd v dua s partnersh ps cor porat ons, and f duc ar es Estate and g ft tax Bas c tax p ann ng and research Prerequis tes ACC 212, profes s ona program bus ness student major ng n Accountancy

432 Problems in Managerial Accounting. 3 N
Cases and computer app cat ons n dec s on-mak ng, p ann ng and contro and cap ta budget ng Prerequ s tes: ACC 331 grade of "C" or h'gher · profess ona pro gram bus ness student major ng n Accountancy

452 Advanced Taxation. 3) F S
Advanced prob ems n bus ness and f duc ary ncome tax estate and g ft tax p ann ng and research Prerequ s tes ACC 351 (grade of C" or h gher profess ona program business student major ng n Accountancy

467 Management Advisory Services. 3 N
Concepts and methods of prov d ng adv sory serv ces w th respect to account ng nformat on systems and f nanc a ana ys s Adm n strat on of consu t ng pract ces Pre requ s tes ACC 347 grade of C" or h gher), profess ona program business student major'ng n Accountancy

475 Accounting in Public-Sector Organizations. 3 N
Pr nc p es of account ng and report ng and budget ng and f nanc a contro systems app ed n governmental un ts and other non-bus ness organ zat ons Prerequ s tes ACC 316 or 331 grade of C" or h gher · profess ona program bus ness student major ng n Accountancy.

481 Auditing Theory and Practice. 3 F S
Concepts standards and methods n aud t judgment for mu at on nternal contro eva uat on program deve op ment and samp ng techn ques Eth ca and ega consid rat ons Prerequ s tes ACC 322 347 grades of C" or gher ; PHI 306; profess ona program business student ma or'ng n Accountancy.

483 Advanced Accounting. 3 F, S
Account ng theory re ated to bus ness comb nat ons con o idated f nanc a statements fore gn operations partner h ps and non bus ness organ zations Prerequ s tes ACC 322 grade of C" or h'gher); profess'ona program business student major ng n Accountancy

495 Contemporary Accounting Theory. 3) F, S
Theory of f nanc a account ng and report ng requ rements for prof t or ented enterprises Prerequ s tes ACC 483 (grade of C" or h gher profess ona program bus ness student major ng in Accountancy

502 Financial Accounting. 3 F S
Financia account ng concepts and procedures for exter nal report ng Prerequ s tes ca cu us, computer teracy graduate degree program student

503 Managerial Accounting. 3) F S
Managena account ng concepts and procedures for nter a report ng Prerequ s tes ACC 502 ECN 502 QBA 502.

511 Tax Planning for Management. 3 A
Econom c mp cat ons of se ected management dec s ons nvo v ng app cat on of federal income tax aws Recogn t on of tax hazards and tax sav ngs Prerequ s te ACC 503 or equ valent.

515 Professional Practice Seminar. 3 F, S
H story structure, environment regu at on and emerg ng ssues of the account ng profess on

521 Tax Research. 3 F S
Tax research source mater a s and techn ques App ca t on to bus ness and nvestment dec s ons Prerequ s te ACC 351.

533 EDP Auditing. 3 S
Analys s of EDP aud t techn ques and eva uation meth ods Emphas s on current top cs such as d stributed proc ess ng and m crocomputers Prerequ s te ACC 481

541 Managerial Accounting Controls. (3 F
mpact of nternal report ng systems on organ zat ona de c s ons and human behavior Des gn mplementat on and eva uat on prob ems. Prerequ s te ACC 331 or 503.

551 Advanced Accounting Theory. 3 N
Account ng measurement theories ncome determ nation, and f nanc a report ng alternat ves

571 Taxation of Corporations and Shareholders. (3 F S
Tax aspects of the format on, operat on, reorgan zat on and qu dat on of corporat ons and the impact on share ho ders Prerequ s te ACC 351

573 Taxation of Partners and Partnerships. 3 A
Tax aspects of the def n t on format on, operation qu da tion and term nat on of a partnersh p. Tax p ann ng s em phas zed. Prerequ s te ACC 351.

575 Estate and Gift Taxation. (3) A
Tax treatment of wea th transfers at death and dunng l fe t me, w th emphas s on tax plann ng Prerequ s te· ACC 351

577 Taxation of Real Estate Transactions. (3) A
Income tax aspects of acqu s t on, operat on, and d sposa of rea estate, synd cat ons, nsta iment sa es exchanges, dea er nvestor ssues, a ternat ve financ ng and p ann ng. Prerequ s te ACC 521 or nstructor approval

579 Multinational Taxation. 3 N
Taxat on of mu t nat ona bus nesses, fore gn nd v dua s subject to U S ncome tax and U S c t zens with fore gn residency.

582 Auditing Theory and Practice. 3) N
Funct on and respons b ty of the aud tor n modern soc ety Advanced top cs n aud t ng theory and methods Contemporary ssues n aud t ng Prerequ s te ACC 481.

586 Problems in Financial Accounting. 3 A
Account ng theory and pract ce for externa reporting Prerequ s te· ACC 503

587 Computerized Accounting Systems. 3) F
Des gn and evaluat on of computer based account ng n format on system Deve opment of computer based f nan c a mode s for p ann ng and contro . Prerequ'site· ACC 347

591 Seminar in Selected Accounting Topics. (3) F S

791 Doctoral Sem nar in Accounting. (3) F, S

Omnibus Courses: See pages 50 51 for omn bus courses that may be offered

Business Administration

REGENTS' PROFESSOR:
FARR S
PROFESSORS:
GUNTERMANN, HENDRICK, HENN NGTON, JENN NGS METCALF VELLENGA
ASSOCIATE PROFESSORS:
SMELTZER (BA 318 , ARANDA, BOHLMAN, BUTLER DANIEL DAV S DUNDAS GARCIA, LEONARD, LOCK, LYNCH, MURRANKA MYLER PEARSON
ASSISTANT PROFESSORS:
ELLRAM FERRIN, RE SS
SENIOR LECTURER:
WIGG NS
PROFESSORS EMERITI:
BATY, BOGGS, FEARON JACKS LEWIS, REUTER A SMITH, C. SMITH TATE

The Department of Business Administration of fers courses in four separate areas: business law, management communication, purchasing and lo gistics management, and real estate

Business Law

This faculty offer the undergraduate and the Mas ter of Business Administration business law core requirements. In addition, the faculty offer spe cialized courses in law relating to health care in surance, real estate, and professional sports.

Management Communication

The management communication faculty serve the College of Business by teaching the Bachelor of Science core requirement GNB 301 Adminis trative Communication In addition, the faculty teach GNB 502 Managerial Communication, a core course in the Master of Business Administra tion degree, as well as other management commu nication courses.

Real Estate

The Real Estate program is designed for students with a professional interest in real estate. Aca demic preparation can lead to careers in land de velopment, investment analysis and counseling, appraisal, property management, sales, and fi nance.

The Real Estate major consists of a minimum of 18 semester hours with at least 15 hours in real estate courses. BLW 411 and REA 300 must b completed before taking other real estate courses. REA 251 is not open to Real Estate majors.

The following 12 hours must be included:

			Semeste Hours
BLW	411	Real Estate Law	3
REA	300	Real Estate Analysis	3
REA	331	Real Estate Finance	3
REA	401	Real Estate Appraisal	3

To complete the major, the student must select one additional upper-division course approved b the Department of Business Administration fac ulty and one of the following·

			Semester Hours
REA	441	Real Estate Land Development	3
REA	456	Real Estate Investments	3
REA	461	Current Real Estate Topics	3

Purchasing and Logistics Management

The major in Purchasing and Logistics Manage ment includes the functions of planning, organiz ing, and controlling the flow of purchased materi- als into and out of the organization. Attention i given to analyzing and selecting vendors, pric determination, value analysis, and disposal of scrap and surplus materials. Emphasis is also on the efficient use of transportation services b business management within a framework of lo gistics systems, government transportation policy relative to freight and passengers transportation, and the management of transportation shipper an carrier organizations. Graduates are employed b industrial firms, carriers, and governmental agen cies.

The major in Purchasing and Logistics Man agement consists of the following 18 semest hours:

			Semester Hours
PLM	345	Traffic and Logistics Management	3
PLM	355	Purchasing and Supplier Management	3
PLM	432	Materials Management	3
PLM	455	Purchasing Research and Negotiation	3
PLM	463	International Transportation and Logistics	3
PLM	479	Purchasing and Logistics Strategy	3

Operations/Production Management and Transportation

Applications are not being accepted for majors i Operations/Production Management and Trans portation.

BUSINESS LAW

BLW 305 Legal Environment of Business. 3) F S
Lega framework govern ng ru es of conduct among bus nesses and the mpact on estab sh ng bus ness po cy.

306 Business Law. 3 A
Lega aspects of contracts sales, commerc a paper, se cured transact ons, documents of t t e, etters of cred t, and bank depos ts and co ect ons

307 Business Law. 3) A
Legal aspects of agency partnersh ps corporat ons regu lation of bus nesses bankruptcy, and property

308 Business and Legal Issues in Professional Sports. 3 N
The econom c structure of profess ona sports and appl cat on of contract, antitrust, arbitrat on and abor aws n the ndustry

411 Real Estate Law. 3 A
Lega pract ces as app ed to the rea estate f eld and to the fe ds of t t es mortgages end ng, and trust work

412 Insurance Law. 3 N
Lega concepts and doctr nes appl cab e to the fie d of n surance Prerequ s te· profess ona program bus ness student.

579 Legal, Political, and Ethical Issues for Business. (3) N
Study of egal, eth ca and po t ca components of bus ness decis ons; se f regu at on and soc a respons b ty as regulatory and po tica strateg es Prerequ s tes ACC 503 FIN 502, MGT 502, MKT 502

Omnibus Courses: See pages 50–51 for omn bus courses that may be offered

GENERAL BUSINESS

GNB 233 Business Communication. 3 N
Wr tten and ora report ng. Organ zat on ana ys s and presentat on of bus ness nformat on us ng e ectron c and other med a Prerequ s tes: ENG 102, sophomore stand ng *[Satisfies General Studies Requ rement· L1]*

301 Administrative Communication. 3 F, S SS
Intrapersona nterpersona and administrat ve commun cat on. 2 hours ecture 1 rec tat on. Prerequ s tes: CIS 00, ENG 102 grade of "C or h gher n ENG 101 and 02 *[Satisfies General Stud es Requ rement L1]*

431 Business Report Writing. 3 N
Organizat on and preparat on of reports ncorporat ng electron c data bases word process ng, and graphics. Prerequ s te GNB 301

451 Business Research Methods. 3 N
Methods of co ect ng nformat on pert nent to bus ness problem so v ng, ncluding des gn co ect on ana ysis, n erpretat on, and presentat on of primary and secondary data

502 Managerial Communication. (3) F S, SS
Ana ys s of various bus ness prob ems, s tuat ons, and de ve opment of appropriate commun cat on strateg es Pre equ s te MGT 502

504 Professional Report Writing. 3 A
Preparat on and presentat on of professional reports.

507 Business Research Methods. 3 N
Techn ques for gathering nformat on for bus ness dec on making Se ection des gn, and comp et on of a busi ess oriented research project.

591 Seminar. 3 N
Top cs such as the fo ow ng w be offered
a Se ected Bus ness Commun cat on Topics

594 Study Conference or Workshop. (3) N

700 Research Methods. (3 N

Omnibus Courses: See pages 50 51 for omnibus courses that may be offered

PURCHASING AND LOGISTICS MANAGEMENT

PLM 301 Principles of Transportation. 3 A
Econom c characterist cs, regulat on, and pub c po cy m- p cations of ra motor a r, water, and p pe ne transporta- t on Manag ng the sh pper's transportat on needs Pre requ s te upper d v s on standing or instructor approva

345 Traffic and Logistics Management. 3 A
Manag ng og st cs act v t es w th emphas s on ntegrat ng transportat on needs with nventory, warehousing fac l ty ocat on customer serv ce, packag ng and materia s han d ng Prerequ s tes. OPM 301 professiona program bus ness student

355 Purchasing and Supplier Management. (3) A
Management of the purchas ng funct on, nc ud ng organ zat on, procedures supp er se ect on, qua ty nventory dec s ons and pr ce determ nat on Prerequ s tes OPM 301, profess ona program bus ness student

405 Urban Transportation. 3 N
Econom c soc a , po t ca , and bus ness aspects of pas- senger transportat on. Pub c pol cy and government a d to urban transportat on deve opment Prerequ'site· upper-d - v s on stand ng or nstructor approva!

432 Materials Management. 3 A
Study of manag ng the product ve flow of materia s n or gan zat ons, nc ud ng MRP J T, qua ty, fac ty plann ng and job des gn Prerequ s tes: OPM 301, profess ona program business student

440 Productivity and Quality Management. 3 A
Product v ty concepts at the nat ona!, organ zational and nd v dua eve s. Qua ty management and ts re at onsh p to product v ty n a organ zat ons. Prerequ s tes PLM 432 or nstructor approva , profess ona program bus ness stu dent

455 Purchasing Research and Negotiation. (3) A
Current ph osophy methods and techniques used to conduct both strateg c and operat ons purchas ng re search and negot at on nc udes negot at on s mu ations Prerequ s tes OPM 301, PLM 355 (grade of C" or h gher 432; profess ona program bus ness student

460 Carrier Management. 3 A
Ana ys s of carr er econom cs regu at on, management and rate-making pract ce, eva uat on of pub c po cy s sues re ated to carr er transportat on Prerequ s te· upper d v s on stand ng or nstructor approva

463 International Transportation and Logistics. (3) A
Logist cs act v t es n nternat ona bus ness w th spec a emphas s on transportat on, global sourc ng, customs s sues and fac ty ocat on n nternat ona env ronment. Prerequ s te PLM 345 or nstructor approva

479 Purchasing and Logistics Strategy (3) A
Synthes s of purchas ng product on transportat on to pro vide a systems perspect ve of materia s management Deve opment of strateg es. Prerequ s tes. PLM 345 355 (grade of C" or h gher , 432 profess ona program bus ness student

532 Materials and Purchasing Management. (3 A
Ana ys's of the incom'ng flow of mater a s and the eco nom c env ronment n wh ch the mater a s acqu s t on and a ocat on funct ons operate

541 National Transportation Policy. (3 F
Po cy a ternat ves and prob ems n transportat on nterre at onsh ps of compet ng transportat on modes, re at on sh ps of pub c nvestment to pr vate operat ons Sem nar

545 Business Logistics. 3 S
Systems management concepts approach to og st cs re quirements of the bus ness enterpr se ana ys s of goods and nformat on f ows and coord nat ng act v t es Sem nar.

591 Seminar. 3 N
Top cs such as the fo ow ng w be offered·
(a) Purchas ng
(b Log stics and Transportat on

791 Doctoral Seminar. 3 A
Top cs may be se ected from the fo ow ng
a Transportat on and Phys ca D str but on Manage ment
a Purchas ng and Mater a s Management.

Omnibus Courses: See pages 50–51 for omn bus courses that may be offered

REAL ESTATE

REA 251 Real Estate Principles. 3 N
Regu at on pract ces ega aspects and professiona op portun t es of the rea estate ndustry Cannot be app ed to Rea Estate major

300 Real Estate Analys s. 3 A
App cat on of econom c theory and ana yt ca techn ques to rea estate markets Top cs nc ude aw f nance ap pra sa market ana ys s nvestments, deve opment Pre requ s te profess ona program bus ness student

331 Real Estate Finance. 3 A
Legal market and nst tut ona factors re ated to f nanc ng proposed and ex st ng propert es. Emphas s on current f nanc ng techn ques and quant tat ve methods Prerequ s tes FIN 300, profess ona program bus ness student.

401 Real Estate Appraisal. 3 A
Factors affect ng the va ue of rea estate Theory and pract ce of appra s ng and preparat on of the appra sa re port Appra sa techn ques Prerequ s tes REA 300 pro fess ona program bus ness student

402 Income Property Appraisal. 3) N
Va uat'on of net ncome streams for var ous types of n come produc ng propert es Prerequ s tes. REA 401, pro fess ona program bus ness students

441 Real Estate Land Deve opment. 3 A
Ne ghborhood and c ty growth. Mun c pa p ann ng and zon'ng Deve opment of res dent a , commerc a ndustr a and spec a purpose propert es Prerequ s tes. REA 300, profess ona program bus ness student

456 Real Estate Investments. 3 A
Ana ysis of investment dec s ons for var ous property types Cash f ow and rate of return analys s Prerequ sites FIN 300, profess ona program bus ness student

461 Current Real Estate Topics. 3 N
Current rea estate topics of nterest are d scussed and ana yzed Prerequ s tes REA 300 profess ona program bus ness student

591 Seminar In Selected Real Estate Topics. 3) N
Top cs may be se ected from the fo ow ng:
a Rea Estate Market Ana ys s.
Ana yt ca tech ques used n perform'ng market re search to assess the feas b ty of proposed res den t a reta , off ce and other deve opments
b Rea Estate F nance and Investments.
Bas c techn ques for analyz ng the f nanc a feas b ty of rea estate nvestments nc udes cash f ow, y eld and r sk ana ys s; taxat on form of ownership an management
c Rea Estate Development.
Deve opment process covering feas b ty s te se ec- t on p ann ng, des gn, f nanc ng, and construction Relat onsh p of and use contro s and regulat ons t the pr vate sector
d Real Estate Research
Rev ews current research in areas such as market stud es mortgage secunt zation, va uat on deve op ment, investments, and government regu ation

Omnibus Courses: See pages 50–51 for omnibu courses that may be offered

Decision and Information Systems

PROFESSORS:
BURDICK (BAC 549 ECK, HERSHAUER, KAZMIER, KIRKWOOD, MAYER, PHIL PPAK S, RUCH WOOD

ASSOCIATE PROFESSORS:
BROOKS, CALLARMAN HUSTON, KEEFER, KEIM, O LEARY, ROY, ST LOU S, D. SM TH DANIELS, V. SMITH DANIELS, VERDIN

ASSISTANT PROFESSORS:
CARROLL CH NG, GOUL, KULKARNI, RAM REZ, REISER, SIFERD, WILSON

PROFESSOR EMERITUS:
McCREADY

The major in Computer Information Systems pre pares students for professional careers involving the analysis, configuration, programming, and da tabase aspects of the design and implementatio of computerized business information system The course work prepares the student for a career in business computer information systems and for admission to graduate programs in computer in formation systems or management informatio systems.

The major in Computer Information Systems consists of a minimum of 18 semester hours. Th following 15 hours must be included:

			Semeste H urs
CIS	235	Computer Information Systems I 3	
CIS	330	Interactive Bus ness Systems 3	
CIS	335	Computer Information Systems II . . 3	
CIS	420	Business Database Concepts 3	
CIS	440	Systems Analysis and Design 3	

To complete the major, the student selects three hours of upper division credit approved in advance by the student's faculty advisor

All Computer Information Systems majors must complete CSE 100 Introduction to Computer Science I, which may be counted in the business core in place of CIS 200.

Admission. To be admitted to the Computer Information Systems major, a student must have completed the following courses with a minimum GPA in these courses of 2 50: CSE 100, MAT 119, 210 (or higher level); QBA 221.

Certificate in Quantitative Business Analysis

The program of study leading to the Certificate in Quantitative Business Analysis prepares students to use quantitative analysis methods in business practice and provides a background for graduate studies in quantitatively oriented business fields. This program is not a substitute for the listed areas of business specialization; rather, the courses required for the certificate add quantitative strength to the student s chosen field of specialization.

Students are required to complete the Bachelor of Science degree from any of the major fields in business at ASU and to complete a minimum of 14 semester hours of approved course work, including the following eight hours:

			Sen e ter H ars
MAT	242	E ementary Linear Algebra	2
QBA	321	Intermediate Business Statistics	3
QBA	391	Management Science .	3

To complete the certificate, the student selects an additional six hours of quantitative courses approved in advance by the advisor for the certificate program.

The student must also complete the following courses with a minimum GPA of 2.50: CIS 200; MAT 119, 210 (or 270), 242; QBA 221, 321, 391; an additional six hours of approved electives.

CSE 100 may be counted in the business core in place of CIS 200

Courses taken as part of an approved program of study for the certificate do not count against the college restriction on business free electives

COMPUTER INFORMATION SYSTEMS

CIS 200 Computers in Business. 3 F S
Uses of computers n process ng bus ness data Introduct on to bus ness programm ng Not open to students w th cred t n a h gher eve CIS c ass. Prerequ s te MAT 210 Pre or corequ's te: ACC 212 *[Sat sf es General Studies Requ rement N3]*

235 Computer Information Systems I. (3) F S
Deve opment of computer generated bus ness reports from bus ness data f es Use of a h gh evel, f e-or ented anguage Prerequ s tes CSE 100, MAT 119 210 or 270 QBA 221

300 Computers in Business II. 3 N
ntroduct on to nformat on systems n bus ness Use of computers for bus ness prob em so v ng Prerequ s tes. C S 200 FIN 300; profess ona program bus ness student

307 Systems Modeling 3 N
Procedures for nvest gat ng and ana yz ng dec s'on sys tems. Use of spec a anguages as too s of ana ys s and s mu at on Prerequ s tes. CSE 100 MAT 119, 210 or 270, profess ona program bus ness student

330 Interactive Business Systems. 3 F, S
A gor thms data structures d alogue and representation techn ques program generators for nteract ve app ca t ons Prerequ s te CSE 100.

335 Computer Information Systems II. 3) F, S
Overv ew of bus ness software concepts and recent deve opments Bus ness app cat ons of the computer v a h gh eve , procedure or ented anguages Prerequ s tes. ACC 212 C S 235

420 Business Database Concepts. 3 F S
Overv ew app cat ons and management of business da tabase systems and methods Prerequ s te CIS 330 Pre or corequ s te CIS 335

430 Advanced Topics in Information Systems. (3) N
App cat ons deve opment and advanced programm ng concepts Program structure and des gn Software deve - opment cyc e. Prerequ s tes profess ona program bus ness student nstructor approva .

440 Systems Analysis and Design. 3 F S
Pr nc p es and app cat ons of computer based manage ment nformat on systems and ana ys s and des gn Prerequ s te C S 420

502 Management Information and Decision Support Systems. 3 F, S
Fundamentals of computer based management nforma- t on and dec s on support systems Prerequ s tes. com plet on of a f rst year MBA courses QBA 502

505 Information Systems. 3 A
Data structures for nformat on representat on and ma n pu at on database management systems des gn of da tabase and nformat on systems Prerequ s tes CIS 335 and a computat ona programm ng anguage *or* nstructor approva

510 Systems Models and Simulation. 3 N
Des gn of computer based dec s on systems. S mu at on as a research and dec s on mak ng too Prerequ s tes. MAT 210 QBA 502 a computationa programming an guage

515 Management Information Systems. 3) A
Systems theory concepts app ed to the co ection reten t on and d ssem nat on of nformat on for management dec s on mak ng Prerequ s te. C S 335 or 502

520 Systems Design and Evaluation. (3) A
Methodologies of systems ana ys s and des gn ssues n c ude project management, nterface, organ zat ona re quirements constra nts documentat on mp ementat on contro and performance eva uat on Prerequ s te. C S 505 or equ va ent

525 Artificial Intelligence in Business. (3 A
Development and app cat on of art f c a nte gence ap proaches to business prob em so v ng. Prerequ s te: C S 505 or equ va ent

530 Information Systems Development. (3) A
Eva uat on of languages and qua ty assurance techn ques for system mp ementat on and maintenance Prerequ s te· CIS 505.

535 Distributed Information Systems. 3) A
ntroduct on to network ng and its mpact on nformat on systems n bus ness Prerequ s'te ACC 587 or CIS 505

541 Business Database Systems. (3 A
Comparat've analys s of h erarch ca network and re a tiona systems. Theory of nformat on storage and retr eva and des gn of business nformat on structures Prerequ s tes C S 505 or equ va ent, MAT 210

551 Decision Support Systems. 3 A
Defin tion descr'pt on and eva uat on of dec s on support systems structure and app cat on of se ected DSS an guages Prerequ s tes CIS 505 or QBA 505 MAT 210.

591 Seminar in Selected Computer Information Systems Topics. 3) A

593 Applied Project. 3 F S

791 Doctoral Seminar in Computer Information Systems. (3 A

Omnibus Courses: See pages 50–51 for omnibus courses that may be offered

QUANTITATIVE BUSINESS ANALYSIS

QBA 221 Statistical Analysis. 3) F, S
Methods of statist ca descr pt on Applicat on of probab ty theory and stat st ca nference n business. Prerequ s tes MAT 119 210 *[Sat sfies General Stud es Requ rement N2]*

321 Intermediate Business Statistics. 3 N
App cat on of regress on and ana ys s of var ance mode s to bus ness and econom c prob ems Prerequ s tes. MAT 210 or equ valent· QBA 221 or equ va ent

391 Management Science. (3 A
Study of mathemat cal mode s and so ution techn ques wh ch can be used to a d decis on makers Prerequ s'tes· MAT 119 210 242, QBA 221 profess ona program bus ness student.

410 Applied Business Forecasting. 3 N
App cat on of forecast ng techn ques in bus ness and n st tut ona env ronments. Prerequ s te· QBA 321

421 Advanced Business Statistics. (3 N
App cat ons of probab ty and stat st ca nference to bus ness dec s ons Probab ty theory dec s on theory, and Bayes an inference Prerequ s tes. MAT 270 QBA 221

450 Decision Analysis Applications. (3 N
mp ementat on of quant tative techn ques for the ana ys s and so ut on of manager a prob ems. Prerequ s tes QBA 391, 410

502 Managerial Decision Analysis. (3) F S
Fundamentals of quant tat ve ana ys s to a d management dec s on mak ng under uncerta nty Prerequ s tes· MAT 210; computer teracy, graduate degree program student.

505 Management Science. (3 A
Quant tat ve approaches to dec s on mak ng nclud ng n ear programm ng and s mu at on, w th an emphasis on bus ness app cat ons. Prerequ s tes· MAT 210, QBA 502

510 Managerial Statistics. (3 A
Stat st ca methods used n dec s on mak ng inc ud ng analys s of variance s mp e and mu t p e near regres s on. Prerequ s tes MAT 210 QBA 502 or an introductory stat st cs course

511 Sampling Techniques in Business. 3) A
P ann ng execut on and analys s of surveys in bus ness research. Prerequis te· QBA 502

525 Applied Regression Models. 3) F S
S mp e near regress on m t p e regress on nd cator var ab es and og'st c regress on Emphas s on bus ness and econom c app cations. Prerequ s tes MAT 210; QBA 510

527 Categorical Data Analysis. 3 A
D screte data ana ys s n bus ness research Mu tid men s ona cont ngency tab es and other d screte mode s Pre requ s te QBA 525

528 Exploratory Data Analysis. (3) A
ntroduces student to pr nc p es and methods of explora tory data ana ys s Prerequis te QBA 502

530 Experimental Design. 3 A
Exper menta des gns used n bus ness research Ba anced and unbalanced factor a des gns repeated meas ures des gns, and mu t var ate ana ys s of var ance Pre requ s te QBA 525 or equ va ent

535 Multivariate Methods. 3 A
Advanced stat stica methods used n bus ness research. Mult var ate ana ys s of assoc at on and nterdependence Prerequ s te. QBA 525

540 Forecasting. 3) A
Foundat on of stat st ca forecasts and forecast nterva s, app cat on of c ass ca and computer-ass sted forecast ng methods to bus ness forecast ng prob ems Prerequ s tes MAT 210; QBA 502

550 Intermediate Decision Analysis. 3 A
Quant tat ve dec s on ana ys s methods for bus ness deci s on mak ng under uncerta nty, nc ud ng dec s on d a grams, subjective probab t es and preference assess ment. Prerequ s tes MAT 210, QBA 502

552 Statistical Decision Theory. 3 A
Stat st ca dec s on methods for bus ness dec s on mak ng under uncerta nty, nc ud ng Bayes an nference, opt ma stat st ca dec s ons and va ue of nformat on assessment. Prerequ s tes MAT 210 QBA 510 or 550

560 Probabilistic Models. 3 A
Deve opment and app cat on of probabi st c mode s for quant tat ve bus ness ana ys s Prerequ s tes MAT 210 QBA 502

561 Mathematical Programming. 3 A
Techn ques for so v ng mathematica programm ng mod e s of bus ness prob ems Prerequ s tes MAT 210 242

562 Network Flow Models. 3 N
ntroduct on to network structure app cat ons and a go r thms, deve opment of data structures for network a go r thms app ed to bus ness prob ems Prerequ s tes QBA 561 *or* MAT 242 and QBA 505

564 Nonlinear Optimization. 3 A
Bas c propert es of so ut ons and a gor'thms for con stra ned and unconstra ned m n m zat on bas c descent methods and barr er methods Prerequ s tes QBA 561 *or* MAT 242 and QBA 505

591 Seminar. (3) A

593 Applied Project. (3) F, S

791 Doctoral Seminar in Quantitative Business Analysis. (3) A

Omnibus Courses: See pages 50–51 for omnibus courses that may be offered.

OPERATIONS AND PRODUCTION MANAGEMENT

OPM 301 Operations and Logistics Management. (3) F, S, SS
Identification and integration of major components of operations and logistics management and their impact on organizational productivity and performance.

502 Operations and Logistics Management. (3) F, S
Conceptual foundations for the total operations and logistics functions for all types of organizations. Application of analytical methods to production problems. Prerequisites: ECN 502; QBA 502.

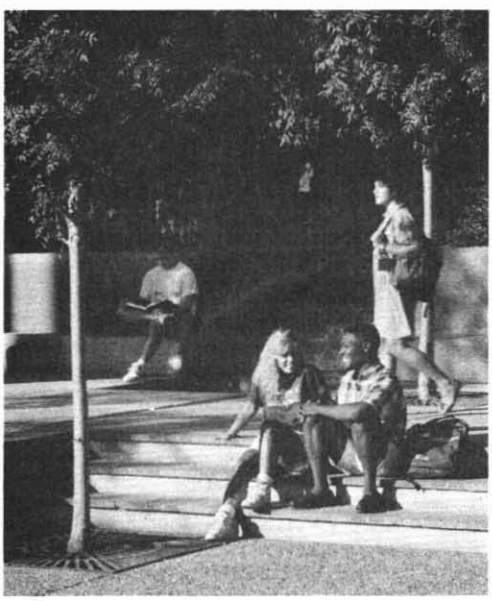
581 Management of Production. (3) A
Analysis of the production function from a managerial point of view. Conceptual foundations, analysis of major problems, and decision processes.

591 Seminar. (3) N
Topics such as the following will be offered:
(a) Production Systems Research
(b) High-Tech Operations
(c) Operations Strategy
(d) Service Operations
(e) Productivity
(f) Quality

791-A Doctoral Seminar in Production/Operations Management. (3) A

791-B Doctoral Seminar in Logistics Systems. (3) A

Omnibus Courses: See pages 50–51 for omnibus courses that may be offered.



Economics

PROFESSORS:
BURGESS (BAC 667), BLAKEMORE, BOYES, BRADA, FAITH, GOODING, HOFFMAN, HOGAN, JACKSON, KINGSTON, KNOX, LOW, McDOWELL, McPHETERS, MELVIN, SCHLAGENHAUF

ASSOCIATE PROFESSORS:
COX, DeSERPA, HAPPEL, MENDEZ, ORMISTON, SMITH, WINKELMAN

ASSISTANT PROFESSORS:
AHN, SCHLEE, WRASE

LECTURER:
ROBERTS

PROFESSORS EMERITI:
COCHRAN, LOWE, PLANTZ

The study of economics affords an opportunity for the student to acquire a general knowledge of the methods by which goods and services are allocated and incomes are generated and why prices, employment, money, and financial markets behave as they do. Some knowledge of economics is crucial not only for those intending to participate in the business world, but for those intending to pursue graduate educations in law or other business fields or to work in the world of journalism and communications.

Economists obtain positions at universities and in government, financial institutions, brokerage houses, private nonfinancial corporations, and international organizations such as International Monetary Fund and the World Bank and as financial journalists and as marketing and management specialists in domestic and international firms.

Economics majors are required to earn a minimum grade of "C" in MAT 270 Calculus with Analytic Geometry I before taking upper-division courses in economics. MAT 270 may be used in place of MAT 210 in the Science and Mathematics area of the requirements described in the "Advising Guide."

The major in Economics consists of 18 semester hours of upper-division courses in economics. The following six hours must be included:

			Semester Hours
ECN	313	Intermediate Macroeconomic Theory	3
ECN	314	Intermediate Microeconomic Theory	3

ECN 313 and 314 must be taken after the completion of MAT 270 and before other upper-division courses in economics. Concurrent enrollment in ECN 313 and 314 is permitted. Concurrent enrollment in ECN 313 or 314 and other upper division courses in economics is subject to the approval of the faculty advisor.

ECONOMICS

ECN 111 Macroeconomic Principles. 3 F, S, SS
Basic macroeconomic analysis. Economic institutions and factors determining income, employment, prices, and employment levels. *[Satisfies General Studies Requirement: SB]*

112 Microeconomic Principles. 3 F, S
Basic microeconomic analysis. Theory of exchange and production including the theory of the firm. *[Satisfies General Studies Requirement: SB]*

313 Intermediate Macroeconomic Theory. (3 F, S
Determinants of aggregate levels of employment, output and income of an economy. Prerequisites: ECN 111, 112, MAT 270 (grade of "C" or higher). *[Satisfies General Studies Requirement: SB]*

314 Intermediate Microeconomic Theory. 3 F, S
Role of the price system in organizing economic activity under varying degrees of competition. Prerequisites: ECN 111, 112, MAT 270 (grade of "C" or higher). *[Satisfies General Studies Requirement: SB]*

315 Money and Banking. 3 SS
Functions of money. Monetary systems, credit functions, banking practices, and central banking policy. This course cannot be applied to the Economics major. Prerequisite: ECN 111. *[Satisfies General Studies Requirement. SB]*

331 Comparative Economic Systems. (3 N
Alternative institutions past and present, for organizing the social division of labor. Property rights, information and incentives in industrial societies. Prerequisite: ECN 111 or 112. *[Satisfies General Studies Requirements: SB, G]*

360 Economic Development. 3) N
Theories of economic growth and development. Role of capital formation, technological innovation, population and resource development in economic growth. Prerequisites: ECN 111, 112. *[Satisfies General Studies Requirements: SB, G]*

365 Economics of the Soviet Union and Eastern Europe. (3 N
Organizations and analysis of contemporary institutions. Comparative development and differentiation in the 20th century. Prerequisites: ECN 111, 112. *[Satisfies General Studies Requirements. SB, G]*

394 Special Topics. 3 SS
Current topics of interest in economics, e.g., managerial economics, microeconomic policy issues, etc. Prerequisites: ECN 111, 112, junior standing with a 2.00 GPA.

404 History of Economic Thought. 3 N
Development of economic doctrines, theories of mercantilism, physiocracy, classicism, neoclassicism, Marxism, and contemporary economics. Prerequisites: ECN 313, 314. *[Satisfies General Studies Requirement: SB]*

421 Labor Economics. 3 A
Organizations of labor movements, analysis of labor unions, labor markets, collective bargaining and current policy issues. Prerequisite: ECN 314. *[Satisfies General Studies Requirement: SB]*

436 International Trade Theory. 3 A
The comparative advantage doctrine including practices under varying commercial policy approaches. The economic impact of international sequestrum. Prerequisites: ECN 313, 314. *[Satisfies General Studies Requirements: SB, G]*

438 International Monetary Economics. 3 A
History, theory and policy of international monetary economics. Balance of payments and exchange rates. International financial markets including Eurocurrency markets. Prerequisites: ECN 313, 314. *[Satisfies General Studies Requirements: SB, G]*

441 Public Finance. 3) A
Public goods, externalities, voting models, public expenditures, taxation and budget formation with emphasis on the federal government. Prerequisite: ECN 314. *[Satisfies General Studies Requirement. SB]*

453 Government and Business. 3 A
Development of public policies toward business. Antitrust activity. Economic effects of government policies. Prerequisite: ECN 314.

480 Introduction to Econometrics. 3 A
Elements of regression analysis, estimation, hypothesis tests, prediction. Emphasis on use of econometric results in assessment of economic theories. Prerequisite: ECN 314. *[Satisfies General Studies Requirement: N2]*

484 Economics Internship. 3 F, S, SS
Academic credit for professional work organized through the Internship Program. Prerequisites: ECN 313, 314, outstanding academic record.

485 Mathematical Economics. 3 A
Integration of economic analysis and mathematical methods into a comprehensive body of knowledge with contemporary economic theory. Prerequisites: ECN 313, 314. *[Satisfies General Studies Requirement. N2]*

494 Special Topics. 3 N
Current topics of interest in economics, e.g., managerial economics, microeconomic policy issues, etc. Prerequisites: ECN 313, 314.

498 Pro-Seminar. 3 A
Chosen from selected topics e.g. money, development, urban economics, economic regulation, area studies, etc. Prerequisites: ECN 313, 314.

502 Managerial Economics. 3 F, S
Application of economic analysis to managerial decision making in areas of demand, production, cost, and pricing. Evaluation of competitive strategies. Prerequisites: calculus, computer literacy, graduate degree program student.

504 Development of Economic Analysis. 3 A
Historical development of economic theory. Emphasis on the development of economic analysis from preclassical economics through Keynes.

509 Macroeconomic Theory and Applications. 3 N
Theory of income, output, employment and price level. Influence on business and economic environment. Prerequisite: ECN 111.

510 Microeconomic Theory and Applications. (3 A
Theory of exchange, production and pricing in a market economy. Influence on business and economic environment. Prerequisite: ECN 112.

511 Macroeconom c Analysis I. 3 A
The nat on s ncome output, emp oyment and genera price eve . Exam nat on of current theoret ca and emp r ca research and po cy prob ems Prerequ s te ECN 313.

512 Microeconomic Analysis I. 3 A
Theory of exchange product on resource use and pr c ng n cap ta st'c and m xed systems Prerequ s te· ECN 314

513 Macroeconomic Analysis II. 3) A
Advanced top cs n macroeconom cs. Emphas s on ap p ed macroeconom c mode s Prerequ s te ECN 511

514 Microeconomic Analysis II. 3 A
Advanced top cs n m croeconom cs. Emphas s on genera equ l brium, we fare econom cs and product on and cap ta theory. Prerequ s te ECN 512

516 Monetary Theory. 3 N
Trad t ona and post Keynes an monetary theory nterest rate determ nat on the demand and supp y of money Prerequis te: ECN 511

517 Monetary Policy. 3 N
Determ nants of the money supp y and nterest rate eve s Federa Reserve po cy and ts effect veness Prerequ s te ECN 516

521 Labor Economics I. 3 N
Deve opment of bas c theoret ca mode s for ana yz ng a bor market ssues. Prerequ s te ECN 512

522 Labor Economics II. 3 N
Extens ons cr t c sms of abor market theor es App ca- t ons to a var ety of po icy ssues Prerequ s te ECN 521

531 Economic Systems and Organizations. (3 N
Ph losoph ca foundat ons of major econom c systems and of propert es of pr nc pa system models Compar son of a ternat ve nst tut ons and system components of contem porary econom es Prerequ s tes ECN 511 512

536 International Trade Theory. 3 A
Theor es of comparat ve advantage and the r emp r cal ver f cat on Theory and po t ca economy of commerc a po cy Resource transfers and the role of the Mu t nat ona Corporat on Prerequ s tes ECN 511 512

538 International Monetary Theory and Policy. 3 A
The fore gn exchange market balance of payments and nternat ona f nanc a nst tut ons and arrangements; the ory and app cat ons. Prerequ s tes· ECN 511 512

543 Public Sector Economics. 3 N
Econom cs of co ect ve act on, pub ic spend ng and taxa- t on mpact of centra governmenta act v ty on resource a ocat on and ncome d str but on Prerequ s te ECN 512

553 Industrial Organization. 3 N
Ana ys s of structure conduct, and performance n ndus tria markets and recent deve opments n ant trust po c es. Prerequ s te ECN 512.

561 Economics of Developing Nations. (3 N
Econom c prob ems ssues and po cy dec s ons fac ng the esser deve oped nat ons of the wor d. Prerequ s tes ECN 511 512

572 Regional Economics. 3 N
ntroduct on to export base nput output near program m ng s mu at on and econometr c mode ng as too s of reg ona analys s Prerequ s te ECN 512.

580 Econometrics I. 3 A
App cat on of mathemat ca and stat st ca techn ques to prob ems of econom c theory Prob ems n the formu at on of econometnc mode s Prerequ s te 6 hours of stat st cs

581 Econometrics II. 3 A
Advanced top cs in econometr cs Emphas s on extend ng the s mp e near mode and on s mu taneous re at on sh ps Prerequ s te ECN 580

584 Economics Internship. 1 3 SS
Academ c cred t for profess ona work organ zed through the nternsh p Program Prerequ s tes ECN 511 512.

591 Seminar in Selected Economics Topics. 3) N

594 Conference and Workshop in Economics. 1–2) F S
Work ng papers by department facu ty and outs de speak- ers are presented and discussed Econom cs ABDs wi l a so present the r thes s proposa s Prerequ s te: nstruc- tor approva

791 Doctoral Seminar in Economics. 3 A

Omnibus Courses: See pages 50 51 for omn bus courses that may be offered

Finance

PROFESSORS:
SMITH (BAC 519), JOEHNK, KAUFMAN, POE SUSHKA

ASSOCIATE PROFESSORS:
BOOTH CESTA, HOFFME STER, MART N WILT

ASSISTANT PROFESSORS:
AMEL, BESSEMBINDER, BROADMAN CHAN, CHANG, GALLINGER HERTZEL

PROFESSORS EMERITI:
ANDERSON DAUTEN, NELSON OLNEY, STEVENSON, TENNEY

The study of finance prepares students to understand the financial implications inherent in virtually all business decisions. Students majoring in Finance are prepared for entry level careers in corporate management, depository institutions, investment management, and financial services. The finance curriculum emphasizes financial markets, evaluation of investments, and efficient allocation of resources.

The major in Finance consists of 18 semester hours. The following courses must be included in the major

			Semester Hours
FIN	331	Financial Markets and Institutions	3
FIN	361	Managerial Finance	3
FIN	421	Security Analysis and Portfolio Management	3
Additional 400 level FIN course			3

All students must complete ACC 315 Financial Accounting and Reporting before taking 400 level FIN courses. In addition, ACC 316 Management Uses of Accounting must be taken.

Students have the option of including the ACC courses as part of the major or as free electives. If the ACC courses are chosen as free electives, the upper division courses used to complete the major must be approved in advance by the Department of Finance

FINANCE

FIN 251 Principles of Personal Investments. 3) N
Investment concepts for individual investors, fundamentals of investment techniques and principles of sound investment For nonmajors Course may be used only for elective credit by College of Business students

300 Fundamentals of Finance. (3 F S, SS
Theory and problems in financial management of business enterprises Prerequisites ACC 212 ECN 112 QBA 221.

331 Financial Markets and Institutions. 3 F S
Analysis of financial markets and intermediaries. Theory of financial intermediation interest rate theory money and capital market instruments and government regulation. Prerequisites FIN 300, professional program business student.

361 Managerial Finance. 3 F, S
Theories and problems in resource allocation cost of capital, CAPM and capital budgeting asset valuation, capital structure and financing policy. Prerequisite FIN 300.

421 Security Analysis and Portfolio Management. 3) F S
Security analysis theory and practice. Selection and management of financial asset portfolios Securities markets and portfolio risk return analysis Prerequisites: ACC 315 or 321 FIN 331 361, professional program business student.

427 Speculative Securities. 3 A
Study of stock options, index options convertible securities, financial futures warrants, subscription rights and arbitrage pricing theory Prerequisites F N 421 professional program business student

431 Management of Financial Institutions. 3 A
Asset/liability and capital management in financial institutions influence of market factors and regulatory agencies Emphasis on commercial banks Prerequisites ACC 315 or 321 FIN 331 professional program business student

451 Working Capital Management. 3 N
Analysis of short term profitability and quality Emphasis on managing cash accounts receivable, inventory, and current liabilities Prerequisites ACC 315 or 321 FIN 300 professional program business student

461 Financial Cases and Modeling. 3 A
Case oriented capstone course in managerial finance Contemporary issues of quality management capital budgeting, capital structure and financial strategy Prerequisites ACC 315 or 321 F N 361· professional program business student

471 Risk Financing. 3 N
Identification, measurement, and treatment of risk financing Control, retention, and transfer as alternate approaches to the risk of loss Prerequisites F N 300, professional program business student

481 Theory of Finance. 3 N
Advanced course in financial theory for honors students and selected senior Finance majors. Honors student or senior Finance major with minimum GPA of 3 40

502 Managerial Finance. 3) A
Theory and practice of financial decision making, including risk analysis, valuation capital budgeting, cost of capital, and working capital management Prerequisites ACC 502 ECN 502 QBA 502

521 Investment Management. (3 A
Valuation of equities fixed incomes and options financial futures in an individual security and portfolio context mathematical asset allocation approaches Not open to students with credit in F N 421 Prerequisite· F N 502

531 Capital Markets and Institutions. 3 A
Recent theoretical and operational developments in economic sectors affecting capital markets and institutions Not open to students with credit in FIN 431. Prerequisite FIN 502

561 Financial Management Cases. (3 N
Case-oriented course in applications of finance theory to management issues Acquisition allocation and management of funds within the business enterprise Working capital management capital budgeting capital structure, and financial strategy. Not open to students with credit in F N 461 Prerequisite· F N 502

581 Theory of Financial Decisions. (3 A
Theories and applications of managerial finance and investments Capital budgeting, capital structure dividend theory, and valuation Prerequisite: F N 502.

781 Theory of Finance. 3 A
Central paradigms of finance theory individual and social allocation of scarce resources through a pricing system with valuation of risky assets Prerequisite F N 502 521 531.

791 Doctoral Seminar in Finance. (3) A
(a Investments. A
Investments and market theory efficient markets hypothesis; option and commodity markets Prerequisite. F N 581
b) Financial Institutions and Markets A
Economic and monetary theory applied to financial markets and institutions implications of financial structure for market performance and efficiency Prerequisite FIN 581.
c Financial Management A
Financial theory pertaining to capital structure, dividend policy valuation cost of capital and capital budgeting Prerequisite F N 581.

Omnibus Courses: See pages 50 51 for omnibus courses that may be offered

INSURANCE

INS 251 Principles of Insurance. 3 N
Coverages available buying methods, regulation claims insurance institutions and career opportunities.

321 Life and Health Insurance. 3 N
Types and uses of life and health policies, industry organization regulations underwriting, and other company operations. Prerequisite professional program business student.

31 Property Insurance Principles and Coverage. 3 N
Princ'p es of property and abi ty nsurance, ndustry or-gan'zat on types and forms of coverages, and commerc a overage fundamentals Prerequ s tes NS 251 or n tructor approva profess ona program bus ness student

461 Estate Planning. 3 N
Use of life nsurance w th w s, trusts and buy se agree ments and tax aspects Needs approach to estate p an ng Prerequ s te profess ona program bus ness stu ent

Omnibus Courses: See pages 50 51 for omn bus courses that may be offered

School of Health Administration and Policy

PROFESSORS:
SCHNELLER (BA 252) JOHNSON, KRONENFELD ZUCKERMAN
ASSOCIATE PROFESSORS:
K RKMAN-LIFF, W LL AMS
ASSISTANT PROFESSOR:
MONDRAGÓN

The Graduate Program in Health Services Administration

The School of Health Administration and Policy offers the Master of Health Services Administra tion (M.H.S.A.). Students enrolled in the school may earn the concurrent M H.S.A./M.B.A. de grees. The school also collaborates with the Col-lege of Law to allow students to earn concurrently the M.H.S.A. J.D. degrees and the College of Nursing to allow students to earn concurrently the M.H.S.A./M S. in Nursing Administration de-grees. The school collaborates with the American College of Physician Executives and the Western Network for Education in Health Administration to offer the Certificate in Healthcare Leadership and Management for physicians.

The M.H.S.A. program is designed to prepare students for entry level management positions in health services delivery, planning/policy and consulting organizations. Although most pro gram graduates have aspired to and successfully found employment in hospitals, the curriculum and research efforts within the school do not fo cus on one categorical setting Students are able to study the characteristics of vertically integrated systems and may choose from courses focused on ambulatory settings, long term care, and other components of the continually evolving health care system. Since so many of the features of the environment of health services are subject to peri-odic change (e.g., reimbursement and informa tions systems , substantial emphasis is on build-ing the basic skills and analytic perspectives nec essary to encounter and react to change through innovation and action.

The program has a special commitment to pro vide students with an understanding of the com petitive nature of the health care system. Since so many of the features of the environment of health services are subject to periodic change, substan tial emphasis is placed on building basic skills to understand and scan environments and to encoun ter and react to change through innovative action. Program students are educated to think independ ently and to recognize the strengths and weak nesses of group processes in decision making.

The mission of the M.H.S.A. program is to de-velop in its students a pattern for skill acquisition, ideology, and style that is necessary for entry into the job market and for pursuing careers as chief executive officers in target organizations To ac complish this mission, the curriculum provides:

1 the skills of understanding, analysis, and ap-plication that are essential to effective health care administration;
2 internship, residency, and project experi-ences that bridge the gap between theory and practice; and
3 opportunities to interact with practioners, both in the classroom and in structured field experiences.

HEALTH SERVICES ADMINISTRATION

HSA 494 Special Top cs In Health Administration. 3) A
Sem nar top cs nc ud ng comparat ve hea th care sys-tems, ambu atory care adm n strat on behav ora hea th, long term care and hea th econom cs Prerequ s te in structor approva

501 Health Care Organization. 3 F, S
Concepts, structures funct'ons and va ues wh ch charac ter ze contemporary hea th care systems n the Un ted States

502 Health Care Organization and Ethics. 4 F, S
Concepts structures, funct ons va ues and b omed cal and manager a eth cs as app ed to the hea thcare sys tem

505 Community Health Care Perspectives. 4) F S
Ep dem o og ca soc o og ca and po t cal perspect ves and techn ques for ana yz ng hea th prob ems and re spond ng to hea th care eeds n commun t es. Prerequ s te HSA 502.

512 Health Care Economics. 3 F S
Econom cs of product on and d str but on of hea th care serv ces w th spec a emphas s on the mpact of regu a

tion, competit on and economic ncent ves Prerequ site HSA 502

520 Hospital Structure and Policy. (3) F S
Funct ona re at onsh ps among manager al elements of hea th care nst'tut ons with major focus on hosp tal gov ernance and po cy dynam cs. Prerequ s te: HSA 502

522 Health Care Management Systems. 3) F S
Systems concepts, quant tat ve methods and nformat on systems app ed to management prob ems n hea th inst - tut ons and commun ty hea th planning Prerequ s tes: HSA 505; QBA 502.

532 Financial Management of Health Services. (3) F S
Acqu s t on a location and management of f nanc a re sources w th n the hea th care enterpr se Budget ng cost ana ys s, f nanc al p ann ng and nterna contro s Prerequ s tes: ACC 503, FIN 502; HSA 502

542 Health Care Jurisprudence. (3) F S
Lega aspects of hea th care de very for hosp ta and health services adm n strat on Lega respons b l ties of the hosp ta adm n strator and staff Prerequ s tes HSA 505, 520

571 Ambulatory Care Management. (3) A
The evo ution, p ann ng, and management of mu t spe c alty group pract ces hea th ma ntenance organ zat ons and other a ternat ve de very systems. Prerequ s te HSA 502.

589 Integrative Seminar. (3) F S
Capstone assessment of current pol c es prob ems and controvers es across the broad spectrum of hea th serv 'ces adm'n strat on Prerequ s tes HSA 505 520 522 532.

591 Seminar. 3) A
Sem nar top cs such as the fo ow ng may be offered
(a) Comparat ve health care systems
(b) Cost conta nment and qual ty assurance
(c) Behav ora hea th
(d) Long term care
(e) Hea th care econom cs
(f) Hea th care abor aw
(g) Top cs n hea th services research
(h) Managing phys c ans
( ) Mult hospita systems

593 Applied Project. (1–6 F S SS
Superv sed on s te exper ence n advanced deve opment of manager a ski s n hea th serv ces adm n strat on and pol cy M n mum of 10 weeks. Prerequ s tes: 18 hours of cred t toward program of study d rector approval

Omnibus Courses: See pages 50–51 for omn bus courses that may be offered

International Business Studies

Certificate in International Business Studies

The program of study leading to the Certificate in International Business Studies is designed to prepare students for positions with multinational firms, banks, government agencies, and international organizations. This program is not a substitute for the listed areas of business specialization; rather, the courses required for the certificate add an international dimension to the student's chosen major.

The requirements for the certificate are as follows:

1. At least 12 semester hours of approved courses in international business are required. The objective of this requirement is to introduce the student to the environment and operating principles of international business, to the international aspects of the student's chosen area of specialization, and to the interaction of all the business disciplines in an international environment. IBS 300 Principles of International Business is required of all candidates for the certificate. Other international business courses are as follows:

ECN	331	Comparative Economic Systems
ECN	360	Economic Development
ECN	365	Economics of the Soviet Union and Eastern Europe
ECN	436	International Trade Theory
ECN	438	International Monetary Economics
MGT	459	International Management
MGT	494	Special Topics: International Management
MKT	435	International Marketing
MKT	494	Special Topics: International Marketing
PLM	463	International Transportation and Logistics

2. At least 18 semester hours of approved electives in international and area studies are required. A minimum of six semester hours must be in courses that provide a cross cultural perspective from the global point of view of one or more disciplines. A minimum of nine semester hours must be in courses that provide an understanding of one region of the world.
3. Evidence of competence in a foreign language equivalent to one year of college study is required.

Since the careful planning and selection of courses are necessary to meet the requirements for the certificate without exceeding the minimum number of hours required for graduation, interested students are urged to consult with an international business faculty advisor as early as possible.

INTERNATIONAL BUSINESS STUDIES

IBS 300 Principles of International Business. (3) A ult d sc p inary analys s of nternationa econom c and f - anc al env ronment Operat ons of mult nationa f rms and eir nteract'on w th home and host soc et es Prerequ - site· ECN 112 *[Satisfies General Stud es Requirement G]*

mnibus Courses: See pages 50–51 for omn bus purses that may be offered

Management

PROFESSORS:
GOMEZ-MEJ A (BA 323J , BOHLANDER, MONTANAR PAST N PENLEY, REIF, WH TE

ASSOCIATE PROFESSORS:
BASSFORD, BRENENSTUHL, CARDY, COOK HOM, KEATS, KELLER, KIN CKI, MANZ, MOORHEAD, OL VAS, SH PPER, VAN HOOK

ASSISTANT PROFESSORS:
CARSON DAVY, GOOD NG, JACOBSON, REGER

SENIOR LECTURERS:
KRE TNER, LEA

PROFESSORS EMERITI:
COCHRAN, DAVIS, GROSSMAN, HEIER, INSKEEP SCHABACKER

Management includes the functions of planning, rganizing, staffing, motivating, and controlling n the business setting; yet management is more than mere administration. Good managers make things happen through their actions within an or- anization and through responsible contributions o society. Good managers also understand the implications of their actions in an international environment. The Department of Management ffers international business seminars for its stu ents, and it provides students opportunities to specialize their studies in management systems or human resources management.

anagement Systems

The purpose of management is to maximize desir- able organizational outputs and minimize undesir ble organizational outputs, given realistic con- traints. Many tools and systems are used to achieve these ends. These tools and systems are the focus of the management systems track. The ollowing courses must be taken to complete this rack:

		Semester Hours
MGT 311	Personnel Management	3
MGT 352	Human Behavior in Organizations	3

Three of the following five courses:

MGT 433	Management Decision Analysis	3
MGT 434	Social Responsibility of Management	3
MGT 440	Entrepreneurship	3
MGT 459	International Management	3
MGT 468	Management Systems	3

In addition, students must take one MGT elec tive approved by a management advisor.

All Management majors are required to take six upper division General Studies hours selected from the College of Business "Advising Guide" and approved by a management advisor.

Human Resource Management

Effective organizational management depends upon creating an internal organization that is designed to accomplish the organizational mission. The human resource management track introduces the student to issues surrounding the human component of organizations. The curriculum encompasses planning, staffing, motivating, training and development, compensation, performance appraisal, labor relations, and labor law. The courses are designed to provide knowledge and skills that will allow HRM graduates to function as personnel specialists. The following courses must be taken to complete the human resource management track:

		Semester Hours
MGT 311	Personnel Management	3
MGT 352	Human Behavior in Organizations	3
MGT 413	Wage and Salary Management	3
MGT 423	Industrial Relations and Collective Bargaining	3

In addition, students must take two MGT electives in human resource management approved by a management advisor.

All Management majors are required to take six upper-division General Studies hours selected from the College of Business "Advising Guide" and approved by a management advisor.

MANAGEMENT

MGT 301 Management and Organization Behavior. (3) F S SS
Adm n strat ve, organ zat ona , and behav oral theories and funct ons of management contr but ng to the effect ve and eff c ent accomp shment of organ zational objectives Prerequ s tes. 1 psycho ogy (soc a and behav ora) 1 course and soc ology course

311 Personnel Management. 3 A
Manpower p ann ng staff ng tra n ng and deve opment compensat on, appra sa and abor re at ons Prerequ s te MGT 301

352 Human Behav or in Organizations. 3 A
Human aspects of bus ness as d st ngu shed from econom c and techn ca aspects and how they nf uence eff c ency mora e and management pract ce Prerequ s te MGT 301

413 Wage and Salary Management. 3 A
nsta at on and adm n strat on of a comp ete wage and sa ary program nc udes object ves, po c es, organ zat on control, job eva uat on and wage survey Prerequ tes MGT 311 profess ona program bus ness student

422 Training and Development. 3 N
Learn ng theory, or entat on and bas c eve tra n ng man agement deve opment resource mater a s and methods Prerequ s tes MGT 311, profess ona program bus ness student

423 Industrial Relations and Collective Bargaining. 3 A
Processes and procedures of co ect ve barga n ng Scope and negot at on of un on contracts

424 Employee Selection and Appraisal. 3 A
Concepts and methods of personnel se ect on and per formance appra sa . nc udes job ana ys s, measurement and ega ssues Exper ent a exerc ses emphas zed. Prerequ s te: MGT 311

433 Management Decision Analysis. 3 A
Dec s on mak ng concepts and methods n the pr vate and pub c sectors and the r app cat on to organ zat onal prob ems. Understand ng of nd v dua and group dec s on mak ng Prerequ s tes MGT 301 profess ona program bus ness student.

434 Social Responsibility of Management. 3 A
Relat onsh p of bus ness to the soc a system and ts env ronment Cr ter a for appra s ng management dec s ons Managers as change agents Prerequ s tes MGT 301 profess onal program bus ness student

440 Entrepreneurship. 3 A
Opportun t es r sks, and prob ems assoc ated w th sma bus ness deve opment and operat on

441 Venture Design and Development. 3 N
Analys s des gn and deve opment of a bus ness p an for a new venture Prerequ s te ACC 212

442 Small Business Management. 3 N
Students, act ng as management consu tants, app y bus ness pr nc p es and make recommendat ons to sma bus nesses wh e learn ng to manage sma f rms Prerequ s te bus ness core except MGT 463

447 Management and the Impact of Technology. 3 N
The mpact of techno ogy on strateg c p ann ng and hu man resources management n bus ness organ zat ons

448 Management and the Impact of Technology: Research. 3 N
Deve opment of research strateg es and cases for study ng the mpact of techno ogy on management theory and pract ce n bus ness organ zat ons Prerequ s te MGT 447

452 Organizational Behavior Applications. 3 A
The comp ex set of behav ora forces and relat onsh ps that nf uence organ zat ona effect veness I tervent on strateg es and app cat on sk s Prerequ s tes: MGT 352 profess ona program bus ness student

459 International Management. 3 A
Concepts and pract ces of mu t nat ona and fore gn f rms. Object ves, strateg es, po c es, and organ zat ona struc tures for operat ng n var ous env ronments Prerequ s te MGT 301

463 Strategic Management. 3 A
Strateg c formu at on and adm n strat on of the total or gan zat on nc ud ng ntegrat ve ana ys s and strateg c p ann ng To be taken ast semester of sen or year Pre requ sites comp et on of 108 hours nc ud ng a othe bus ness adm n strat on core requ rements professiona program bus ness student *[Sat sf es Genera Stud es Requ rement L2]*

468 Management Systems. 3 A
Systems theory and pract ce app ed to organ zat on proc ess and research Organ zat ons seen as open systems nteract ng w th chang ng env ronments Prerequ s te MGT 301

494 Spec al Topics. 3 N
Chosen from top cs n human resources, strategic man agement, and nternat ona management nc ud ng sem nars n nternat ona management n As a or Europe etc

502 Organization Theory and Behavior. 3 F S
mportant concepts and app cat ons n management n c ud ng mot vat on, eadersh p, group dynam cs, organ za t on des gn dec s on mak ng, commun cat on and organ zat on change Prerequ s tes. ca cu us; computer l teracy graduate degree program student

503 Complex Organizations. 3 N
Co cepts and app cat ons n macro organ zat on theory Top cs nc ude organ zat on structure strateg c cho ce cu ture boundary spann ng, effect veness and d fferent perspect ves of nterorgan zat ona re at ons

504 Competitive Strategy. 3 N
Industry compet tor and f rm strateg c pos t on ng ana y s s a med at ga n ng susta nab e compet t ve advantage Lecture d scuss on Prerequ s tes ECN 502, FIN 502 MGT 502 MKT 502

520 Problems in Personnel Management. 3 A
Se ect ng deve op ng ma nta n ng and ut z ng a compe tent abor force Case stud es of personne prob ems Preparat on of a wr tten personne program

522 Labor Relations and Public Policy. (3 A
State and federa eg s at on Recent dec s ons of courts and abor boards Lega r ghts and dut es of emp oyers un ons and the pub c.

559 International Comparative Management. 3 A
Ana ys s of comparat ve management pract ces prob ems, and ssues Management strateg es for the mu t na t ona organ zat on mpact of nat ona and cu tura env ronments

589 Strategic Management. 3 F S
Formu at on of strategy and po cy n the organ zat on emphas z ng the ntegrat on of dec s ons n the funct ona areas Prerequ s tes ACC 503 C S 502 ECN 502 FIN 502 GNB 502; MGT 502, MKT 502 OPM 502; QBA 502 comp et on of at east 36 hours of program of study cred ts

591 Seminar. 3 N
Top cs such as the fo ow ng w be offered
a Manager a P ann ng and Contro
b Compet t ve Strategy
c Eth cs
(d Human Resources Systems

598 Special Topics. 3 N
Graduate spec a top cs chosen from human resources strateg c management, and nternat ona management n c ud ng spec a top'cs n nternat ona management in As a or Europe

791 Seminar: Doctoral Seminar in Management. (3 A
Top cs such as the fo ow ng w be offered
(a) Organizat ona Behav or
b) Organizat ona Theory
(c) Research Des gn and Methodo ogy
(d Strateg c Management
(e) Human Resource Management
(f) Compensat on

Omnibus Courses: See pages 50 51 for omn bus courses that may be offered

Marketing

PROFESSORS:
BROWN GWINNER, HUTT JACKSON, OSTROM, RE NGEN, SCHLACTER B J. WALKER

ASSOCIATE PROFESSORS:
MOKWA (BAC 471), BELTRAMIN BLASKO CROSBY, EVANS GOURLEY STEPHENS, SWARTZ

ASSISTANT PROFESSORS:
BITNER, CHO, KALE R. KLE NE S KLEINE, SINHA, B WALKER, WARD

SENIOR LECTURER:
SPIERS

PROFESSORS EMERITI:
BESSOM, HARRIS OVERMAN, ROWE, SCHM DT, ZACHER

Study in the field of marketing involves analysis of how businesses plan, organize, administer, and control their resources to achieve marketing ob jectives. Focus is placed on market forces, growth and the survival of firms in competitive markets, and on the marketing strategy and tactics of the firm. Through the proper selection of courses, a student may prepare for a career in:

1. advertising;
2. general marketing administration,
3. industrial marketing;
4. international marketing,
5. market research and planning,
6. promotion management;
7. retail merchandising and management; or
8. selling and sales management.

The major in Marketing consists of 18 semester hours. The following 12 hours must be included:

		Semester Hours
MKT 302	Fundamentals of Marketing Management	3
MKT 304	Consumer Behavior	3
MKT 351	Marketing Intelligence	3
MKT 460	Strategic Marketing	3

To complete the major, students, in consulta tion with their faculty advisors, select six addi tional hours from among the following list of courses:

		Semester Hours
ADV 301	Advertising Principles	3
ADV 311	Advert sing Creative Strategy	3
ADV 371	Advertising Media	3
ADV 461	Advertising Management	3
MKT 310	Principles of Selling	3
MKT 325	Publ c Relations in Business	3
MKT 411	Sales Management	3
MKT 412	Promotion Management	3
MKT 424	Retail Management	3
MKT 434	Industrial Marketing	3
MKT 435	International Marketing	3
MKT 444	Marketing Channels	3

In addition, all Marketing majors are required to take six hours from a list of communications and behavioral science courses approved by the Department of Marketing. The list of approved courses is contained in the *Marketing Field of Specialization Student Curriculum Guide*, a copy of which can be obtained from the department of fice.

ADVERTISING

ADV 301 Advertising Principles. 3) F S SS
Advert s ng as a commun cat ons too n marketing and bus ness management Survey of market segmentat on, creat ve strategy med a and effectiveness measures Prerequ s te MKT 300

311 Advertising Creative Strategy. (3) F, S
App cat on of commun cat on theory to advert s ng Evaluat on of strateg es and execut ons Creat on of a portfo o conta n ng pr nt and broadcast advert sements. Prerequ s tes ADV 301 non bus ness majors must ob ta n department approva

371 Advertising Media. 3 F S
Med a strategy as an extens on of market ng strategy conceptua aspects of med a p ann ng; quant tat ve and qua tat ve ana ys s of med a Prerequ s tes ADV 301· non bus ness majors must obta n departmental approva

461 Advertising Management. 3 A
A capstone course n advert s ng dea ing w th the man agement of advert s ng from both the c ent and agency perspect ves Prerequ s tes ADV 311 371 MKT 351

Omnibus Courses: See pages 50–51 for omnibus courses that may be offered

MARKETING

MKT 300 Principles of Marketing. (3) F, S, SS
Role and process of marketing within the society, economy, and business organization. Prerequisite: ECN 112.

302 Fundamentals of Marketing Management. (3) F, S, SS
Marketing planning, implementation, and control by organizations, with special emphasis on identifying market opportunities and developing marketing programs. Prerequisite: MKT 300.

304 Consumer Behavior. (3) F, S, SS
Application of behavioral concepts in the analysis of consumer behavior and the use of behavioral analysis in marketing strategy formulation. Prerequisite: MKT 300.

310 Principles of Selling. (3) A
Basic principles underlying the selling process and their practical application in the sale of industrial goods, consumer goods, and intangibles. Prerequisite: MKT 300.

325 Public Relations in Business. (3) N
Role of public relations in business, government, and social institutions, emphasizing policy formulation from a managerial perspective. Prerequisite: MKT 300.

351 Marketing Intelligence. (3) F, S, SS
Integrated treatment of the traditional approaches to marketing research and analysis of environmental factors affecting marketing decisions in the firm. Prerequisites: MKT 300; QBA 221.

411 Sales Management. (3) A
Application of management concepts to the administration of the sales operation. Prerequisite: MKT 302.

412 Promotion Management. (3) A
Integration of the promotional activities of the firm including advertising, personal selling, public relations, and sales promotion. Prerequisite: MKT 302.

424 Retail Management. (3) A
Role of retailing in marketing. Problems and functions of retail managers within various retail institutions. Prerequisite: MKT 300.

434 Industrial Marketing. (3) A
Strategies for marketing products and services to industrial, commercial, and governmental markets. Changing industry and market structures. Prerequisite: MKT 302 or instructor approval.

435 International Marketing. (3) A
Analysis of marketing strategies developed by international firms to enter foreign markets and to adapt to changing international environments. Prerequisites: MKT 302 or instructor approval; professional program business student.

444 Marketing Channels. (3) N
Distribution channels used by firms engaged in marketing and manufacturing. Strategies for marketing-channels management. Relationships among marketing intermediaries. Prerequisites: MKT 302; professional program business student.

460 Strategic Marketing. (3) F, S, SS
Policy formulation and decision making by the marketing executive. Integration of marketing programs and consideration of contemporary marketing issues. Prerequisites: MKT 302, 304, 351; professional program business student.

502 Marketing Management. (3) F, S
Managing the marketing function; market and environmental analysis; marketing planning, strategy, and control concepts. Development and management of marketing programs. Prerequisite: ECN 502.

520 Strategic Perspectives of Buyer Behavior. (3) N
Concepts and theories from the behavioral sciences as they relate to marketing strategy formulation. Prerequisite: MKT 502 or equivalent; or instructor approval.

522 Marketing Information. (3) A
Marketing research, marketing information systems, and modern statistical techniques in marketing decision making. Prerequisite: MKT 502.

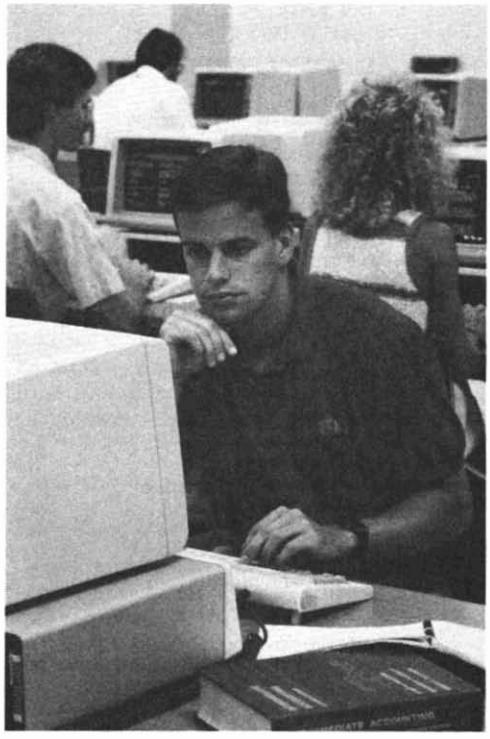
524 Services Marketing. (3) F, S
Strategies for marketing services emphasizing the distinctive challenges and approaches that make marketing of services different from marketing manufactured goods. Prerequisite: MKT 502 or equivalent.

563 Marketing Strategy. (3) A
Planning and control concepts and methods for developing and evaluating strategic policy from a marketing perspective. Prerequisite: MKT 502.

591 Seminar. (3) A
Topics such as the following will be offered:
(a) Product Strategy
(b) Channel Strategy
(c) Promotion Strategy
(d) Marketing in International Operations
(e) Marketing Strategy in Not-for-Profit and Public Sector Organization
(f) Advertising Strategy

791 Doctoral Seminar in Marketing. (3) F, S

Omnibus Courses: See pages 50–51 for omnibus courses that may be offered.



College of Education

L. Dean Webb, Ph.D.
Interim Dean

Purpose

For students, choosing a professional college is a major decision It represents the choice of a profession within which a career will be built. The College of Education provides a stimulating, challenging forum wherein scholars and practitioners interact in the discovery and mastery of the science and art of educational endeavors. This balanced approach, in which research and practice are viewed as essential and complementary, enables the college to produce superior educators.

The purposes of the faculty of the College of Education are as follows:

1. to engage in the scholarly, scientific, and professional study of education;
2. to prepare competent professionals who will serve in a variety of critical educational roles;
3. to develop productive scholars who will make significant contributions to the educational literature and to the quality of educational practice; and
4. to serve the education profession at the local, national, and international levels.

In accord with these purposes, the College of Education is committed to producing quality scholarship and research and to excellence in teaching.

Organization

The College of Education is organized into three divisions. These divisions and their academic programs are listed below:

Division of Curriculum and Instruction
Program Areas
- Adult Education*
- Early Childhood Education
- Educational Media and Computers
- Elementary Education
- Multicultural Education
- Reading and Library Science*
- Secondary Education
- Special Education

Division of Educational Leadership and Policy Studies Program Areas
- Educational Administration and Supervision
- Educational Policy Studies
- Higher Education

Division of Psychology in Education
Program Areas
- Counseling Psychology
- Counselor Education
- Learning and Instructional Technology
- Lifespan Developmental Psychology
- Measurement, Statistics and Methodological Studies
- School Psychology

Services to students and the community are provided through the following centers and offices:

The *Center for Bilingual Bicultural Education* conducts interdisciplinary research on classroom interaction, language development, and cognitive development. The focus of these research efforts is bilingual and bicultural students in Arizona.

The *Center for Indian Education* serves as a service agency to Indian communities, school districts, and Indian students attending ASU. The center also conducts research on Indian education in Arizona and other states with American Indian populations.

The *Office of Student Affairs* assists individuals interested in teacher preparation programs through advisement, admission, and retention ac-

* Applications are not being accepted in Adult Education or Library Science

tivities, and certification assistance. Other services include program of study validation, petition review, student communications, and high school and community college visitations/relations.

The *Office of Professional Field Experiences* places all teacher preparation students in public schools and similar institutions for internships and student teaching, monitors students' progress in their field experiences, sponsors courses for cooperating teachers, and conducts research on student performance in the field.

The *Office of Educational Services* counsels students regarding College of Education scholarships and provides recruitment and support services for minority students wishing to enter the Professional Teacher Preparation Program (PTPP).

The *Center for Academic Precocity* provides academic services to intellectually advanced students in grades Pre-K through 11. These services include individual assessment, talent identification, and a variety of courses.

The *Counselor Training Center* provides counseling for ASU students, staff, and the community at large in personal and career development, stress management, and marriage and family issues. Counseling is conducted by graduate students in counseling and counseling psychology under the supervision of certified psychologists.

The *Special Education Evaluation Clinic* determines the level of academic competence and areas of remediation for children experiencing learning difficulties.

The *Reading Clinic* assesses causes of reading problems and offers one-to-one tutoring or small group instruction by experienced teachers to students referred by parents and recommended by school districts.

Other units within the college offering specialized research and educational services include the Math Clinic, College of Education Preschool, School Personnel Evaluation and Learning Laboratory, Arizona Educational Information System, University Testing Service, Microcomputer Research Clinic, Mountain States Multifunctional Resource Center, Parent Development International, University Council for Educational Administration, and the National Center for Postsecondary Governance and Finance Research.



Degrees

MAJOR FIELD	DEGREE	DIVISION
Baccalaureate Degrees		
Early Childhood Education	B.A.E [1]	Curriculum and Instruction
Elementary Education bilingual education/English as a second language	B.A.E	Curriculum and Instruction
Secondary Education academic specializations: biological sciences; business, office and distributive education; chemistry; Chinese; communication; economics; English; French; general science[2]; geography; geology; German; history, home economics; humanities; Japanese; journalism, mathematics; physical education; physics; political science; Russian, social studies; Spanish	B.A.E	Curriculum and Instruction
Selected Studies in Education	B.A.E	Interdisciplinary
Special Education	B A.E.	Curriculum and Instruction
Graduate Degrees		
Counseling	M.C.	Psychology in Education
Counseling Psychology	Ph.D.	Psychology in Education
Counselor Education	M.Ed., Ed.D.	Psychology in Education
Curriculum and Instruction	Ph.D.[3]	Curriculum and Instruction
Educational Administration and Supervision	M.A , M.Ed., Ed.D., Ed.S.[2]	Educational Leadership and Policy Studies
Educational Leadership and Policy Studies	Ph.D.	Educational Leadership and Policy Studies
Educational Media and Computers	M.Ed.	Curriculum and Instruction
Educational Psychology	M.A , M.Ed., Ph.D.	Psychology in Education
Elementary Education	M.A , M Ed., Ed.D., Ph.D.[2]	Curriculum and Instruction
Learning and Instructional Technology	M.A., M Ed., Ed.D.[2], Ph.D.	Psychology in Education
Higher and Adult Education	M.Ed., Ed.D.	Educational Leadership and Policy Studies
School Library Science	M.A [2], M.Ed.[2]	Curriculum and Instruction
Secondary Education	M.A , M.Ed., Ed.D.	Curriculum and Instruction
Social and Philosophical Foundations	M.A.	Educational Leadership and Policy Studies
Special Education	M.A., M Ed., Ph.D [2]	Curriculum and Instruction

[1] Early Childhood Education students currently major in Elementary Education and are certified to teach in grades K–8.

[2] Applications are not being accepted.

[3] The Ph.D in Curriculum and Instruction is offered by the Interdisciplinary Committee on Curriculum and Instruction

The teaching majors of Art, Choral Music, Dance, Instrumental Music, and Theatre with the degree of Bachelor of Fine Arts are available through the College of Fine Arts. See pages 384–419 for more information.

Undergraduate programs leading to the Bachelor of Arts in Education degree are described below. Descriptions of graduate degree programs can be found in the *Graduate Catalog*.

Bachelor of Arts in Education

Candidates for the Bachelor of Arts in Education degree must complete the Professional Teacher Preparation Program (PTPP) offered by the College of Education. Students completing the program are able to demonstrate proficiency in specified knowledge areas or skills, including:

1. principles and application of effective instruction;
2. classroom organization and management;
3. content or subject matter;
4. specific curriculum and teaching strategies;
5. interrelationship of culture and schooling in a multicultural society;
6. human development;
7. communication skills;
8. theories of learning and motivation;
9. assessment and evaluation; and
10. computer literacy.

Each student in the PTPP selects one of three majors areas that provide specialized instruction and preparation. These majors are:

1. Elementary Education;
2. Secondary Education; and
3. Special Education.

Those in Elementary Education have these options:

1. to complete a general program in Elementary Education, grades K–8;
2. to specialize in early childhood education; or
3. to complete an endorsement in either bilingual education or English as a second language.

Those in Secondary Education can be certified in one or more specific academic specializations. Students in art, music, or physical education complete a K–12 endorsement in their field. Special Education majors can be certified in mental retardation, emotionally handicapped, or learning disabilities.

PTPP Areas and Optional Emphases or Endorsements

Elementary Education
- bilingual education
- early childhood education
- English as a second language

Secondary Education
- certification in specific academic specializations
- K–12 endorsements in art, music, or physical education

Special Education
- emotionally handicapped
- learning disabilities
- mental retardation

Elementary Education prepares students to teach in grades K–8. Students in this major develop the knowledge and skills needed to teach children from a variety of language, cultural, and developmental backgrounds. The bilingual education/English as a second language (ESL) option prepares students to work in bilingual/ESL settings in grades K–8. The early childhood option prepares students to work in infant programs, preschools, and grades K–3. The Special Education major prepares students to teach in special education settings in grades K–12. Students selecting any of the above majors or options must also complete requirements for an academic specialization in human development. Careful planning and early advisement in developing an approved program of study is essential for students if they are to complete graduation requirements within the typical 126-semester-hour undergraduate degree program.



Secondary Education provides preparation for teaching subjects in grades 7 12. Teaching fields approved by the College of Education are offered in academic units of the Colleges of Liberal Arts and Sciences, and Public Programs. Students with teaching majors in the College of Fine Arts earn the appropriate bachelor's degree from the College of Fine Arts.

All students pursuing teaching certificates should seek early advisement from the Office of Student Affairs in the College of Education. Secondary Education majors who are accepted to the PTPP have an advisor in the Office of Student Affairs and an advisor in the academic department that offers courses in the student's major teaching field(s).

Admission

Preprofessional Admission

Students admitted to ASU may enroll in the College of Education with preprofessional status during their freshman or sophomore years. Preprofessional students should seek advisement within the College of Education through its Office of Student Affairs, EDB 7. *Admission to ASU with preprofessional status in the College of Education does not guarantee admission to the PTPP*

Professional Program Admission

Consideration for admission to the PTPP requires that students:

1. complete a minimum of 56 semester hours of appropriate university course work with a cumulative GPA of 2.50 or higher;
2. achieve passing scores on the *Pre-Professional Skills Test (PPST)*, which assesses basic skills in reading, writing, and mathematics;
3. be admitted to ASU as a degree seeking student; and
4. submit an application form by deadline dates to the Office of Student Affairs.

Some academic departments have additional requirements. *Students seeking admission to K–12 or secondary education programs* should consult the Office of Student Affairs (602/965–3877) to determine if there are additional admission requirements for the academic major.

Students who want to enter the PTPP fall semester must apply early during the preceding spring semester; those who want to begin spring semester must apply early during the preceding fall semester. Applicants should contact the Office of Student Affairs for exact application deadline dates, which are determined yearly.

Because PPST scores must be included for an application to be complete, applicants should plan to take the PPST *well in advance* of application deadlines. In most cases, the PPST can be taken as early as the end of the freshman year.

Admission to the PTPP is selective and based on available resources. Not all students who meet minimum requirements are admitted to the program.

Transfer Students

To be considered for admission to the PTPP, transfer students must first be formally admitted to ASU (see page 35). Transfer students must also meet all PTPP admission requirements and should contact the Office of Student Affairs within the College of Education for admission procedures and advisement. The Admissions Office should receive the application for admission to the university, transcripts, applicable test scores, and other required information at least three months before the application deadline date for the desired PTPP admission.

Students completing their first two years of course work at a community college or at a four-year institution in Arizona other than ASU should consult academic advisors during those two years for advice in planning a general studies sequence of courses that will meet ASU General Studies requirements.

Advisement

For any major in the PTPP, students should seek early advisement in the Office of Student Affairs (EDB 7) and become familiar with specific program and College of Education requirements. Each student in Secondary Education must also consult an advisor in an academic unit offering course work in his or her field of study in the Colleges of Liberal Arts and Sciences, Fine Arts, or Public Programs. Each Secondary Education major admitted to the PTPP has an advisor in the Office of Student Affairs and an advisor in the major teaching field

Degree Requirements

General Studies Requirements

Undergraduate students must meet all University General Studies and college graduation requirements in order to earn the Bachelor of Arts in Education degree. General Studies requirements are usually met before formal admission to the

PTPP. Each student should consult an advisor early in the college course work in order to select General Studies courses carefully. The University General Studies guidelines are on pages 58–61 of this catalog.

General Studies courses are regularly reviewed. To determine whether a course meets one or more General Studies course credit requirements, see the listing of courses, pages 62–88.

Key to General Studies Credit Abbreviations

L1	Literacy and Critical Inquiry Core Courses (Intermediate level)
L2	Literacy and Critical Inquiry Core Courses (Upper division)
N1	Numeracy Core Courses (Mathematics)
N2	Numeracy Core Courses (Statistics and Quantitative Reasoning)
N3	Numeracy Core Courses (Computer Applications)
HU	Humanities and Fine Arts Core Courses
SB	Social and Behavioral Sciences Core Courses
S1	Natural Sciences Core Courses (Introductory)
S2	Natural Sciences Core Courses (Additional Courses)
G	Global Awareness Courses
H	Historical Awareness Courses

Program of Study

PTPP students must file a program of study during the semester before the time when they will register for their 87th semester hour. The intent of this university policy is to guide students toward the successful completion of degree requirements in a timely manner. The portion of the program of study that centers on the four-semester PTPP includes core courses that all students must complete, regardless of area or option selected. It also includes additional courses to meet degree requirements in the specific areas or options of early childhood education, elementary education, bilingual education, English as a second language, secondary education, or special education.

The general pattern listed below should be followed for each of the majors in the PTPP in the development of a program of study. Students should consult an advisor for assistance during the first semester of the program. *The PTPP is sequential in nature; the four semesters may not be combined.*

Any exceptions to the above requirements must be approved by the Standards and Appeals Committee of the Division of Curriculum and Instruction.

Human Development Specialization. Early childhood education, elementary education, bilingual education/English as a second language, and



special education students enrolled in the PTPP must complete 18 semester hours of course work in human development. Early childhood and elementary education students are required to include MCE 446 Understanding the Culturally Diverse Child as part of their human development specializations. Special Education students are required to include SPE 314 Introduction to Bilingual/Multicultural Special Education in their human development sequences of courses.

Academic Specialization. Each early childhood education, elementary education, and special education student in the PTPP must also complete an 18 semester hour academic specialization in a subject area taught at the school level at which he or she plans to teach. The academic specialization must be taken outside the College of Education.

Four-Semester Requirements Professional Teacher Preparation Program

Elementary Education (K–8) Major

Semester I — 7 semester hours

DCI 396 Field Experience
EDP 301 Learning and Motivation in Education
EDP 303 Human Development
SPF 301 Culture and Schooling

Semester II — 7 semester hours

DCI 302 Principles and Applications of Effective Instruction
DCI 303 Classroom Organization and Management
DCI 396 Field Experience
EDP 302 Assessment and Evaluation in Education
EMC 300 Computers in Education

Semester III 11 semester hours

EED 401 Teaching Science and Social Studies to Children
EED 402 Teaching Strategies in Mathematics
EED 404 Language Arts
EED 496 Field Experience
RDG 401 Decoding and Reading
RDG 402 Reading Practicum

Semester IV — 14 semester hours

EED 478 Student Teaching in the Elementary School (12)
SPF 401 Theory and Practice in Education 2)

Elementary Education (K–8) Major with an Option in Bilingual Education/English as a Second Language

Semester I — 7 semester hours

DCI 396 Field Experience
EDP 301 Learning and Motivation in Education
EDP 303 Human Development
SPF 301 Culture and Schooling

Semester II — 7 semester hours

DCI 302 Principles and Applications of Effective Instruction
DCI 303 Classroom Organization and Management
DCI 396 Field Experience
EDP 302 Assessment and Evaluation in Education
EMC 300 Computers in Education

Semester III — 11 semester hours

BLE 401 Teaching Science and Social Studies to Children
BLE 402 Teaching Strategies in Mathematics
BLE 405 Decoding and Reading
BLE 406 Reading Practicum
BLE 407 Language Arts
BLE 496 Field Experience

Semester IV — 14 semester hours

BLE 478 Student Teaching in the Elementary School 12
SPF 401 Theory and Practice in Education 2)

Elementary Education (K–8) Major with an Option in Early Childhood Education

Semester I — 7 semester hours

DCI 396 F eld Experience
EDP 301 Learning and Motivation in Education
EDP 303 Human Development
SPF 301 Culture and Schooling

Semester II — 9 semester hours

DCI 302 Principles and Applications of Effective Instruct on
DCI 303 Classroom Organization and Management
DCI 396 Field Experience
ECD 404 Language Arts
EDP 302 Assessment and Evaluation in Education
EMC 300 Computers in Education

Semester III 9 semester hours

ECD 401 Instructional Strategies: Social Studies and Creative Arts
ECD 402 Instructional Strategies· Math and Science
ECD 496 Field Experience
RDG 401 Decoding and Reading
RDG 402 Read ng Practicum

Semester IV — 14 semester hours

EED 478 Student Teaching in the Elementary School 12
SPF 401 Theory and Practice in Education (2

Secondary Education (7 12) Major

Semester I — 7 semester hours

DCI 396 Field Experience
EDP 301 Learning and Motivation in Education
EDP 303 Human Development
SPF 301 Culture and Schooling

Semester II — 7 semester hours

DCI 302 Principles and App ications of Effective Instruction
DCI 396 F eld Experience

EDP 302 Assessment and Evaluation in Education
RDG 301 Content Area Reading. Decoding
RDG 302 Content Area Reading: Practicum
EMC 300 Computers in Education

Semester III — 7 semester hours

SED 403 Principles, Curricula, and Methods
SED 496 Field Experience
A 480 Major Methods course

Semester IV — 14 semester hours

SED 478 Student Teaching in the Secondary Schools (12
SPF 401 Theory and Practice in Education 2)

Special Education (K–12) Major

Semester I — 15 semester hours

EDP 301 Learning and Motivation in Education
EDP 302 Assessment and Evaluation in Education
EDP 303 Human Development
EED 404 Language Arts
EMC 300 Computers in Education
SPE 311 Orientation to Educat on of Except onal Children
SPE 314 Introduction to Bilingual/Multicultural Special Education

Semester II — 12 semester hours*

EED 402 Teaching Strategies in Mathematics
RDG 401 Decoding and Reading
RDG 402 Reading Practicum
SPE 412 Evaluating Exceptional Children
SPE 413 Methods in Language, Reading, and Arithmetic for Exceptional Children
SPE 496 Field Experience

Semester III — 15 semester hours*

EED 320 Teaching Sc ence to Children
SPE 411 Parent Involvement and Regulatory Issues
SPE 414 Methods and Strategies in Behavior Management
SPE 415 Social Behavior Problems of Exceptional Children
SPE 496 Fie d Experience

Semester IV — 12 semester hours

SPE 478 Student Teaching in Special Education

* *Select two of the f> low ing during semester II c III*
SPE 312 Mental Retardation
SPE 336 Behavioral and Emotiona Problems in Children
SPE 361 Introduct on to Learning Disabilities

Field-Experience Requirements

In addition to course work, students admitted to the PTPP are required to participate in directed field experiences during each of the four semesters of the program. The field experiences progress from short term observation and participation to long-term supervised practice teaching. *Students should expect these field experiences to be above and beyond the class times listed in the* Schedule of Classes *for each semester.* Such field experiences typically take place in public schools throughout the greater Phoenix area. Regular attendance is required during all field experiences. Students should plan extra travel time and expect to confer with placement teachers and field facilitators before or after scheduled field experiences. To meet field experience requirements, students must plan to have their own transportation and *be available during regular school hours*

Student Teaching. The major field experience, called *student teaching*, occurs in the fourth semester of the PTPP and is a full-day, full semester obligation. *Student teaching is only possible during fall and spring semesters*

Applications for student teaching must be completed early during the semester before the student teaching semester. To be accepted for student teaching, students must meet the following requirements:

1. an overall GPA of 2.50 or better;
2. a GPA of 2.50 or better in professional course work;
3. the completion of all required professional education course work;
4. the removal of all academic deficiencies, such as grades of "D," "E," or "I" before placement;
5. the demonstration of appropriate professional conduct during the first three semesters of the program; and
6. completion of the application procedure and approval to student teach from the Office of Professional Field Experiences at least 10 weeks before the beginning of the student teaching term.

Student teachers must adhere to the calendar, regulations, and philosophy of the schools in which they are placed. Beginning and ending dates for student teaching are determined by the Office of Professional Field Experiences in cooperation with the placement schools. Because student teaching is on a full day schedule, 8:00 a.m. to 4:00 p.m. Monday through Friday for 15 consecutive weeks, student teachers are strongly encouraged to avoid extra activities and course work that would interfere with the heavy demands placed upon them while student teaching.

Graduation Requirements

Candidates for the degree of Bachelor of Arts in Education are required to complete an approved

program of at least 126 semester hours. The College of Education expects its degree candidates to meet individual course assessment standards, field experience observation criteria, courses required for teacher certification, and other proficiency standards and performance criteria required to demonstrate knowledge and skill in the areas listed under the Bachelor of Arts in Education description on page 260 of this catalog.

Certification for Teaching

The curricula for both the undergraduate and postbaccalaureate teacher education programs meet the requirements for teacher certification in the State of Arizona.

In addition to the course requirements specified in this catalog, there are other requirements for teacher certification mandated by the State of Arizona. These include U.S. Constitution and Arizona Constitution; most teaching areas have specific math and fine arts requirements.

Because these requirements vary over program areas and may be changed at any time, students are encouraged to maintain close contact with the Office of Student Affairs regarding the most current state certification requirements.

The College of Education is accredited by the National Council for Accreditation of Teacher Education and approved by the Arizona Department of Education for the preparation of elementary, secondary, and special education teachers. Students who complete an approved program of study and meet all graduation requirements of the university and the college are recommended for certification to the Arizona Department of Education. The Office of Student Affairs (EDB 7) maintains information about current certification requirements in Arizona and other states.

The College of Education also offers programs of study leading to special endorsements by the Arizona Department of Education. Of special interest are endorsements in the areas of bilingual education (BLE) and English as a second language (ESL), middle school education, and reading. The bilingual education endorsement is required of all teachers specifically responsible for providing bilingual instruction. The English as a second language endorsement is required of all teachers specifically responsible for providing ESL instruction. Students should contact the Office of Student Affairs for information and advisement regarding teaching concentrations or special teaching endorsements.

Academic Standards

Retention and Disqualification

Students admitted to the College of Education on *preprofessional status* are subject to the general standards of academic good standing of the university. *However, students who maintain standards of academic good standing during their freshman and sophomore years do not necessarily qualify for admission to any teacher preparation program offered by the College of Education.*

Students admitted to the PTPP within the College of Education must maintain academic standards and demonstrate requisite qualifications for successful teaching, including sound physical and mental health, interpersonal skills, basic communication skills, a positive attitude, appropriate professional conduct and satisfactory performance in field experiences. Because PTPP standards are higher than those for the university, a student who is suspended from the PTP Program may still be eligible to enroll in other non PTPP courses.

To be considered in good standing, students must maintain an overall cumulative GPA *and* a GPA in PTPP course work of 2.50 or higher with at least a grade of "C" in each PTPP course. Any first- or second-semester PTPP student whose ASU cumulative or PTPP course work GPAs fall below 2.50 may be placed on academic probation or suspended from enrollment in the next semester of the PTPP program. Third-semester PTPP students must meet the requirements for student teaching described earlier.

Students on academic probation or suspension from the university and/or PTPP must seek advice from the Office of Student Affairs before registering for additional course work. A complete copy of the retention policy for the PTPP is available from the Office of Student Affairs in EDB 7.

Probation and suspension status for academic reasons begins on the first day of classes of the semester after the probation or suspension action. Students placed on probation for any reason are subject to disqualification by the College of Education at the end of the following semester if the conditions imposed for reinstatement are not met. A student placed on probation or suspension for any reason has his or her status reviewed at the end of the following semester.

Students demonstrating behaviors or characteristics that make it questionable whether they can succeed in the teaching profession are reviewed by the Standards and Appeals Committee of the Division of Curriculum and Instruction. The

committee's review may result in a decision to disqualify the student or the specification of conditions under which continued participation is permitted, i.e., probation.

Students who wish to appeal decisions of the Standards and Appeals Committee of the Division of Curriculum and Instruction may do so in writing to the dean of the college or the University Undergraduate Admissions Board or both. Any exceptions to the above retention and disqualification policies and procedures must be approved by the Standards and Appeals Committee of the Division of Curriculum and Instruction and the dean of the College of Education.

Special Programs

Postbaccalaureate Initial Teacher Certification (ITC) Programs

Postbaccalaureate programs that lead to initial teaching certification are designed for those who hold a bachelor's degree in an area other than education. The college offers postbaccalaureate programs in early childhood education, elementary education, secondary education, and special education. Information on postbaccalaureate programs is available through the Office of Student Affairs (OSA), EDB 7. The OSA provides academic advisement and information regarding requirements, procedures, and deadline dates.

A student who wishes to be considered for entry must meet the College of Education admission requirements for postbaccalaureate programs:

1. an earned bachelor's degree from an accredited institution;
2. a cumulative GPA of 2.50 or better on the last 60 semester hours of credit earned;
3. passing scores on the PPST or verbal and quantitative scores of 450 or above on the Graduate Record Examination (GRE), and
4. submission of a completed application form and supporting materials by the appropriate deadline dates during the semester before admission.

Admission to postbaccalaureate programs is selective and based on available resources. *Not all students who meet the minimum requirements are admitted to the program.* A student admitted to a postbaccalaureate program who does not begin course work within one calendar year of the date of admission must reapply for admission.

A student who also wishes to pursue a master's degree should contact the program coordinator in the intended area of study. The student must meet the admission requirements of both the College of Education and the Graduate College. No more than nine semester hours of graduate credit earned before formal admission to the Graduate College can be included in a candidate's master's degree program of studies.

Student Teaching

Students in the Postbaccalaureate Initial Teacher Certification Program must file student teaching applications early in the semester before the student teaching term. To be accepted for student teaching, students must satisfy the following requirements:

1. attain a cumulative GPA of 2.50 or higher in required professional education course work;
2. complete all required professional education course work other than one preapproved course that can be taken concurrently with student teaching);
3. remove all academic deficiencies such as grades of "D," "E," or "I" before placement; and
4. attain a final approval from the Office of Professional Field Experiences. This review considers performance in field settings and academic achievement.

Multicultural Teaching Emphasis

An emphasis in multicultural education is offered at the undergraduate level. Courses in bilingual education, Indian education, and multicultural education are offered through the Division of Curriculum and Instruction. Courses taken in any area of concentration are usually in addition to regular program requirements.

Selected Studies in Education

An undergraduate student who is interested in a career in education other than public school teaching can elect to develop an individualized degree program. A student who wants to develop a program of selected studies must fulfill College of Education admission requirements and should contact the Office of Student Affairs for program advisement. A program of study must be filed during the first semester of a student's program and be approved by the Standards and Appeals Committee of the Division of Curriculum and Instruction. This Selected Studies major is not designed to lead to teacher certification.

Correspondence Course Work for Credit

It is the general policy of the College of Education not to accept course credit for *courses in education* taken through correspondence. Exceptions to this policy may be approved if the correspondence course work has been approved in advance of enrollment in the course by the student's advisor, respective program coordinator, and division director. In all such cases, an appropriate rationale must be submitted with the request to enroll.

College of Education

All graduate programs of the College of Education include a core of courses designed to give students an understanding of the context of American education and of the methods of scholarship by which an understanding of the educational system is deepened.

Candidates for M.Ed. and M.C. degrees must complete courses COE 501, 504, and 505 for a total of nine semester hours. Doctoral candidates must complete COE 502, 503, 504, and 505 for a total of 12 semester hours. The core courses are offered each semester and during the summer session. Students are urged to take the core courses early in the program since these courses form the foundation on which many subsequent courses are built.

The core courses follow.

COLLEGE OF EDUCATION

COE 501 Introduction to Research and Evaluation in Education. (3) F, S, SS
Overview of educational inquiry from controlled quantitative to qualitative naturalistic Emphasis on locating and critically interpreting published research

502 Introduction to Quantitative Methods. (3 F S SS
Topics in statistical analysis, measurement, and research design Exploratory data analysis, estimation theory and statistical inference. Use of computers for data analysis Cross listed as EDP 502

503 Introduction to Qualitative Research. (3 F S SS
Terminology, historical development approaches including ethnography, ethnomethodology critical theory, grounded theory and hermeneutics, and qualitative versus quantitative social sciences methods of inquiry. Cross listed as EDP 503

504 Learning and Instruction. 3 F, S SS
Introduction to psychology of learning and instruction. Includes the foundations of learning theories and their application to educational practice Cross listed as EDP 504

505 American Education System. 3 F, S SS
Political, historical, and philosophical analyses of American education at all levels Examination of primary sources, legal findings and case studies

Omnibus Courses: See pages 50 51 for omnibus courses that may be offered

Division of Curriculum and Instruction

(EDB 225, 965–1644)

PROFESSORS:
BERLINER, BITTER, EDELSKY, EDWARDS, FAAS, FREEMAN, GRYDER, HIGGINS, MOYER PRIETO RAY, RUTHERFORD, SATTERTHWAITE, SEARFOSS, WALLEN, ZMILES ZUCKER

ASSOCIATE PROFESSORS:
BAKER (ED 409), ANDERSON, ARIAS AXFORD, BARONE, BENAVIDES, BLANCHARD, CHRISTIE, COHEN, COHN, EEDS FINER, GOMEZ, HUDELSON, KAMINS KNAUPP, MANERA, McCOY McGOWAN, McISAAC, NELSON, PETERSON, PIBURN, RADER, ROBERTS, SANTOS, STAHL STALEY, THOMAS, VALLEJO, WILSON, WISEMAN

ASSISTANT PROFESSORS:
BLUMENFELD JONES, DI GANGI, FREDERICK GUZZETTI, HATFIELD, HUGHES HURSTON, KLEIN, KNUPFER SERNA, SURBECK, SWISHER

LECTURER:
DUNHAM

PROFESSORS EMERITI:
ARMSTRONG BATCHELOR, J.E. BELL, J.W. BELL, M. BELL, BOYD, BROOK, CHASEY, CHRISTINE, COOK, CROUCH DOYLE, DUDEK, FRASER FRAZIER, FULLERTON, GILL, GRIFFITH, HAGGERSON HARDT HOOVER, JACOBS, JELINEK, JONES KIESOW, KINGSBURY, KOZACIK LAMM, LEE MALONE, McGRATH, MITCHELL MOORE OBEIRNE, O'BRIEN, OLMSTED PODLICH RICE ROVER, SCHALL, SHOFSTALL, SILVAROLI STEERE, SULLIVAN, SUNDWALL, VEATCH, WAMACKS

Program Areas

Adult Education*
Early Childhood Education
Educational Media and Computers
Elementary Education
Multicultural Education

* Applications are not being accepted in Adult Education

Reading and Library Science*
Secondary Education
Special Education

Degrees: B.A.E., M A., M.Ed., Ed.D., Ph D.

The Division of Curriculum and Instruction offers undergraduate and graduate academic programs The undergraduate programs are designed to prepare persons to teach effectively in early childhood, elementary, secondary, and special education settings. Concentrations available at the undergraduate level include bilingual education, English as a second language (ESL), Indian education, and multicultural education. Programs of study leading to special endorsements by the Arizona Department of Education are bilingual education (BLE), English as a second language (ESL , middle school education, and reading

Postbaccalaureate programs leading to teaching certification are available in early childhood, elementary, secondary, and special education areas The graduate programs in this division are designed to prepare persons for roles such as master teachers, educational leaders, researchers, media and computer specialists.

Faculty within the division are engaged in research and professional training projects. Graduate students have opportunities to participate in varied teaching, research, and professional training on- and off-campus activities.

CURRICULUM AND INSTRUCTION

DCI 302 Principles and Applications of Effective Instruction. 3 F S
Principles of teaching identified by research on teaching effectiveness Application of principles to classroom practice. For majors only. Prerequisite EDP 303

303 Classroom Organization and Management. 2 F S
Develops understanding and application of classroom organization and management principles, strategies and procedures For majors only Prerequisites EDP 301 303; SPF 301

396 Field Experience. 0 F S
Observation and limited participation in a school setting Focus on observation of development learning management instruction, assessment and motivation Corequisite: semesters and II of the PTPP

Omnibus Courses: See pages 50 51 for omnibus courses that may be offered.

* Applications are not being accepted in Library Science.

Adult Education

AED 510 Introduction to Adult Education. 3 N
History development, core content and principal areas of adult education

511 Program Development in Adult Education. (3) N
An andragogical approach to planning programs for adults Emphasis on agencies

512 Characteristics of Adult Learners. (3) N
Characteristics of the adult learner throughout the life span

566 International Adult Education. (3 A
Review and comparison of adult education programs and factors in selected countries

Omnibus Courses: See pages 50–51 for omnibus courses that may be offered.

Early Childhood Education

ECD 308 Introduction to Early Childhood Education. 3 S F
An overview of the early childhood education field, including professional options, historical roots and current theories and policy developments at national state and local levels

310 Educational Environments: Infants/Toddlers. (3) F S
Organizing planning and implementing educational practices based on developmental theories that will enable early childhood educators to provide optimal learning environments for infants and toddlers Prerequisite ECD 314

311 Social Studies in Early Childhood Education. (3) F
Development of democratic living in areas of the curriculum Objectives, problem solving selection of content scope and sequence construction of instructional materials, and resources Experiences with children.

312 Educational Environments: Preschool Kindergarten. 3 F S
Considers aspects of curriculum Philosophy, principles practices, problems and evaluation in the integrated experience program

314 The Developing Child. (3 F S SS
Provides a base for understanding and working with young children Examines aspects of development of children birth through age eight with implications for teachers and parents Prerequisite CDE 232 or equivalent.

322 Communication Arts in Early Childhood Education. 3 F
Factors affecting language development Setting conditions for learning in listening speaking, reading and writing Prerequisite ENG 213 or equivalent.

378 Practicum in Early Childhood Development. (3 F S
Provides a field based experience in selected early childhood settings outside the public schools prior to student teaching) Prerequisite ECD 314

401 Instructional Strategies: Social Studies and Creative Arts. 3) F S
Presents materials, techniques and resources for a balanced program of social studies and aesthetic expression appropriate for children in preschool through 3rd grade, with emphasis on the integrated curriculum Corequisites. ECD 402 496 RDG 401 402

402 Instructional Strategies: Math and Science. 3 F, S
Emphasizes developmentally appropriate educational strategies and instructional techniques in teaching mathematics and science to children preschool through 3rd grade), within an integrated curriculum approach Prerequisites: BIO 100 MTE 180 or equivalent PHS 110 or equivalent Corequisites ECD 401, 496 RDG 401 402.

404 Language Arts. (2 F S
Presents theory on the social nature of oral and written language and congruent classroom practices Corequisites: DCI 302 303 396; EDP 302, EMC 300

411 Early Childhood Education: Programs and Materials. (3 F, S SS
Principles, experiments research studies and recent trends as factors related to the education of children through age eight Prerequisite ECD 312 or equivalent

496 Field Experience. 0 F, S
Application of course content in a preschool through 3rd grade setting Emphasis on observation, focus on child centered curriculum, planning and delivering instruction and assessment. Corequisites ECD 401 402, RDG 401, 402

522 Developmental Social Experiences in Early Childhood Education. 3 F
Materials, techniques, aesthetic expressive activities, and values in the integrated curriculum Prerequisite: ECD 311 or equivalent

525 Communication Arts in Early Childhood Education. (3 S
Problems and trends of current programs and oral language development Effort to bring together language acquisition findings with educational practices Opportunity for self-directed learning study. Prerequisite. ECD 322 or equivalent

527 Mathematics in Early Childhood Education. 3) F
Theory and practice in the use of manipulative materials for teaching mathematics to preschool and primary grade children Prerequisite. EED 380 or 402 or equivalent.

544 Play Education. 3 S, SS
Theories of play and the educational implications of each Practical applications at the early childhood eve

555 Modern Practices in Early Childhood Education. 3) F, SS
Trends and practices instructional and resource materials and methods and techniques in early childhood education

733 Social and Emotional Development. 3) A
Inquiry into the social and emotional development dynamics in children such as peer relationships self-concept, and parenting processes with implications for teachers

744 Evaluative Procedures: Young Children. 3 S
A critical examination and use of developmentally appropriate evaluative procedures for children from birth through age eight

Omnibus Courses: See pages 50–51 for omnibus courses that may be offered

Educational Media and Computers

BUSINESS EDUCATION

BUE 480 Teaching Business Subjects. (3) S
Organization and presentation of appropriate content for business subjects in the secondary school

501 Principles of Business Education. 3) F
History philosophy principles and objectives of business and distributive education

502 Organization and Management of Cooperative Programs. 3) F
Work study programs for business occupations in high schools and community colleges.

503 Competency-Based Business and Vocational Education. 3 S
Development and administration of competency based individualized programs in business and vocational education

505 Current Literature in Business and Vocational Education. 3 S
Critical analyses generalizations, and trends in business and vocational education.

506 Information Processing for Business and Vocational Teachers. 3 SS
Development of curriculum and strategies for teaching information processing hardware software evaluation and equipment acquisition techniques in business and vocational education.

512 Technology in Business and Vocational Education. 3) SS
Emerging curricula and instructional technology in business and vocational education

515 Distributive Education. 3 F
Planning, organizing and implementing marketing and distributive education programs in secondary schools and community colleges

Omnibus Courses: See pages 50–51 for omnibus courses that may be offered

EDUCATIONAL MEDIA AND COMPUTERS

EMC 300 Computers in Education. (1 F, S
An introduction to word processing, databases spreadsheets teacher utility programs and evaluation of educational software. Required for Education majors

321 Computer Literacy. 3) F, S SS
Survey of the role of computers in business and education Emphasis on word processing database, and spreadsheets *[Satisfies General Studies Requirement N3]*

323 Computer Applications. (3) F, S
Introduction to computer applications such as HyperCard Telecommunications, Authoring Languages Expert Systems etc Lecture lab *[Satisfies General Studies Requirement N3]*

455 Animation and Special Effects. 3) F
An examination of the art, science, and impact of animation and other special effects used in film

502 Current Issues and Problems in Media Computer Education. 3 F
Cnt cal ana ys s of current pract ces n nstruct ona med a/ computer Prerequ s te 6 hours n EMC or nstructor approva

507 Computers in Educational Administration. 3) F S
Survey of computer use and app cations n educat ona adm n stration. Lecture, ab. Cross sted as EDA 507.

511 Computer Applications in Education. 3 F SS
Use and eva uat on of computers for word process ng, n format on management, graph cs and author ng nstruct on in educat onal sett ngs

513 Introduction to Media Production. 3) N
Introduction to med a product on emphas zing p ann ng and product on of overhead transparenc es, s de tape programs and v deo programs

521 Instructional Media Design. 3 F S
Preparing spec f cat ons for nstruct ona telev s on f m, s de tape programs, and computer based nstruct on

522 Evaluating Computer Materials. 3 S SS
Se ect on, ut zat on, des gn and eva uat on of nstruc tional computer matena s

523 Telecommunication for Instruction. 3) F
nstruct ona uses of sate te, te econference and e ec tron c networks for d stance earn ng

524 Instructional Photography. 3 F
Des gn and product on of photographs for use n educa t ona presentat ons and pub cat ons Lecture, stud o

525 Presentation Graphics. (3) S
Des gn product on and d sp ay of computer graph cs for group presentations Prerequ s te EMC 521 or nstructor approva

527 Instructional Television. 3 F
Des gn and product on of nstruct ona programs for te ev sion Lecture ab Prerequ s te EMC 521 or nstructor approva .

528 Advanced Photographic Media Production. 3 S
Des gn and product on of mu t med a nstruct ona pro grams Emphas s on s de tape format Lecture, ab Pre requ s te. EMC 521 or nstructor approva

530 Development of Computer-Based Instruction. 3 S
The systemat c des gn, deve opment and format ve eva u ation of computer based nstruct on Prerequ s te EMC 511 or nstructor approva

532 Desktop Publishing. 3 F SS
Des gn and product on of educat ona mater a s us ng computer-based word process ng graph cs and page ay out programs. Lecture, ab

584 Instructional Media Internship. 1–6 F S SS
Prerequis tes LNT 502 EMC 521 nstructor approva

637 Computers in Elementary School Curriculum. 3 SS
Exper ences w th educat ona uses of computers com puter awareness fam y soc eta mpact c assroom app cations software and curr cu um development

701 Advanced Technologies in Education. 3 S
Exam n ng the role and mpact of art f c a nte gence ex pert systems and related advanced techno og es n edu cat on

702 Research in Technology-Based Education. (3) F
Cr tica exposure to theor es research and methods in techno ogy-based educat on

Omnibus Courses: See pages 50 51 for omn bus courses that may be offered

Elementary Education

EED 320 Teaching Science to Children. (3) F S SS
Deve ops students persona phi osoph es of the nature of e ementary school sc ence· why teach sc ence and how ch dren earn sc ence. Know edge and sk i s n plann ng nstruct on, us ng nstruct onal mode s ntegrat ng the cur r culum emp oy ng current sc ence programs and mater a s and eva uat ng ch dren s learn ng Prerequ s te· A bas c b o og ca and phys ca sc ence course L mited to students admitted to the postbacca aureate certif cation program.

333 Communication Arts in the Elementary School. 3 F, S SS
Factors affect ng anguage growth. Sett ng cond tions for teach ng ora and wr tten L m ted to students adm tted to the postbacca aureate cert f cat on program

344 E ementary School Organization and Management. 3) F S SS
Overa program of the e ementary schoo . Pract ca ap proaches to d sc p ne and to p ann ng, organ zing and manag ng the c assroom L m ted to students adm tted to the postbacca aureate cert f cat on program

355 Social Studies in the Elementary School. (3 F S, SS
Methods and mater a s for teach ng Soc al Studies n the e ementary grades L m ted to students adm tted to the postbacca aureate cert f cat on program.

366 Observation and Participation. 1–3) F, S, SS
Students observe and work d rectly w th e ementary ch dren n a c assroom s tuat on nc udes a cr t ca L m ted to students adm tted to the postbacca aureate cert f cat on program.

380 The Teaching of Mathematics in the Elementary School. 3) F S SS
A beg nn ng course n methods and mater a s used. Labo ratory exper ences and computer appl cat ons w th curr cu um mater a s C assroom observat on requ red Lim ted to students adm tted to the postbacca aureate cert ficat on program Prerequ site MTE 180 or equ va ent

401 Teaching Science and Social Studies to Children. 4 F S
Exam nes core funct ons, processes concepts mater a s goa s object ves scope and sequence un t and esson p ann ng and mode s of nstruct on. Corequ s tes EED 402 404 496 RDG 401, 402.

402 Teaching Strategies in Mathematics. (2 F S
Strategies and methodo og es of teach ng e ementary mathemat cs ntegrat ng modern techno og es prob em so v ng man pu at ves current research, and earn ng theor es Prerequ s te MTE 180 or equ va ent Corequ s tes RDG 401 402

404 Language Arts. 2 F S
Presents theory on the soc a nature of ora and wr tten anguage and congruent c assroom pract ces Corequ s tes EED 401 402 496 RDG 401, 402

478 Student Teaching in the Elementary School. 3 15 F, S
Superv sed teach ng n the area of spec a zat on A syn thes zed experience n curricu um nstruction and c ass room management Prerequ s tes· 2 50 GPA, comp etion of profess ona course sequence, approva of Profess ona F e d Exper ences

96 Field Experience. 0 F S
App cat on of course content n a (K–8) schoo c assroom Emphas s on observat on, pupi management p ann ng nd de very of nstruct on and assessment. Corequ s tes. ED 401, 402 404; RDG 401, 402

11 Principles of Curriculum Development. 3 F, S SS
Contemporary curncu um theories Curncu um as an nter ated ent ty Pr nc p es of conceiv ng and effect ng hange

26 Communication Arts in the Elementary School. (3) S, SS
A cr t ca exam nat on of schoo anguage arts teach ng ocus ng on theoret ca assumpt ons regard ng ora - and r tten language development.

28 Social Studies in the Elementary School. (3 F, SS
Prob ems and trends of current programs Deve opment of a balanced and art cu ated program of soc al stud es Pre equ s te EED 355 or equ va ent

29 Science in the Elementary School. 3 S
Prob ems and trends of current programs. Deve opment of a balanced and art cu ated sc ence program. Prerequi- te· EED 320 or equ va ent

30 Outdoor Education. 3 SS
se of various outdoor sett ngs as aborator es for c ass room-related exper ence, study, observat on, nquiry re search, and recreat on

37 *Mathematics in the Elementary School.* (3 F SS
Contemporary mathemat cs teach ng. Content, materia s, nd approaches to nstruct on Prerequis te. EED 380 or 402 or equ va ent

578 Student Teaching in the Elementary School. 9–15) F, S
Superv sed teach ng for postbacca aureate students syn- hesized experience n curr cu um nstruct on, and c ass- room management. Prerequisites comp etion of 21 hours of dent f ed course work from an approved program of tudy; a GPA of 2 50 (postbacca aureate nondegree) or .00 (postbacca aureate degree approva of Profess ona e d Experiences

581 Diagnostic Practices in Mathematics. 3) F S
Spec fic sk ls n d agnos ng/treat ng ch dren s earn ng d f- icu ties n mathemat cs Inc udes pract cum exper ences oth on and off campus, n dent fy ng strengths weak- nesses and n t a remed at on Prerequ site EED 380 or 402 or nstructor approval.

585 Contemporary Issues in Elementary Education. 3) S, SS
A sem nar wh ch deve ops an understand ng of a broad range of contemporary ssues. Assists n estab sh ng an nformed profess'ona v ew Prerequ s te EED 511 or equ va ent

670 Qualitative Research in Elementary Education. (3 S
Survey of ethnograph c and natura st c stud es of teracy microethnograph c ethnomethodo og ca and soc o n guist c stud es of c assroom nteract on ethnograph es of e ementary schoo ng Prerequ s te COE 503

720 Language in Education. 3 A
Socio ngu st c sem nar on language ssues 'n educat'on nc ud ng anguage acqu s t on classroom nteract on lan guage att tudes relat on language and c ass gender eth n c ty

Omnibus Courses: See pages 50 51 for omn bus courses that may be offered.

Multicultural Education

BILINGUAL EDUCATION

BLE 401 Teaching Science and Social Studies to Children. (4 F S
Introduct on of teach ng strateg es to be ut zed n work'ng n b l ngual ESL c assroom sett ngs Corequ s tes: BLE 402 405, 406 407, 496

402 Teaching Strategies n Mathematics. (2) F, S
Introduct on and mp ementat'on concepts for teach ng mathemat cs to m nor ty language popu at ons Corequi- sites BLE 401 405, 406, 407, 496 MTE 180 or equ va- ent

405 Decoding and Reading. (2 F S
Techn ques for teach ng read ng to students who are b n gua ESL. Decod ng phon cs , vocabu ary comprehen- s on, and eva uat on concepts are ntroduced. Prerequi- s te ENG 213 or equ va ent Corequ s tes BLE 401, 402 406, 407, 496

406 Reading Practicum. (1 F S
Superv sed schoo based exper ence in teach ng read ng to b ngua ESL students Corequ s tes BLE 401, 402, 405, 407 496

407 Language Arts. (2 F S
Theory of the soc a nature of ora and written anguage and congruent c assroom pract ces for students prepar ng to teach b l ngual and ESL students. Corequ s tes: BLE 401, 402 405, 406 496

478 Student Teaching in the Elementary School. 3–15 F S
Superv sed teach ng n the area of spec a zat'on. A syn thes zed experience n curr cu um nstruct on and c ass room management n a b ngual educat on ESL setting. Prerequ s tes 2 50 GPA, comp et on of professiona course sequence; approva of Office of Profess onal Fie d Experiences.

496 Field Experience. 0 F, S
App cat on of course content n a b ngua ESL school setting. Emphas s on observat on pup management, plann ng and de ver ng nstruct on, and assessment Corequ s tes· BLE 401, 402 405 406, 407

511 Introduction to Language Minority Education. (3 A
H storica , ph osoph ca theoret ca and pedagogica foundat ons of anguage m nor ty educat on n the Un ted States

514 Bilingual Multicultural Aspects of Special Education. 3 S
Theor es and ssues re ated to the educat on of b l ngual and cultura y d verse except ona ch dren

515 Instructional Methods for Bilingual Students. (3) F S
An introduct on to genera dua anguage teach ng ap proaches Focuses on the effect ve teach ng of l m ted Eng sh prof c ent popu at ons. Prerequ s te· BLE 511.

516 Teaching Strategies for Native American ESL Programs. 3 A
nc udes nstruct ona act v ty deve opment cu tura char- acter st cs and nfus on of cu tura y re evant content n ESL programs of nstruct on Prerequ s te BLE 511

520 ESL For Children. (3) S
Exam nes approaches to second anguage deve opment for ch dren congruent w th recent research n second an guage acqu s t on in ch dren Prerequ s te BLE 511.

522 Literacy Biliteracy Development. 3) S
Exam nes approaches to f rst and second anguage read ng and wr t ng for b ngual second anguage earners from a who e anguage perspect ve (Span sh Eng sh em phas s). Prerequ s te BLE 511

528 Social Studies for Bilingual ESL Teachers. 3 S
Prov des anguage and nstruct ona methodolog es re e vant to b ngua mu t cu tura students n soc a stud es content de vered n Span sh and Eng sh Prerequ s te BLE 511

533 Reading-Teaching Bilingual Students. (3 F S
Acqua nts teachers with a soc o psycho ngu st c perspec t ve on f rst and second anguage read ng and w th strate g es for read ng deve opment Span sh Eng sh empha s s Prerequ s te BLE 511

535 Sociolinguistic Issues in Bilingual Education. 3 F
Survey of major theoret ca issues (e.g. anguage s tu at ons commun cative competence, anguage att tudes nterrelat ng language soc a processes and b ngua education Prerequ s te BLE 511

541 Nature of Bilingualism Second Language Acquisition. 3) A
B ngua and second anguage acqu s t on w th emphas s on ch ldren and ado escents Cogn t ve soc a , and cu tura aspects w be stressed Prerequ s te BLE 511

543 Bilingual Education Models. 3 A
B ngua educat on programs n other countr es ana ys s of po t ca soc a econom c, and educat ona mp cat ons, pract ce in p ann ng b ngua educat on curr cu a See a so offerings under MCE SED, SPE and SPF Prerequ s te. BLE 511

561 Parent Involvement in Language Minority Education Programs. 3) F S
Examines ssues approaches and strateg es for mprov ng parenta and commun ty nvo vement n the schoo ng of anguage m nority ch dren and youth. Prerequ s te. BLE 511

580 Practicum. 1–6 F S
Prov des for pract ca app cat on n schoo sett ngs of pr n c p es of b ngual educat on or Eng sh as a Second Lan guage Spec a perm ss on requ red.

Omnibus Courses: See pages 50 51 for omn bus courses that may be offered

INDIAN EDUCATION

IED 411 Foundations of Indian Education. (3 F, S
H stor ca deve opment of nd an affa rs and nd an educa t on nclud ng contemporary educat ona ssues trad - t ona ndian concepts of educat on and nd an cu tures

422 Methods of Teaching Indian Students. 3) F
Ph osoph es methodo og es, and mater als used n Ind an educat on Exam nat on of oca and tr ba classroom ma ter a s Experimentat on with new teach ng concepts Prerequ site IED 411

424 Curriculum and Practices for Indian Education. 3) S
Curricula phi osoph es and research n nd an educat on. Techn ques for curricu um deve opment change and m provement. Prerequ s te ED 411.

433 Counseling the Indian Student. 3 A
Techn ques and methods used n counsel ng, w th em- phasis on understand ng nd an cu tures and va ues Ex- perimentat on w th new counse ng concepts Prerequ s te ED 411

490 Problems of Teachers of Indian Students. 3 S
Current ssues, trends and prob ems encountered by teachers V ab e so ut ons d scussed Research reviewed and eva uated Prerequ s te ED 411

500 PS: Administration and Management of Indian Education Programs. 3) A
Exam nat on of adm n strat ve and programmatic pract ces re ated to the schoo ng of Amer can nd an popu at ons

502 PS: Development of Indian Cultural and Language Materials. 3 A
Prov des a cu tura anguage approach to curricu um de ve opment Exam nat on of nstruct ona materia s used n Amer can nd an b ngua /b cu tura educat on programs

511 Community Schools in Indian Education. (3 A
Deve opment mp ementat on and adm n strat on of n d an commun ty schoo s Techn ques and methods for ef- fect ve schoo commun ty re at ons

522 Family Literacy in Language Minority Communities. 3 F, S SS
Exam nes theories and pract ces re ated to teracy deve - opment n adu ts Spec al emphas s s g ven to Nat ve American fam es

544 Role of Tribal, State, and Federal Government in Indian Education. 3 A
Exam nes respons b t es and re at ionsh ps of each agency n the operat on of Ind an educat on programs Ana yzes eg s at on f nanc a resources and tr ba con tro

594 Workshop in Indian Education. 6) SS
Pract ca approaches to teach ng Ind an students Curricu lum and mater a s deve opment community nvo vement current ssues, and research exam ned

Omnibus Courses: See pages 50–51 for omn bus courses that may be offered

MULTICULTURAL EDUCATION

MCE 446 Understanding the Culturally Diverse Child. 3 F, S, SS
Survey of cu tural and ngu st c d vers ty n Amer can edu cat on nc ud ng educat on equ ty p ura sm earn ng sty es, and ro es of schoo s n a mu t ethn c soc ety

447 Methods of Teaching the Culturally Diverse Child. 3 A
Techn ques for organ z ng and prov d ng spec al educa t ona exper ences for students from cu tura y and ngu s- t ca y d fferent popu at ons Prerequ s te MCE 446

Omnibus Courses: See pages 50–51 for omn bus courses that may be offered.

Reading and Library Science

LIBRARY SCIENCE

LIS 410 Children's Literature. 3) F S SS
Se ect ng, ana yz ng and us ng modern and c ass c l tera ture with young readers

10 Library Automation. 3 S
L brary uses of computers Fundamenta concepts and s sues 'n the f e d of brary automat on Prerequ s tes LIS 71 and 581 *or* nstructor approva

33 Current Library Problems. (3) F
r t ca ana ys s of current pract ces and prob ems n schoo l brar ansh p. Prerequ s tes L S 540 and 561 and 571 and 581 *or* nstructor approva

34 Evaluation of Literature for Young Readers. 3 S
pply ng standards of terary cr t c sm to terature for young readers Prerequ s te. LIS 410 or nstructor approva

540 Classification and Cataloging. 3 F
escr ptive cata og ng and Dewey Dec mal C ass f cat on f pr nt and nonpr nt brary materia s

561 Selection of Library Materials. 3 F
Pr nc ples and procedures used 'n the se ect on of mater ls for the schoo brary.

63 Library Materials for Children. (3 F
select ng and us ng pr nt and nonprint mater a s to support the e ementary schoo curriculum

564 Library Materials for Adolescents. 3 F
e ect ng and us ng pr nt and nonprint materia s to support he secondary schoo curricu um

565 Literature for Hispanic Youth Literatura para Jóvenes Hispanoparlantes. 3 S
Se ecting ana yz ng and ut z ng terature for H span c nd Span sh speak ng ch dren and ado escents

71 Basic Reference Resources. 3 S
Prov d ng reference serv ce n the schoo brary Content and use of bas c resources

581 School Library Administration. 3 S
dm nistrat on of K 12 brar es and med a centers

84 School Library Internship. (1–6 F, S
Prerequ s tes L S 410 540 561 571 581 Concurrent enro ment n LIS 581 s perm tted.

Omnibus Courses: See pages 50 51 for omnibus courses that may be offered.

READING EDUCATION

RDG 301 Content Area Reading: Decoding. 1 F, S
Requ red course for a Secondary Educat on cand dates ntroduces theory and nstruct ona strateg es for earn ng from text across academ c d sc p nes Corequ s te RDG 302

302 Content Area Reading: Practicum. 1 F, S
Superv sed f e d exper ences app y ng nstruct ona strateg es 'ntroduced n RDG 301 Requ red course for al Sec ondary Educat on cand dates Corequ s te RDG 301

314 Introduction to Teaching of Reading. (3 F S, SS
For elementary teachers n tra n ng. Survey course pro v des bas c teacher ski s eva uation, c assroom env ronments and read ng methods L m ted to students adm t ted to the postbacca aureate cert ficat on program Prerequ s te ENG 213 or equ va ent

315 Decoding in Reading. 3) F S SS
Emphas zes psycho ngu st c and soc o ngu st c aspects of teach ng read ng ncludes teach ng sound symbo cor respondence through phon cs D scuss on sess ons m ght be nc uded L m ted to students adm tted to the postbac ca aureate program May be taken concurrent y w th RDG 481 Prerequ s te RDG 314

401 Decoding and Reading. (2) F S
Requ red course for Elementary Early Ch dhood, and Spec a Educat on cand dates Decod ng (phon cs) vocabu ary comprehens on, and eva uat on concepts are introduced Prerequ s te ENG 213 or equ va ent Corequi s tes: ECD 401 and 402 and 496 *or* EED 401 and 402 and 496 *or* EDP 301 and 303 and EED 320 and EMC 300 and SPE 311 and SPF 301; RDG 402

402 Reading Practicum. (1) F S
A superv sed schoo -based pract cum ut l z ng d agnost c and treatment procedures w th ch ldren exper enc ng read ng d ff cu ty Requ red for Elementary, Ear y Ch d hood and Spec a Educat on cand dates. Corequis tes: ECD 401 and 402 and 496 *or* EED 401 and 402 and 496 *or* EDP 301 and 303 and EED 320 and EMC 300 and SPE 311 and SPF 301 RDG 401.

481 Practicum: Elementary Reading. 3 F S SS
Pract cum exper ence through superv sed tutonng of K 8 pub c schoo students experiencing read ng d fficulty. Conducted n pub ic schoo sett ng L m ted to students adm tted to postbacca aureate program. May be taken concurrent y w th RDG 315. Prerequ s te: RDG 314

505 Developmental Reading. (3 F, S SS
For c assroom and spec a read ng teachers Specif c pro fess ona ski s n decod ng, comprehens on, and eva uat on Requ red for Spec'a Read ng Endorsement Prerequ s te: teach ng cert f cate

507 Content Area Reading. 2 F, S SS
Theory rat ona e, and teach ng strateg es concern ng earn ng from text across subject matter d sc p nes Core qu s te: RDG 508

508 Practicum: Content Area Reading. 1) F, S SS
Pract ca app cat on of content area read ng princ p es in f eld s tes or through on campus s mu at ons Corequisite RDG 507

533 Reading-Teaching Bilingual Students. 3 F, S
Acquaints teachers w th theory and pract ce n second an guage acqu s t on and w th strateg es for deve op ng word recogn t on and comprehens on in nat ve anguage and second anguage read ng Span sh Eng sh emphas s .

544 Comprehensive Secondary Reading Methods and Programs. 3 S
Teach ng methods program deve opment/eva uat on, and resource work as carried out by the contemporary secondary read ng spec a st. Prerequ s tes: RDG 507, 508.

550 Practicum Experiences in Reading. 3) F, S, SS
Exper ence ut l z ng read ng d agnost c and nstruct ona techn ques for classroom and cl n c settings Part cipants tutor pub c schoo! students tw ce week y. Lab sect ons See RDG 557 for State of Ar zona read ng endorsement) Prerequis te: RDG 505 or equ va ent

556 Assessment Procedures in Reading. (3) F S SS
Techn ques for c assroom and c n ca reading d agnos s and nstruct on. Emphas s on cont nuous assessment May be taken concurrent y w th RDG 557. Recommended for State of Arizona read ng endorsement. Prerequ s te. RDG 505

557 Reading Clinic Practicum Experience. (3) F,S
Advanced pract cum expenence ut z ng spec a zed read ng and other d agnost c and nstruct on techniques Par tic pants tutor pub c schoo students tw ce weekly Lab sect ons. Recommended for State of Ar zona read ng en dorsement May be taken concurrent y w th RDG 556. Prerequ sites RDG 505; nstructor approval

581 Literature-Based Reading Programs. (3 F, S, SS
For c assroom and spec a read ng teachers The ro e of l terature n the acqu s t on and deve opment of teracy Spec fic suggest ons for he p ng students learn to read and or expand the r reading ab ty w th terature ntro duction to terature stud es Prerequ s te teach ng cert f cate

629 Seminar: History of Reading Instruction and Research. 3 S
Recurrent themes prom nent author t es, and s gn f cant research and pub cat ons n the h story of read ng educa t on and re ated curr cu a. Prerequ s te. nstructor ap prova

630 Research in Reading. (3 F
For advanced graduate students nterested n app ed re search prob ems terature of read ng nstruct on and ma jor ssues re ated to read ng research Prerequ s te n *structor approva*

Omnibus Courses: See pages 50–51 for omn bus courses that may be offered

Secondary Education

HUMANITIES EDUCATION

HUE 101 Ideas and Values in the Humanities. 4 F, S
Interrelat on of art architecture, terature mus c ph oso phy, re g on theatre and other perform ng arts n the *modern wor d 2 hour lectures, 2 hour d scuss on meet* ngs per week *[Satisfies Genera Studies Requirement HU]*

102 Ideas and Values in the Humanities. 4 F S
See HUE 101 *[Sat sf es General Stud es Requ rement. HU]*

118 Encountering the Arts. 3 F, S
ntroductory course emphas z ng persona contacts w th the f ne and perform ng arts Attendance of a w de range of events, with ana ys s and eva uation

130 Introduction to Popular Culture. (3 F S
Ref ect ons of Amer can va ues n 20th century popu ar arts Mus c pr nt art, te ev s on rad o mov es and the es thet cs of popu ar cu ture *[Sat sfies Genera Stud es Re qu rement HU]*

401 Humanities in World Cultures. 3–6 N
A human t es study program of foreign trave Fine and perform ng arts of the var ous wor d cu tures May be re peated for cred t Prerequ s te. nstructor approva

480 Methods of Teaching the Humanities. 3 N
Methods of nstruct on organ zat on, d scuss on and pres entat on of the courses n the nterd sc p nary human t es Prerequ s tes HUE 101 and 102 *or* nstructor approva

Omnibus Courses: See pages 50 51 for omn bus courses that may be offered.

SECONDARY EDUCATION

SED 403 Principles, Curricula, and Methods. 4 F S
Advanced eve of deve opment of know edge and sk s of nstruct ona plann ng and methods of teach ng and eva u at ng n the secondary schoo Observation part c pat on requ red Corequ s te· SED 496

478 Student Teaching in the Secondary Schools 3 12 F S
The pract ce of teach ng The re at onsh p of theory and pract ce n teach ng. Prerequ s tes: SED 403; spec a methods approva of Off ce of Profess ona Fie d Exper ences

480 Special Methods of Teaching Social Studies. 3) F, S
nterd sc p nary approaches product on and co lect on o mater a s

496 Field Experience. 0 F, S
App cat on of course content in a secondary schoo set t ng Emphas s on observat on pup management p an n ng and de ver ng nstruct on and assessment Corequ s te SED 403

501 Introduction to Effective Instruction. 6) F, S SS
Introductory course for postbacca aureate cert f cat on pro gram n secondary educat on Emphas s upon deve opin bas c c assroom management nstruct on and eva uat on Inc udes a fie d ass gnment of at east 120 hours. Pre requ s te adm ss on to postbacca aureate cert f cat on program

522 Secondary School Curriculum Development. (3 F S SS
Soc a processes, ssues, pr nc p es patterns and proce dures in curr cu um deve opment.

533 Improving Instruction in Secondary Schools. (3 F S SS
Ana yses of procedures methods techn ques and experi ments n teach ng n secondary schoo s. Prerequ s tes: SED 478, 578

577 Issues and Trends in Secondary Education. *(3)* N
Analyses of ay and profess ona reports prob ems and s sues n Amer can secondary educat on. Prerequ s tes. SED 478 578

578 Student Teaching in the Secondary Schools. 3 12 F, S
The pract ce of teaching. The re at onsh p of theory and pract ce n teach ng Post Bacca aureate students on y. Prerequ sites complet on of approved post bacca aureate program a m n mum 2 50 GPA approva of Off ce of Pro fess ona F e d Exper ences.

588 Human Relations in the Secondary Schools. (3 A Prob ems n human relat ons nherent n the nteract on of pup s teachers adm n strators nonprofess ona staff, and aymen Prerequ s tes. SED 478 578.

711 Secondary Curriculum Development. 3) S SS
Theor es and processes of deve oping curricu um eva u at on of research Prerequ s tes. SED 478 522 (or equ va ent , 578

722 Improvement of Instruction in the Secondary School. 3 F
Eva uat on of the research ssues and theor es re ated to the mprovement of nstruct on Prerequ s te: SED 533.

Omnibus Courses: See pages 50–51 for omnibus courses that may be offered.

Special Education

SPE 311 Orientation to Education of Exceptional Children. (3) F S SS
Inc udes g fted m ld y handicapped severe y hand capped, and the b ngua mu t cu tura except ona ch d *[Sat sfies Genera Stud es Requ rement SB]*

312 Mental Retardation. 3) F S SS
Character'st cs and assessment spec f c to menta retar dat on. Term nology deve opment educationa program m ng and therapeut c procedures w l be emphas zed Prerequ s te SPE 311

314 Introduction to Bilingual Multicultural Special Education. 3 F S, SS
Theoret ca background and pract ca app cat on of gen era ssues regard ng the educat on of b l ngua mu t cu tu ra hand capped ch dren Prerequ s te SPE 311

336 Behavioral and Emotional Problems in Children. (3 F S SS
Character st cs and assessment spec'f c to emot ona y and behav ora y d sturbed ch dren Term no ogy, deve opment and educat ona programm ng emphas zed Pre requ s te SPE 311

361 Introduction to Learning Disabilities. 3 F S SS
Character st cs and assessment spec f c to earn ng d s ab t es Term no ogy deve opment and educat ona pro gramm ng emphas zed Prerequ s te SPE 311

411 Parent Involvement and Regulatory Issues. 3 F S
Emphas's on parent and schoo re at ons through effect ve commun cat on and state and federa regu ations mpact ng serv ces for the hand capped Prerequ s tes SPE 311 majors on y

412 Evaluating Exceptional Children. 3 F S
Normat ve and cr ter on referenced d agnost c techn ques, nc ud ng format ve eva uat on Emphas s upon app ca t on Da y pract cum requ red Prerequ s tes EDP 301, 302· EED 404 SPE 311. Corequ's'tes ECD 402 RDG 401, 402 SPE 413 496

413 Methods in Language, Reading, and Arithmetic for Exceptional Children. 3 F S
Methods techn ques and mater a s for use n prescr pt ve teach ng Dai y pract cum requ red Corequ s tes· SPE 412, 496

414 Methods and Strategies in Behavior Management. 3) F S
The organ zat on and de very of nstruction, nc uding for mat ve eva uat on techn ques Techn ques of behav o management Da y pract cum requ red Prerequ s tes RDG 401 402 SPE 412 413 Corequ s tes SPE 415, 496.

415 Social Behavior Problems of Exceptional Children. 3 F S
Ana ys s and ntervention nto soc a behav or prob ems of except onal popu at ons Da y pract cum requ red Pre requ s tes· RDG 401, 402 SPE 412 413 Corequ tes SPE 414 496

455 Early Childhood and the Handicapped. 3 F
Early ch dhood educat on as t app es to the hand capped chi d

478 Student Teaching in Special Education. (3–15) F S
Y" grade on y Prerequ s tes approva of spec al educa t on program coord nator; comp et on of spec f ed pre requ'sites in spec a educat on.

496 Field Experience. (0 F S
App cat on of course content n a spec a education set t ng. Emphas s on observat on pup management, p an n ng and de ver ng nstruct on and assessment. Corequ s te SPE 411 or 413 , 412 414, 415

511 The Exceptional Child. 3 F, S, SS
Educat onal needs of except ona ch dren and adu ts Not recommended for students who have comp eted SPE 311.

512 Individuals with Mental Retardation. (3 F, SS
Et o ogy d agnos s and management of nd v dua s with mental retardat on Current trends n prevention, pro gramm ng and teacher preparat on Not recommended for students who have comp eted SPE 312.

513 Teaching Students with Mental Retardation. (3) N
Spec f c methods mater a s and curr culum for students with m d or moderate retardat on. Prerequisite SPE 312 or 512

514 Bilingual Mult'cultural Aspects of Special Education. 3 S
Theories and issues re ated to the education of b l ngual and cu tura y d verse except ona chi dren

515 Methods for the Remediation of Learning Problems of Exceptional Children. 3 S SS
Methods and mater a s for remed at ng the bas c aca dem c prob ems of except onal ch ldren. Prerequ s tes: SPE 511; a methods course n the teach'ng of read ng and mathemat cs

531 Behavior Management Approaches with Exceptional Children. 3 F, SS
Behav or management approaches for c assroom behav or of except ona ch dren. Prerequ s te SPE 511 or equ valent.

536 Characteristics of Children with Behavioral Disorders. 3 F, SS
Var ab es contr buting to behav or patterns of behavior dis ordered ch dren

538 Methods of Teaching Students with Behavioral Disorders. 3 N
Deve opment of methods for managing the academ c and soc a behav or of behav ora y d sordered ch ldren and youth n educat ona sett ngs Prerequ s te· SPE 336 or 536

551 Teaching Young Children with Special Needs. 3) S
Methods, mater a s and curr cu um for preschoo and pn mary aged ch dren w th specia needs Prerequ s tes. SPE 455 and 511 *or* equ va ents

552 Management of Individuals with Severe Handicaps. 3 S
Instruct on and management of schoo -aged and adult in d v dua s w th severe phys ca or mu t ple hand caps Pre requ s tes· SPE 511 or equ va ent instructor approva

553 Developmental Functional Assessment. 3 F
Teacher focused deve opmenta /functional assessment of preschoo and severe y, phys ca y and mult p y handi capped nd v dua s F e d experience requ red Prerequ s tes SPE 511 and 512 and 574 *or* equ va ents

554 The Parent/School Partnership. (3) S
ncludes know edge and procedures for nvo vement and tra n ng of parents and careg vers of preschoo and severely hand capped nd v duals F e d exper ence re qu red Prerequ s tes· SPE 455 and 511 *or* equ va ents

561 Characteristics/Diagnosis of Learning Disabilities. (3) F SS
Theor es re ated to learn ng d sab it es nc ud ng dent f cat on and characteristics

562 Methods of Teaching Students with Learning Disabilities. (3) N
Various methods and ntervent on strateg es for remed ating earning d sab it es of ch dren and youth Prerequ s te· SPE 361 or 561

574 Educational Evaluation of Exceptional Children. (3) F, SS
Des gn and statist cal cons derat ons of normat ve and cr ter on-referenced tests. Col ect on record ng, and ana ys s of data from formative eva uation Prerequ s tes SPE 511 or equ va ent; a methods course n the teach ng of read ng and mathemat cs

575 Current Issues in the Education of Exceptional Children. (3 F, SS
Mainstream ng noncategor ca , f nancing, ega d agnos tic, abe ng legis ative and other cr tica and controversia ssues related to the educat on of except ona ch dren

577 Mainstreaming Methods. (3) S
Successfu ma nstreaming methods practica problem so v ng sess ons related to teacher s c assroom needs and individual contracts focusing on ma nstream ng ssues are addressed. Genera educators encouraged.

578 Student Teaching in Special Education. (9–15) F, S
"Y" grade on y Prerequisites· comp et on of spec f ed courses, approva by the specia education program coord nator

579 Supported Employment for the Severely Handicapped. (3) F
Emphas s on trans t on from schoo to integrated commun ty and work settings for the severe y and profoundly handicapped Pract cum requ red. Prerequ s tes SPE 552, courses on the severe y hand capped

582 Classroom Research with Exceptional Children. (3) S
Introduction to nterpret ng research. Spec f c research techn ques with primary emphas s on classroom research, nclud ng appl ed behavior analys s

585 Creativity: Research and Development. (3) S
Nature of creativ ty exp ored n terms of ph osoph'cal underpinnings, empir ca ev dence, human deve opment, se f-actua zation, and the eco ogy surrounding the creative event.

586 Advising the Gifted Child. (3) A
Focus on educat ona plann ng and gu dance, socia and emot'onal deve opment and fam y prob em so v ng re gard ng needs of g fted ch ldren.

587 Controversies in Educating the Gifted. (3) F
In-depth analys s of major controvers es n educating the g'fted, including nature nurture, the ro e of mental tests, and sex differences

588 The Gifted Child. (3) F SS
Gifted ch dren s character st cs ident fication, needs, schoo and home environments def nit ons, and misun derstandings. Research by Pressey, Stan ey, Terman and others

589 Methods in Teaching the Gifted. (3) S SS
Methods n teach ng elementary and secondary school g fted ch dren, includ ng nd v dua zed and computer-as s sted instruction, team teach ng Prerequ s te SPE 588

775 Evaluation and Intervention in Special Education. (3) S
n-depth ana ys s of research and iterature on eva uation procedures and ntervent on approaches for exceptional nd v duals at al age levels Lecture, discuss on.

781 Research and Evaluation in Special Education. (3) S
ssues and problems in conducting research and/or eva uation programs nvo ving exceptiona ch dren.

Omnibus Courses: See pages 50–51 for omn bus courses that may be offered

Division of Educational Leadership and Policy Studies

(ED 108, 965–6357)

PROFESSORS:
APPLETON (ED 108), FENSKE, GLASS, HUNNICUTT JORDAN, METOS, NORTON, RICHARDSON, SHAFER, SMITH, R STOUT, WEBB

ASSOCIATE PROFESSORS:
BOGART, HARTWELL HUNN CUTT, LEVAN NOLEY, PADILLA, T PPECONNIC, WALKER, W LKINSON

ASSISTANT PROFESSORS:
CASANOVA, KAZAL-THRESHER

PROFESSORS EMERITI:
ASHE, BELOK, BONTRAGER, DEMEKE, DRAKE, HUFF, MENKE, M. STOUT WARREN, WOCHNER, WOOTON

Program Areas

Educational Administration and Supervision
Educational Policy Studies
Higher Education

Degrees: M.A., M.Ed., Ed.S.*, Ed.D., Ph.D.

Programs of the Division of Educational Leadership and Policy Studies are designed to develop leaders, researchers, and policy analysts for careers in schools, colleges, and private and government agencies. Graduates are able to examine educational institutions, theories, and practices within broad economic, historical, political, so-

* Applications are not being accepted for the Educational Specialist program.

cial, and intellectual contexts in this country and abroad.

Three basic emphases exist within the division's programs. One strand focuses on the administration and policies of educational institutions and practices from preschool through secondary education. The second strand focuses on the administration and policies of postsecondary education. The third strand emphasizes (1) inquiry into the processes by which educational policy is formulated and (2) evaluation of policy decisions. Each strand brings together the methods and perspectives of the social sciences and the social and philosophical foundations of education.

Faculty within the division are involved in both databased and theoretical research. Qualitative and quantitative paradigms are employed. Students have the opportunity to work on research projects in the College of Education and in school districts and educational agencies throughout the country.

The division is a member of the University Council for Educational Administration.

Educational Administration and Supervision

EDA 501 Competency Performance in Educational Administration. (6) F, SS
The nature of educational administration and the concept of competency as it applies to educational administration

507 Computers in Educational Administration. (3) F, S
Survey of computer use and applications in educational administration Lecture lab Cross-listed as EMC 507

510 Introduction to Organization and Administration of American Public Schools. 3 F, S
Organizational structure and administration of public education are explored through the application of legal and ethical concepts and relevant information of the social sciences. Cross listed as SPF 510

511 School Law. (3 F S SS
Constitutional statutory, and case law that relates to a school personnel, pupils the school district and other governmental units Contracts dismissals, tenure retirement, pupil injuries ability of personnel and district school district boundary changes and bonding.

521 Evaluation of Teaching Performance. 3) F
In depth analysis of legal bases of teacher appraisal, teacher competency measurement of teacher performance and application of performance appraisal systems.

524 Theory and Application of Educational Administration. 3 F, SS
History and development of public school administration in the United States current organizational patterns for public education at local, intermediate, state, and national levels current theoretical positions in educational administration

525 Human Relations and Societal Factors in Education. (3) N
Interrelations between problems of educational administration and interdisciplinary social sciences Communications skills moral, authority and perception Concepts from political science, economics and social psychology useful to the administrator

526 Instructional Supervision. (3) F S SS
Administering curriculum improvement, in service education, evaluating and improving teaching competence administrative instructional responsibilities

527 Managerial Functions in School Administration. 3) N
Relates to the work of the central district office staff and the school principalship Use of human resources educational planning and organization and management of time.

538 Administration of the Community School. (3) N
Philosophy, history, organization, and operation of the community centered school Introduction of the community education concept into a school system and making it operational.

544 Public School Finance. (3) F
Measures of ability efforts and educational need capital outlay funding tax revenues federal, state and local financing alternatives; major issues and trends in the financing of public education

548 Community Relations in Education. (3) N
Administrative factors of primary importance in developing community involvement in public schools. Emphasis on theory and skill of school system and individual communication.

555 Educational Facility Planning. 3) F
School building needs, educational planning for facilities responsibilities of architects, duties of contractors, and equipping and furnishing of school buildings

571 School Business Management. (3) F, S, SS
Purchasing budgeting, accounting payroll management, auditing, financial reporting insurance and administration of nonteaching personnel and services

573 School Personnel Administration. (3 S
Organization for personnel services, development of policy to govern selection orientation, placement, remuneration transfers, separations and development of morale among instructional and noninstructional personnel

576 The School Principalship. (3) F S SS
Problem and laboratory approaches used to provide application of administrative activities of elementary and secondary schools

634 Instructional Leadership. 3 N
Curricular practices and processes used by instructional leaders who plan, organize and coordinate the professional activities in elementary and secondary schools. Prerequisite EDA 526.

675 Politics of Education. (3 S
Social science theory and research are used to consider the political context of educational policy making

676 The School Superintendency. 3) S
Critical examination of the school superintendency and the primary functions of this educational position. The duties, responsibilities activities and problems of the school superintendent are included. The unique leadership role of the school superintendent is examined Prerequisite instructor approval.

679 Administration of Special Programs in Education. (3) N
For personne adm n stering spec al educat ona serv ces respons b t es of superintendents pr nc pa s, supervisors, and d rectors for spec a educat on student personne aud ov sua brary sc ence, and others

711 Administrative Leadership. 3 F
Emphas s on research n eadersh p; app cat on of re search f nd ngs to adm n strat ve and superv sory func t'ons n educat ona endeavors Prerequ s tes 30 semes ter hours n educationa adm n strat on, admiss on to doc toral program

722 Administration of Instructional Improvement. 3 S
Recent research re at ng to adm nistrat ve and superv sory respons b t es for the improvement of the educat ona program. Effect ve processes by adm n strators, superv sors consu tants, and coord nators Prerequ s tes 30 semester hours n educat onal adm n stration; adm ss'on to doctora program

733 Administrative Management. (3 S
Recent research re at ng to schoo management Schoo f nance, aw bu ldings transportat on, food serv ces and supp y management Prerequ s tes 30 semester hours n educat ona adm n strat on adm ss on to doctora pro gram

Omnibus Courses: See pages 50–51 for omn bus courses that may be offered.

Educational Policy Studies

SPF 111 Exploration of Education. 3 F S
Education as an nstrument n the deve opment of the ind v dua and soc ety and ts s gn f cance as an Amer can n st tut on

301 Culture and Schooling. 2) F S
For the professional teacher preparat on program· an overv ew of the cu tura soc a and po t ca m eus n wh ch forma schoo ng takes p ace n the Un ted States For educat on majors on y.

401 Theory and Practice in Education. 1 2) F S
For the profess ona teacher preparat on program. The analys s and nterpretat on of c assroom behav or from perspectives der ved from ph osophy soc a sc ence, and aw. For educat on majors on y

457 Third-World Women. (3 F
Econom'c soc opo t ca and demograph c context for un derstand ng the ro es of th rd wor d women n hea th, fam ly, work educat on, and commun ty. Cross sted as FAS 494 NUR 457/WST 457. Prerequ s te 6 hours of soc a sc ence credit or nstructor approva *[Sat sf es Genera Stud es Requ rements SB, G]*

510 Introduction to Organization and Administration of American Public Schools. 3 F, S
Organ zat ona structure and adm n stration of pub c edu cat on are exp ored through the app cat on of ega and eth ca concepts and re evant nformat on of the soc a sc ences. Cross sted as EDA 510

511 School and Society. 3 F S SS
Interrelat onship of schoo and soc ety and the ro e of edu cat on in soc a change

515 Education of Women. 3 A
Ana ys s of ro es and status of women educational prac t ces and a ternat ves

520 Cultural Pluralism and Education. 3 N
Ph osoph c ana ys s of the concept of cu tura p ura sm and ts soc a mp ıcat ons for Amer can educat on

533 Comparative Education in the Western World. 3) F
Educat ona pract ces and trad t ons n the ead ng nat ons of Europe and the Sov et Un on

534 Education and Change: Developing Nations. 3) S
Educat on as econom c and soc opolit ca change agent n Afr ca As a the M ddle East and Lat n Amer ca

543 Bilingual Education Models. 3) N
B ngua educat on programs n other countr es, ana ys s of po t ca soc a, econom c and educat ona mpl cat ons pract ce n p ann ng b ngual educat on curr cu a.

544 Philosophical Foundations of Education. 3 F
Theor es of education n anc ent med eva and modern c ass ca and contemporary ph osoph es

566 History of Education. 3 S
Deve opment of educat ona nst tut ons and deas n the Western Wor d from anc ent t mes to the 20th century

711 Social and Historica Foundations of Education. 3 S, SS
Prob ems of Amer can educat on and the r soc oh stor ca context

Omnibus Courses: See pages 50 51 for omn bus courses that may be offered

Higher Education

HED 510 Introduction to Higher Education. 3) F, S
An overv ew of Amer can h gher educat on nclud ng ph osoph ca, po t ca and soc al aspects

516 Management Concepts in Higher Education. 1) N
ntroduct on to concepts of management theory and prac t ce

533 The Community-Junior College. 3 F, S
H story, funct ons organ zat on and current ssues. Meets Ar zona commun'ty co ege course requ rement for cert f - cation.

611 Curriculum and Instruction. 3 S
Curr cu um deve opment nstruct ona organ zat on and mprovement of struct on in h gher educat on. Prerequ s te. HED 510

644 Higher Education Finance and Budgeting. (3) S
F nanc a p ann ng and budget ng n h gher educat on nst tut ons ssues re ated to f nanc ng pub c and pr vate co eges and un vers t es Prereq s te. HED 510.

649 Law of Higher Education. 3 F
Ana ys s of ega ssues re ated to h gher educat on exami nat on of key court dec sions Prerequis te. HED 510

689 Administration. 3 F
Theory and pract ce of adm n strat on n h gher educat on nst tut ons. Prerequ s te HED 510

Omnibus Courses: See pages 50 51 for omn bus courses that may be offered

Division of Psychology in Education

(EDB 301, 965–3384)

REGENTS' PROFESSOR:
KULHAVY

PROFESSORS:
HELMSTADTER (EDB 301A) BERLINER, BERNSTEIN, BURKE CABIANCA CLAIBORN, GLASS GRINDER, HACKETT, HARRIS HORAN, B. KERR, N KERR, KRUS, McWHIRTER, NELSEN, ROB NSON, SATTLER, SM TH, SNYDER, STROM, SULLIVAN, VAN WAGENEN

ASSOCIATE PROFESSORS:
ARCINIEGA, BARONA, BETZ, BROWN, CHRISTIANSEN, COHN, CUMMINGS, GROSS KINNIER, METHA, MOORE, SHELL

ASSISTANT PROFESSORS:
KLE N, SANTOS DE BARONA

PROFESSORS EMERITI:
BENEDICT, BLACKHAM, BLAESSER, BOETTO, CHURCH LL, DAANE, DAV S, GAFFNEY, GERLACH, GU NOUARD, KIMLER, MAZEN M LLER MOULTON, N CHOLS, NOBLE RICHARDSON, STAFFORD, VERGIS, WRENN

Program Areas

Counseling Psychology
Counselor Education
Learning and Instructional Technology
Lifespan Development Psychology
Measurement, Statistics and Methodological Studies
School Psychology

Degrees: M.A., M.C., M.Ed., Ed.D., Ph.D.

The faculty in the Division of Psychology in Education offer graduate degrees in a number of program majors. Master's degrees are offered in Counseling, Counselor Education, Educational Psychology, and Learning and Instructional Technology. Doctoral degrees are offered in the program majors of Counselor Education (applications for the doctorate in Counselor Education are no longer being accepted), Counseling Psychology (a program accredited by the American Psychological Association), Educational Psychology, and Learning and Instructional Technology. In the Ph.D. program in Educational Psychology, concentrations are available in: school psychology (a program accredited by the American Psychological Association); measurement, statistics, and methodological studies, and lifespan developmental psychology.

Students applying to the graduate programs in Counseling Psychology or Educational Psychology are required to submit scores on the Graduate Record Examination (GRE). The Miller Analogies Test may be substituted for the GRE in the concentrations of Counselor Education and Educational Technology. All degree programs require the successful completion of comprehensive examinations.

Additional information on graduate programs may be obtained directly from the division office. Persons requesting information should specify the program of interest.

Counseling Psychology

CPY 613 Child Counseling. (3) N
App cat ons of counsel ng theory n work ng w th chi dren n cl n cs and e ementary schools. Integrated pract cum ava ab e w th perm ss on of instructor. Prerequisite CED 577 or equ va ent

622 Group Counseling. 3) F, S
Theor es and methodo ogies used n group counse ng Prerequ s tes CED 567 and 577 *or* equ va ents

634 Organizational Development and Planned Change. (3 N
Organ zat ona nd v dua dynam cs, nc ud ng theory, ana ys s techn ques and consu tat on intervention strategies used n organ zationa deve opment. F e d consu ta t on projects Prerequ s tes: CED 567 and 577 *or* equ va ents

644 Psychology of Careers. (3) S
Advanced career counse ng nc ud ng theory, research and pract ce Prerequisite: CED 577 or equiva ent

645 Professional Issues and Ethics. (3) F, S
Ethical, ega and profess ona ssues of concern to practi tioners and researchers funct on ng n a var ety of settings Prerequ s tes CED 512 and 523 *or* equ va ents

666 Comparative Theories of Personality. (3) F
Comparat ve ana ys s of persona ty theories n re ation to counsel ng practices Prerequ s te· CED 577 or equiva ent.

667 Patterns of Behavior Disorders. (3) A
Et o ogy and treatment of a var ety of psycho og ca prob- ems particu ar y those represented n DSM I R Pre requ s te CED 577 or equ va ent

670 Behavioral Counseling. (3) N
Theory, procedures, and appl cat ons of behav or mod fi- cat on and therapy n working with chi dren, parents, and adu t c ents n schoo , c n c, and nst tut ona settings. D - dact c nstruct on and ana ys s of ndiv dua and group prob ems and d rected experiences Prerequ s te· CED 577 or equ va ent.

671 Multicultural Counseling. (3) N
Prov des awareness of the nf uence of soc ocultura var ab es on human deve opment and exp ores mp cat ons for counse ng m nor ty popu at ons Prerequ s te CED 577 or equ va ent

672 Human Diversity: Social Psychological Perspectives. 3) A
Implicat ons for psycho og ca pract ce of soc'a , psycho og ca , and b o og ca factors n the deve opment of be hav ora d fferences

674 Counseling Women. 3 F
Explores women s development and ts mp cat ons for counsel ng Sex sm n menta hea th sex d fferences n diagnos s and psychopatho ogy and women s part cu ar treatment needs

675 Counseling Interventions in Stress Management. (3 N
Theory procedures and app cat on of stress manage ment techn ques nc ud ng b ofeedback med tat on re laxat on autogen c therapy v sua zat on, and magery. Prerequisites CED 577 or equ va ent· instructor approva

677 Advanced Counseling. 3 N
Advanced top cs n counse ng theory research and prac tice Prerequ s te CED 577 or equ va ent

679 History and Systems of Psychology. 3 A
Exam nat on of the deve opment and different at on of the d sc p ne of psychology from ts or g ns n ph' osophy to the present

701 Science and Practice of Counseling Psychology. (3 F
Directed exper ences nvo v ng the ntegrat on of theory research and pract ce n counse ng psycho ogy Pre requ site. nstructor approval

702 Research Methods in Counseling Psychology. 3 A
The app ication of exper mental and/or quas -exper menta methods to theory construct on and treatment eva uat on n counse ng psycho ogy Prerequ s te COE 502 or equiva ent

Omnibus Courses: See pages 50 51 for omn bus courses that may be offered

Counselor Education

CED 512 Introduction to the Helping Relationship. 3 F S SS
ntroduct on to the sk s used n the he p ng profess ons and an exam nation of the sett ngs n wh ch they occur

522 Personality Development. 3 F S SS
nteract on of affect ve and cogn t ve factors n persona ty deve opment at d fferent age eve s Var ous persona ty theories examined

523 Psychological Tests. 3 F S, SS
Standard zed tests n the study of the nd v dua w th em phas s on test score interpretat on n counse ng

534 Occupations and Careers. (3) F S, SS
The world of work career deve opment educat on, and train ng for occupational entry and mob ity

545 Analysis of the Individual. (3 F S SS
Theory and methods common y used n study ng the nd v dua Observat ona methods, d agnost c nterv ews structured and sem structured methods for assess r persona ty Pre or corequ s te CED 523

567 Group Procedures. 3) F S, SS
Socia psycho og ca factors determ n ng nteract on, effe t veness and mora e n sma groups Techn ques of o servat on, assessment, and eadersh p

577 Counseling. 3 F S, SS
Princ p es and app cat on of counse ng w th part cu ar emphas s on counse ng theor es. Prerequ s tes CE 512 534 545 adm ss on to M C. or school counse or ce t f cat on program

655 Student Development Programs in Higher Education. 3) A
Emerg ng conceptua mode s of student developmer Overview of student personne and student affa rs pr grams n commun ty co eges four year co eges and un vers t es Observat on on campuses.

656 The American College Student. 3 A
Se ected theor es of human deve opment w th app cat o to academ c socıopsycho og ca learn ng tasks postsecondary env ronmenta nf uences nc ud ng facu ty expectat ons and campus subcu tures

672 Marriage and Family Counse ing I. (3 F
ntroduct on to marr age and fam y counse ng theor e Emphas s s on a systems commun cat on mode ut z n co-counse ng.

673 Marriage and Family Counseling II. 3 S
Advanced analys s and app cat on of systems commun cat on counse ng Focus on mar ta and sexua counse ng Pract cum recommended

681 Supervised Practice. 3 F S
Superv sed exper ences n schoo s or commun ty agen- c es. Prerequ s te nstructor approva

Omnibus Courses: See pages 50 51 for omn bu courses that may be offered

Educational Psychology

EDP 301 Learning and Motivation in Education. 2 F S
Us ng a case format, earn ng and mot vat on pr nc p es are app ed to educat on contexts Educat on majors only

302 Assessment and Evaluation in Education. (1) F S
Us ng a case format assessment and eva uat on pr n c ples are app ed to educat on contexts Educat on major on y

303 Human Development. 3 F S
Se ected aspects of ch d and ado escent deve opment Emphas s on poss b t es for nf uence by teachers an parents For majors on y Prerequ s te: CDE 232 o equ valent.

310 Educational Psychology. (1–6 F, S SS
Human behav or n educat ona s tuat ons presente through nstruct ona modu es Students may re-enro fo cred t to a tota of 6 hours *[Sat sf es Genera Stud es Re quirement SB]*

313 Childhood and Adolescence. 3 F, S, SS
Pr nc ples under y ng tota deve opment of pre and ear y ado escent ch dren Emphas s on phys ca nte ectua soc a and emot ona deve opment w th pract ca mp ca t ons for teachers grades 5–9. Prerequ s te EDP 303 or

dm ssion to Co ege of Educat on postbacca aureate pro gram

454 Introduction to Statistical Data Analysis in Education. (3 F, S, SS
he ro e of stat st cs n research Tabu ar and graph c ata presentat on Frequency d stribut ons, descr pt ve n dexes, and introduction to stat st cal nference Prerequ site MAT 117 *[Sat sfies Genera Stud es Requ rement. N2]*

502 Introduction to Quantitative Methods. 3 F, S, SS
op cs n stat st ca ana ys s measurement, and research des gn Exp oratory data ana ys s est mat on theory, and stat st ca nference Use of computers for data ana ys s. Cross listed as COE 502

503 Introduction to Qualitat ve Research. 3) F S SS
erm no ogy h'stor cal deve opment approaches (nc ud- ng ethnography ethnomethodology, cr t ca theory, grounded theory and hermeneutics , and qua itative ver us quant tat ve soc a sc ences, methods of nqu ry. Cross sted as COE 503

504 Learning and Instruction. (3 F, S, SS
Introduct on to psychology of earn ng and nstruct on In c udes the foundat ons of earn ng theones and the r app at on to educat ona pract ce Cross sted as COE 504.

510 Essentials of Classroom Learning. 3) F, S, SS
heoret ca and emp r ca foundations of learn ng in the classroom m eu. Cr t ca exposure to research and method n nstruct ona psycho ogy Cross sted as LNT 510

513 Child Development. 3) F, S, SS
Exam nat on of prob ems and ach evements exper enced by chi dren grow ng up n a techno og ca soc ety Empha s s on d scover ng the ch d s perspect ve

514 Psychology of the Adolescent. 3) F S, SS
Cognit ve phys cal and soc a deve opment of ado es- cents n contemporary soc ety Impact of fam ly schoo and work place on ado escent deve opment. Prerequ s te: EDP 310 or PGS 100 or equ va ent

530 Theoretical Issues and Research in Human Development. 3) F
Psycho og ca theories research, and methods relevant to human development emphasiz ng the re at ons between ear y deve opment and ater performance

532 Psychology of Exceptionality. 3) S
Genera psycho og ca theory and exper menta research relevant to except ona ty emphas z ng mp cat ons for educat ona programs that recogn ze un que earner char cter st cs F eld work

534 Principles of Behavior Modification. 3 F
Pr nc p es of cond t on ng as app ed to behav or mod f ca- t on current research on the exper mental anaiys s of be hav or n educat ona psycho ogy

540 Theoretical Views of Learning. 3 F S
Class ca and cogn t ve theor es of earn ng p us recent or entat ons ustrat ve exper menta and rat ona founda t ons imp cat ons for educat ona pract ce Cross l sted as LNT 540

542 The Psychology of Learning and Instruction. 3) S
Cr t ca rev ew and eva uat on of research on earn ng var ab es re evant to acqu s t on and retent on of instruct ona matena s. Lab. Cross sted as LNT 542.

543 Psychological Research on Life-Span Development. 3) S
Cnt ca rev ew and evaluat on of contemporary research on cognitive and affect ve deve opment across the fe span. Prerequ s te· EDP 530 or equ valent.

544 Psychology of Reading. (3 N
A ternate ana yses of the read ng process des gns and procedures for nvest gat ng nstruct ona and non n struct ona var ab es re ated to read ng achievement

550 Introduction to Measurement in Education. (3) F S
Nature and types of educat ona measures Cntiquing and se ecting appropriate measuring dev ces Construct ng measur ng dev ces Soc al controvers es about tests

551 Expository Writing and Research Heuristics. (3) F
Week y writ ng pract ce mak ng use of heur st c concepts and expos tory pr nc p es The construct on of rat ona es for research prob ems Log c and coherence n rhetor c Wr t ng sty e appropr ate to expos t on

552 Basic Statistical Analysis in Education. (3) F, S SS
Nature of educat ona data and stat st ca ana ys s. Fre quency d str but ons and descr pt ve ndexes. Introduction to hypothes s test ng ANOVA and regress on

554 Intermediate Statistical Data Analysis in Education. (3) F S SS
Mu t p e regress on, ANOVA by mu tip e regress on, re peated measures and other des gns covariance analys s and ntroduction to MANOVA Prerequ s te COE 502 or EDP 552 or pass ng grade on a qua fy ng exam.

556 Data Processing Techniques in Measurement and Research. (3) S
Advancement of statist ca des gn and measurement sk s through deve opment of data process ng techn ques and usage of spec a programs and data processing programs Prerequ s te: EDP 554.

560 Individual Intellectual Assessment. 1–6) F, S
Exper ence in adm n ster ng and interpreting nd v dua tests Theoret cal bas s for ab ty test ng, eth ca cons d erat ons and diagnost c use of test resu ts In t a enrol ment 3 hour min mum Lab exper ence Prerequ s tes: EDP 454 and adm ss on to a program n profess onal psycho ogy *or* nstructor approva

562 School Psychology: Theory and Practice. (3 F
Deve opment and present status of schoo psycho ogy, n c ud ng an overview of assessment and ntervent on strateg es and profess ona 'ssues.

563 Interventions in School Psychology. 3 F
Exam nat on of case based consultation and consu tat on research re evant to school psycho ogy pract ce. F e d ex per ence Prerequ s te schoo psycho ogy program or n structor approva .

566 Diagnosis of Learning Difficulties. (3) S
C n ca d agnos s of learn ng d ff cu t es emphas z ng spe c f c academ c prob ems. Use and nterpretat on of d ag nost c nstruments n pract ca schoo s tuat ons. Prerequ s tes EDP 560 and 562 *or* equ va ents; nstructor ap prova

567 School Psychological Services to Minority Students. 3) S
H stor ca perspect ves and major ssues n psycholog cal and academ c assessment and intervent ons with m nor ty schoo ch dren

568 Organizational Development: School Psychological Perspectives. (3) F
App cations of organ zat on deve opment strateg es and techn ques n fac tat ng the pos t ve mpact of schools on students earn ng and soc a funct on ng.

651 Methods and Practices of Qualitative Research. (3) S
Advanced course for students familiar with theory and extant work. Topics include data collection, analysis, reporting, and an extensive fieldwork project. Prerequisite: COE 503.

652 Multivariate Procedures in Data Analysis I. (3) F
Multivariate analysis of variance and covariance, multivariate multiple comparison procedures, power analysis and effect size, discriminant analysis, and repeated measures analysis. Prerequisite: EDP 554 or passing score on qualifying exam.

654 Multivariate Procedures in Data Analysis II. (3) S
Multivariate multiple regression, canonical correlation, factor analysis, categorical data analysis, log linear models, and structural equation models. Prerequisite: EDP 554 or passing score on qualifying exam.

Omnibus Courses: See pages 50–51 for omnibus courses that may be offered.

Learning and Instructional Technology

LNT 501 Foundations of Educational Technology. (3) F, S
Introduction to instructional development. An examination of accomplishments and problems in the field.

502 Design and Development of Instruction. (3) F, S
Design, development, and formative evaluation of objectives-based instructional materials.

503 Research Techniques for Instructional Development. (3) F
Procedures for analyzing the effects of alternative instructional practices.

504 Educational Evaluation. (3) S
Evaluation procedures in instruction and training.

510 Essentials of Classroom Learning. (3) F, S, SS
Theoretical and empirical foundations of learning in the classroom milieu. Critical exposure to research and method in instructional psychology. Cross-listed as EDP 510.

540 Theoretical Views of Learning. (3) F, S
Classical and cognitive theories of learning, plus recent orientations. Illustrative experimental and rational foundations; implications for educational practice. Cross-listed as EDP 540.

542 The Psychology of Learning and Instruction. (3) S
Critical review and evaluation of research on learning variables relevant to acquisition and retention of instructional materials. Lab. Cross-listed as EDP 542.

584 Educational Technology Internship. (1–6) F, S, SS
Prerequisites: LNT 501, 502; instructor approval. Pre- or corequisite: EMC 521.

780 Advanced Instructional Development. (1–3) S
Conducting and documenting selected instructional development activities. Prerequisites: LNT 502; instructor approval.

792 Advanced Instructional Research. (3) F
Design and execution of instructional research on selected topics. Prerequisites: LNT 503; instructor approval.

Omnibus Courses: See pages 50–51 for omnibus courses that may be offered.



College of Engineering and Applied Sciences

C.R. Haden, Ph.D.
Dean

Purpose

The purpose of the College of Engineering and Applied Sciences is to provide a university education of such fundamental background and scope that a student may achieve competency in engineering, agribusiness and environmental resources, technology, computer science, or construction. Every effort is made to carry on well rounded, well integrated programs that not only give the student proficiency for a professional career but also develop character, judgment, ideals, breadth of view, and appropriate cultural attitudes. Students are taught to recognize that their professional efforts will cause change and that they must accept responsibility for the social consequences of those efforts.

Organization

The College of Engineering and Applied Sciences comprises the following units:

School of Agribusiness and Environmental Resources

School of Construction and Technology

- Department of Aeronautical Technology
- Department of Construction
- Department of Electronics and Computer Technology
- Department of Manufacturing and Industrial Technology

School of Engineering

- Department of Chemical, Bio and Materials Engineering
- Department of Civil Engineering
- Department of Computer Science and Engineering
- Department of Electrical Engineering
- Department of Industrial and Management Systems Engineering
- Department of Mechanical and Aerospace Engineering
- Programs in Engineering Special and Interdisciplinary Studies

Research Centers. The college is committed to becoming one of national prominence in research. In addition, it is the policy of the college to encourage exceptional upper division undergraduate students and graduate students to participate with faculty in research activity. Most faculty are conducting research on government or industry sponsored programs. Research activities include aerodynamics, agribusiness, arid land agriculture, bioengineering, biomedical, biotechnology, CAD CAM, computer design, computer science and applications, computer integrated manufacturing, environmental, materials science, microelectronics manufacturing, natural resource management, nuclear radiation, power systems, rotor dynamics, semiconductor materials and devices, signal processing, solar energy, solid state electronic devices, structural dynamics, structures, telecommunications, thermosciences, transportation systems, and turbine design. These activities are carried out under the academic divisions or departments listed in the following catalog material and also through the interdisciplinary research centers listed below.

- Aerospace Research Center
- Center for Advanced Research in Transportation
- Center for Agribusiness Policy Studies
- Center for Energy Systems Research
- Center for Solid State Electronics Research
- Computer Integrated Manufacturing Systems Research Center

Systems Science and Engineering Research Center
Telecommunications Research Center

Center for Professional Development. The Center for Professional Development in the College of Engineering and Applied Sciences establishes a cooperative focus with the college's academic departments and research centers to provide a wide variety of technical conferences, institutes, seminars, short courses, research briefings, and televised and satellite transmitted programs to enable engineers, scientists, and technical managers locally, nationally, and internationally to continue their lifelong learning in a constantly changing technical world.

Programs may be conducted on campus in the center's conference room, at various off campus locations, or at company sites upon request.

For information, contact the director, Center for Professional Development, ECG 148, 602 965 1740

Admission

Students who wish to be admitted to freshman standing in the College of Engineering and Applied Sciences should present certain secondary units that are specified in the requirements of the three schools. Students who have omissions or deficiencies in secondary school subject matter preparation may be required to complete additional university course work that may not be applied toward their degrees.

Students who are not admissible to programs in this college and who enroll in another college at ASU may not register for any 300- or 400 level courses in this college unless such courses are required in their degree programs and the students have the proper course prerequisites.

Entrance requirements of this college may differ from those of other ASU academic units. Students may be admitted under two different classifications, the professional and preprofessional programs.

Professional Program. For admission to a *professional program*, Arizona residents must meet one of the following requirements:

	Minimum Scores		
	H S Rank	ACT	SAT
Agribusiness and Environmental Resources	Upper 50%	22	930
Construction	Upper 50%	23	1050
Engineering	Upper 25%	23	1050
Technology	Upper 50%	22	930

For admission to a professional program, *nonresident* must meet one of the following requirements:

	Minimum Scores			
	H.S. Rank	ACT	SAT	TOEFL
Agribusiness and Environmental Resources	Upper 25%	24	1010	500
Construction	Upper 25%	24	1050	550
Engineering	Upper 25%	24	1050	550
Technology	Upper 25%	24	1010	500

* *For international students, see pages 40–41 and 45*

Students admitted to the university by the General Education Development (GED) are required to take either the ACT or the SAT in order to be admitted to a professional program.

Preprofessional Program. A student not admissible to a professional program within the college but otherwise admissible to ASU may be admitted as a *preprofessional* student to any one of the departments or schools of the college. International students whose TOEFL scores do not meet the above minimum scores also may be admitted to the preprofessional program. A student admitted into this classification follows the freshman sophomore sequence of courses as required by the chosen major. Courses are selected with the assistance of an academic advisor. After completing a minimum of 30 semester hours of required or approved elective courses *with a cumulative GPA equivalent to that required of transfer students and corresponding to the chosen major*, students may apply for admission to the professional program. *International students must also submit a* TOEFL *score equivalent to that required for admission to the professional programs* Students admitted as preprofessional students are not permitted to register for 300 and 400 level courses in the College of Engineering *and Applied Sciences until their status is changed* to the professional classification.

Readmission. Students applying for readmission to professional status for any program in this college must have a cumulative GPA for all college course work equal to that of the transfer admission requirements shown below. A student *who does not meet these requirements may re*quest admission to the preprofessional program subject to the restrictions shown above.

Transfer into and within the College. Students transferring into or between schools or departments within the college or from other colleges within the university must meet both the

cumulative GPA requirement and the catalog requirements of the new school or department in effect at the time of transfer. Students who are transferring from an Arizona community college and have been in continuous residence may continue under the catalog in effect at the time of entering the community college.

Transfer Students. A student who contemplates transferring into this college from another institution, whether a community college or four-year institution, should study carefully the pertinent sections under this college pertaining to the particular program and, if possible, consult an advisor in this college before enrolling in the other institution. This assures a smooth transition at the time of transfer. Transfer students may request admission to either preprofessional or professional status in any of the programs offered by this college. The restrictions with regard to preprofessional status are shown above. The departments and schools may impose additional admission and graduation requirements to those minimums specified by the college.

No grades lower than "C" are accepted as transfer credit to meet the graduation requirements of this college.

The minimum requirements for admission of resident and nonresident transfer students to the professional program are as follows:

	Transfer GPA[1]		
	Resident	Nonresident	TOEFL[2]
Agribusiness and Environmental Resources	2.00	2.50	500
Construction	2.25	2.50	550
Engineering	2.50	2.50	550
Technology	2.25	2.50	500

[1] The cumulative GPA is calculated using all credits from ASU and from other colleges and universities.

[2] For international students (see pages 40–41 and 45).

Credit is granted for transferred courses deemed equivalent to corresponding courses in the selected program of study, subject to grade and senior residence requirements. Credits transferred from a community college are applied only as lower-division credits. Prospective Arizona community college transfer students should consult their advisors and refer to the annual *Arizona Higher Education Course Equivalency Guide* for a listing of the acceptable courses transferable to the various college degree programs.

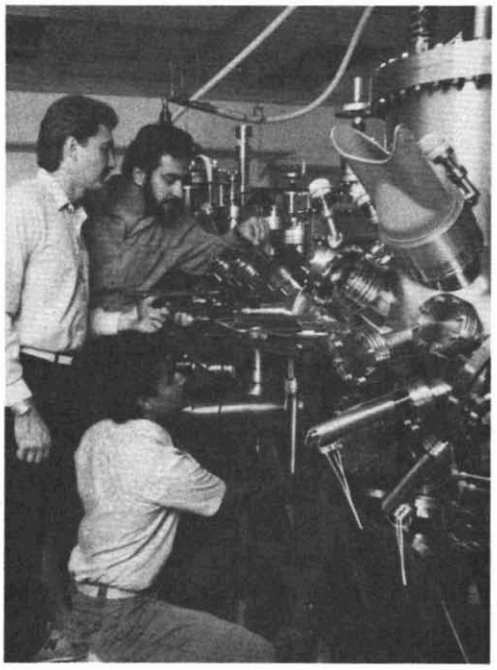
It should be noted that some courses taken in other colleges of this university or other universities may be acceptable for general university credit but may not be acceptable toward the degree requirements of this college. Determination of those particular courses acceptable to a specific degree program is made within the appropriate department or school with the approval of the dean.

Advisement

For assistance and counseling in planning a program of study, each student in this college is assigned a faculty advisor who is familiar with the chosen field of specialization and who must be consulted before registering each semester. The student should inform the advisor of any outside work or activity so that course loads may be adjusted accordingly.

The associate director of Student Academic Services is also available to all students for counseling and advising.

Minority Engineering Program. The Minority Engineering Program director and the academic advisor are available to assist prospective, newly admitted, and continuing students with academic advisement and a variety of support services. Advisement is also provided in the procurement of financial aid, scholarships, and professional development.



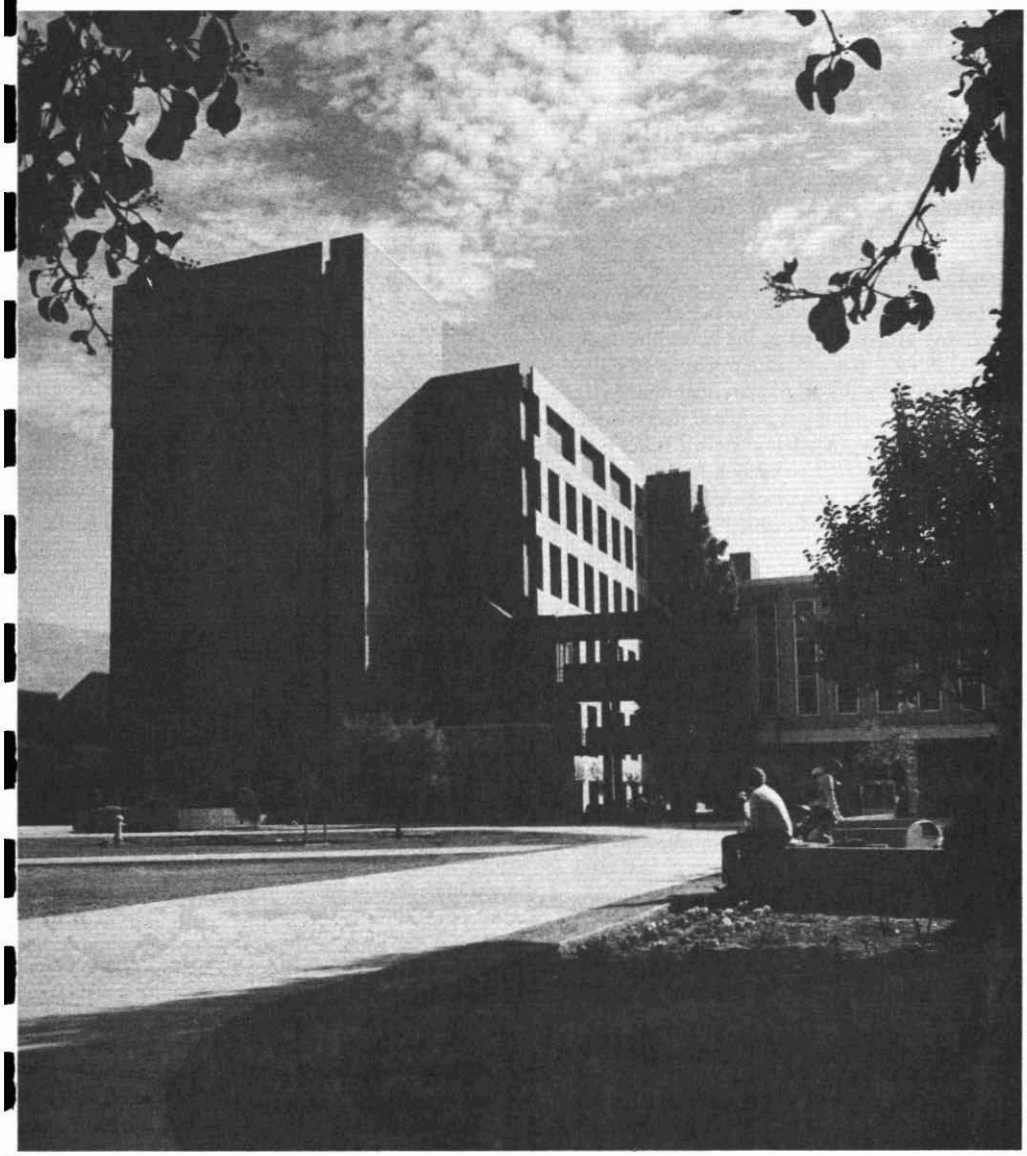
Degrees

Majors. Programs leading to the B.S. and B.S.E. degrees are offered by the College of Engineering and Applied Sciences, with majors in the following subjects Each major is administered by the academic unit indicated.

MAJOR FIELD	DEGREE	DEPARTMENT/SCHOOL
School of Agribusiness and Environmental Resources		
Agribusiness	B.S.	Agribusiness and Environmental Resources
Environmental Resources in Agriculture	B S.	Agribusiness and Environmental Resources
School of Construction and Technology		
Aeronautical Engineering Technology	B.S.	Aeronautical Technology
Aeronautical Management Technology	B.S.	Aeronautical Technology
Construction	B.S.	Construction
Electronics Engineering Technology	B.S.	Electronics and Computer Technology
Industrial Technology	B.S.	Manufacturing and Industrial Technology
Manufacturing Engineering Technology	B.S	Manufacturing and Industrial Technology
School of Engineering		
Aerospace Engineering	B.S.E.	Mechanical and Aerospace Engineering
Bioengineering	B.S.E.	Chemical, Bio and Materials Engineering
Chemical Engineering	B.S.E.	Chemical, Bio and Materials Engineering
Civil Engineering	B.S.E.	Civil Engineering
Computer Science	B S.	Computer Science and Engineering
Computer Systems Engineering	B.S.E.	Computer Science and Engineering
Electrical Engineering	B S.E	Electrical Engineering
Engineering Business[1] and Pre law	B.S.	Engineering Interdisciplinary Programs
Engineering Mechanics[2]	B.S.E.	Mechanical and Aerospace Engineering
Engineering Synergy[3]	B.S.E	Engineering Special Programs
Geological Engineering	B S.	Engineering Interdisciplinary Programs
Industrial Engineering	B.S.E.	Industrial and Management Systems Engineering
Manufacturing Engineering[2]	B.S.E.	Industrial and Management Systems Engineering
Materials Science and Engineering	B.S.E.	Chemical, Bio and Materials Engineering
Mechanical Engineering	B.S.E.	Mechanical and Aerospace Engineering
Microelectronics Manufacturing Engineering[2]	B.S.E.	Electrical Engineering

MAJOR FIELD	DEGREE	DEPARTMENT/SCHOOL
Nuclear Engineering Science[2]	B.S.E.	Electrical Engineering
Pre-medical Engineering[2]	B.S.E.	Chemical, Bio and Materials Engineering
Systems Engineering[2]	B.S.E.	Electrical Engineering

[1] These options under the Engineering Interdisciplinary Programs are administered by the Office of the Dean.
[2] These options under the Engineering Special Programs are administered by the departments shown above.
[3] These options under the Engineering Special Programs are administered by the Office of the Dean.



Integrated B.S.E.–M.S. Program. To pro vide greater program flexibility, qualified students of the School of Engineering may undertake a program with an integrated fourth and fifth year sequence of study in one of several fields of specialization in engineering. This provides an opportunity to meet the increasing demands of the profession for graduates who can begin their engineering careers at an advanced level.

Students admitted to this program are assigned a faculty committee that supervises a program of study in which there is a progression in the course work and in which earlier work is given application in the later engineering courses for both the bachelor's and master's degrees. Entry into the integrated program requires an application submitted to the dean through the faculty advisor and the department chair. Applications are reviewed by a school committee that recommends the appropriate action to the dean The application may be submitted in the fifth semester

Graduate Degrees

Deficiencies for admission to the graduate degree programs are specified at the time of admission The Graduate Record Examination (GRE)—the verbal, quantitative, and analytical components is recommended but not required unless specified by the respective academic unit. TOEFL scores must be submitted by foreign student applicants before admission is considered. The minimum required score is determined by each academic unit.

Master of Computer Science Degree (M.C.S.)

The M.C S. program provides a professionally oriented, graduate-level education in computer science and engineering. All of the Graduate College entrance requirements and departmental academic performance and preparation requirements must be satisfied for admission. The applicant must have a baccalaureate degree in Computer Science, Computer Engineering, or a closely related field The M.C S. program requires a minimum of 36 semester hours of approved graduate level course work. At the end of the program of study, the student must pass a final comprehensive examination over the graduate course work taken for the degree and over the appropriate undergraduate prerequisites. Details of the content and format of the examination are available from the department

Master of Science Degree (M.S.)

Agribusiness and Environmental Resources. This program provides competent students with opportunities to complete advanced studies with emphasis on research. Areas of concentration in agribusiness are management, marketing, finance, international agriculture, and food industry. Areas of concentration in environmental resources in agriculture are natural resource management and range ecology. Admission requires completion of 18 semester hours in agribusiness and environmental resources or closely related course work. Scores from the GRE or Miller Analogies Test (MAT are required. The Graduate Management Admission Test (GMAT is accepted for Agribusiness students only A minimum of 30 semester hours of approved graduate course work is required, including a thesis. An oral examination in defense of the thesis is required.

Computer Science. This graduate program provides opportunities for qualified students holding a baccalaureate degree in Computer Science or related fields to complete advanced studies with emphasis on research. A minimum of 30 semester hours of approved course work is required, including a thesis. An oral examination in defense of the thesis is required.

Engineering. These are research oriented graduate degree programs, providing opportunities to highly competent students to major in aerospace, bio , chemical, civil, electrical, industrial, or mechanical engineering or engineering science. Options in aerospace engineering, biotechnology, engineering mechanics, engineering science, materials science and engineering, nuclear engineering sciences, and system science and engineering are available under the Engineering Science major. M.S E and Ph.D. degree programs are also available in these options.

The M.S. degree program (including all options) is administered through the office of the college assistant dean for graduate studies. Admission normally requires an appropriate undergraduate engineering degree and satisfaction of all Graduate College admission requirements and special department requirements. A minimum of 30 semester hours of approved graduate course work is required, which must include a thesis and an oral examination at the completion of the program. Students writing a thesis must enroll in a combination of both 592 Research and 599 Thesis, totaling six semester hours.

Master of Science in Engineering Degree (M.S.E.)

These professionally oriented graduate degree programs are intended as a preparation for a career in professional practice. Two options are available: the thesis (engineering report or research paper) option and the no thesis, no report option. Both require a minimum of 30 semester hours of approved graduate level course work. For entry the student must satisfy all Graduate College admission requirements and special department requirements and must have a baccalaureate degree in engineering or another closely related degree program.

Option One This option is designed primarily for full time students. The M.S.E. degree option one is awarded upon successful completion of graduate course work, engineering projects, and a research endeavor resulting in a thesis (engineering report or research project). A final oral examination is required in defense of the thesis.

Option Two This option is designed primarily for students who hold full time jobs and must attend university classes on a part time basis. The M.S.E. degree option two is awarded upon successful completion of graduate course work. A final written comprehensive examination of the graduate course work taken for the degree and over the respective undergraduate prerequisites is required. Students selecting this option should check with their respective departments for the format of the final examination.

Master of Technology Degree (M.Tech.)

This degree program is designed for flexibility, permitting the student to select a combination of courses in technology and supporting areas to meet individual career goals. Selected areas of concentration are designed to provide graduates with technical and professional skills for use in preparation for and advancement in leadership positions found in industry and education. The Master of Technology is offered by the Departments of Aeronautical Technology, Electronics and Computer Technology, and Manufacturing and Industrial Technology. Admission requires an appropriate baccalaureate degree with a minimum of 30 semester hours in technology or equivalent. A minimum of 32 semester hours of approved course work is required, including a practicum or applied project. An oral examination in defense of the practicum or applied project is required.

Doctor of Philosophy Degree

The Ph.D. degree is awarded in Engineering or Computer Science upon the satisfactory completion of an approved program of graduate study, research, and dissertation. For specific reference to this degree, see the "Graduate College" section of this catalog or the *Graduate Catalog*.

Degree Requirements

For detailed information on the degree requirements of a major in the College of Engineering and Applied Sciences, refer to that department's or school's individual descriptions on the ensuing pages.

English Proficiency Requirement. English proficiency is required. As a minimum each student must complete both ENG 101 and 102 or ENG 105, but any student whose written or spoken English in any course is unsatisfactory may be required to take additional course work by the appropriate director or department chair. See "First-Year Composition Requirement," page 89

Pass/Fail Grades. Students enrolled in the College of Engineering and Applied Sciences do not receive degree credit for pass/fail courses taken at this institution. In addition, no course in this college is offered for pass fail credit. Students requesting credit for pass fail courses taken at another institution must file a Petition for Adjustment to Curriculum Requirements. Each request is judged on its particular merits.

Entry into Upper-Division Courses. Before enrolling in courses at the 300 level and above, a student in good academic standing must secure the approval of his or her advisor. A student who is not in good academic standing must secure the approval of his or her advisor and director or department chair. Students whose grades in 300 level courses are unsatisfactory may be required to retake one or more courses for which credit has previously been granted.

The departments and schools have certain additional requirements that must be met in addition to the above college requirements and students should consult them for details.

Course Work Currency. Courses taken more than five years before admission to degree programs in this college are not normally accepted for transfer credit at the option of the department in which the applicant wishes to enroll. Courses completed within the five years preceding admission are judged as to their applicability to the student's curriculum.

General Studies Requirements

Higher education should provide the student not only with competency in the chosen subject field, but also with experiences that facilitate the student's growth in ability to perceive significant relationships, to make intelligent value judgments, to express ideas with ease, clarity, and good taste, and to develop the qualities of character and personality requisite for a successful career. The development of moral, ethical, and social concepts and a sound professional attitude is required. It is expected that the attainment of an interest and pleasure in the above pursuits will inspire continued study. Courses are selected with the aid of an advisor to provide planned sequences and to place emphasis on the interrelationships that exist among fields of knowledge.

Specific attention should be directed to the University General Studies requirements shown on pages 58–61. Additional requirements and recommended course selections are shown in appropriate catalog sections for the schools and departments of this college.

School of Engineering majors have some restrictions on the selections of course work used to fulfill the General Studies requirements in humanities (HU), social and behavioral sciences (SB), and lower division literacy (L1). Please refer to page 328 for details.

General Studies courses are regularly reviewed. To determine whether a course meets one or more General Studies course credit requirements, see the listing of courses by core and awareness area, pages 62–88. General Studies courses are also identified following course descriptions according to the following key:

Key to General Studies Credit Abbreviations

L1	Literacy and Critical Inquiry Core Courses (Intermediate level)
L2	Literacy and Critical Inquiry Core Courses (Upper division)
N1	Numeracy Core Courses (Mathematics)
N2	Numeracy Core Courses Statistics and Quantitative Reasoning
N3	Numeracy Core Courses (Computer Applications)
HU	Humanities and Fine Arts Core Courses
SB	Social and Behavioral Sciences Core Courses
S1	Natural Sciences Core Courses Introductory
S2	Natural Sciences Core Courses (Additional Courses)
G	Global Awareness Courses
H	Historical Awareness Courses

Graduation Requirements

Graduation requirements in this college are listed under the description of each school or major.

Academic Standards

Retention. A student is expected to make satisfactory progress toward completion of degree requirements in order to continue enrollment in the College of Engineering and Applied Sciences. Any one of the following conditions is considered unsatisfactory progress and results in the student being placed on probationary status:

1. a deficiency of five grade points;
2. a semester or summer session with a GPA less than or equal to 1.50;
3. two successive semesters with GPAs less than 2.00; or
4. grades of "E," "W," or "I" in half the semester hours appearing on the official enrollment record for any semester.

Students not meeting department standards are placed on probation at the department's discretion.

Students on probation are subject to disqualification if:

1. they do not attain a semester GPA of 2.25 and their cumulative GPA is below 2.00 at the end of the probationary semester (items 1, 2, and 3 above);
2. if they are placed on probation for two consecutive semesters, or
3. if they receive an "I," "E," or "W" during the probationary semester (for item 4 above).

Courses completed during the summer sessions may not be used to reevaluate a student's fall probationary status.

Probationary students may not register for the next semester without a special permit from Student Academic Services. Special permits are not given until grades are recorded by the registrar for the current semester.

Disqualification. During a semester on probationary status, a student who fails to meet the retention standards specified above is disqualified. Students may request a review of their disqualification status by contacting the associate director of Student Academic Services in ECG 115. Any disqualified student who is accepted by another

college at ASU may not register for courses in this college unless the courses are required for the new major. Disqualified students who do register for courses in this college may be withdrawn from these courses any time during that semester. Furthermore, students at the university who have been disqualified academically by this college are not eligible to enroll in summer session courses in this college until the disqualification period has expired and they have been reinstated.

Reinstatement. The College of Engineering and Applied Sciences does not accept an application for reinstatement until the disqualified student has remained out of this college for at least a 12-month period. Merely having remained in a disqualified status for the above period of time does not, in itself, constitute a basis for reinstatement. Proof of ability to do satisfactory college work in the chosen discipline is required, for example, completing pertinent courses in the discipline at a community college with better than average grades.

Student Responsibilities

Course Prerequisites. It is expected that students consult the *Schedule of Classes* and the catalog with regard to course prerequisites. Students who register for courses without the designated prerequisites may be withdrawn without the student's consent at any time before the final examination. Such withdrawal may be effected by the instructor, the chair of the department offering the course, the director of the Student Academic Services, or the dean of the college. In such cases, there is no monetary reimbursement to the student. However, such withdrawal is considered to be unrestricted as described on pages 53 54 and does not count against the number of restricted withdrawals allowed.

Special Programs

Student Academic Services. The dean's office of the College of Engineering and Applied Sciences maintains a special office staffed to assist students in various matters. This office coordinates the work of the College Admissions and Standards Committee and administers the probation, disqualification, and readmission processes for those students who are academically deficient.

Academic Honors. Students completing baccalaureate degree requirements receive the appropriate honors designations on their diplomas consistent with the requirements specified by the university.

Students in the College of Engineering and Applied Sciences are encouraged to seek information concerning entry into those honor societies for which they may qualify. Membership in such organizations enhances the student's professional stature. The following honor societies are active within the college:

1. Alpha Pi Mu Industrial Engineering Honor Society;
2. Alpha Zeta Agriculture Honor Society,
3. Chi Epsilon—Civil Engineering Honor Society;
4. Eta Kappa Nu Electrical Engineering Honor Society;
5. Pi Tau Sigma Mechanica Engineering Honor Society;
6. Sigma Lambda Chi—Construction Honor Society;
7. Tau Alpha Pi National Honor Society, Engineering Technologies;
8. Tau Beta Pi National Engineering Honor Society; and
9. Upsilon Pi Epsilon National Computer Science Honor Society.

Information on any of these organizations may be obtained from the respective department or school offices or Student Academic Services.

University Honors College. The College of Engineering and Applied Sciences participates with the University Honors College, which affords superior undergraduates opportunities for enhanced educational experiences. Participating students can major in any academic program, including the engineering synergy option under Engineering Special Programs. A description of the requirements and the opportunities offered by the University Honors College can be found on pages 98 100 of this catalog.

Scholarships. Academic scholarships for continuing students in this college may be applied for by contacting the Student Academic Services Office or the various department or school offices. Other scholarships may be available through the university Student Financial Assistance Office.

ASU 3+2 Programs. Students desiring to earn a baccalaureate degree from Grand Canyon University Phoenix, Arizona) in Mathematics, Chemistry, or Physics, or from Southwestern University (Georgetown, Texas) in Physical Science and a baccalaureate degree in Engineering or Construction from ASU can take advantage of a 3+2 program approved by these institutions. Stu

dents from Grand Canyon University may also select a degree program in Construction. Such students complete the first three years of study at their respective college or university and the last two years of study at ASU. At the end of the fourth or fifth year, assuming all degree requirements have been met, the baccalaureate degree is awarded by the student's respective college or university and the appropriate engineering or construction baccalaureate degree is awarded by ASU. More information can be obtained by writing to one of the following offices:

Office of the Administrative Vice President
Grand Canyon University
3300 W. Camelback Rd.
Phoenix, Arizona 85017–1097

or

Provost and Dean of
The Brown College of Arts and Sciences
Southwestern University
Georgetown, Texas 78626

or

Office of the Dean
College of Engineering and Applied Sciences
Arizona State University
Tempe, Arizona 85287–5506

The Department of Construction also has 2+2 agreements with several selected out-of-state colleges and universities. For a listing and additional information, contact the department chair:

Department of Construction
Arizona State University
Tempe, Arizona 85287–0204
602/965–3615

ROTC Students. Students pursuing a commission through either the Air Force or Army ROTC programs are required to take from 12 to 20 hours in the Department of Aerospace Studies or Department of Military Science. To preclude excessive overloads, these students should plan on at least one additional semester to complete degree requirements. Because of accreditation requirements, aerospace studies (AES) courses are not acceptable for engineering or engineering technology degree credit as a social or behavioral science under General Studies. ROTC students must also meet all other degree requirements of this college.

A military construction option is available in the Department of Construction.

General Information

Definition of Terms. The terms used in this college to describe offerings are defined below for purposes of clarity.

Program of Study. This is a broad term describing the complete array of courses included in the study leading to a degree. Examples: agribusiness and environmental resources, construction, engineering, and technology.

Major. This is a specialized group of courses contained within the program of study. Example: program of study—engineering; major—Civil Engineering. Example: program of study—technology; major—Industrial Technology.

Area of Emphasis (Technical Electives), Option or Concentration. Each of these is a selection of courses within a major or among one or more majors. The number of technical electives varies from curriculum to curriculum. In a number of the majors, the technical electives must be chosen from preselected groups. For this reason the choice of specific technical electives for an area of emphasis should be done with the advice and counsel of an advisor. Example: major—Mechanical Engineering; area of emphasis—thermosciences.



School of Agribusiness and Environmental Resources

Eric P. Thor, Ph.D., Director

PROFESSORS:
THOR AG 281), BRADY CHALQUEST
EDWARDS GORDON STILES

ASSOCIATE PROFESSORS:
BROCK MADDY, W. M LLER, RACCACH
SEPERICH, WHYSONG

ASSISTANT PROFESSOR:
GREEN

PROFESSORS EMERITI:
BARRETT LYTLE, V M LLER, MOODY,
RASMUSSEN, RICHARDSON,
ROB NSON, TAYSOM

Purpose

The School of Agribusiness and Environmental Resources provides academic programs directed toward agribusiness and the environmental aspects of agriculture. Agribusiness is a dynamic industry that provides employment to about 23% of the U.S. labor force Environmental resources emphasizes both the conservation of wildland resources for the needs of future generations and their use to meet present day needs. Courses in the School of Agribusiness and Environmental Resources are designed to prepare students for the wide range of job opportunities that exist in the agricultural industries and governmental agencies. The academic programs are especially designed to meet the needs of the urban student who has had little or no previous agriculture experience. An interest in plants, animals, or foods can be the starting point for career development in agricultural industries or natural resource management. The undergraduate programs also provide the necessary training for students preparing to enter graduate degree programs.

Organization

The academic programs are organized into two separate majors: Agribusiness and Environmental Resources in Agriculture Options for specialization within these majors are as follows:

Agribusiness

Concentration	*Option*
Agribusiness	Food Industry
	International Agribusiness
	General Agribusiness
Computer Analysis	
Pre-Veterinary Medicine	

Environmental Resources in Agriculture

Concentration	*Option*
Natural Resource Management	Range Ecology
	Wildlife Habitat Management

Center for Agribusiness Policy Studies

The Center for Agribusiness Policy Studies carries out research and development relating to agribusiness, rural development, multiple use of scarce resources, and public policy. The center addresses regional, national, and international development in the context of global and competitive markets for agricultural products and inputs. Of particular interest is the development of private sector strategies and public policy alternatives that go beyond traditional government subsidy programs to find innovative, market oriented ways to enhance competitiveness in international markets, increase rural incomes and create new jobs. A related center concern is the development of "win win" strategies for environmental management and the multiple use of scarce natural resources by competing interest groups. The goal of such policy development is to resolve or manage conflict regionally, nationally or globally and to promote long term, sustainable agriculture in terms of regional economic growth Of particular interest to the center are innovative rural credit programs for developing nations, strategic marketing to identify profitable "niche" markets and further processing to create jobs and add value to agricultural products. For information, contact the Center for Agribusiness Policy Studies Director's Office, AG 281, 602 965 3585.

Degrees

Bachelor of Science (B.S.). The School of Agribusiness and Environmental Resources offers the Bachelor of Science degree in Agribusiness and in Environmental Resources in Agriculture.

Master of Science (M.S.). The School of Agribusiness and Environmenta Resources offers the Master of Science degree in Agribusiness and in Environmental Resources in Agriculture The program includes research and the preparation of a thesis A minimum of 30 semester hours of graduate level course work is required for the de-

gree. Additional details for this degree are given in the *Graduate Catalog*

Admission

See pages 34–41, 55–57, 284–285, and 290–291 for information regarding requirements for admission, transfer, retention, disqualification, and reinstatement

In addition, students who are beginning their initial college work in the School of Agribusiness and Environmental Resources should present secondary school units in accordance with the minimum university requirements. There are no secondary school agricultural course requirements.

Graduation Requirements

The completion of a minimum of 126 semester hours including university General Studies, the school and major cores, and option courses leads to the B.S. degree. An overall GPA of 2.00 is required. Of the semester hours required for graduation, 40% must be upper division. Also see special graduation requirements under the pre veterinary medicine concentration described on page 297.

Majors

The Agribusiness major is an applied, industry oriented curriculum. The study of animals, plants, and their utilization in the food and fiber system forms the base of the program Students learn to analyze firms involved in input supply activities, commodity processing, food manufacturing, and food distribution. Students also study government agricultural programs and national policy activities that affect agribusiness Because of the U.S. role in supplying commodity and food products to the world markets, international aspects of agribusiness development and trade are emphasized.

The natural resource management concentration within the Environmental Resources in Agriculture major emphasizes the study of wildland ecosystem management. Application of the systems approach in a wide variety of resource management situations is emphasized. Students pursue an ecological emphasis in the range ecology option or the wildlife habitat management option. In both cases, students are trained to apply ecological principles to management of wildlands Students with particular interest in vegetation, water, and soil resources should pursue the range ecology option. Students with a particular interest in animal resources should pursue the wildlife habitat option.

The baccalaureate degree requirements in Agribusiness and Environmental Resources in Agriculture include the General Studies, the School of Agribusiness and Environmental Resources core, a proficiency core, the major core, and the option courses and elective courses to complete the graduation requirement of 126 semester hours. Before entering the junior year, each student, with the aid of an advisor, is expected to select a concentration and an option.

Degree Requirements

All students pursuing a B.S. degree in the School of Agribusiness and Environmental Resources must satisfy English proficiency and General Studies requirements as follows:

		Semester Hours
English Proficiency		
ENG 101, 102	First Year Composition[1] 6	
	or ENG 105 Advanced First Year Composition (3	
General Studies		
Literacy and Critical Inquiry[2]		
(6 semester hours minimum)		
One course, generally at the sophomore level, that includes a series of formal, graded, written or spoken assignments in critical literature		3
A second course, upper division, that involves critical writing in a specialized discipline		3
Numeracy		
6 semester hours minimum [1]		
Humanities and Fine Arts		
Social and Behavioral Sciences[2]		
15 semester hours minimum)		
At least one course must be upper division level two courses must be from same department in two departments or more must be represented in total selection		
Humanities and Fine Arts	. . . . .	6 to 9
Social and Behavioral Sciences	. . . . .	6 to 9
Natural Sciences		
(8 semester hours minimum)		
Total General Studies	. . . . .	35

NOTE. One course in the area of global awareness* and one course in historical awareness[2] *must* appear in the final list of courses offered in the student's graduation program of study If desired, these can be included in the humanities and fine arts social and behavioral sciences course selections

[1] See the school academic advisor for approved courses

* See pages 62–88 for the acceptable courses in these categories

Agribusiness and Environmental Resources in Agriculture Core

All students pursuing a B.S. degree in the school must complete the following general core courses:

			Semester Hours
AGB	300	Livestock Management	3
AGB	302	Introduction to Agribusiness	3
AGB	310	Crop Management	3
ERA	346	Natural Resource Conservation	3
		Total	12

The following proficiency core courses are required of all students except those in the computer analysis and pre-veterinary medicine concentrations:

			Semester Hours
BIO	181, 182	General Biology	8
		or AGB 130 Plant Science (3 and AGB 150 Animal Science 3	
CHM	101	Introductory Chemistry	4
		or CHM 113 General Chemistry (4 and CHM 115 General Chemistry with Qualitative Analysis 5	
ECN	111	Macroeconomic Principles*	3
ERA	350	Applied Quantitative Methods*	3
MAT	117	College Algebra*	3
		or MAT 210 Brief Calculus (3)	
A minimum of one computer course			3
(A list of acceptable courses is available in School of Agribusiness and Environmental Resources Office			
		Total	24–29

* These courses are a part of the General Studies requirements

Agribusiness

The Agribusiness major offers several concentrations and options. It combines business and technical agriculture as they relate to the management, marketing, and financial objectives of agribusiness firms. Topics of interest include the supplying of input resources and services to agricultural producers, the management of crop and livestock enterprises, the processing of raw agricultural products and the management and quality assurance of food manufacturing. Food distribution is examined from the points of view of food wholesalers and retailers as well as food service firms, which include restaurants and specialized food firms. The study of agribusiness also includes analysis of the critical roles of government in regulating certain aspects of agribusiness and promoting international trade in agribusiness products.

Agribusiness. The agribusiness concentration contains the general agribusiness, international agribusiness, and food industry options.

General agribusiness integrates the knowledge and skills needed to manage people, products, and services in agribusiness enterprises. Agribusiness management combines the agricultural sciences, behavioral science, and common sense. Functional, institutional, and behavioral aspects of marketing are examined while studying the flows of products and services through the various market channels for agricultural inputs, commodities, and food. Emphasis is placed on up to date management/marketing methods that allow graduates to meet challenges in the food and fiber industries. Graduates are qualified to make significant contributions in a broad range of career opportunities that exist in agribusiness. Many start career paths that lead to upper level agribusiness management marketing positions.

International agribusiness relates worldwide agricultural resources to the requirements and potentials of the various nations Particular emphasis is given to economic development and to the international trade of food and fiber products. Special courses are offered to form a unique curriculum that is designed to train either the U S. or foreign student to work in the enhancement of agricultural programs of foreign countries. Provided is a basic knowledge of U.S. agricultural techniques that is extended to the global aspects of agriculture. Graduates in this area are particularly qualified to aid in the development of the world's agricultura potential to provide food to meet the expanding populations. Jobs exist in commercial industries and in government agencies national, international, and foreign. A language capability in addition to English is recommended.

Food industry focuses on the scientific and technical competence required for employment in this field. Strong emphasis is given to basics such as food chemistry, food processing, and food safety. This unique program offers employment opportunities for graduates in food industries, regulatory agencies, and consumer organizations.

Students selecting the agribusiness concentration are required to take the following courses:

			Semester Hours
ACC	211	Introductory Financial Accounting or AGB 390 Agribusiness Accounting	3
AGB	312	Agribusiness Marketing	3
AGB	332	Agribusiness Finance	3
AGB	342	Agribusiness Management I	4
AGB	364	Agribusiness Technology	3
AGB	412	Agricultural Commodities	3
AGB	443	Agribusiness Management II	3
AGB	444	Agribusiness Analysis	3
AGB	455	Agricultural Marketing Channels	3
AGB	458	International Agribusiness	3
AGB	474	Agribusiness Policy and Government Regulations	3
AGB	490	Recent Advances in Agribusiness	1
ECN	112	Microeconomic Principles	3
		Total	38

Typical Curriculum for the Agribusiness Concentration

First Year

			Semester Hours
AGB	130	Plant Science	3
AGB	150	Animal Science	3
CHM	101	Introductory Chemistry	4
ENG	101, 102	First Year Composition	6
MAT	117	College Algebra	3
General Elective Courses			6
Social and Behavioral Sciences Courses*			6
		Total	31

Second Year

ACC	211	Introductory Financial Accounting or AGB 390 Agribusiness Accounting (3	3
AGB	302	Introduction to Agribusiness	3
ECN	111	Macroeconomic Principles	3
ECN	112	Microeconomic Principles	3
Agribusiness Electives Course			9
General Elective Courses			6
Humanities and Fine Arts Courses*			6
		Total	33

Third Year

AGB	300	Livestock Management	3
AGB	310	Crop Management	3
AGB	312	Agribusiness Marketing	3
AGB	332	Agribusiness Finance	3
AGB	342	Agribusiness Management I	4
AGB	364	Agribusiness Technology	3
ERA	346	Natural Resource Conservation	3
ERA	350	Applied Quantitative Methods	3
Option Courses			6
		Total	31

Fourth Year

AGB	412	Agricultural Commodities	3
AGB	443	Agribusiness Management II	3
AGB	444	Agribusiness Analysis	3
AGB	455	Agricultural Marketing Channels	3
AGB	458	International Agribusiness	3
AGB	474	Agribusiness Policy and Government Regulations	3
AGB	490	Recent Advances in Agribusiness	1
General Elective Courses			3
Option Courses			9
		Total	31

* See pages 58 88 for the requirements and the approved list.

Computer analysis. This concentration gives students the necessary background to move into a wide variety of career opportunities involving the use of computers in the agribusiness industries. A basic core of agricultural science courses is combined with a proficiency core of agribusiness marketing, management, finance, and critical computer science courses. A graduate of this program is prepared to handle the problems agribusiness firms and organizations face in applying the latest computer technology to operations.

Students choosing the computer analysis concentration are required to take the following proficiency core courses:

			Semester Hours
AGB	312	Agribusiness Marketing	3
AGB	332	Agribusiness Finance	3
AGB	342	Agribusiness Management I	4
BIO	181, 182	General Biology	8
CSE	100, 101	Introduction to Computer Science I and II	6
CSE	120	Digital Design Fundamentals	3
CSE	201	Application Languages Programming Laboratory	1
CSE	310	Data Structures	3
CSE	340	Structure of Programming Languages	3
ERA	350	Applied Quantitative Methods	3
MAT	243	Discrete Mathematical Structures	3
MAT	271, 272	Calculus with Analytic Geometry II and III or MAT 290, 291 Calculus I and II (10)	8
MAT	342	Linear Algebra	3
		Total	51 53

Typical Curriculum for the Computer Analysis Concentration

First Year

			Semester Hours
CSE	100, 101	Introduction to Computer Science I and II	6
ENG	101, 102	First Year Composition	6
MAT	243	Discrete Mathematical Structures	3
MAT	270, 271	Calculus with Analytic Geometry I and II	8
Humanities and Fine Arts Courses*			6
Social and Behavioral Sciences Courses*			3
		Total	32

Second Year

AGB	302	Introduction to Agribusiness	3
BIO	181, 182	General Biology	8
CSE	120	Digital Design Fundamentals	3
CSE	201	Application Languages Programming Laboratory	1
CSE	310	Data Structures	3
MAT	272	Calculus with Analytic Geometry III	4
General Elective Courses			9
		Total	31

Third Year

AGB	300	Livestock Management	3
AGB	310	Crop Management	3
AGB	312	Agribusiness Marketing	3
AGB	332	Agribusiness Finance	3
AGB	342	Agribusiness Management I	4
CSE	340	Structure of Programming Languages	3
ERA	350	Applied Quantitative Methods	3
MAT	342	Linear Algebra	3
Social and Behavioral Sciences Courses*			6
		Total	31

Fourth Year

		Semester Hours
ERA	346 Natural Resource Conservation	3
General Elective Courses		13
Supporting Courses		16
	Total	32

* See pages 58–88 for the requirements and the approved list

Pre-veterinary medicine. This concentration is primarily designed to meet the entrance requirements of professional veterinary medical schools in the United States and Canada. Selection of this area permits students to complete the pre-veterinary requirements for entrance to professional veterinary school. The curriculum permits the student to obtain some course work in agribusiness, especially as it relates to professional practice and industry. This background also provides an important alternative for the student who does not actually enter veterinary school. Completion of all requirements for a B.S. degree in Agribusiness at ASU is provided by completing additional credits, if desired. A pre-veterinary medicine student who has been accepted to a school of veterinary medicine and who also elects to earn a Bachelor of Science degree in the School of Agribusiness and Environmental Resources may do so by completing a minimum of 30 semester hours at ASU and by completing the Agribusiness and Environmental Resources in Agriculture and General Studies requirements. The student may then receive a written statement from the dean of the College of Engineering and Applied Sciences giving senior-in-absentia privileges. The student is eligible to receive the B.S. degree after the Registrar's Office receives a recommendation from the dean of the professional school and a transcript of credit indicating the student has completed a total of 126 semester hours with a cumulative GPA of 2.00 or better

Although this concentration is primarily intended for the student preparing to enter professional veterinary medicine as a career, it is also an excellent basis for future graduate degree programs or many of the scientifically related jobs in agribusiness and government.

Students selecting the pre veterinary medicine concentration are required to take the following proficiency core courses:

			Semester Hours
BIO	181, 182	General Biology	8
CHM	113	General Chemistry	4
CHM	115	General Chemistry with Qualitative Analysis	5
CHM	231	Elementary Organic Chemistry or CHM 331, 335 General Organic Chemistry and General Organic Chemistry Laboratory (4) and CHM 332, 336 General Organic Chemistry and General Organic Chemistry Laboratory (4)	4
ERA	350	Applied Quantitative Methods	3
MAT	117	College Algebra or MAT 210 Brief Calculus (3)	3
MIC	206	Microbiology Laboratory	1
MIC	220	Biology of Microorganisms	3
		Total	31 35

Typical Curriculum for the Pre-Veterinary Medicine Concentration

First Year

			Semester Hours
CHM	113	General Chemistry	4
CHM	115	General Chemistry with Qualitative Analysis	5
ENG	101, 102	First Year Composition	6
MAT	117	College Algebra or MAT 210 Brief Calculus (3	3
Humanities and Fine Arts Courses[1]			6
Social and Behavioral Sciences Courses[1]			6
Total			30

Second Year

AGB	300	Livestock Management	3
AGB	353	Wildlife and Domestic Animal Nutrition	3
BIO	181, 182	General Biology	8
CHM	231	Elementary Organic Chemistry or CHM 331, 335 General Organic Chemistry and General Organic Chemistry Laboratory (4) and CHM 332, 336 General Organic Chemistry and General Organic Chemistry Laboratory (4)	4
General Elective Courses			9
Humanities and Fine Arts Courses[1]			3
Total			30–34

Third Year

AGB	439	Veterinary Practices	3
BIO	340	General Genetics	4
CHM	361	Principles of Biochemistry	3
CHM	367	Elementary Biochemistry Laboratory	1
ERA	346	Natural Resource Conservation	3
ERA	350	Applied Quantitative Methods	3
MIC	206	Microbiology Laboratory	1
MIC	220	Biology of Microorganisms	3
PHY	111, 113	General Physics and General Physics Laboratory	4
PHY	112, 114	General Physics and General Physics Laboratory	4
General Elective Courses			4
Total			33

Fourth Year[2]

General Elective Courses	6
Supporting Courses	15
Upper Division Courses	12
Total	33

[1] See pages 58–88 for the requirements and the approved list.

[2] Assuming the student has applied and has been accepted to a veterinary college during the beginning of the third year, the courses from the first year of the veterinary program are substituted for the classes of the fourth year for the B.S. degree.

Environmental Resources in Agriculture

Natural resource management and conservation are the primary emphasis of the Environmental Resources in Agriculture major. Particular attention is given to the study of ecosystem characteristics as they relate to man's use of renewable resources. Applications of ecological principles to resource management are considered using examples drawn from Arizona's forest, range, and agricultural ecosystems. Employment opportunities in environmental resource management, range ecology, land reclamation, soil conservation, and agribusiness exist with both private firms and government resource management agencies.

Natural resource management. This concentration includes the range ecology and wildlife habitat management options.

Range ecology emphasizes the study of renewable rangeland resources based on a strong background of agricultural and biological sciences. The specific areas of plant, animal, and soil sciences with strong supporting courses in ecology constitute primary training in this option. Students may choose careers as professional range or soil conservationists for federal and state agencies or in private industry. Range and soil conservationists both perform work concerned with inventorying, analyzing, improving, protecting, and managing the natural resources of rangelands and related wildlands.

Wildlife habitat management emphasizes the interaction of renewable resources with the wildlife populations that inhabit them. Primary training is in the areas of ecology, plant, and soil science, with strong supporting courses in wildlife. Students completing this option may choose careers as professional wildlife habitat managers for federal and state agencies or in the private sector.

Students selecting the natural resource management concentration are required to take the following courses:

			Semester Hours
BIO	320	Fundamentals of Ecology	3
BOT	370	The Flora of Arizona	4
ENG	301	Writing for the Professions	3
ERA	325	Soils	3
ERA	326	Soils Laboratory	1

ERA	333	Water Resources Management	3
ERA	360	Range Ecosystem Management	4
ERA	402	Range Habitat Inventory	4
ERA	407	Range Plants and Habitats	4
ERA	420	Range Habitat Improvements	3
ERA	475	Wildlife and Range Animal Management	3
ERA	490	Recent Advances in Environmental Resources	1
		Total	36

Typical Curriculum for Environmental Resources in Agriculture

First Year

			Semester Hours
BIO	181, 182	General Biology	8
CHM	101	Introductory Chemistry	4
ENG	101, 102	First-Year Composition	6
MAT	117	College Algebra	3
Computer Course			3
General Elective Courses			7
		Total	31

Second Year

BOT	370	The Flora of Arizona	4
ERA	325	Soils	3
ERA	326	Soils Laboratory	1
Humanities and Fine Arts Courses[1]			8
Option Requirements[2]			7
Social and Behavioral Sciences Courses[1]			8
		Total	31

Third Year

AGB	300	Livestock Management	3
AGB	302	Introduction to Agribusiness	3
AGB	310	Crop Management	3
ERA	346	Natural Resource Conservation	3
ERA	350	Applied Quantitative Methods	3
ERA	360	Range Ecosystem Management	4
Option Requirements[2]			14
		Total	33

Fourth Year

ERA	490	Recent Advances in Environmental Resources	1
General Elective Courses			4
Option Requirements[2]			26
		Total	31

[1] See pages 58–88 for the requirements and the approved list.

[2] Option requirements as listed for individual programs.

AGRIBUSINESS

AGB 101 Food Chain. 2) F
Dependence of the quality quantity, and cost of national food supplies on technology, marketing, and world agricultural policies *[Satisfies General Studies Requirement G]*

130 Plant Science. 3 S
Plant growth and development in the rural and urban environment Lecture, lab

150 Animal Science. 3) F
Comparative growth development, and propagation of farm animals. Lecture, lab.

160 Veterinary Medicine Today. 2) N
Introduction to the role of the veterinarian as related to the feeds of food supply and veterinary medicine.

300 Livestock Management. (3) F
Methods of managing livestock enterprises, economics, loss prevention, and marketing Prerequisites: BIO 181 182

302 Introduction to Agribusiness. (3 F
Impact of national policy and world agriculture on the cost, quantity and quality of the U.S food resources.

310 Crop Management. 3 S
Crop production management principles and their application to crop growth and development Prerequisites: BIO 181 182.

312 Agribusiness Marketing. 3) F
Marketing arrangements for agricultural products. Prerequisite AGB 342

332 Agribusiness Finance. (3 S
Agribusiness investment management and financial institutions that serve agriculture Prerequisites: AGB 342· ECN 111

335 Establishing an Agribusiness. 3 F
Establishing entrepreneurship in agriculture including legal status financing planning marketing and management Prerequisite junior standing

342 Agribusiness Management I. 4 S
Principles of management including planning organizing, integrating measuring and developing people in agribusiness organizations Lecture, computer lab.

353 Wildlife and Domestic Animal Nutrition. 3) S
Feedstuffs feeding standards, and their application in meeting nutritional needs of animals producing food and fiber

364 Agribusiness Technology. 3) S
Biotechnology and other technologies of the three sectors of agribusiness including input production, and commodity food processing and distribution Prerequisites· BIO 181 and 182 *or* instructor approval.

368 Food Processing. 3) F
An introduction to processed food quality assurance, statistical sampling and inspection procedures Prerequisites AGB 364; ERA 350

369 Food Analysis. 3 F
Processing control and scientific instrumentation used in food quality assurance laboratories Lecture, lab. Prerequisites: CHM 225, 226

370 Companion Animals to Man. 3 N
Selection breeding health and care of pets includes their social and economic impact on urban living

390 Agribusiness Account ng. 3 N
ntroduct on to manager a account ng for agr bus ness us ng computer zed account ng systems for the deve opment of f nanc a data requ red for management dec s on mak ng Prerequ s te Computer teracy.

402 Agricultura Cooperatives. 3 N
Organ zat on operat on and management of agr cu tura cooperat ves

404 Sales and Merchandis ng In Agribusiness. 3 N
The pr nc p es and techn ques of se ng and commod ty merchand s ng n the agr cu tura ndustr es Lecture, ab

412 Agricultural Commodities. 3 F
Trad ng on futures markets Empha s on the hedg ng pract ces w th gra ns and meats P erequ s te AGB 312 or 1 market ng or f nance course

413 F'nanc'al Commodities. 3 S
Trad ng on futures markets Emphas s on the hedg ng pract ces w th f nan a and urrency nstruments. Pre requ s te AGB 332 or FIN 300

414 Advanced Commodity Trading. 3 N
Advanced ana y s of trad ng techn ques w th emphas s on hedg ng n the futures markets Prerequ s te AGB 412 or 413

423 Food and Industrial Microbiology. 4 F
Food and ndustr a re ated m croorgan sms deter orat on and preservat on of ndustr a commod t es. Lecture, ab Prerequ s te M C 205 or 206 or nstructor approva

424 Food and Industr al Fermentations. 4 S
Management man pu at on, and metabo c act v t es of n dustr a m crob a cu tures and the r processes Lecture ab Prerequ s te AGB 423 or nstructor approva

425 Food Safety. 3 S
Contro prevent on and pred ct on of m crob a and chem ca food borne d seases Prerequ s te AGB 423 or nstructor approva

426 Food Chem stry. 4 S
The b ochem ca and chem ca nteract on that occur n raw and pro essed foods Lecture ab Prereq s tes: CHM 115 231

428 Comparative Nutrition. 3 N
Effects of nut t on on an ma systems and metabo func t ons Prerequ s tes AGB 305 CHM 231

433 Diseases of Domestic An mals. 3 N
Contro and prevent on of nfect ous and non nfect ous d ea es of domest c an ma s Prereq s te M C 2 6 or 220

435 Animal Physiology I. 4 F
Contro and fun t on f the nervous mus u ar card ovas cu ar resp ratory, and rena systems of domest an ma s Lecture ab Cross sted as BME 435 Prerequ s tes B O 181 CHM 113

439 Veterinary Practices. 3 F S
Observat on of and part c pat on n veter nary med c ne and surgery superv sed by oca veter nar ans Prerequ s te advanced pre veter nary st dent

440 Food Marketing. 3 S
Food process ng packag ng d str but on market re search, new food research and deve opment, a d soc a mp cat ons Prerequ s te AGB 312

443 Agribusiness Management II. 3 F
Pr nc p es of human resource management w th empha s s on the spec a prob ems of agr bus nes sy tem Pre requ s te AGB 342

444 Agribusiness Analysis. 3 S
Ana ys s of agr bus ness f rm dec s ons n the eco og cal, econom c, soc a and po t ca env ronments. Spec a em phas s on eth ca ssues surround ng food product on and consumpt on Prerequ s tes AGB 312 and 332 *or* equ va ents *[Satisf es Genera Stud es Requ rements. L2]*

450 International Agricultural Deve opment. 3 F
Trans t on of deve op ng countr es from subs stence to modern agr cu ture. Techno ogy transfer and food im provement programs are emphas zed Prerequ s te AGB 312. *[Sat sf es Genera Stud es Requ rements SB G]*

452 World Food Dynamics. 3 N
Trans t on and deve opment of raw agr cu tura commod t es nto nutr t ona food products Emphas s g ven to food expans on n deve op ng countr es Pre equ s te AGB 302

453 World Agricultural Resources. 3 S
Wor d product on and consumpt on of agricu tura prod ucts nternat ona re at onsh ps and agenc es concerned w th wor d agr cu tura deve opment prob ems Prerequ s te. AGB 302 *[Sat sf es Genera Stud es Requirement G]*

454 International Agricultura Trade. 3 N
D mens ons ocat ons m x methods, and changes of nternat ona trade n agr c tura products Prerequ s te AGB 312

455 Agr cultural Marketing Channels. 3 S
Operat ona stages of agr cu tura commod t es n norma d str but on systems and mp ementat on of market ng strateg es Prerequ s te AGB 312

458 Internat onal Agribusiness. 3 N
Ident f cat on a d ana ys s of methods prob ems, and fu ture of nternat ona agr bus ness operat ons Emphas zes spec a prob ems assoc ated w th nternat onal agr busi ness systems Prerequ s te AGB 312 *[Sat sf es General Stud es Requ rement G]*

460 Agr business Management Systems. 4 S
The deve opment and use of dec s on support systems for agr bus ness management and market ng. Lecture, ab. Prerequ s tes AGB 332, 342; ERA 350

474 Agribusiness Policy and Government Regulations. 3 F
The deve opment a d mp ementat on of government food drug pest c de and farm po c es and regu at ons that affect the management of agr bus ness. Prerequ s tes AGB 312 342 412

490 Recent Advances in Agr business. 1 F S
Reports and d scuss ons of current top and prob ems assoc ated w th agr bus ness May be repeated for cred t

505 Commod ty Analysis. 3 N
Ana ys s of commod ty markets Prerequ s te. 1 year of econom cs or market ng

508 Advanced Agribusiness Marketing. 3 F
Theory and ana ys s of market ng farm commod t es r sks, and the effect of future trad ng on cash pr ces.

509 Advanced Agribusiness Market ng Channels. (3) S
Ana ys s of agr bus ness market channe systems Formu at on of market ng strateg es

510 Advanced Agribus ness Management I. 3 F
Assessment and current prob ems n manag ng human and f nanc a resources n agr bus ness Case stud es and ana y of spec a agr bus ness prob ems Prerequ s te AGB 342

511 Advanced Agribusiness Management II. 3 S
Ana ys s of organ zat on behav or change and resource requ rements w th n agr bus ness systems Prerequ s te AGB 342

512 Food Industry Management. 3 S
Operat ons and management of food pr cess ng factor es food d str but on centers, and reta food hand ng f rms

516 International Agricultural Techniques. 3 N
Coord nat on of product on and market ng techn ques to consumpt on object ves w th agr cu tura products n for e gn countr es

518 World Agricultural Development. 3 N
Factors that nf uence product on process ng and market ng of agr cu t ra products n deve op ng co ntr es.

520 Advanced Agribusiness Analysis I. 4 S
Vert ca ntegrat on and d fferent at on n food and agr cu tura ndustnes Lecture, rec tat on. Prerequ s tes. AGB 508 and 510 and 532 *or* equ va ents

521 Agribus'ness Coordination. 4 N
Organ zat ona a ternat ves for agr bus ne s, w th empha s s on cooperat ves and trad ng ompan es Lect re rec tat on Prerequ s tes. AGB 508 and 5 0 and 532 *or* equ va ents

525 Advanced Agribusiness Management Systems. 3) N
Deve opment and use of de s on support systems for ag nbus ness management dec s on mak ng Prerequ s tes AGB 510 532.

527 Agribusiness Research Methods. 3 N
The use of mode bu d ng hypothes s test ng and emp r ca ana ys s n so v ng agr bus ness prob ems

530 Advanced Agribusiness Policy. 3 N
Po cy mak ng h story structure and process Prerequ s te AGB 508

532 Advanced Agr business Finance. 3 F
Financ'a management of agr bus ness f rms agr bus ness f nanc a ana ys s nvestment ana ys s agr cu tura r sk management, and ntroduct on to agr cu tura f nanc a n termed ar es

535 Advanced Food Science. 3 N
Chem ca and phys ca nature of processed foods Em- phas s on food product deve opment Prerequ s te AGB 364.

Omnibus Courses: See pages 50 51 for omn bus courses that may be offered.

ENVIRONMENTAL RESOURCES IN AGRICULTURE

ERA 325 Soils. 3 F
Fundamenta propert es of so s and the r re at on to p ant growth and the nutr t on of man and an ma s Re at on of soi s to environmenta qua ty Prerequ s te CHM 101 or 113 or equ va ent

326 Soils Laboratory. 1 F
Se ected exerc ses to broaden the background and under standing of bas c so pr nc p es. Lab. Corequ s te ERA 325

332 Agricultural Chem ca s. 3 N
Compos t on propert es and use of agr cu tura commer c a fert zer and pest c des and the r effects on so , a r and water qua ty

333 Water Resources Management. 3 S
Sources, the r deve opment and conservat on n and re g ons for agr cu tura , natura resources and urban uses Prerequ s te· CHM 101 or 113

346 Natural Resource Conservation. (3 S
A g oba perspect ve on the conservat o of w ld and and agr cu tura resources Deve opment/resource conserva t on nterre at onsh ps *[Sat sf es Genera Stud es Re qu rement G]*

350 Applied Quantitative Methods. 3 F
Stat st ca methods w th app cat ons n natura resource management and the agr cu tura sc ences Use of d g ta computer Prerequ s te MAT 117 or equ va ent. *[Satisf es Genera Stud es Requ rement. N2]*

360 Range Ecosystem Management. 4 F
nterre at on h ps between vegetat on so s, and graz ng an ma s. Eva uat on of graz ng an ma mpact vestock and w d fe Mu t p e use of range and resources. Lec ture, rec tat on. Prerequ s tes B O 320 and ERA 346 *or* equ va ents

365 Watershed Management. 3 N
Hydro og c phys ca b o g ca , and eco og ca pr nc p es app ed to watershed management mpact of ecosystem man pu at ons on water y e d a d qua ty 1 weekend f e d tr p Prerequ tes ERA 325, 346

370 Forest Silvics and Management. 3 N
S v cu tura pr nc p es unde y ng the pract ce of forestry Growth of trees and stands forest s te eva uat on, ma n pu at on of stands to d rect success on and forest meas urements Lecture ab Prereq s tes BIO 320 ERA 346 350

402 Range Habitat Inventory. 4 S
Vegetat on samp ng and nventory as re ated to an ma hab tat re at ons Lecture ab 1 weekend fie d tr p Pre requ s tes. ERA 350 360

407 Range Plants and Habitats. 4 F
The d str but on, eco og ca character st cs dent f cat on of key p ant , and va ues of hab tats on western range ands Laboratory emphas s on grass dent f cat'on Lecture ab. Prerequ s te BOT 370 or equ va ent

410 Wildlife Habitat Relations. 3 N
nteract ons am ng an ma popu at ons and the r hab tat. Systems s mu at on of popu at on dynam cs as nf uenced by compet t on and management strateg es Lecture 1 weekend f e d tr p Prerequ s te ERA 360

420 Range Habitat Improvements. 3 S
Current pract ces 'n brush and weed contro , revegetat on, b rn ng water deve opments fenc ng and grazing as too s for range mprovement Lecture 1 weekend f e d tr p Prerequ s te· ERA 360

425 Soil Class'fication and Management. 3 N
Pr nc p es of so genes s morpho ogy and c ass f cat on Management and conservat on pract ces w be pre sented Prerequ s te· ERA 325

446 Soil Ferti ity. 3 S
Ab ty of so s to reta n and supp y p ant nutr ents Reac t ons of fert zers n so s Prerequ s tes. ERA 325, 326

448 Soil Ecology. 3 N
So s v ewed n an ecosystem context so p ant re at on sh ps nutr ent budgets and ab ot c factors that nf uence so processes Prerequ s tes B O 320 and ERA 325 and 326 *or* nstructor approva

452 Soil, Water, and Irrigation. (3) N
Water measurement, conveyance, and conservation, with emphasis on crop production and soil-plant water relations. Prerequisite: ERA 325.

460 Applied Systems Ecology. (3) N
The systems approach applied to analysis and management of natural resource ecosystems. Use of simulation models. Prerequisites: ERA 350 or equivalent; 1 course in ecology.

470 Land Reclamation. (3) N
Problems of reestablishing vegetation on disturbed sites. Special revegetation techniques, surface modifications, and government regulations. 1 weekend field trip. Prerequisites: ERA 407 and 420 and 446 and 448 *or* instructor approval.

475 Wildlife and Range Animal Management. (3) N
Principles and techniques for management of domestic and nondomestic animals using rangeland ecosystems. Emphasis on practical applications of management. Weekend field trips. Prerequisite: instructor approval.

480 Natural Resource Planning. (3) S
Planning for management and conservation of wildland ecostystems. Ecological, economic, and social constraints on long-term sustainable resource development. Computer tools for resource planning. Lectures, 1 weekend field trip. Prerequisites: ERA 402 or equivalent; senior standing.

490 Recent Advances in Environmental Resources. (1) N
Current literature and significant developments involving environmental resources. May be repeated for credit.

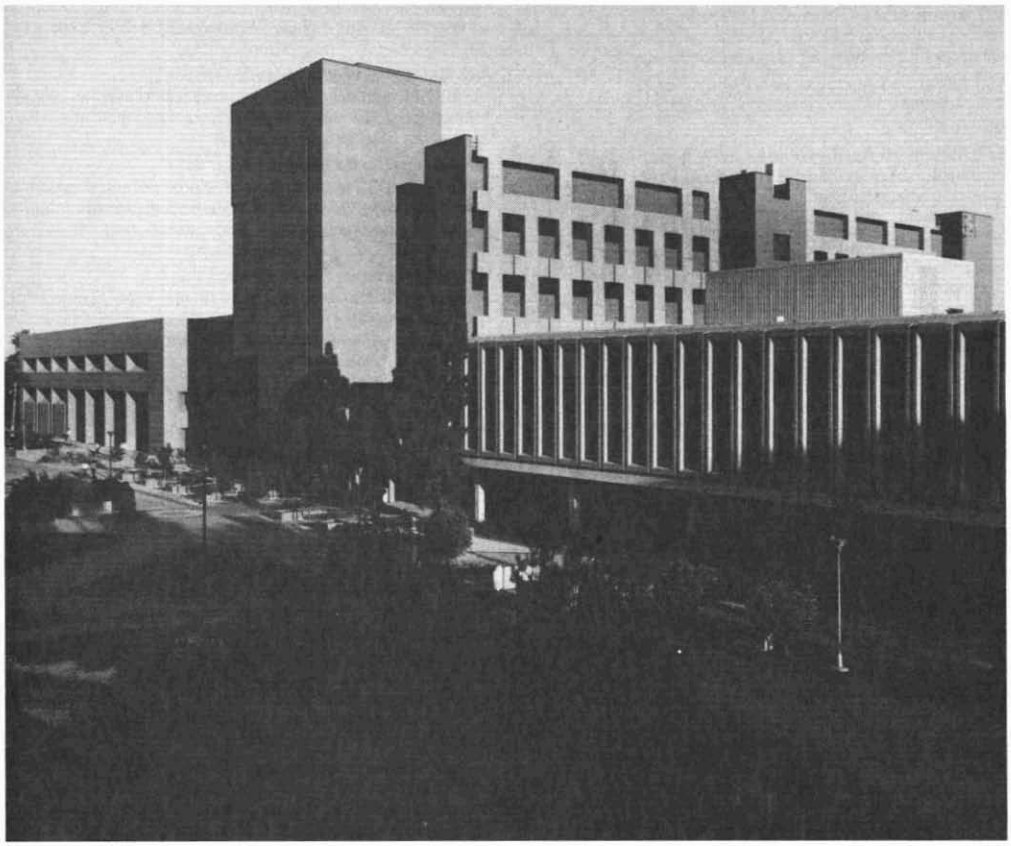
540 Plant Responses to Environmental Stresses. (3) N
Reaction of plants to environmental stresses: herbivores, fire, pesticides, mechanical treatments, aerial pollutants, and soil amendments. 1 weekend field trip. Prerequisites: BOT 360 and ERA 420 *or* instructor approval.

548 Plants, Soils, and Environmental Quality. (3) N
Effects of air quality on plants and soils, and their role in removing contaminants from the atmosphere. Prerequisite: ERA 325.

550 Vegetation Dynamics. (3) N
Succession concept and its use in site evaluation. Habitat type concept. Herbivore as an ecological process. Prerequisite: BOT 420 or instructor approval.

560 Systems Ecology. (3) N
Quantitative description and mathematical modeling of ecosystem structure and function. Techniques for model construction and simulation. Lecture, lab. Prerequisites: ERA 350 or equivalent; computer programming; 6 hours in ecological studies.

Omnibus Courses: See pages 50–51 for omnibus courses that may be offered.



School of Construction and Technology

Richard W. Kelly, Ph.D., Director

Purpose

The primary purpose of the school is to provide students the opportunity to obtain a quality education in construction and technology and to qualify them directly for positions of leadership and responsibility in industrial, commercial, educational, and government activity.

The construction program and its options provide a well-integrated program that gives the student proficiency for a professional construction career. In addition to technical skills, it develops the ideals, judgment, character, and breadth of view important to success in the industry.

The technology programs provide the opportunity to earn a degree that stresses theory reinforced by laboratory application a more applied approach than engineering students experience. The technology programs assist in preparing for challenging career opportunities in industry and government for the forward-looking student. The technology graduate in industry becomes a member of the total engineering effort, contributing an applications orientation to complement the engineer's more theoretical concepts. The student is educated to render practical decisions with safety and economy in mind, to install and operate technical systems, to develop or improve a product, to revise systems, and to provide customer support when needed.

Degrees

Bachelor of Science degree programs and options within each major are offered in the four departments as shown on page 286. Each curriculum includes some elective courses that are reserved for the student's use to add a unique emphasis or dimension. These credits are traditionally referred to as technical electives and are normally restricted to upper division courses in technology, construction, engineering, and computer science. In each case, the choice of technical electives must be approved by the student's faculty advisor and department chair. Requirements for each of the majors offered are described on the following pages.

In addition to the undergraduate degrees offered in the School of Construction and Technology, a graduate degree, the Master of Technology (M.Tech.), is offered by each of the three departments in technology in accordance with the details given on page 289. See the *Graduate Catalog* for complete details.

Admission

See pages 34–41, 55 57, 284–285, and 290–291 for information regarding requirements for admission, transfer, retention, disqualification, and reinstatement.

A preprofessional category is available for applicants deficient in regular admission requirements.

The Department of Construction requires secondary school units totaling three and a half units in mathematics, including geometry, advanced algebra, and trigonometry. Students having omissions or deficiencies in subject matter preparation are required to complete additional university credit course work that is not applied toward a Construction major. These may include MAT 118 Precalculus Algebra and Trigonometry and PHY 101 Introduction to Physics. Vocational and craft-oriented courses taught at community colleges are not accepted for credit toward a bachelor's degree in Construction.

Entry into a program in one of the departments of technology as a freshman student assumes three years of high school math (algebra I and II and geometry). High school chemistry and physics are recommended. Students without the required math background must take appropriate deficiency courses before entry or immediately upon enrollment at ASU. Associate degree transfer students are expected to have completed college algebra and trigonometry.

Students who begin their college education at institutions other than ASU with intent to transfer to ASU should consult the given major requirements and seek equivalent courses at the transfer institution. Any transfer courses from a community college are applied only as lower-division credit.

The GPA requirement for admission of transfer students into the School of Construction and Technology is 2.25 for Arizona residents and 2.50 for nonresidents. The freshman and sophomore programs of study are designed to facilitate transfer of junior and community college students or associate degree graduates.

International students are required to have a TOEFL score of 550 for admission to a Construction major and 500 for admission to a technology major.

Degree Requirements

All baccalaureate degree programs in the School of Construction and Technology require completion of the university English proficiency requirement, a General Studies component, and a construction and technology core component. The engineering technology programs also require completion of an engineering technology core. All programs require a minimum of 132 semester hours.

The specific course requirements for the English proficiency, General Studies, construction and technology core, and the engineering technology core are listed below. Refer to the individual majors or options for their additional required courses.

English Proficiency — *Semester Hours*

ENG 101, 102 First Year Composition[1] 6
or ENG 105 Advanced First Year Composition (3)

General Studies

Literacy and Critical Inquiry[2]
(6 semester hours minimum
One course must be chosen from the university approved list. The course must be sophomore level and include a series of formal, graded, written or spoken assignments in composing critical discourse ... 3
ETC 400 Technical Communications[1] ... 3

Numeracy
(6 semester hours minimum)
ECE 106 Introduction to Computer Aided Engineering[1] ... 3
MAT 118 Precalculus Algebra and Trigonometry ... 3

Humanities and Fine Arts
Social and Behavioral Sciences[2]
(15 semester hours minimum)
At least one course must be of upper division level, two courses must be from the same department and two or more departments must be represented in total selection
Humanities and Fine Arts ... 6 to 9
Social and Behavioral Sciences ... 6 to 9
ECN 111 Macroeconomic Principles[1] ... 3

Natural Sciences
(8 semester hours minimum
PHY 111 General Physics[1] ... 3
PHY 112 General Physics[1] ... 3
PHY 113 General Physics Laboratory[1] ... 1
PHY 114 General Physics Laboratory[1] ... 1

Total General Studies ... 35

NOTE: One course in the area of global awareness[2] and one course in historical awareness[2] *must* appear in the final list of courses offered in the student's graduation program of study. These can be included in the humanities and fine arts/social and behavioral sciences course selections. See the list of acceptable courses.

[1] Graduation requirement for the baccalaureate degree

[2] See pages 58–88 for the requirements and the approved list.

Construction and Technology Core

The following courses constitute the Construction and Technology Core and are required in all baccalaureate degree programs in the School. These courses, with the exception of ECE 105, are included in the General Studies component. Refer to the individual department descriptive material for specific departmental degree requirements.

			Semester Hours
ECE	105	Introduction to Languages of Engineering	3
ECE	106	Introduction to Computer Aided Engineering	3
ECN	111	Macroeconomics	3
ETC	400	Technical Communications	3
PHY	111	General Physics	3
PHY	112	Genera Physics	3
PHY	113	General Physics Laboratory	1
PHY	114	General Physics Laboratory	1
		Total	20

Engineering Technology Core

The following courses constitute the engineering technology core and are required in all baccalaureate degree programs in the engineering technologies:

			Semester Hours
CHM	101	Introductory Chemistry	4
		or CHM 113 General Chemistry (4)	
		or CHM 114 General chemistry for Engineers (4	
ETC	201	Applied Electrical Science	4
ETC	211	Applied Engineering Mechanics: Statics	3
ETC	340	Applied Thermodynamics and Heat Transfer	3
MAT	260	Technical Calculus I	3
MAT	261	Technical Calculus II	3
		Total	20

Graduation Requirements

In order to qualify for graduation from the School of Construction and Technology, a student must have an overall GPA of at least 2.00 for the required courses in the major field.

Professional Accreditation and Affiliations

The Department of Construction is a member of the Associated Schools of Construction, an organization dedicated to the development and advancement of construction education. The Construction program is accredited by the American Council for Construction Education ACCE).

The programs in Aeronautical Engineering Technology, Electronic Engineering Technology, and Manufacturing Engineering Technology are accredited by the Accreditation Board for Engineering and Technology.

Special Programs

ASU 2+2 Programs. The School of Construction and Technology maintains a cooperative agreement with most community colleges within Arizona and also with selected out of state colleges and universities to structure courses that are directly transferable into the construction and technology programs at ASU.

ASU 3+2 Programs. The Department of Construction is participating in the ASU 3+2 programs with Grand Canyon University and Southwestern University. See page 291 292 for details.

ENGINEERING TECHNOLOGY CORE

ETC 201 Applied Electrical Science. 4 F S, SS
Principles of electricity passive elements and dc and ac circuit analysis. Laboratory exploration of circuit concepts and techniques using instrumentation and the computer as a tool Lecture ab Prerequisites ECE 105 MAT 118

211 Applied Engineering Mechanics: Statics. (3 F S SS
Vectors forces and moments force systems equilibrium analysis of basic structures and structural components friction, centroids and moments of inertia. Cross listed as CON 221. Prerequisites: MAT 261 or equivalent, PHY 111, 113

340 Applied Thermodynamics and Heat Transfer. 3) F, S
Thermodynamic systems and processes first and second laws of thermodynamics properties of pure substances and applications to heat engines and specific systems Fundamentals of conduction radiation and convection Prerequisites MAT 261, PHY 112 114.

400 Technical Communications. (3 F S SS
Planning and preparing technical publications and oral presentations based on directed library research related to current technical topics Prerequisites: senior standing as a CEAS major completion of first-year English requirements; L1 course. *[Satisfies General Studies Requirement L2]*

Omnibus Courses: See pages 50 51 for omnibus courses that may be offered

Aeronautical Technology

PROFESSORS:
(TC 100B), MATTHEWS
ASSOCIATE PROFESSORS:
GESELL LAT GO, REED, ROPER SALMIRS
INSTRUCTOR:
ROGERS
LECTURER:
HOMAN
VISITING ASSISTANT PROFESSOR:
BALOGH
PROFESSORS EMERITI:
CARLSEN, COX, PEARCE
SCHOEN THOMASON

The Department of Aeronautical Technology offers two majors leading to a Bachelor of Science degree. The options within the Aeronautical Engineering Technology major are aeronautical technology and helicopter technology, and the options within the Aeronautical Management Technology major are aircraft flight management and airway science management.

Graduates are prepared for entry into the aerospace industry in productive, professional employment or, alternatively, for graduate study. The curricula emphasize the recognized principles underlying the application of technical knowledge as well as current technology, preparing the graduate to adapt to the rapid and continual changes in aerospace technology.

Aeronautical Engineering Technology—B.S.

The Aeronautical Engineering Technology degree program is accredited by the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology. The curriculum is designed to prepare the technologist for technical support of engineering activities throughout the aerospace field. Areas of responsibility include the application of applied engineering practice related to fixed wing aircraft and aerospace vehicle design, helicopter applications, internal combustion engines, combustion processes, turbomachinery, systems analysis, computer modeling, quality assurance and nondestructive testing, and low speed wind tunnel applications.

Aeronautical Engineering Technology students are required to complete a minimum of 132 semester hours, including at least 50 semester hours of upper-division courses. All degree requirements are shown on the student's Curriculum Check Sheet. These requirements include English proficiency, General Studies, engineering technology core, and specific additional courses listed in the following section.

Degree Requirements

In addition to the required courses listed for English proficiency, General Studies, and the engineering technology core (see page 329 330), the following additional courses are required in both options: AET 280, 281, 287, 300, 310, 312, 320, 321, 409, 414, 487, CHM 114, COM 225; CSE 183; ECE 105, EET 305 or MET 325; IEE 300; MAT 262; MET 230 or CET 250 , 313, 432; STP 420

The following courses are also required for the option listed:

Aeronautical technology. AET 415, 417, four elective hours.

Helicopter technology. AET 360, 461, 462, 463, 464

Suggested Course Pattern for Freshmen

First Semester			Semester Hours
CHM	114	General Chemistry for Engineers	4
ECN	111	Macroeconomic Principles	3
ENG	101	First Year Composition	3
MAT	118	Precalculus Algebra and Trigonometry	3
MET	230	Engineering Materials and Processing	3
		Total	16
Second Semester			
CSE	183	Applied Problem Solving with FORTRAN	3
ECE	105	Introduction to Languages of Engineering	3
ENG	102	First Year Composition	3
MAT	260	Technical Calculus I	3
PHY	111	General Physics	3
PHY	113	General Physics Laboratory	1
		Total	16

Aeronautical Management Technology—B.S.

The Aeronautical Management Technology curriculum is designed to combine a thorough technical training with an interdisciplinary general university education. The graduate is prepared to assume responsibilities in a wide area of managerial and technically related areas of aviation. The student gains a background in aircraft structures, reciprocating and turbine engines, performance, design, management skills, business principles, systems analysis, and a variety of course work specific to aircraft flight, airport operations, and air transportation systems. The degree offers two options, airway science management and aircraft flight management. These curricula have the approval of the Federal Aviation Administration and can lead to employment in that agency. The two options are described separately below.

Aircraft Flight Management Option

Flight training is certified by the Federal Aviation Administration.

Aircraft flight management combines academic studies and flight training to prepare graduates for a variety of positions within the air transportation industry, primarily in the area of flight operations. Ground school and flight training are available, allowing the student to obtain the private pilot, commercial pilot, and flight instructor certificates and also the instrument pilot, instrument instructor, and multiengine pilot ratings.

This curriculum concentrates on flying plus the technical, management, and computer-related applications necessary to operate aircraft in the high density environment of modern airspace. This career option leads to the development, administration, and enforcement of safety regulations, including airworthiness and operational standards in civil aviation. The program emphasizes critical thinking, and cognitive, analytical, and communication skills

While enrolled at ASU, students do not receive college credit for flight instruction received at flight schools other than schools with which the university has currently contracted for such instruction. Consideration for credit is given for flight experience and certificates received before enrollment at the university

Flight instruction costs are not included in university tuition

Aircraft flight management students are required to complete a minimum of 132 semester hours, including at least 50 semester hours of upper division courses All degree requirements are shown on the student's Curriculum Check Sheet. These requirements include English proficiency, General Studies, and specific additional courses listed in the following section:

Degree Requirements

In addition to the required courses listed for English proficiency and General Studies (see pages 329 330), the following additional courses are required: AET 182, 183, 220, 222, 280, 281, 287, 300, 308, 314, 342, 344, 382, 383, 385, 386, 387, 389, 391, 392, 393, 395, 408, 410, 489; CHM 113 or 114, COM 225; CSE 181; ECE 105; ETC 201; HIS 414; IST 346 (or MGT 301), 452 (or MGT 311), 480 (or MGT 352); MAT 260; MET 230 (or CET 250); PGS 100; STP 420.

Suggested Course Pattern for Freshmen

First Semester			*Semester Hours*
AET	100	Primary Flight Course	0
AET	182	Private Pilot Ground School	3
CHM	113	General Chemistry or CHM 114 General Chemistry for Engineers (4)	4
CSE	181	Applied Problem Solving with BASIC	3
ENG	101	First Year Composition	3
MAT	118	Precalculus Algebra and Trigonometry	3
		Total	16
Second Semester			
AET	183	Private Pilot Certificate	1
AET	220	Aviation Meteorology	3
ECE	105	Introduction to Languages of Engineering	3
ENG	102	First Year Composition	3
MAT	260	Technical Calculus I	3
PHY	111	General Physics	3
PHY	113	General Physics Laboratory	1
		Total	17

Airway Science Management Option

The airway science management option is designed to prepare graduates for managerial and supervisory positions throughout the air transportation industry. A depth of technical training is included along with a broad exposure to business and management courses. This program of study, interdisciplinary in nature, prepares the aeronautical career-oriented student for such positions as air traffic control specialist, air carrier manager, airport manager, and general aviation operations manager.

Airway science management students are required to complete a minimum of 132 semester hours, including at least 50 semester hours of upper division courses. All degree requirements are shown on the student's Curriculum Check Sheet. These requirements include English proficiency, General Studies, and specific additional courses listed in the following section

Degree Requirements

In addition to the required courses listed for English proficiency, General Studies, and the engineering technology core (see pages 329 330), the following additional courses are required: ACC 211; AET 182, 201, 280, 281, 287, 308, 342, 344, 408, 410, 489; CHM 113 or 114; COM 225, 410; CSE 181; ECE 105; ECN 112; ETC 201; HIS 414; IEE 431; IST 346 (or MGT 301), 452 (or MGT 311), 480 (or MGT 352), 491 (or MGT 423), 498 (or BLW 305); MAT 260; MET 230 or CET 250; PGS 100; SOC 301, STP 420; six elective hours.

Suggested Course Pattern for Freshmen

First Semester			*Semester Hours*
AET	182	Private Pilot Ground School	3
CHM	113	General Chemistry or CHM 114 General Chemistry for Engineers 4)	4
CSE	181	Applied Problem Solving with BASIC	3
ENG	101	First-Year Composition	3
MAT	118	Precalculus Algebra and Trigonometry	3
		Total	16
Second Semester			
ECE	105	Introduction to Languages of Engineering	3
ECN	111	Macroeconomic Principles	3
ENG	102	First Year Composition	3
MAT	260	Technical Calculus 1	3
PHY	111	General Physics	3
PHY	113	General Physics Laboratory	1
		Total	16

Student Organizations

The department hosts the local chapter of Alpha Eta Rho, the international professional aviation fraternity. Students also are eligible for membership in Tau Alpha Pi, the national honor society for engineering technology, and the Precision Flight Team, which competes in regional and national flying safety competitions.

AERONAUTICAL TECHNOLOGY

Flight instruction costs are not included in university tuition

AET 100 Primary Flight Course. 0) F S SS
Allows student to accrue flight time in preparation for the Private Pilot Certificate Flight participation is required Pre or corequisite AET 182 or equivalent

182 Private Pilot Ground School. 3) F, S, SS
Ground school leading to FAA Private Pilot Certification Student may begin flight training when concurrently enrolled in AET 100 Aerodynamics navigation performance and regulations

183 Private Pilot Certificate. 1 F S SS
F ght tra n ng for the FAA pr vate p ot cert f cate Sat sfac tory comp etion of FAA tests s requ red Prerequ s tes AET 182 passed FAA wr tten.

200 Interim Flight Course. 0 F S SS
A ows students to accrue f ght t me n preparat on for ad vanced rat'ngs and cert f cates F ght part c pat on s re q red Prerequ s te Pr vate P ot Cert f cate or nstructor approva

201 Air Traffic Control. 3 S
Ground and a r operat ons Weat er serv ces commun'ca t ons and rout ng F ght p ans and FR operat ons Depar tures and arr va s A rport cond t ons and emergenc es. Prerequ s te AET 182

220 Aviation Meteorology. 3 F S
Eva uat on ana ys s, and nterpretat on of atmospher c phenomena. Low and h gh a t tude weather from the p ot s v ewpo nt Nepho ogy Prerequ s te AET 182

222 Instrument Pilot Ground School. 3 F
Ground schoo ead g to the FAA nstrument P ot Rat ng. 10 hours ground tra ner nc uded Prerequ s te: Pr vate P' ot Cert f cate. Pre or coreq u s te AET 220

280 Aerospace Structures and Materials. 3 F
Bas c aerodynam cs aerospace veh c e structura des gn and mater a s Manufactur ng pro esses as emb y and repa r techn ques, and ha dware se ect on Lecture ab Prerequ s'tes: PHY 111, 113

281 Aerospace Systems. 3 S
Modern a rcraft and aero pace veh c e systems hydrau cs, pneumat cs aux ary contro nstrument etc we ght and ba ance and nspect on requ rements and methods Lecture ab Prerequ s tes PHY 111 113

283 Instrument Pilot Rat'ng. 1 F S SS
F ght tra n ng for the FAA str ment P ot Rat ng Sat s factory comp et o of FAA Instrument Rat ng requ red Not for Aeronaut ca Techno ogy majors Prerequ s tes AET 222, passed FAA wr tten

287 Aircraft Powerplants. 4 F S
Theory and performance ana ys s of gas turb ne and re c procat ng a rcraft eng nes Eng ne accessor es sys tems and env ronmenta contro . Lecture ab Prerequ s tes CHM 113 or 114 PHY 112 114. Pre or coreq u s te MAT 260.

300 Aircraft Design I 3 F S
Bas c app ed aerodynam cs prope er performance and a rp ane performance ana ys s Prerequ s tes: AET 280, 287; ECE 106; MAT 260 PHY 112 114

308 Air Transportation. 3 F
A r commerce re ated to the transportat on system H s tor ca deve opment of a r transportat on regs the regu a tors, and the regu atory c mate w th n the Nat ona A r space System Prerequ s'te. jun or stand ng.

310 Instrumentation. 3 F
Measurement systems, components system response, and the characteri st cs of exper menta data Methods of co ecting and ana yz ng data Lecture, ab Prerequ s tes ETC 201 MAT 261 MET 313

312 Applied Engineering Mechanics: Dynamics. 3 F, S
Masses; mot on k nemat cs, dynam cs of mach nery Pre requ s tes: ETC 211 MAT 261

314 Commercial Pilot Ground School. 3 S
Ground schoo ead ng to Commerc a P ot cert f cat on 10 hours ground tra ner nc uded Prerequ s te Pr vate P ot Cert f cate Pre or coreq u s tes AET 222

320 Applied Aerodynamics I. 3 F
Introduct on to potent a and v scous f ows and the r re a t onsh p to a rcraft ft and drag Prerequ s tes. AET 300; ECE 106 MAT 262.

321 Applied Aerodynamics II. 3 S
W nd tunne theory, measurements and ana ys s A rcraft stab 'ty and contro Lecture ab Prerequ s te AET 320

342 Aviation Law Regulations. (3 F S
Study wh ch encompasses the f e d of av at on w th n the context of the U S Common Law system Pub 'c aw, ad m n'strat ve ru e mak ng sovere gnty enforcement, and case aw ana ys s Prerequ s te jun or stand ng

344 Airport Management and Planning. 3 S
Career or entat on nto adm n strat on and management of modern pub c a rport to nc ude an overv ew of p ann ng, fund ng and deve opment of a rport fac t es Prerequ s te. AET 308 or nstructor approva

360 Introduction to Helicopter Technology. 3 S
ntroduct on to the work ng funct ons of modern rotary w ng a rcraft. Rotary w ng f ght theory, aerodynam cs contro s f ght and power requ rements Prerequ s tes PHY 111, 113, jun or stand ng.

382 Air Navigation. 3 F
Advanced D R nc ud ng theory app cat on of modern nav gat on systems pressure pattern, and gr d nav gat on Prerequ s te AET 222

383 Commercial Pilot Certificate and Instrument Rating. 2 F, S SS
F ght tra n ng for the FAA Commerc a P ot Cert f cate w th A rp ane S ng e Eng ne Land and nstrument A rp ane Rat ngs Sat'sfactory comp et on of FAA Cert f cate Rat ng requ red Prerequ s tes AET 222 314 passed FAA wr t ten; f y ng t me 150 hours m n mum

385 Flight Instructor Ground School. 3 F
Ground schoo n preparat on for the FAA F ght nstructor Cert f cate Prerequ s te AET 383

386 Flight Instructor Certificate. 1 F S, SS
F ght tra n ng for FAA F ght Instructor Cert f cate. Cert fi cate requ'red for course c mp et on Prerequ s tes AET 385 passed FAA wr tten

387 Mult -Engine Ground School. 1 F
Ground schoo preparat on for the FAA Mu t Eng ne Rat ng Prerequ s te AET 383 or nstructor approva

389 Multi-Engine Rating. 1 F S SS
F ght tra n ng for add t on of an unrestr cted FAA Mu t Eng ne Rat ng to a commerc a p ot cert f cate FAA rat ng requ red for course comp et on Coreq u s te AET 387.

391 Multi-Engine Instructor Ground Schoo . 2 F S
Ground schoo preparat on for the FAA Mu t Eng ne F ght Instructor Rat ng. Prerequ s tes AET 386 387 389

392 Flight Instructor Instrument Ground School. 2 S
Ground Schoo preparat on for the FAA nstrument F ght Instructor Rat ng Prerequ s te. AET 386 or n tructor ap- prova .

393 Flight Instructor Instrument Rating. 1 F S SS
F ght tra n ng for the FAA CF CF Rat ng requ'red for course comp et on. Prerequ s tes. AET 386 392; passed FAA wr tten

395 Multi-Engine Land, Airplane Flight Instructor Rating. 1 F S SS
Norma and emergency f ght operat ons Instruct on tech n ques and procedures assoc ated w th ght mu t eng ne and, a rp ane CF AME Rat ng requ red for course com p et on Prerequ s tes AET 386, 389

408 National Airspace System. 2 S
A rway fac t es Operat ons and commun cat ons a r route traff c contro centers and f ght serv ce stat ons Navigat on a ds, a rport env ronment cert f cat on and se cur ty Prerequ s tes AET 201 or 222 , 344.

409 Nondestructive Testing and Quality Assurance. (3) F, S
Purpose of 'nspect'on and qua ty assurance Theory and app cat on of nondestruct ve nspect on methods App cation of pert nent standards spec f cat ons, and codes Lecture, lab. Prerequ s te AET 280 or MET 230 Pre or corequ s te ETC 400

410 Aviation Safety. 3 F
Av ation acc dent prevent on human factors fe support fire prevent on, acc dent nvest gat on, and crash surv va b 'ty Deve opment and ana ys s of av ation safety pro grams Prerequ s te jun or stand ng

414 Applied High Speed Aerodynamics. 3 F
Bas c concepts of compress b e f u d mechan cs nc ud ng nterna and externa f ows Prerequ s tes ETC 340 MAT 262

415 Propulsion. 3 S
Thrust, performance cyc es, and aerothermodynam c analys s of rocket and air breathing a rcraft eng nes ntro duct on to advanced propu s on systems Prerequ s te AET 414.

417 Aerospace Structures. 3 F
Analys's and design of a rcraft and aerospace structures Shear flow Sem'monocoque structures Effects of dy nam'c oad ng Prerequ s tes AET 300 312 MAT 262; MET 313

461 Applied Helicopter Aerodynamics and Performance Measurements. 3 F
Hover ng theory vertica f ght, b ade mot on, and rotor control Aerodynam cs of forward f ght stab ty Prerequ s tes. AET 300, 360

462 Aerodynamics of Wind Tunnel Models. 3) S
He copter mode types des gn cons derat ons propulsion, oads surfaces mount ngs, and instrumentat on. Pre requ s tes AET 321 461

463 Aircraft/Helicopter Handling Qualities. 3 F
FARs M LSPECs, human resources analyt cal tech niques s mu ator and f ght test techn ques. W'nd tunne data acqu s t on and ana ys s. Prerequ s te. AET 461

464 Flow Modeling Validation. 3 S
Flow model concepts and f ow mode s in a rp ane and he 'copter design. Test requ'rements, data ana ys s, and error ana ys s Prerequ s te AET 462

484 Aeronautical Internship. (1 3 F, S, SS
Work experience ass gnment at a rports or with aerospace ndustry commensurate w th student s program. Spec a projects gu dance by ndustry w th un vers ty superv'sion. Prerequ s tes adv sor approva jun or stand ng

487 Aircraft Design II. (3 F, S
Bas'c aerodynam cs and a rplane performance ana ys s methods appl ed to pract ca des gn project Prerequis te AET 300.

489 Airline Administration. 2 S
Adm n strat ve organ zat ons economics of a r ne admin stration, operat ona structure and re at onsh p w th fed era government agenc es Prerequ s te AET 308 or n structor approva

490 Advanced Applied Aerodynamics. (3 S
Study of f u d mot on and aerodynam'cs. Essent a s of in compress b e aerodynam cs and computat ona f u d dy nam cs. E ements of am nar and turbu ent f ows Lec ture ab Prerequ s'tes. AET 312· ECE 106, MAT 262.

Omnibus Courses: See pages 50 51 for omn bus courses that may be offered

Construction

PROFESSOR:
ROUNDS
ASSOCIATE PROFESSORS:
BADGER (COB 268) BURTON MULLIGAN, WEBER, WHELAN
INSTRUCTOR:
K RK
PROFESSORS EMERITI:
HAST NGS, MICHELS PETERMAN, SELLECK, WARD, WOODING

Purpose. Construction careers are so broadly diversified that no single curriculum prepares the student for universal entry into all fields. As an example, heavy construction contractors usually place more emphasis on technical and engineer ing science skills than do residential contractors/ developers, who usually prefer a greater depth of knowledge in management and construction. To ensure a balanced understanding of the technical, professional, and philosophical standards that distinguish modern-day constructors, advisory groups representing leading associations of con tractors and builders provide counsel in curriculum development. Construction has a common core of engineering science, management, and be havioral courses on which students may build defined options to suit individual backgrounds, apti tudes, and objectives These options are not abso lute but generally match major divisions of the construction industry.

Degrees. The Department of Construction of fers the Bachelor of Science degree with a major in Construction. Five options are available: gen eral building, general development, heavy construction, military construction, and specialty construction.

Each option is arranged to accent requisite technical skills and to develop management, leadership, and competitive qualities in the student. Prescribed are a combination of general studies, technical courses basic to engineering and construction, and a broad range of applied manage ment subjects fundamental to the business of con struction contracting. The military construction

option complements the heavy construction option but permits the use of 18 semester hours of ROTC credits for appropriate technical electives and management type courses.

Student Organizations. The department has a chapter of Sigma Lambda Chi, a national honor society that recognizes high academic achievement in accepted construction programs. The department is also host to the Associated General Contractors of America (AGC) student chapter.

Scholarships. Apart from those given by the university generally, a number of scholarships from the construction industry are awarded to students registered in the construction program. They are awarded on the basis of academic achievement and participation in activities of the construction program.

Degree Requirements

Students complete the following basic requirements before registering for advanced courses: (1) all first-semester, first year courses and the university English requirement (see page 89) must be completed by the time the student has accumulated 48 semester hours of program requirements and (2) all second semester, first year courses must be completed by the time the student has completed 64 semester hours of program requirements. Transfer students are given a one semester waiver.

Any student not making satisfactory progress is permitted to register for only those courses required to correct any deficiencies.

Construction—B.S.

Students in all options are required to complete a construction core of science-based engineering, construction, and management courses. Since the semester hours vary for some alternative courses in the core, any difference in credits is made up in the selected fields of specialization to achieve a minimum of 132 semester hours. The sequential arrangement of course work is shown below.

English Proficiency (6 semester hours)		*Semester Hours*
ENG 101, 102	First Year Composition or ENG 105 Advanced First Year Composition	6

General Studies Requirements
(36 semester hours)

Literacy and Critical Inquiry[2]
(6 semester hours minimum)

COM 225	Public Speaking[1]	3
ETC 400	Technical Communications	3

Numeracy
(6 semester hours minimum)

ECE 106	Introduction to Computer Aided Engineering[1]	3
MAT 270	Calculus with Analytic Geometry I[1] or 260 and 261	4

Humanities and Fine Arts
Social and Behavioral Sciences[2]
(15 semester hours minimum)
At least one course must be of upper division level two courses must be from the same department, and two or more departments must be represented in the total selection

Humanities and Fine Arts ..... 9 to 6
One course must be CON 101 Introduction to Construction (3)

Social and Behavioral Sciences ..... 6 to 9
ECN 111 Macroeconomic Principles[1] 3)
ECN 112 Microeconomic Principles [1](3)

Natural Sciences
(8 semester hours minimum)

PHY 111	General Physics	3
PHY 112	General Physics	3
PHY 113	General Physics Laboratory[1]	1
PHY 114	General Physics Laboratory[1]	1

Total General Studies 36

NOTE: One course in the area of global awareness[2] and one course in historical awareness[2] *must* appear in the final list of courses offered in the student's graduation program of study. If desired, these can be included in the humanities and fine arts social and behavioral sciences course selections

[1] Required for graduation

[2] See pages 62–88 for the requirements and the approved list

Construction Core Requirements Common to *All* Options

		Semester Hours
ACC 211	Introductory Financial Accounting	3
CON 221	Applied Engineering Mechanics: Statics	3
CON 243	Heavy Construction Equipment, Methods, and Materials	3
CON 244	Construction Graphics	2
CON 251	Microcomputer Applications for Constructors	3
CON 252	Building Construction Methods, Materials, and Equipment	3
CON 323	Strength of Materials	3
CON 341	Surveying	3
CON 383	Construction Estimating	3
CON 389	Construction Cost Accounting and Control	3
CON 495	Construction Planning and Scheduling	3

CON	496	Construction Contract Administration	3
ECE	105	Introduction to Languages of Engineering	3
STP	226	Elements of Statistics	3
Science Elective			4
		Total Common to All Options	45

Secondary Core for General, Heavy, and Specialty Options

			Semester Hour
BLW	306	Business Law	3
CEE	310	Testing of Materials for Construction	3
CEE	340	Hydraulics and Hydrology	3
CEE	450	Soil Mechanics in Construction	3
CON	273	Electrical Construction Fundamentals	3
CON	345	Mechanical Systems	3
CON	371	Construction Management and Safety	3
CON	424	Structura Design	3
CON	453	Construct on Labor Management	3
CON	463	Foundations and Concrete Structures	3
Technical Elective			3
		Total Secondary Core Required	33

Secondary Core for the General Development Option

			Semester Hour
ACC	212	Introductory Managerial Accounting	3
APH	314	History of Western Architecture II	3
BLW	306	Business Law	3
COM	222	Argumentation	3
CON	483	Advanced Building Est mating	3
FIN	300	Fundamentals of Finance	3
FIN	361	Managerial Finance	3
GPH	111	Introduction to Physical Geography	4
PUP	301	Introdu tion to Urban Planning	3
REA	251	Real Estate Principles	3
Technica E ective			3
		Total Secondary Core Required	34

Secondary Core for the Military Option

			Semester Hour
CEE	310	Testing of Materials for Construction	3
CEE	450	Soil Mechanics in Construction	3
CON	273	Electrical Construction Fundamentals	3
CON	344	Route Surveying	3
CON	345	Mechanical Systems	3
CON	371	Construction Management and Safety	3
CON	424	Structural Design	3
CON	463	Foundation and Concrete Structures	3
CON	472	Development Feasibility Reports	3
		Tota Secondary Core Required	27

Advisor approved alternates transfer credits for courses listed above may vary from the total required semester hours indicated. Such variances do not reduce the minimum of 132 semester hours required for the degree.

The course work for the first two years is the same for the general, heavy, and speciality options. The specific lower division requirements are shown below.

			Semester Hours
First Semester			
CON	101	Introduction to Construction	3
ECN	111	Macroeconom c Principles	3
ENG	101	First Year Composition	3
MAT	270	Calculus with Analytical Geometry	4
PHY	111	General Physics	3
PHY	113	Genera Physics Laboratory	1
		Total	17
Second Semester			
ECE	105	Introduction to Languages of Engineering	3
ECN	112	Microeconomic Principles	3
ENG	102	F rst Year Composition	3
PHY	112	General Physics	3
PHY	114	General Physics Laboratory	1
Humanit es Elective			3
		Total	16
Third Semester			
CON	221	Applied Engineering Mechanics Statics	3
CON	243	Heavy Equipment, Methods, and Materials	3
ECE	106	Introduction to Computer Aided Eng neering	3
STP	226	Elen ents of Statistics	3
Bas c Science Elective			4
		Total	16
Fourth Semester			
ACC	211	Introductory Financial Accounting	3
CON	244	Construction Graphics	2
CON	251	Microcomputer Applications for Constructors	3
CON	252	Building Construction Methods, Materials, and Equipment	3
CON	273	Electrical Construction Fundamentals	3
CON	323	Strength of Materials	3
		Tota	17

Option in General Building Construction

The general building option provides a foundation for students who wish to follow careers as managers or owners of firms engaged in the construction

of residential, commercial, and institutional structures. While conventional building is still a major factor in this field, modern educational focus is on building systems required for the mass development and production of large scale projects. General construction is treated as an integrated process from conception through delivery of completed facilities to users.

Requirements			Semester Hours
BLW	411	Real Estate Law	3
CON	472	Development Feasibility Reports	3
CON	483	Advanced Building Estimating	3
REA	251	Real Estate Principles	3
		Total	12

Option in General Development

The general development option prepares the student to participate in the development of land and buildings. Courses equip the student to understand the economics, acquisition, financing, marketing, and managing of developments, which normally vary with location, projected "highest and best" use, and owner requirements.

Requirements			Semester Hours
BLW	411	Real Estate Law	3
CON	472	Development Feasibility Reports	3
CON	484	Internship	2
CON	494	ST: Construction Process	3
		Total	11

Option in Heavy Construction

The heavy construction option prepares students for careers with constructors. Typical projects in which they are involved are highways, railroads, airports, power plants, rapid transit systems, process plants, harbor and waterfront facilities, pipe lines, dams, tunnels, bridges, canals, sewerage and water works, mass earthwork, and other heavy public works.

Requirements			Semester Hours
BLW	307	Business Law	3
CON	344	Route Surveying	3
CON	482	Cost Engineering	3
CON	486	Heavy Construction Estimating	3
		Total	12

Option in Military Construction

The military construction option is open only to students in the four-year ROTC program leading to a commission in the U S Army It prepares students for careers in either the military or engineering/highway construction field.

Requirements	Semester Hours
Approved Military Science Courses	18

Option in Specialty Construction

Specialty construction includes areas such as mechanical, electrical, air conditioning, roofing, concrete, commercial and industrial refrigeration, and fire protection systems This option is also intended to provide a program for those students interested in such areas as utility contracting, quarrying, and land development or other specialty areas. Upon application by the student and in consultation with an advisor, a specific program of courses to be added to the General Studies and the core sequence may be developed subject to courses offered within the university and the approval of the department chair.

Requirements			Semester Hours
CON	455	Construction Office Methods	3
CON	468	Conceptual and Electrical Estimating	3
CON	482	Cost Engineering	3
Approved Technical Elective			3
		Total	12

CONSTRUCTION

CON 101 Introduction to Construction. 3 S F
Review the history of construction and the impact on society An introductory course to this emerging discipline Lecture speakers field trips *[Satisfies General Studies Requirements HU G]*

221 Applied Engineering Mechanics: Statics. 3 F S SS
Vectors forces and moments force systems equilibrium analysis of basic structures and structural components friction, centroids and moments of inertia Cross listed as ETC 211. Prerequisites MAT 261 or equivalent PHY 111 113

243 Heavy Construction Equipment, Methods, and Materials. 3 F, S
Emphasis on Horizontal" construction Fleet operations maintenance programs methods, and procedures to construct tunnels, roads dams and the excavation of buildings Lab field trips

244 Construction Graphics. 2 F, S
Sketching and architectural drafting of building materials and systems Computer graphic applications for construction Lecture, ab fied trps. Prerequisite ECE 106 or equivalent

251 Microcomputer Applications for Constructors. (3 F S
Application of the microcomputer as a problem solving tool for the constructor Characteristics of microcomputer hardware and operating systems Use of spreadsheets statistical packages database management, and software Prerequisites ECE 106 STP 226.

252 Building Construction Methods, Materials, and Equipment. 3 F, S
Emphas s on Vert ca ˜ construction Methods, mater a s, codes and equ pment used n bu d ng construct on corre spond ng to the 16 d v s on Master Format Lecture ab Prerequ s te CON 243

273 Electrical Construction Fundamentals. 3 F S
C rcu ts and mach nery Power transm ss on and d str bu t on w th emphas s on secondary d str bution systems Measurements and nstrumentat on F e d trips Prerequ s'tes. MAT 261 or 270 PHY 112 114

323 Strength of Materials. 3 F, S
Ana ys s of strength and r g d ty of structura members n res st ng app ed forces Stress stra n shear, moment de f ect ons comb ned stresses connect ons and moment d strnbut on Both US and SI un ts of measurement Pre requ s te CON 221.

341 Surveying. 3 F S
Theory and f e d work n construct on and and surveys. Lecture ab Prerequ s te MAT 118

344 Route Surveying. 3 F
S mple compound and trans t on curves, nc ud ng re conna ssance pre m nary and ocat on surveys Ca cu a t on of earthwork D mens ona contro for construct on projects Lecture, ab Prerequ s te CON 341.

345 Mechanical Systems. 3 F S
Heat ng and coo ng systems for bu d ngs. San tary and water p p ng ayout and s mp e des gn Computer a ded ca cu at ons. Lecture ab f e d tr ps Prerequ s tes CON 243 251 PHY 111 113

371 Construction Management and Safety. 3 F S
Organ zation and management theory app ed to the con struct on process Leadersh p funct ons. Safety proce dures and equ pment OSHA requ rement for construc t on Prerequ s te jun or stand ng or nstructor approva

383 Construction Estimating. 3 F S
Methods and techn ques used in est mat ng construct on costs Standard approach to quant ty surveys empha s zed Pract ce n takeoffs cost ng and f na b d prepara t on M crocomputer usage for seme ter project Lecture project workshop Prerequ s tes CON 243 244 251 Con struct on major or nstructor approval

389 Construction Cost Accounting and Control. 3 F, S
Nature of construct on cost Deprec at on and tax theory and var ab e equ pment costs Cash f ow theory nvest ment mode s, prof tab ty and ana ys s Computer app cat ons Fund ng sources and arrangements Bu der s n surance Prerequ s tes: ACC 211 CON 251 or equ va ent , 383 *[Sat sfies General Stud es Requ rement· N3]*

424 Structural Design. 3 F S
Econom c use of stee re nforced concrete and wood n bu d ng and eng neered structures Des gn of beams co umns, and connect ons. E ast c and u t mate strength de sign. Student des gn pro ects F e d tr ps Prerequ s te CON 323

453 Construction Labor Management 3 F S
Labor and management h story, un on and open shop or gan zat on of bu d ng and construct on workers, app cab e aws and government regu at ons goa s, economic power, jurisd ct ona d spute and gr evance procedures Lec ture, lab Prerequ s tes CON 371 ECN 112 *[Sat sf es General Stud es Requ rement H]*

455 Construction Office Methods. 3 S
Adm n strat ve systems and procedures for the construc t on company off ce nc ud ng methods mprovement and work s mp f cat on, off ce ayout bus ness forms and de gn and off ce manua s Prerequ s te CON 389.

463 Foundations and Concrete Structures. 3 F S
Subsurface construct on theory and pract ce for founda t ons of bu d ngs and eng neered fac t es Concrete form des gn for foundat ons and structura frames Underp n n ng, p ng dry and wet excavat ng dewater ng coffer dams and ca ssons Lecture rec tat on f e d tr ps Pre requ s tes CEE 450, CON 424

468 Conceptual and Electrical Estimating. 3 F
System of est mat ng constr ct o costs before des gn has been n t ated Cost est mat ng for arge projects Ana ys s and organ zat on of e ectnca est mate Prerequ s te CON 383

472 Development Feasibil ty Reports. 3 S
Integrat o of econom c ocat on theory, deve opment cost data market research data and f nanc a a a ys s nto a feas b ty report Computer or entat on. Prerequ s te CON 389; ECN 112 REA 251

477 Resident al Construction. 3 F
Study of des gn concerns construct on mater a and con tract adm n strat on prob ems re ated to res dentia con struct on. Owner and contractor re at onsh p F e d tr ps. Prerequ s te jun or stand ng or nstructor approva

482 Cost Eng'neering. 3 F, S
App cat on of eng neer ng pr nc pa s to project costs Sys tem ana ys s of est mat ng des gn construct on and operat ng funct ons to opt m ze the fe cyc e cost Prerequ s tes CON 389 483 or 486

483 Advanced Building Estimating. 3 F S
Concepts of pr c ng and markup deve opment of histor c costs fe cyc e cost ng change order and conceptua est mat ng and emphas z ng m crocomputer methods. Pre requ s te CON 383

486 Heavy Construction Estimating. 3 F, S
Methods ana ys s a d cost est mat on for construct on of h ghways br dges tunne s dams and other eng neer ng works F e d tr ps Prerequ s tes CON 344 and 383 *or* nstructor approva

495 Construction Planning and Scheduling. 3 F, S
Var ous network methods of pro ect schedu ng such as AOA AON Pert bar chart ng ne of ba ance and VPM techn ques. M crocomputers used for schedu ng, re source a ocat on and t me cost ana ys s Prerequ s tes: CON 389, Construct on ma or or nstructor approva *[Sat sfies Genera Stud es Requ rement N3]*

496 Construction Contract Adm nistration. 3 F S
Case stud es Effects of organ zat on on construct on con tract operat ons Essent a s of construct on aw. Pr me contracts subcontracts, jo nt venture and consort um agreements and change orders Documentat'on. Cla ms, arb trat on and t gat on Qua ty contro requ rements. Bond ng nsurance, and ndemn f cat on procedures Eth cal pract ce cens ng codes etc F e d tr ps Prerequ s tes CON 371 ETC 400 and sen or stand ng *or* nstructor approva

531 Economics of the Construction Industries. 3 F
The econom c env ronment of construct on w th emphas s on un que aspects cr t cal rev ew of econom c terature dea ng w th the construct on ndustr es Prerequ s te· CON 496 *or* nstr ctor approva

551 Facilities Operation and Maintenance. 3 S
Ana ys s of ma ntenance work. Structure of the ma nte-nance work and organ zat on Contract ma ntenance and force account econom cs Ma ntenance contro and super-v s on of operat ons F e d tr ps Prerequ s te: CON 495 or nstructor approva

577 Construct on Systems Engineering. 3 F
Systems theory as app ed to the construct on process A ternates for structur ng nformat on f ws and the contro of projects Prerequ s te EE 476 or equ va ent.

Omnibus Courses: See pages 50 51 for omn bus courses that may be offered

Electronics and Computer Technology

PROFESSORS:
McHENRY TC 301A , MA SEL
ASSOCIATE PROFESSORS:
FORDEMWALT McBR EN MUNUKUTLA
NOWL N, STRAWN, WOOD
ASSISTANT PROFESSORS:
MAC A PETERSON
VISITING ASSISTANT PROFESSORS:
KAHN SADDLER
PROFESSORS EMERITI:
BAXTER, EDWARDS

Purpose. Electronics engineering technology is a technological field of specialization that requires the application of scientific and engineering knowledge and methods combined with technical skills n support of electrical electronic engineering activities It lies in the occupational spectrum between the craftsman and the engineer at the end of the spectrum closest to the engineer The electronics engineering technologist is a member of the electrical engineering team that consists of electrical engineers, electronics engineering technologists, and electronics engineering technicians.

The electronics engineering technologist is applications oriented, building upon a background of applied mathematics including the concepts and applications of calculus. Utilizing applied science and state of the art technology, the electronics technologist is able to produce practical, workable, and safe results quickly and economically, to install and operate technical systems, to configure hardware for unique applications from proven concepts, to develop and produce products, to service machines and systems, to manage construction and production processes, and to provide customer support to technical products and systems.

Degrees. The Department of Electronics and Computer Technology offers the Bachelor of Science degree in Electronics Engineering Technology B.S./EET) Four options are available: computer systems, electronic systems, microelectronics, and telecommunications.

The *computer systems* option combines applied electronics and computer hardware software concepts and applications. It has been formulated to meet the needs of persons who wish to engage in digital and computer systems applications as a career focus

The *electronic systems* option is aimed at preparing persons for careers in instrumentation, control, and power systems applications. This option allows a student to develop a broad based knowledge of electrical electronic fundamentals with an applications perspective Sixteen of the 23 specialization hours are specified and the remaining seven hours are approved technical electives. The Department of Electronics and Computer Technology has had a concentration in electronic systems or instrumentation and systems control for many years The course patterns in support of these emphasis areas have been well developed and continue to provide strong support for the electronic systems option under the B.S./EET program.

The *microelectronics* UET) option combines applied electronics, monolithic and hybrid integrated circuit processing and applications, device and component fabrication, and manufacturing. The objective of this option is to prepare persons to assume positions in the area of microelectronics manufacturing with immediately applicable knowledge as well as to develop a strong foundation of electronic fundamentals and methods Students should be interested in the design, fabrication, and manufacture of imprinted circuitry, monolithic integrated circuits (bipolar and MOS), and hybrid thick film and thin film circuitry, components, and systems Graduates of this program have various career opportunities in industry, particularly in semiconductor processing, fabrication, manufacturing, and device product application areas The continuing explosion in semiconductor and related technologies and their applications to electronic and computer related products offers unique and challenging opportunities. Graduates of this program option secure positions in processing, manufacturing, operations, and applications areas in industry as members of the diverse scientific engineering team

The *telecommunications* option has been structured to take advantage of the recent changes in the telecommunications industry. The program encompasses the fundamentals of information and signal processing, modern bandwidth efficient digital radio analysis with RF and microwave circuits and systems. Applications include telephone pulse code modulation, cable TV, fiber optic links, and satellite transmission circuits and systems.

A Master of Technology degree program with a concentration in electronics engineering technology is available for qualified B.S. graduates. The undergraduate program options are supported as emphasis areas in the master's degree program. See the *Graduate Catalog* for more information.

Electronics Engineering Technology—B.S.

The departmental curriculum is organized into two categories, technical studies and General Studies. Technical studies consist of core areas and the option specialty area. General Studies consist of courses selected to meet the University General Studies requirement as well as the math/science requirement of TAC/ABET. A minimum of 50 upper division hours is required, including at least 24 semester hours of EET, CET, or UET upper division hours to be taken at ASU. Complete program of study guides with typical four-year patterns are available from the department for each option.

The technical studies curriculum component consists of 91 semester hours of course work, which includes the engineering technology core (20 hours), electronics engineering technology core (44 hours), and an option (27 hours). The General Studies portion of the B.S./EET curriculum has been carefully structured to meet the specific requirements of the university and to include the content required by TAC ABET, the professional accrediting agency for such curricula.

Degree Requirements

In addition to the courses listed for English proficiency, General Studies, and the construction and technology core, the following courses are required:

			Semester Hours
Literacy and Critical Inquiry Elective:			
	COM	225 Public Speaking	3
Social and Behavioral Science Elective.			
	ECN	112 Microeconomic Principles	3

Engineering Technology Core

The following courses are required as part of the engineering technology core:

			Semester Hours
CHM	113	General Chemistry	4
ETC	201	Applied Electrical Science	4
ETC	211	Applied Engineering Mechanics Statics	3
ETC	340	Applied Thermodynamics and Heat Transfer	3
MAT	260	Technical Calculus I	3
MAT	261	Technical Calculus II	3
	Total		20

Electronics Engineering Technology Core Requirements

			Semester Hours
CET	250	Digital Systems and Microprocessors	3
CET	350	Digital Logic Principles	4
CET	354	Microcomputer Principles	4
CSE	183	Applied Problem Solving with FORTRAN	3
ECE	105	Introduction to Engineering Languages	3
EET	205	Electronic Devices and Circuits	4
EET	208	Electric Circuits	3
EET	301	Electric Networks I	3
EET	310	Electronic Circuits	4
EET	372	Communication Systems	3
EET	396	Professional Orientation*	1
MAT	262	Technical Calculus III	3
UET	331	Semiconductor Materials Science/Devices	3
UET	415	Electronic Manufacturing Engineering Principles	3
	Total		44

* Students must take EET 396 the semester in which they are enrolled in the 87th hour of credit (ASU plus transfer hours). If this occurs in summer session, students should take EET 396 the prior spring semester.

Electronics Engineering Technology Options

Computer systems. CET 452, 456, 457, 473, 483; nine hours of *approved* technical electives.

Electronic systems. EET 307, 406, 430, 460; 11 hours of *approved* technical electives.

Microelectronics. CHM 116; UET 416, 418, 432; 13 hours of *approved* technical electives.

Telecommunications systems. CET 473; EET 304, 470, 478, 11 hours of *approved* technical electives.

Electronics Engineering Technology
Program of Study
Typical First- and Second-Year Sequence

Freshman Year

First Semester			Semester Hours
ENG	101	First Year Composition	3
MAT	118	Precalculus Algebra and Trigonometry	3
PHY	111	General Physics	3
PHY	113	General Physics Lab	1
HU/SB		Elective	6
		Total	16
Second Semester			
ECE	105	Introduction to Languages of Engineering	3
ENG	102	First Year Composition	3
ETC	201	Applied Electrical Science	4
MAT	260	Technical Calculus I	3
PHY	112	General Physics	3
PHY	114	General Physics Laboratory	1
		Total	17

Sophomore Year

First Semester			
CHM	113	General Chemistry	4
ECE	106	Introduction to Computer Aided Engineering	3
EET	208	Electric Circuits	3
EET	205	Electronic Devices and Circuits	4
MAT	261	Technical Calculus II	3
		Total	17
Second Semester			
CET	250	Digital Systems and Microprocessors	3
COM	225	Public Speaking	3
CSE	183	Applied Problem Solving with FORTRAN	3
ETC	211	Applied Engineering Mechanics Statics	3
MAT	262	Technical Calculus III	3
		Total	15

Student Organizations

The department hosts one of the local chapters of the Institute of Electrical and Electronics Engineers (IEEE), the International Society for Hybrid Microelectronics (ISHM), and the Instrument Society of America (ISA). Students may also be elected to membership in Tau Alpha Pi, the national honor society for engineering technology.

ELECTRONICS ENGINEERING TECHNOLOGY

EET 205 Electronic Devices and Circuits. 4 F, S
Active device characteristics, models, and basic electronic circuit design principles Lecture lab Prerequisites ETC 201 MAT 260

208 Electric Circuits. 3 F S
Graphical and analytical analysis of electric circuits transient, and sinusoidal excitation Applications of circuit theorems and computer solutions Prerequisite ETC 201. Corequisite MAT 261

301 Electric Networks I. 3 F, S
Analytical and graphical analysis of electric networks transients steady state sinusoidal frequency response, and transfer functions using calculus essentials and Laplace transforms Prerequisites. EET 208; MAT 261

304 Transmission Lines and Waveguides. 4 S
Theory and application of transmission lines waveguides fiber optics and microwave components Analysis and matching using the Smith Chart. Lab Prerequisite EET 301

307 Electrical Power Circuits and Machines. 4 F S
Principles and analysis of electrical power circuits and components transformers rotating machines and related control equipment Lecture, lab Prerequisites: PHY 112, 114· ETC 201

310 Electronic Circuits. 4 F S
Analysis and design of bipolar and FET electronic circuits using the model approach Amplifier and transfer function principles Lab Prerequisites EET 205 208

372 Communication Systems. 3) F S
Systems analysis and design of AM FM PCM and SSB communication systems Noise and distortion performance of communication systems Prerequisites EET 301, 310

396 Professional Orientation. 1 F S
Technical, professional, economic, and ethical aspects of electronics computer engineering technology practice and industrial organization Lectures, projects Prerequisite: junior standing

401 Electric Networks II. 3 A
Graphical and analytical analysis of discrete systems. Time, frequency and transform domain techniques and waveform analysis. Software applications Prerequisites EET 301, MAT 262

406 Control System Technology. 4 S
Control system components, analysis of feedback control systems stability performance, and application Lecture lab, computer simulations Prerequisites EET 301; MAT 262

410 Linear Filters and Applications. 4 F
Frequency response and feedback design of multistage electronic circuits Active and passive filter design. Computer analysis Lecture lab. Prerequisites: EET 301 310

420 Operational Amplifier Theory and Application. 4) A
Differential and operational amplifier circuitry, feedback configurations op amp errors and compensation, and linear and nonlinear circuitry Applications Lecture lab Prerequisites EET 301, 310

422 Electronic Switching Circuits. 4 S
Analysis and design of electronic circuits operating in a switching mode Waveshaping timing and logic SPICE analysis Lecture lab Prerequisites CET 350, EET 301 310

430 Instrumentation Systems. 4 F
Measurement princip es and nstrumentat on, techn ques. S gna and error ana ys s. Lecture ab. Prerequ s tes CET 350 EET 301, 310

440 Electrical Power Systems Technology. (3 S
E ectr ca power systems ana ys s transm ss on d str bu t on nstrumentat on protect on, and re ated system com ponents Prerequ s te EET 307

460 Power Electronics. 4 S
Ana ys s of c rcu ts for control and convers on of e ectrica power and energy Lecture, ab Prerequ s tes· CET 350, EET 301, 310

470 Communication Circu ts. 4 S
Ana ys s and des gn of pass ve and act ve commun cat on c rcu ts Coup ng networks f ters and mpedance match ng. Modu at on and demodu at on techn ques Computer solut ons Lecture ab Prerequ s tes EET 372 MAT 262

478 Communication Transmission System Design. 4 S
App ed des gn of transm ss on and propagat on systems antennas, cab e TV and f ter opt cs Lecture ab Pre requ s tes EET 304, 372, MAT 262

482 Industrial Practice: Internship Coop. 1–4 F S, SS
Spec a y ass gned or approved act v t es n e ectron c in dustr es or nst tut ons Report requ red Max mum of 10 cred ts. Prerequ s te majors on y enro ed at jun or sen or leve

490 Electronics Project. 1–4 F S SS
nd vidua or sma group projects n app ed electron cs, w th emphas s on aboratory pract ce or hardware so u tions to pract cal prob ems. Prerequ s te nstructor ap prova

501 Digital Signal Processing and Application I. 3 A
Fundamenta s and app cat on of d screte s gna s and sys tems app cat on of DFT and FFT and the des gn of recur- s ve f ters using computer techn ques Prerequ s tes EET 401 or nstructor approva , MAT 262

502 Digital Signal Processing and Applications II. 3 S
Des gn and app cat on of nonrecurs ve d screte f ters convo ut on w th FFT power spectrum ana ys s and ran- dom s gna s. Prerequ s te· EET 501

506 System Dynamics and Control. 3 S
Time, frequency, and transform doma n ana ys s of phys· ca systems Transfer funct on ana ys s of feedback con tro systems performance and stab ty Compensat on Prerequ s tes EET 301 501 or MAT 262

510 Linear Integrated Circuits and Applications. 3 F
Ana ys s des gn and app cat ons of near ntegrated c r cu ts and systems Prerequ s tes CET 350· EET 301, 310

522 Digital Integrated Circuits and Applications. 3 S
Ana ys s des gn and app cat ons of ntegrated c rcu ts and systems. Prerequ s tes· CET 350; EET 301 310

530 Electronic Test Systems and Applications. 3 F
Ana ys s des gn, and app cat on of e ectron c test equ p ment, test systems, spec f cat ons and documentation Prerequ s tes CET 354; EET 301 310

540 Electrical Power Systems. 3 S
E ectr ca power system ana ys s, transm ss on, d str bu t on nstrumentat on, protect on, and re ated system com ponents Prerequ s tes EET 301, 307

560 Industrial Electronics and Applications. (3 A
Ana ys s des gn and app cat on of spec a e ectronic de v ces and systems to ndustria contro power commun - cat ons and processes Prerequ s tes CET 350 EET 301, 310.

574 Communication Circuits and Applications. (3) F
Ana ys s and des gn of m crowave c rcu ts us ng s para meters and computer a ded des gn Match ng networks, coup ers f lters and ampl f ers. Prerequ s tes: EET 304 372

576 Modern Telecommunication Systems. (3 S
App ed ana ys s and des gn of d g ta sate te commun ca t on systems App cat ons of coherent systems des gn and compensat on Prerequ s tes· CET 473 MAT 262 or nstructor approva

578 Communication Transmission Systems. 3 S
E ectromagnet c s gna propagat on and transm ss on and antenna princ p es and app cat on Cable TV and other commun cat on transm ss on systems Prerequisites· EET 304 372 MAT 262

Omnibus Courses: See pages 50 51 for omn bus courses that may be offered

COMPUTER ENGINEERING TECHNOLOGY

CET 250 Digital Systems and Microprocessors. (3) F, S
Fundamenta s of d g ta systems and m croprocessors, w th Boo ean A gebra and comb nat ona og c M cropro cessor programm ng and app cat ons. Lecture demon strat on Prerequ s tes ECE 105 ETC 201 *[Satisfies Genera Stud es Requ rement· N3]*

350 Digital Logic Principles. 4 F S
Comb nat ona og c ana ys s and des gn and sequent a c rcu t ana ys s and des gn w th ab Lecture, ab Pre requ sites CET 250· ECE 106.

354 Microcomputer Principles. 4 F S
Microcomputer organ zat on pr nc p es, and assemb y an guage programm ng w th ab Prerequis te: CET 250.

408 Digital Control and Simulation. 3 F
D g ta systems ana ys s contro techn ques and com puter s mu at on and des gn Prerequ s tes CET 354; CSE 183 EET 310

452 Digital Logic Applications. 4 S
Des gn of sequent a machines us ng system design tech n ques and comp ex MS LS dev ces w th ab Prerequi s tes CET 350 CSE 183

456 Min computer Systems and Programming. (3) S
Assemb y anguage programm ng nput output and off ne d agnost cs Ut ty operating system and software. Pre requ s tes CET 354 CSE 183 or 100.

457 Microcomputer Systems and Applications. 4 S
App cat ons of m n -and or m crocomputer hardware and software Spec a purpose contro ers, nterface des gn. Lecture, ab Prerequ sites CET 350 354; CSE 183 EET 310

473 Digital Data Communication Systems. (4) F S
S gna s d stort on, no se, and error detection correct on. Transm ss on and systems des gn. nterface techn ques and standards D g ta hardware App cat ons w th ab. Prerequ s tes CET 350, 354, EET 372

483 Unix Utilities Using C Language. 3 S
App cations of C anguage to the development of pract ca programs for the Un x operat ng system Prerequisite. senior stand ng n techno ogy or equ va ent.

485 Digital Testing Techniques. 3 S
Hardware software aspects of d gita test ng technology; systems, board and log c testing and equ pment Lec ture, ab Prerequ s'tes CET 350, 354 CSE 183 EET 310

486 Electronics Computer Aided Design. 3) F
CAD CAM for e ectron cs manufactur ng Pr nted c rcu t ayout, documentation, and schemat c plott ng Prerequi sites CET 250 CSE 183 EET 310

508 Computer Process Control Technology. 3) F
Process computer contro hardware, software Samp ed data control systems process mode ng, m croprocessor control techn ques, computer a ded des gn, and s mu a tion Process app cat ons Prerequ s tes CET 354 EET 401 or 406

552 Digital Systems and Applications. (3) S
Analys s design and app cat ons of d g ta networks and systems Prerequ s tes CET 350 354 CSE 183.

556 Computer Software Technology. 3 S
Assembly anguage programm ng techn ques and opera tions operat ng system character stics and systems soft ware appl cat ons Prerequ s te CET 354.

557 Microcomputers and Applications. (3) F
App cat ons of sma computer systems, min and m cro computer hardware and software Prerequ s tes CET 354, CSE 100 or 183 EET 310

Omnibus Courses: See pages 50–51 for omn bus courses that may be offered

MICROELECTRONICS ENGINEERING TECHNOLOGY

UET 331 Semiconductor Materials Science Devices. (3) F S
ntroduct on to mechan ca and e ectromagnet c propert es of mater'als used n e ectron cs Sem conductor phys cs and so id state dev ce character st cs and materia proper t es Prerequ s tes: CHM 101 or 113, ECE 105 EET 310 PHY 112, 114

415 Electronic Manufacturing Engineering Principles. (3) F S
E ectronic equ pment des gn and fabr cation princ ples and pract ce Comp et on of e ectron cs hardware des gn proj ect and report Lecture ab W th ab fee. Prerequ s te EET sen or stand ng 113 hours

416 Monolithic Integrated Circuit Technology. 3) F
Process ng and fabr cat on of mono thic b po ar and MOS integrated circu ts. Lecture ab Prerequ s te UET 331

418 Hybrid Integrated Circuit Technology. (4) S
Layout fabr cation, design and manufacture of th n and th ck f m hybr d c rcu ts Lecture ab Prerequis tes. EET 310; UET 331

432 Semiconductor Packaging and Heat Transfer. 3 S
Packaging theory and techn ques, hermet c and plast c assemb y therma management e ectrica characterist cs and reliabi ty Prerequisites ETC 340 and UET 331 *or* equ va ents

437 Integrated Circuit Testing. (3) F
Pr nc p es techn ques, and strateg es emp oyed n wafer level and f na product test ng; both destruct ve and non destruct ve Prerequ s te UET 416

513 Microelectronics Technology. 3) A
Specia processes techn ques and advances n mono ith c and hybr d techno ogy Emphas s on manufacturing pract ce and product app cation for LSI and VLSI Pre requ site. instructor approva

516 IC Technology and Applications. 3) F
Advanced process ng and fabr cat on techno ogy of mono th c ntegrated c rcu ts Lecture, ab Prerequ s te UET 416

518 Hybrid IC Technology and Applications. 3) S
Theory, process ng, fabr cat on and manufactur ng of hy br d m croe ectron cs dev ces and products App cat ons Prerequ s'te· UET 33† or equ va ent or nstructor approva

Omnibus Courses: See pages 50–51 for omn bus courses that may be offered

Manufacturing and Industrial Technology

PROFESSORS:
COLLINS (TC 201F), PETERSEN

ASSOCIATE PROFESSORS:
BOWERS, DAHL H RATA, HOROW TZ, KELLEY K S ELEWSKI, LAWLER, MATSON, MEITZ PALMGREN, SCH LDGEN, SCHMIDT

ASSISTANT PROFESSORS:
BARCHILON GAFFORD, HUMBLE, LAMERAND McCLELLAND, PELTIER

PROFESSORS EMERITI:
AUTORE, BROWN, BURDETTE, BURK, CAVALL ERE KEITH, KIG N MINTER, PARDINI, PRUST, ROE, ROOK SHELLER, STADM LLER, WATK NS W LCOX

Purpose. Technology is the study of the appli cation of science, systematic methods, techniques, procedures, materials, and devices for the development, improvement, and implementation of state of the art solutions to industrial problems. Increased complexity and sophistication have created great demand for those individuals who possess a working knowledge of the technical phases of planning, testing, production, and fabrication of consumer and industrial products and equip ment. Emphasis is placed on health and safety within the workplace.

The mission of the Department of Manufacturing and Industrial Technology is to provide stu dents with a broad technical and managerial back ground in a variety of disciplines that qualify them for positions of leadership and responsibility in industrial, commercial, educational, and gov ernment activities.

The goal of the department is to prepare graduates who are able to develop technological solutions to industrial problems, to perform management functions in systems operations, product improvement, production evaluation, and customer support, and to serve as industrial trainees to facilitate technical transfer in industry and government.

Majors and Options. To accomplish the mission, the department offers two majors leading to the Bachelor of Science degree, Industrial Technology and Manufacturing Engineering Technology. Three options are available under the Industrial Technology major: graphic communications, industrial management, and interactive computer graphics. Five options are available under the Manufacturing Engineering Technology major: computer-integrated manufacturing engineering technology, manufacturing engineering technology, mechanical engineering technology, robotic and automation engineering technology, and welding engineering technology.

Admission. Those students who seek admission to the program from other programs within the College of Engineering and Applied Sciences may be admitted with a minimum GPA of 2.25 for Arizona residents and 2.50 for the nonresidents. Students admitted to the program are required to develop an area of specialization.



Degree Requirements

Manufacturing Engineering Technology—B.S.

	Semester Hours
Engineering Technology Core	10
General Studies requirements	45
Manufacturing Engineering Technology Core	28
Selected Option	43
University English proficiency	6
Total	132

The following courses constitute the Manufacturing Engineering Technology Core and are required of all Manufacturing Engineering Technology students. Refer to the specific options for additional requirements.

Manufacturing Engineering Technology Core

			Semester Hours
ECE	105	Introduction to Languages of Engineering	3
ECE	106	Introduction to Computer-Aided Engineering	3
MET	230	Engineering Materials and Processing	3
MET	231	Manufacturing Processes	3
MET	300	Applied Metallurgy	3
MET	302	Welding Survey	4
MET	313	Applied Engineering Mechanics: Materials	3
MET	401	Statistical Process Control	3
MET	460	Manufacturing Capstone Project or MET 461 Mechanical Capstone Project (3) or MET 462 Capstone Project/Weldment Design (3) (for Robotic and CIM projects, see department chair)	3
		Total	28

Option in Computer-Integrated Manufacturing Engineering Technology. Computer-integrated manufacturing (CIM) has proved to be a powerful tool for increasing productivity in manufacturing. This impact will be greater in the future as the full potential of computers is integrated into the manufacturing factory. Computer-integrated manufacturing engineering technology is concerned with the coordination of computer information and computer implementation in manufacturing.

Required courses: IST 452; MET 303, 341, 345, 416, 443, 448, 451, 453; 15 hours approved technical electives.

Option in Manufacturing Engineering Technology. This option is designed to prepare technologists with both conceptual and practical applications of processes, materials, and products related to metalworking industries. Accordingly, this concentration is intended to prepare students to meet the responsibilities in planning the processes of production, developing the tools and machines, and integrating the facilities of production or manufacturing.

Required courses: AET 409; MET 303, 341, 344, 345, 346, 416, 442, 444; 15 hours approved technical electives.

Option in Mechanical Engineering Technology. The primary objective of the mechanical engineering technology option is to prepare the student for entry level work in mechanical design and testing either in engineering or manufacturing departments in product oriented industries. Major emphasis is placed on reducing the amount of time required by industry to make the graduate productive in any area of work. The student obtains a well rounded academic background with an emphasis in mechanics and thermal sciences.

Required courses: AET 312; MET 303, 331, 432, 433, 434, 436, 438, 17 hours of approved technical electives.

Option in Robotic and Automation Engineering Technology. The challenges to improve productivity, product quality, and reliability and to reduce costs must be addressed by integrating robots and automation in manufacturing. This option addresses the field of automating manufacturing processes.

Required courses MET 303, 341, 345, 346, 416, 444, 451, 452, 453; 15 hours approved technical electives.

Option in Welding Engineering Technology. This option is designed primarily to prepare individuals for technical positions in industries utilizing welding and related processes. The focus is on the application of welding technology as applied to current and near future industrial needs The program is structured to provide the individual with a balance of theory, application, and hands on experience. The general areas covered by the courses are welding processes, materials, nondestructive testing, and weldment design. The student also has the opportunity to work with robots in robotic welding applications. Also, a laser is available for investigating the area of high energy welding processes.

Graduates of this program have the capability to function in a variety of technical positions related to welding and manufacturing. Typically, a graduate from this program may work in the areas of robotic welding, metallurgy, quality control, nondestructive evaluation, welding process evaluation, and technical sales.

Graduates may find employment in the aerospace, automotive, heavy machinery, heavy fabrication, and energy production industries.

Required courses: AET 409, MET 321, 322, 341, 344, 346, 420, 421, 425; 16 hours of approved technical electives.

Industrial Technology—B.S.

	Semester Hours
General Studies requirements	39
Industrial Technology Core	25
Selected Option	62
University English Proficiency	6
Total	132

The following courses constitute the Industrial Technology Core and are required of all Industrial Technology students. Refer to the specific options for additional requirements.

Industrial Technology Core

			Semester Hours
ECE	105	Introduction to Languages of Engineering	3
ECE	106	Introduction to Computer Aided Engineering	3
ETC	201	Applied Electrical Science	4
ITC	200	Impact of Communications Technology on Society	3
ITC	202	Creative Thinking and Design	3
ITC	343	Occupational Safety	3
ITC	444	Industrial Organization	3
MET	230	Engineering Materials	3
		Total	25

Option in Graphic Communications (GRC). The purpose of the graphic communications option is to prepare people for a wide variety of professional positions in the printing and graphic communications industry. The graphic communications option offers a blend of technological and managerial skills and knowledge It has been specifically designed to prepare graduates to address the opportunities and increased competitive challenges taking place in the industry as a result of technological change and turbulent economic and human relations concerns.

All courses are industry responsive. The students are exposed to case histories and problems related to actual industry issues. Throughout the entire four year curriculum, students are exposed to practical, situational analysis and effective

problem-solving techniques. As a prerequisite for graduation, students are expected to acquire job related industry experience as practical preparation for making an immediate contribution to an employer's business.

Students are required to take designated graphic communications courses during the first two years of the program. After the sophomore year, each student must select an area of emphasis in consultation with an advisor. The areas of emphasis are operations management, sales marketing, and technology.

To achieve its objectives, the graphic communications option offers the following required and technical elective courses: GRC 135, 237, 331, 332, 333, 334, 336, 339; IST 346; 35 hours approved technical electives.

After selecting the area of emphasis that best suits the student's interests, courses are to be selected, with an advisor, that relate to the following topics:

Operations management. Computer graphics applications, conformance requirements for government regulation; decision making in a manufacturing environment; industrial cost accounting; instrumentation for graphic arts manufacturing; manufacturing strategy; materials testing and performance prediction; optimization of production systems; organizations and layout, planning and scheduling for manufacturing; plant design, plant information systems; printing systems maintenance; product development and management; production management; production coordination; supervisory techniques; traffic management.

Sales marketing. Customer education; estimating and job costing; finance, personnel and human relations; markets for printing, print and electronic media; sales management; sales service; strategic planning; market planning.

Technology. Analytical modeling for manufacturing systems; applied electronics for the graphic communications industry, creation, management and transmission of digital imaging information; environmental control; evaluation of new technologies; integrated computer graphics; printing plant engineering, quality management and process control; scientific properties of graphic communications materials, technological planning and forecasting.

Option in Industrial Management. The purpose of this option is to prepare supervisors and high-level personnel for management and marketing functions in marketing, industry, manufacturing, and public service organizations.

The industrial management option is articulated with the Maricopa Community College District, Pima Community College, and Yavapai College. Consultation with an advisor is required to coordinate the course selection for transfer to the industrial management areas of emphasis.

Classes are scheduled to accommodate the student who is employed in a full time position. Classes may be scheduled at facilities where the demand is sufficient to justify a class.

Before completion of the degree, the student must show evidence of adequate and appropriate occupational experience.

To achieve its objectives, the industrial management and supervision option requires the following courses: IST 346, 402, 451, 452, 453, 461, 480, 491; PGS 430, 35 hours approved technical electives.

A technical support area must be chosen by the student in consultation with an advisor. Typical areas of emphasis are: areonautics, construction, electronics, fire science, graphic communications, hazardous materials, safety and health, interactive computer graphics, and manufacturing. Articulation agreements are to be followed by consulting an advisor.

Option in Interactive Computer Graphics. The purpose of the interactive computer graphics (ICG) option is to prepare students for entry into the diverse field of computer graphics. The ICG option provides a strong academic foundation in the technological, managerial, and discipline-specific applications of graphics analysis, communication, databases, design, documentation, image generation, modeling, programming, and visualization.

Graduates are qualified computer graphics technologists who have acquired extensive knowledge and technical competency in their respective areas of emphasis, thereby preparing them to advance into professional positions of leadership within the industry. The ICG courses are industry responsive and provide a high level of technical applicability in the use of computer graphics systems, hardware, and software within a variety of discipline environments.

Typical areas of emphasis leading to specialized career paths may include: applications development, applications supervision and management; business and analytical graphics; design (specialty areas such as electronics, advertising/graphics design, mechanical, manufacturing, animation, rendering and illustration, and computer-aided design and drafting); field engineering, service and support; graphics systems and data-

base analysis, sales and marketing; technical graphics and publication; testing, and implementation; training (administration and instruction)

Typical career paths may include: applications development testing implementation; applications supervision and management; design (specialty areas such as electronics, graphics design, mechanical, manufacturing, illustration), graphics system analysis; operational services and support supervision; sales marketing/field service; technical graphics and publications; training (administration instruction).

To achieve its objectives, the interactive computer graphics option requires the following courses: ICG 212, 310, 312, 313, 314, 412, 417, 461; 38 hours approved technical electives.

Technical support areas and courses must be chosen by the student in consultation with an advisor.

INDUSTRIAL TECHNOLOGY CORE

ITC 200 Impact of Communications Technology on Society. 3 F S
Develop ng an awareness of ssues such as privacy de persona zat on, and contro of nformat on that have been affected by recent deve opments n commun cat ons tech no ogy Act v t es nc ude research ng eva uat ng f nd ngs and present ng arguments n support of pos t ons. Pre requ s te ENG 102 or 105 or 108 *[Sat sf es Genera Stud es Requ rement· L1]*

202 Creative Thinking and Design. 3 F S
Fundamenta methods, concepts and techn ques of crea t ve th nk ng des gn, and prob em so v ng A so nc udes commun cat on manager a cu tura , and soc eta nf u ences. Lecture ab Prerequ s te ECE 106 or nstructor approva .

343 Occupational Safety. 3 F
Acc dent prevent on acc dent factors methods of record ng and report ng ana ys s psycho og ca aspects att tudes recent eg s at on safety consc ousness and ab ty. Prerequ s te jun or status

444 Industrial Organizat on. 3 S
Industr a organ zat on concepts. Top cs re ate to ndus tr a re at ons governmenta regu at on organ zat ona structure abor re at ons, human factors and current n dustr a pract ces F e d tr ps Prerequ s te jun or status

Omnibus Courses: See pages 50 51 for omn bus courses that may be offered

GRAPHIC COMMUNICATIONS

GRC 135 Graphic Communications. 3 F S
ntroduct on to the techno og es nvo ved n the des gn m age generat on transm ss on and product o of mu t p e mages for consumer ut zat on Lecture ab f e d tr ps.

136 H story of Pr nting in the Western World. 3 N
H stor ca perspective of techno og ca deve opments n pr nt ng and soc a mpacts on Western c v zat on n re a t on to other forms of commun cat on F e d tr ps

237 Image Preparation. 3 F
Bas c pr nc p es of typograph c ayout Preparat on of thumbna s, roughs comprehens ves and mechan cals. ntroduct on to photocompo t on systems Lecture, ab

331 Quality Assurance for the Reproduction Processes. 3 S SS
nstrumentat on and methodo og es for mater a s test ng and qua ty contro n the major reproduct on processes F e d tr ps

332 Film Assembly and P atemaking. 3 F
Str pp ng negat ves and pos t ves, ne ha ftone duo tone and fu co or contact ng f ats onto var ous types of mage carr ers Lecture ab, f e d tr ps Prerequ s te GRC 135

333 Sheetweb Press Technology. 3 S
Funct on of the offset pr nt ng equ pment L thograph c dy nam cs of both sheetfed and sheetweb systems Lecture ab Prerequ s te· GRC 332 or 'nstructor approva .

334 Photomechanical Reproductions. 3 F
Theory and product on of ne work, ha ftones, contact work and spec a effects for the graph c arts ndustry Lecture ab

335 Printing and Fin shing Techniques. 3 S
Ana ys s of major pr nt ng processes of f exography screen process and re ef product on b ndery and f n sh- ng procedures Prerequ s te GRC 135

336 Color Separation. 3 S
Methods of produc ng separat on negat ves and pos t ves Prerequ s te GRC 334

337 Production Management. 3) F
P ann ng and contro ng work f ow of graph c arts prod ucts F e d tr ps Prerequ s te. GRC 135

339 Estimating and Cost Analysis. 3 S
Management re at onsh p between f nanc a , product on and sa es departments n pr nt ng ndustr es ana ys s of equ pment abor and mater a costs use of paper and standard pr c ng cata ogs Prerequ s te GRC 135

433 Production Techniques. 3 N
Systemat c product on p ann ng exper ence Lecture ab Prerequ s tes GRC 333 334

435 P ant Management. 3 F
Concepts pract ces, and processes used by the commer c a prnt ng p ant manager re at ng to the operat on of the p ant Prerequ s te GRC 135 or nstructor approva

436 Gravure Technology. 3 S
n depth study of the market prof e and product on se quences re ated to the gravure method of pr nting. Pre requ s te GRC 336

437 Advanced Color Reproduction. 3 F
Sc ent fic ana ys s for the eng neer ng of co or reproduc t on systems used n the graph c arts ndustry F e d tr ps Prerequ s te GRC 336

438 Graphic Arts Techniques and Processes. 3 F, S SS
Survey of product on sequences and prof e of the pr nt ng and pub sh ng ndustry Lecture ab Prerequ s te jun'or stand ng

439 Electronic Imaging for Publications. 3) S
ntroduct on and n depth nvest gat on nto e ectronic pub sh ng systems used n pr nt ng and pub sh ng ndustry for transm ss on and generat on of copy

537 Current Issues in Quality Assurance. 3 N
D rected group study of se ected ssues re at ng to qua ty assurance n the pr nt ng and pub sh ng ndustry

Omnibus Courses: See pages 50–51 for omn bus courses that may be offered

INDUSTRIAL MANAGEMENT

IST 346 Management Dynamics. 3 S
Elements of human re at ons tra n ng and the conse quences of superv sory behav ora patterns n effect ve y deal ng w th emp oyees

402 Industrial Laws, Contracts, and Regulations. 3 F
Review of c ty state, county and federa aws that affect ndustria and construct on operat ons, mater a s supp es, and acqu s t on procedures

445 Industrial Internship. 1 10 F S, SS
Work exper'ence ass gnment n ndustry commensurate w th student s program Spec a zed nstruct on by ndustry w th un vers ty superv s on. Prerequisites. adv sor ap prova jun or status; 2.50 GPA.

451 Materials Control. 3 F
Act v t es of mater a hand ng nc ud ng purchas ng re ce v ng, warehous ng traff c p ant ayout nventory and product on contro and sh pp ng re at ng to techn ca pro cedures

452 Industrial Management. 3 S
Concepts and practices of eadersh p n the ndustr a en v ronment nc ud ng product on p ann ng qua ty enhan e ment prob em so v ng and po cy nterpretat on Prerequ s te ST 346 or nstructor approva

453 Safety Management. 3) S
Deve opment and management of safety programs edu cat on and tra n ng and re at onsh ps w th n an organ za t on. Prerequ s te: iTC 343 or nstructor approva

454 Occupational Hygiene. 3 S
Fundamenta concepts and pr nc p es of ndustr a hyg ene and occupat ona env ronmenta hea th nc udes OSHA and EPA aws regu at ons, standards, chem ca and phys cal hazards a r samp ng equ pment and contro measurers Prerequ s te TC 343 or nstructor approva .

455 Industrial Sales and Demand. 3 F
Customer and sa es strateg es for ndustr a organ zat ons nc ud ng current pract ce and future p ann ng Prerequ s tes. ECN 111; adv sor and nstructor approva jun or stand ng

460 Legal Aspects of Safety. 3 F
OSHAct adm n stration, c v and cr m na t gat on, ndus tr a nsurance workers' compensat on, and other safety and hea th aws

461 Production Supervision Principles. 3 F
Introduct on to superv sory pr nc p es as app ed to produc t on of goods and serv ces Prerequ s te TC 444

480 Organizational Effectiveness. 3 F
Human aspects of superv sory behav or n the ndustr a sett ng and how they nfluence eff c ency mora e and or gan zat ona pract ce

491 Introduction to Labor Concerns. 3 S
Introduct on to abor re at ons organ zat on of abor un ons and federat ons co ect ve barga n ng gr evances and ar bitrat on and app cab e abor leg s at on

542 Global Management Philosoph'es. 3 F
Ana ys s and compar son of s gn f cant superv s on ph losoph es deve oped n var ous ndustr a nat ons a d the r potent a appl cat on n the Un ted States

549 Research Techniques and Applications. 3 F S
Select on of research problems, ana ys s of terature, nd v dua nvest gat ons prepar ng reports, and proposa wr t ng.

550 Industrial Training. 3 S
Tra n ng techn ques and earn ng processes P ann ng, deve op ng and eva uat ng tra n ng programs n ndustry and governmenta agenc es Prerequ s te adv sor ap prova

570 Project Management. 3 S
P ann ng, organ z ng, coord nat ng, and contro ng staff and project groups to accomp sh the project object ve

598 Spec al Topics. 1 2 F S
Spec al top cs cour es nc ud ng the fo ow ng wh ch are regu ar y offered, are open to qua f ed students
- a Pr nc p es of Hazardous Mater a s and Waste Management
- b Regu atory Framework for Tox c and Hazardous Substances
- c Pr nc p es of Tox co ogy
- d Techno og es for Storage Treatment and D sposa of Hazardous Mater a s
- e Quant tat ve Ana ys s and Pract ca Laboratory Techn ques
- f ndustr a Hyg ene
- g A r Po ut on and Tox c Chem ca s
- h Groundwater Hydro ogy. Mon tor ng Protect on and C ean up
  Emergency Preparedness Response and P ann ng for Hazardous Mater a s
- (j R sk Assessment for Hazardous Mater a s
- k Fate of Tox c Substances n the Env ronment

Omnibus Courses: See pages 50 51 for omn bus courses that may be offered

INTERACTIVE COMPUTER GRAPHICS

ICG 212 Design Documentation. 3 S
Us ng m cr computer based graph cs systems for product des gn and documentat on. Geometr c shape ana ys s and descr pt on Documentat on techn ques and stan dards D mens on ng Lecture ab, f e d tr ps Prerequ s te: ECE 106

310 Computer Graphics Fundamentals. 3 S
Computer mage creat on transformat on and man pu a t on Current techn ques for database generat on Con cepts of app cat ons software deve opment Hands on exper ence Lecture, ab f e d tr ps Prerequ s te: pro- gramm ng background he pfu but not necessary *[Satis f es Genera Stud es Requ rement N3]*

312 Computer-Aided Design and Drafting. 3 F
Us ng computer a ded des gn a d draft ng app cat on soft ware for advanced geometr'c construct on. System and workstat on conf gurat on and product v ty Mode ng ap p cat ons Lecture ab f e d tr ps Prerequ s te CG 212. *[Sat sf es General Stud es Requ rement N3]*

313 Techn cal Illustration. 3 F
P ctor a draw ng shades and shadows, and mu t med a render ng techn ques Lecture, ab Prerequ s te CG 212

314 Computer Graphics Database. 3 S
Prepar ng the product def'n t on database for computer n tegrated manufactur ng Documentat on and process re qu rements, systems and standards Prec s on d men s on ng Lecture ab, f e d tr ps. Prerequ s te CG 212 or MET 230 or CET 250 or equ va ent

412 Computer Graphics Modeling. 3 F
Estab sh ng and man pu at ng 3 d mens onal computer mode s Appl cat ons, nc ud ng so ds mode ng concepts, des gn analys s dynam c s mu at on, and graph c data ex change f es Lecture, ab, f e d tr ps Prerequ s te ICG 312. *[Sat sf es Genera Stud es Requ rement· N3]*

413 MicroCadd Applications. 3 F
Student se ected modu es nc ud ng arch tectura con struct on, c v ut ty and e ectron c draw ng· mechan ca manufactur ng, an mat on computer graph cs, and others Lecture ab f e d tr ps Prerequ s'te: CG 212

417 Graphics Systems Management. 3 S
P ann ng mp ement ng and manag ng computer graph cs systems App cat ons, needs assessment, ana ys s of components, system ergonom cs nterfac ng, ma nte nance and human resources management Lecture ab fie d trips Prerequ s te nstructor approva

461 Computer Animation. 3 F
Fundamenta techno ogy used n creat ng 2 d mens ona and 3 d mens ona an mat on through mode ng, scr pt ng and render ng as re ated to eng neer ng s mu at on Lec ture, ab f e d tr ps Prerequ s te CG 310 or nstructor approva

517 Graphics Systems Development. 3 S
Research and deve opment n computer graph cs sys tems App ied pro ect management deve opment eva u at on and mp ementat on Lecture ab f e d tr ps Pre requ s te CG 412 or nstructor approva

Omnibus Courses: See pages 50–51 for omn bus courses that may be offered

MANUFACTURING TECHNOLOGY

MET 110 Welding Survey. 3 N
Oxyacety ene arc braz ng res stance and gas tungsten arc we d ng procedures for ferrous and nonferrous meta s Lecture, ab

116 Aeronautica Welding. 2 F
Oxyacety ene and tungsten gas tungsten arc we d ng pro cedures and braz ng techn ques used for a rcraft struc tures Lecture ab

230 Engineering Materials and Processing. 3 F S, SS
Mater a s, the r structures propert es fabr cat on charac ter st cs, and app cat ons Matena form ng jo n ng and f n sh ng processes Automat on and qua ty contro Pre requ s te CHM 101 or 113 or 114

231 Manufacturing Processes. 3 F
Metal removal processes, emphas'z ng dr ng m ng and athe processes nc d ng too bit gr nd ng Emphas s on product on speeds and feeds Lecture ab. Prerequ s tes: ECE 106 MET 230.

300 Applied Metallurgy. 3 F
Pr nc p es of meta urgy emphas z ng concepts most re e vant to typ ca manufactur ng requ rements, factors affect ng propert es and eva uat on methods; meta ography ex per ences Lecture ab Prerequ s te MET 230 or n structor approva

302 Welding Survey. 4 F
Theory and app cat on of ndustr a weld ng processes n troductory we d ng meta urgy and we dment des gn SMAW GTAW GMAW Oxyacety ene and braz ng expe r ences Lecture, ab. Prerequ site: upper c ass stand ng

303 Machine Control Systems. 3 N
Theory and app cat on of e ectromechan ca hydraul c, pneumat c f u d c and e ectr ca contro systems for manufactur ng Lecture ab Prerequ s tes ETC 201 o PHY 112 MAT 260

313 Applied Engineering Mechanics: Materials. (3 F S, SS
Stress stra n re at ons between stress and stra n shear moments def ect ons and comb ned stresses. Lecture ab. Prerequ s te ETC 211

321 Engineering Evaluation of Welding Processes. 3) N
Theory and app cat on of the arc we d ng processes and oxy f e cutt ng f xturing procedures safety codes and experimenta techn ques are covered Lecture ab Pre requ s tes MET 302; PHY 112

322 Engineering Evaluation of Nontraditional Welding Processes. 3 N
Theory and app cat ons of EBW LBW so d state bond ng, braz ng and so dering Lecture ab Prerequ s tes: MET 302 PHY 112

325 Electrical Power Source Analysis. 4 N
Des gn and operat ng character st cs of e ectr ca power sources and re ated equ pment Equ pment select on, setup and troub eshoot ng procedures covered Lecture, ab Prerequ s tes. ETC 201 MET 302 PHY 112 114.

331 Design for Manufacturing I. 3 S
Introduct on to des gn of mach nes and structures, w th emphas s on ayout des gn draw ng Bas cs of gears, cams fasteners spr ngs bearing nkages cy ndr ca f ts flat pattern deve opment and surface f n sh requ rements emphas zed. Prerequ s te MET 313

341 Manufacturing Analysis. 3 S
Introduct on to the organ zat ona and funct ona requ re ments for effect ve product on Inc udes wr t ng prod ct on operat on p ans. Prerequ s te MET 231

343 Mater al Processes. 4 S
ndustr a process ng as app ed to ow med um and h gh vo ume manufactur ng Bas c and secondary process ng fasten ng and jo n ng coat ng and qua ty contro Lec ture ab

344 Casting and Forming Processes. 3 S
Ana ys s of var ous form ng processes to determ ne oad requ rements necessary for a part cu ar meta form ng op erat on Th s nformat on s used to se ect equ pment and des gn too ng Meta casting processes and design of cast ngs ntroduct on to powder metal urgy Prerequ s tes: MET 300 and 313 *or* nstructor approva .

345 Advanced Manufacturing Processes. 4 S
Meta remova processes emphas z ng m ng, gr nd ng turret and tracer athe and cutter sharpen ng App cat on of mach nab ty theory to pract ce Product on feeds speeds and too wear measurement Lecture ab Pre requ s tes MET 231 and 300 *or* nstructor approva .

346 Numerical Control Point to Po nt and Continuous Path Programming. 3 N
Methods of programm ng, set up and operat on of numeri ca contro mach nes, emphas z ng athe and m systems Lecture ab Prerequ s te MET 231.

354 Mechanics of Materials. 4 F
Vectors force systems fric on equ br um, centro ds, and moment of ner a Concepts of stress stra n, and stress ana ys s as app ed to beams co umns and comb ned oad ng Nonmajors on y Prerequ s tes MAT 118 PHY 111

401 Statistical Process Control. 3 S
ntroduct on to stat st ca qua ty contro methods as ap p ed to to erances, process contro , samp ng and re ab - ty. Prerequ s te. MAT 118.

407 Aerospace Materials. 2 N
Mater als used for a rcraft powerp ants and a rframes· em phas s on cr ter a for se ect on n terms of mechan ca propert es and manufactur ng processes Prerequ s te: MET 230 or equ va ent

416 Applied Computer Integrated Manufacturing. 3 F S
Techn ques and pract ces of Computer ntegrated Manu facturng w th an emphas s on Computer A ded Des gn and Computer A ded Manufactur ng Prerequ s te MET 346 or nstructor approva *[Satisf es Genera Stud es Re qu rement N3]*

420 Welding Metallurgy. 4 N
Metal urg cal pr nc p es app ed to structura and a oy stee and a um num we dments; aboratory emphas s on we d ng exper ments meta ography and mechan ca test ng. Lecture ab Prerequ s tes CHM 114 MET 300 302

421 Welding Metallurgy. (3 N
Metal urg cal pr nc p es as app ied to sta n ess stee , super a oy, t tan um and other refractory meta we dments and braze jo nts Prerequ's tes CHM 114; MET 300

425 Welding Codes. 2) N
Fam ar zat on w th and app cat on of the var ous codes standards and spec f cat ons app cab e to we dments. Prerequ s te MET 302 or equ va ent

432 Applied Thermodynamics and Heat Transfer. 3 F S
Thermodynam cs of m xtures Combust on process Ap p ication s of thermodynam cs to power and refr gerat on cyc es Heat transfer, nc ud ng steady state conduct on convect on, and rad at on Prerequ s te ETC 340

433 Thermal Power Systems. 4 N
Analysis of gas power, vapor power and refr geration cyc es Components of a r cond t on ng systems Direct energy convers on Psychrometry Ana ys s of nterna combust on eng nes and f u d mach nes Lecture, ab Prerequ s te. MET 432 or instructor approva

434 Applied Fluid Mechanics. 3) N
F u'd statics Bas c f u d f ow equat ons V scous flow n p pes and channe s Compress b e f ow App cat ons to f u d measurement and f ow n condu ts Prerequ s te ETC 340

436 Turbomachinery Design. 3 N
The app cat on of thermodynam cs and f u d mechan cs to the ana ys s of mach nery des gn and power cyc e per formance pred ct ons Prerequ s te MET 432 or nstruc tor approva

438 Design for Manufacturing II. 4 N
The app cat on of mechan cs n the des gn of mach ne e ements and structures The use of exper menta stress analys s n des gn eva uat on. Lecture ab. Prerequ s tes: AET 312 and MET 231 and 331 *or* nstructor approva .

442 Specialized Production Processes. 3 S
Nontradit ona manufactur ng processes, emphas z ng EDM, ECM ECG CM, PM HERF EBW LBW etc Pre requ s te MET 230

443 N C Computer Programming. 3 F
Theory and app cat on of computer a ded N C anguages with programm ng emphas s w th APT and su tab e post processors Lecture lab Prerequ s te MET 346 or n structor approva

444 Production Tooling. 3) F
Fabr cat on and des gn of j gs, f xtures and spec al ndus tr a too ng re ated to manufactur ng methods Lecture, ab. Prerequ s te. MET 345

448 Expert Systems in Manufacturing. 3) S
Introduct on to expert systems through conceptua ana y s s, with an emphas s on manufactur ng app cat ons Pre requ s te MET 231

451 Introduction to Robotics. 3 F
Introduct on to ndustr a robots Top cs nc uded are robot geometry robot workspace, trajectory generat on, robot actuators and sensors des gn of end effectors, and eco nom c just f cat on Prerequ s te MET 303 or nstructor approva

452 Implementation of Robots in Manufacturing. 3 S
Robot c workce des gn nc ud ng end effectors parts presentors, and opt mum mater a f ow Prerequ s te MET 451 or instructor approva

453 Robotic Applications. 3 S
Lab course ut z ng robots and other automated manufac- tur ng equ pment to produce a part Students are requ red to program robots, as we as nterface the robots w th other equ pment Prerequ s te MET 303 or 325 or nstruc tor approva .

460 Manufacturing Capstone Project. 3 S
Sma group project app y ng manufactur ng techn ques w th an emphas s on demonstrat ng state of the art tech no ogy. Prerequ s te: MET 416. *[Sat sf es Genera Studies Requ rement. L2]*

461 Mechanical Capstone Project. 3 S
ntegrat on of mater a s mechan cs and power nto ana y s s of eng neer ng des gn of system components Pre requ s tes MET 432, 438

462 Capstone Project/Weldment Design. 3 S
Des gn of we ded structures and mach ne e ements n terms of a owab e stresses jo nt conf gurat ons process capab ties, and cost ana ys s we d ng procedures em phas zed Prerequ s tes MET 302 313

517 Applied Computer Integrated Manufacturing. 3) F, S
Techn ques and pract ces of Computer ntegrated Manu facturing, w th an emphas s on Computer Aided Des gn and Computer A ded Manufactur ng Prerequ s te MET 346 or instructor approva

542 N/C Computer Programming. 3 S
Theory and app cat on of computer a ded N C anguages with programm ng emphas s w th APT and su tab e post processors App cat on case stud es are nc uded Lec ture ab Prerequ s te: MET 346 or nstructor approva

552 Introduction to Robotics 3 F
ntroduct on to ndustr a robots Top cs nc uded are robot workspace, trajectory generat on, robot actuators and sen sors des gn of end effectors and econom c just f cat on App cat on case stud es. Prerequ s te MET 303 or n structor approva .

Omnibus Courses: See pages 50 51 for omn bus courses that may be offered.

School of Engineering

George C. Beakley Jr., Ph.D., Director

Purpose

A large percentage of all engineering degree holders are found in leadership positions in a wide variety of industrial settings. Although an education in engineering is generally considered to be one of the best of technical educations, it also provides an opportunity for the development of many additional activities, aptitudes and interests, including moral, ethical, and professional concepts. In this era of rapid technological change, an engineering education serves our society well as a truly liberal education. Society's needs in the decades ahead call for engineering contributions on a scale not previously experienced. The well-being of our civilization as we know it may well depend upon how effectively this resource is developed.

Students studying engineering at ASU are expected to acquire a thorough understanding of the fundamentals of mathematics and the sciences and their applications to the various engineering fields. The program is designed to develop a balance between science and engineering and an understanding of the economic and social consequences of engineering activity. The goals include the promotion of the general welfare of the engineering profession.

The courses offered are designed to meet the needs of the following students:

1. those who wish to obtain a degree in engineering and who plan careers in which science, mathematics, and analytical methods are of special value;
2. those who wish to do graduate work in engineering;
3. those who wish to have one or two years of training in mathematics, applied science and engineering in preparation for a technical career;
4. those who desire pre-engineering for the purpose of deciding which program to undertake or those who desire to transfer to another college or university; and
5. those who wish to take certain electives in engineering while pursuing another program in the university.

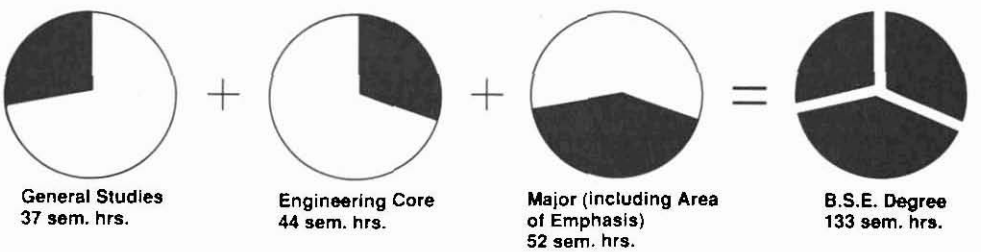
Admission

See pages 34–41, 55–57, 284–285, and 290–291 for information regarding requirements for admission, transfer, retention, disqualification, and reinstatement.

In addition, college students who are beginning their initial college work in the School of Engineering should present certain secondary school units in addition to the minimum university requirements. A total of three units is required in mathematics. College algebra, geometry, and trigonometry must be included. The laboratory sciences chosen must include at least one unit in physics and one unit in chemistry. Calculus and biology are recommended.

Students who have omissions or deficiencies in subject matter preparation may be required to complete additional university credit course work that may not be applied toward an engineering degree. One or more of the courses—CHM 113 General Chemistry, ENG 101 First-Year Composition*, MAT 118 Precalculus Algebra and Trigonometry, PHY 111 and 113 College Physics (or PHY 105)—are taken to satisfy omissions or deficiencies.

* See statement on English examinations under "Placement Examinations for Proficiency," page 47.



Degrees and Majors

The Bachelor of Science (B.S. and Bachelor of Science in Engineering (B S.E degrees are composed of three parts: University General Studies, an engineering core, and a major. This combination is illustrated in the charts shown on pages 326 and 327.

The General Studies satisfy a university requirement and include literacy and critical inquiry, humanities and fine arts, social and behavioral sciences, numeracy and natural sciences see pages 58–61). In addition, there are requirements in the areas of historical awareness and global awareness. These courses constitute approximately 28% of the degree program.

The engineering core is a specific and organized body of knowledge that serves as a foundation to engineering and for further specialized studies in a particular engineering major. These courses constitute approximately 33% of the degree program.

The courses included in the engineering core are taught in such a manner that they serve as basic background material: 1 for all engineering students who will be taking subsequent work in the same and related subject areas and (2 for those students who may not desire to pursue additional studies in a particular subject area. Thus, subjects within the engineering core are taught with an integrity and quality appropriately relevant to the particular discipline but always with an attitude and concern for both engineering in general and for the particular major(s).

The majors available are of two types 1 those associated with a particular department within the School of Engineering for example, Electrical Engineering and Civil Engineering and (2) those offered as special and interdisciplinary studies (for example, nuclear engineering sciences and pre medical engineering). In general, all curricula are extensions beyond the engineering core and cover a wide variety of subject areas within each field. About one fourth of the major credits are reserved for the student's use as an area of emphasis. These credits are traditionally referred to as *technical electives*

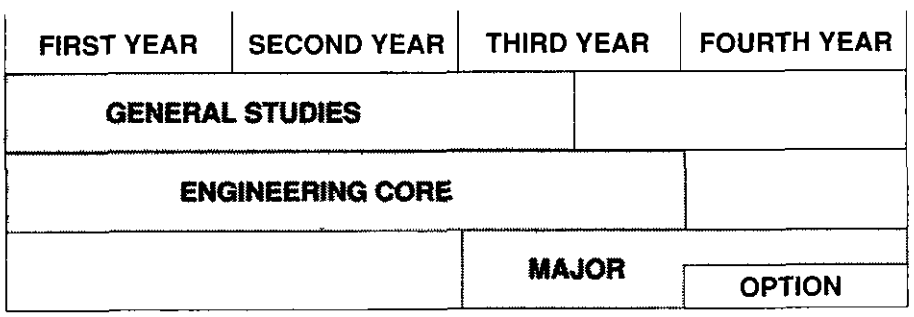
Majors and areas of emphasis are offered by the six engineering departments. Chemical, Bio and Materials Engineering; Civil Engineering; Computer Science and Engineering; Electrical Engineering; Industrial and Management Systems Engineering; and Mechanical and Aerospace Engineering. The majors of the Engineering Special Programs and Engineering Interdisciplinary Programs are administered by the Office of the Dean and are designed for those students whose educational objectives require more intensity of concentration or flexibility than is possible in the traditional departmental fields (see pages 375 383).

The first two years of study are concerned primarily with the General Studies and the engineering core, with more time being spent on General Studies. The final two years of study are concerned with the engineering core and the major, with a considerable part of the time being spent on the major. This arrangement can be illustrated by the chart below.

The sequential arrangement of all course work for the B.S. and B.S.E. degrees into the three categories shown below is especially helpful to the beginning student. The semester by semester selection of courses varies from one field to another An example of a typical freshman engineering schedule is shown below.

Typical Freshman Year

First Semester			*Semester Hour*
CHM	114	General Chemistry for Engineers .. ...4 or CHM 116 General Chemistry 4)	
ECE	105	Introduction to Languages of Engineering[2].	3
MAT	290	Calculus I[3]	5



General Studies Electives		HU or SB [4]. or ENG 101 First Year Composition (3	6
		Total	18

Second Semester

ECE	106	Introduction to Computer Aided Engineering	3
ENG	102	First Year Composition or ENG 105 Advanced First Year Composition (3 [5]	3
MAT	291	Calculus II [3]	5
PHY	121	University Physics I: Mechanics [6]	3
PHY	122	University Physics Laboratory I	1
General Studies Elective (HU or SB [4]			3
		Total	18

[1] Chemical Engineering, Bioengineering, Materials Science and Engineering, and Pre Medical engineering students take CHM 113 and 116.

[2] Students with no computer background should enroll in CSE 181 Applied Problem Solving with BASIC before enrolling in ECE 105

[3] MAT 270, 271, and 272 may be taken in lieu of MAT 290 and 291 only 10 hours may be used to satisfy graduation requirements

[4] See pages 58 88

[5] Students not eligible for ENG 105 should complete ENG 101 in the preceding semester

[6] Students who have not completed one unit of physics in high school should complete PHY 111 and 113 (or 105) in the preceding semester

Well prepared students usually can complete the program of study leading to an undergraduate degree in engineering in four years or less by attending summer sessions. Many students, however, may find it advantageous or necessary to devote more than four years to the undergraduate program by pursuing, in any semester, fewer studies than are regularly prescribed. Where omissions or deficiencies exist, e.g., in chemistry, English, mathematics, and physics, the student must complete more than the minimum of 133 semester hours. Therefore, in cases of inadequate secondary preparation, poor health, or financial necessity requiring much time for outside work, the undergraduate program should be extended to five or more years.

Degree Requirements

The degree programs in engineering at ASU are intended to develop habits of quantitative thought having equal utility for both the practice of engineering and other professional fields. It is the intent of the faculty that all students be prepared in the following areas:

1. *Competency in oral and written English.* This is considered to be essential for the engineering graduate. Although the requirement of specific course work may serve as a foundation for such competency, the development of communication skills should be demonstrated by student work in engineering courses. As a minimum and in addition to the 133 semester hour course requirements, all students must satisfy the university English proficiency requirements (see page 89)
2. *General Studies.* This is to ensure that the engineering student acquires a satisfactory level of basic knowledge in the humanities and fine arts, social and behavioral sciences, literacy and critical inquiry, numeracy and natural sciences. These subjects are so selected as to give the engineer an increased awareness of social responsibilities, to provide an understanding of related factors in the decision making process, and to provide a foundation for the study of engineering.

   School of Engineering students must use caution in selecting their lower division literacy and critical inquiry course (L1) because of accreditation requirements. The course selected must be one that is evaluated by the University General Studies Council as 'L1' and 'HU' or 'L1' and "SB'. Otherwise, the student must complete a total of 16 semester hours of humanities and social and behavioral sciences to satisfy the baccalaureate degree requirements in engineering.

   Because of accreditation requirements, aerospace studies (AES) courses are not acceptable for engineering degree credit as a social and behavioral science
3. *Fundamental studies.* Studies in engineering and related subjects further develop the foundation for engineering and provide the base for specialized studies in a particular engineering discipline.
4. *Major studies.* These courses provide a depth of understanding for a more definitive body of knowledge appropriate to a particular aspect of societal concern. These studies include technical elective course work in an area of emphasis that may be selected by the student with the assistance of an advisor.

Also refer to the individual engineering department material for any additional specific departmental requirements.

The specific course requirements for the three parts of the B.S. and B.S.E. degrees are listed below.

B.S. and B.S.E. Degree Requirements

English Proficiency			Semester Hours
ENG	101 102	First Year Composition	6
		or ENG 105 Advanced First Year Composition	3)

General Studies

Literary and Critical Inquiry
(6 semester hours minimum)

ECE	400	Engineering Communications[2]	3

One course to be chosen from the university approved list that is designated as L1 and HU or L1 and SB (see pages 62 88 for General Studies list 3

Numeracy
(6 semester hours minimum

ECE	106	Introduction to Computer Aided Engineering[2]	3
MAT	290	Calculus I[2]	5
		or MAT 270 Calculus with Analytic Geometry I 4)	

Humanities and Fine Arts
Social and Behavioral Sciences[1]
(15 semester hours minimum)

ECN	111	Macroeconomic Principles[2]	3
		or ECN 112 Microeconomic Principles 3	

At least one course must be of upper division level two courses must be from the same department, and two or more departments must be represented in total selection. If L1 course is not also an HU or SB course 16 hours are required

Humanities and Fine Arts ..... 9 to 6
Social and Behavioral Sciences ..... 3 to 6

Natural Sciences
(8 semester hours minimum

PHY	121	University Physics I Mechanics[2]	3
PHY	122	University Physics Laboratory I[2]	1
PHY	131	University Physics II Electricity and Magnetism	3
PHY	132	University Physics Laboratory II[2]	1

Total General Studies 37

NOTE One course in the area of global awareness[1] and one course in historical awareness *must* appear in the final list of courses in the student's graduation program of study These courses can be included in the humanities and fine arts social and behavioral sciences course selections

[1] Refer to pages 58–88 for the specific requirements and the approved list

[2] Required for graduation.

[3] Aerospace studies (AES courses are not acceptable for engineering degree credit

Engineering Core			Semester Hours
CHM	114	General Chemistry for Engineers	4
		or CHM 116 General Chemistry (4	
ECE	105	Introduction to Languages of Engineering	3
ECE	210	Engineering Mechanics I Statics	3
		or PHY 321 Newtonian Mechanics 3)[1]	
ECE	301	Electrical Networks I	4
MAT	274	Elementary Differential Equations	3
MAT	291	Calculus II	5
		or MAT 271 4 and MAT 272 4)	
Approved Mathematics Content Electives			4
Basic Science Elective			3
Minimum five of the following six courses are required[2]			15
ECE	312	Engineering Mechanics II Dynamics 3	
		or PHY 322 Analytical Mechanics (3)[1]	
ECE	313	Introduction to Deformable Solids (3	
ECE	333	Electrical Instrumentation 3	
		or ECE 334 Electronic Devices and Instrumentation 4)	
ECE	340	Thermodynamics (3	
		or CHM 441 General Physical Chemistry 3	
ECE	350	Structure and Properties of Materials (3)	
		or CHM 442 General Physical Chemistry (3) or ECE 351 Engineering Materials 3 or ECE 352 Properties of Electronic Materials 3)	
Microcomputer/Microprocessor Elective (3			
Select one:			
CEE	400	Microcomputer Applications in Civil Engineering 3)	
CHE	461	Process Control (3	
CSE/EEE	225	Assembly Language Programming Motorola (3	
CSE/EEE	226	Assembly Language Programming (Intel 3)	
IEE	463	Computer Aided Manufacturing and Control 3	
MAE	305	Measurements and Micro computers (4)	
Total Required Minimum Engineering Core			44

Subject to department approval If PHY 321 is selected, PHY 322 must also be completed

[2] Courses to be selected are subject to department approval See department requirements.

A summary of the degree requirements is as follows:

	Semester Hours
General Studies	37
Engineering Core	44
Major (including area of emphasis)	52
The requirements for each of the majors offered are described on the following pages	
Total Degree Requirements	133
Plus university English proficiency requirements	

Graduation Requirements

In order to qualify for graduation from the School of Engineering, a student must have a minimum cumulative GPA of 2.00 in addition to having a GPA of at least 2.00 for the 52 semester hours of required courses in the major field.

Professional Accreditation

The undergraduate program majors Aerospace Engineering, Bioengineering, Chemical Engineering, Civil Engineering, Computer Systems Engineering, Electrical Engineering, Industrial Engineering, Mechanical Engineering, Engineering Special Programs and Engineering Interdisciplinary Programs are accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET).

ANALYSIS AND SYSTEMS

ASE 100 College Adjustment and Survival. 2 F S
Exploration of career goals and majors. Emphasis on organization and development of study skills, including time management, stress management, and use of the library.

399 Cooperative Work Experience. (1) F S SS
Usually involves two 6 month work periods with industrial firms or government agencies alternated with full time semester and summer sessions. Students. Not open to students from other colleges on campus. Prerequisites: at least 45 hours completed in major area with minimum 2.50 GPA, instructor approval.

485 Engineering Statistics. 3 F, S, SS
Statistical methods applied to engineering problems. Estimation, tests of hypotheses, regression, correlation, analysis of variance and nonparametric statistics. Prerequisite: ECE 383. *[Satisfies General Studies Requirement. N2]*

490 Project in Design and Development. (2–3 F S SS
Individual project in creative design and synthesis. Prerequisite: senior standing.

496 Professional Seminar. 0 F S
Topics of interest to students in the engineering specialties and interdisciplinary studies.

500 Research Methods: Engineering Statistics. 3 F S SS
Statistical methods applied to engineering problems. Estimation, tests of hypotheses, regression, correlation, and analysis of variance and nonparametric statistics. Open only to students without previous credit in ASE 485. Prerequisite: ECE 383 or 500.

582 Linear Algebra in Engineering. 3) F
Development and solution of systems of linear algebraic equations. Applications from mechanical, structural and electrical fields of engineering. Prerequisite: MAT 242 or equivalent.

586 Partial Differential Equations in Engineering. 3) S
Development and solution of partial differential equations in engineering. Applications in solid mechanics vibrations and heat transfer. Prerequisites: ECE 386, MAT 242, 274.

Omnibus Courses: See pages 50–51 for omnibus courses that may be offered.

ENGINEERING CORE

ECE 105 Introduction to Languages of Engineering. 3 F S SS
Computer programming using C, freehand drawing, visualization and computer graphics. Lecture, recitation, lab. Prerequisites: CSE 181 or BASIC programming experience, algebra.

106 Introduction to Computer-Aided Engineering. (3) F, S
Computer aided analysis and design, computer graphics, modeling, optimization and graphic documentation. Lecture, recitation, lab. Prerequisites: ECE 105 and 1 year high school physics *or* corequisite of PHY 105 or 112 or 131. *[Satisfies General Studies Requirement. N3]*

107 Freehand Drawing and Visualization. 1 F, S SS
Representational drawing from direct observation to assist visualization, spatial awareness and perception. Techniques include contour, gesture and value drawing. Media include pencil and computer graphics. 3 hours lab.

210 Engineering Mechanics I: Statics. 3 F, S, SS
Force systems, resultants, equilibrium, distributed forces, area moments, fluid statics, internal stresses, friction, energy criterion for equilibrium and stability. Lecture, recitation. Prerequisites: ECE 106, MAT 271 or 291, PHY 121, 122.

301 Electrical Networks I. 4 F, S, SS
Introduction to electrical networks. Component models, transient, and steady state analysis. Lecture, recitation, lab. Prerequisites: ECE 106, PHY 131, 132, Corequisite: MAT 274.

312 Engineering Mechanics II: Dynamics. 3 F, S, SS
Kinematics and kinetics of particles, translating and rotating coordinate systems, rigid body kinematics, dynamics of systems of particles and rigid bodies, and energy and momentum principles. Lecture, recitation. Prerequisites: ECE 210, MAT 274.

313 Introduction to Deformable Solids. 3 F S SS
Equilibrium, strain, displacement, relations, and stress-strain temperature relations. Applications to force transmission and deformations in axial, torsional and bending of bars. Combined loadings. Lecture, recitation. Prerequisites: ECE 210, MAT 274.

333 Electrical Instrumentation. 3 F, S, SS
Survey of electronics as applied to instrumentation measurements. Diodes, transistors/basic transistor amplifiers, op amps, digital logic gates as applied to electrical and electronic instruments. Electrical sensors, transducers. Lecture, lab. Prerequisite: ECE 301.

334 Electronic Devices and Instrumentation. 4) F S, SS
App cat on of e ectr c network theory to sem conductor d screte and ntegrated circu ts E ectron c device and c r cu't appl cat ons aboratory c rcu t des gn, test ng and ver f cat on Lecture rec tat on ab Prerequ s te ECE 301

340 Thermodynamics 3 F, S SS
Work heat, and energy transformat ons and re at onsh ps between propert es, aws concepts, and modes of ana y s s common to a app cat ons of thermodynam cs n eng neenng Lecture, rec tat on Prerequ s tes CHM 114 or 116 ECE 210 PHY 131. Corequ s'te MAT 274

350 Structure and Properties of Materials. 3) F, S, SS
Bas c concepts of mater a structure and its re ation to propert es App cation to eng neer ng prob ems Prerequ s tes: CHM 114 or 116 PHY 121

351 Engineering Materials. 3 F, S
Structure and behav or of c v eng neer ng materials. Laboratory nvestigat ons and test cr'ter a. Lecture ab Prerequ s te. ECE 313

352 Properties of Electronic Materials. 3 F, S, SS
ntroduct on of Schrod nger wave equat on treatment of potent a barr er prob ems n wave mechan cs, hydrogen atom and the per od c tab e bonds of crysta s free e ectron mode the band theory of so ds, sem conductors n troduct on of sem conductor dev ces, superconductor die ectr c, and magnet c properties of e ectron c mater a s Prerequ s tes ECE 333 or 334 MAT 274

383 Probability and Statistics for Engineers. 2 F, S SS
Probab i ty, random var ab es, d screte and cont nuous d stribut ons descr pt ve stat st cs and samp ng d str bu t ons Prerequ s te MAT 272 or MAT 291 *[Sat sf es General Studies Requ rement N2]*

384 Numerical Analysis for Engineers I. 2) F S
Numer ca solut on of a gebra c and transcendenta equa t ons and systems of near equat ons Numer ca ntegra t on. Curve f tt ng Error bounds and error propagat on Emphas s on use of d g ta computer Prerequ s tes: ECE 105 MAT 272 or 291.

385 Numerical Analysis for Engineers II. (2) S
Cont nuat on of ECE 384 Numer ca so ut on of part a d f ferent a equat ons and m xed equat on systems Intro duct on to exper menta des gn and opt m zation techn ques Prerequis te ECE 384

386 Partial Differential Equations for Engineers. 2 F, S
Boundary va ue prob ems separat on of var ab es, and Four er ser es as app ed to n t a boundary va ue prob ems Prerequ s te MAT 274

400 Engineering Communications. 3 F, S, SS
P ann ng and preparing eng neer ng pub cat ons and ora presentat ons based on d rected brary research re ated to current eng neer ng top cs Prerequ s te. sen or stand ng n an eng neer ng f e d and complet on of f rst year Eng sh requ rements p us sophomore cr t ca wr t ng course *[Sat isfies General Stud es Requ rement L2]*

500 Research Methods: Probability and Statistics for Engineers. (2 F S SS
Probabi ity, random var ab es, d screte and continuous distr but ons, descr pt ve stat st cs, and samp ng d str bu t ons. Open on y to students w thout prev ous cred t for ECE 383. Prerequ s te MAT 272 or 291.

Omnibus Courses: See pages 50 51 for omn bus courses that may be offered

SOCIETY, VALUES, AND TECHNOLOGY

STE 202 Global Awareness within Engineering Design. 3 F
Strateg es for ntegrat ng ong term env ronmenta eco nom c and eth ca cons derat ons nto eng neer ng des gn. Biomed ca env ronmenta b otechno og ca , and mater a s eng neering case stud es Lecture crit ca d scourse. Cross sted as BME 202 Prerequ s tes: ECE 106 ECN 111 or 112, ENG 102 *[Sat sf es General Stud es Re qu rement L1]*

Omnibus Courses: See pages 50 51 for omnibus courses that may be offered

Chemical, Bio and Materials Engineering

Joseph D. Henry, Ph.D., Chair
(ECG 202)

Historically, materials have had a tremendous impact on the advancement of civilization, as reflected in the words "stone," "bronze," "iron," and "paper" attached to the various ages in the development of society. Until recently an arbi trary distinction was made between chemically reactive materials and relatively inert solid phase materials. As our technological know-how advances, we recognize that the fundamental principles, the molecular level mechanisms, and the processing techniques are very similar regardless of the state, phase, or shape of the materials. Understanding of these principles and their application to real systems is the key to future progress as specially designed materials are sought for the solution of complex technological problems. Therefore, it is logical that the educational program of future scientists and engineers dealing with the engineered materials be comprehensive, covering all aspects of the materials world.

Similarly, the human body and other living systems process materials by analogous steps as do the chemical industries These living systems are small, sophisticated integrated plants utilizing pumps, aerators, separators, and reactors involving fluid flow, thermodynamics, heat and mass transfer, and other familiar principles Therefore, it is appropriate that chemical, bio , and materials engineers work together in both education and research

Students aspiring to be engineers in either the chemical, bio , or materials engineering areas must prepare to solve a wide variety of problems utilizing chemistry, physics, mathematics, life sciences, and engineering sciences. As professionals

in industry, they apply these fundamentals to creatively develop, economically design, and productively operate systems, constituent equipment, and specialized analytical facilities

The department offers three B.S.E degrees, in Chemical Engineering, in Bioengineering, and in Materials Science and Engineering. A B S.E. degree program in pre medical engineering is also available at ASU, it is described separately on pages 380–381.

Chemical Engineering—B.S.E.

PROFESSORS:
BERMAN, DORSON, GU LBEAU, HENRY
KUESTER SATER ZW EBEL
ASSOCIATE PROFESSORS:
BECKMAN BELLAMY, CALE, RAUPP,
R VERA, TORREST
ASSISTANT PROFESSORS:
BURROWS, GARC A
PROFESSOR EMERITUS:
RE SER

Chemical engineers are generally concerned with chemical change. They design and operate processes that accommodate such changes, including the chemical activation of materials. Typically this involves complex multicomponent systems wherein the interactions between species have to be considered and analyzed. The new challenge in chemical engineering is to apply the principles of mass transfer, solution thermodynamics, reaction kinetics, and separation techniques to technological endeavors such as integrated circuit design, solid state surface treatments, and materials processing.

Consequently, in addition to the chemical and petroleum industries, chemical engineers find challenging opportunities in the plastics, solid state, electronics, computer, metals, space, food, drug, and health care industries, where they practice in a wide variety of occupations, such as environmental control, surface treatments, energy and materials transformations, biomedical applications, fermentation, protein recovery, extractive metallurgy, and separations. While a large percentage of the industrial positions are filled by graduates with bachelor's degrees, there are lucrative and creative opportunities in research and development for those who acquire postgraduate education.

Subspecializations have developed within the profession. However, the same broad body of knowledge is generally expected of all chemical engineers for maximum flexibility in industrial positions. The preparation for chemical engineering is accomplished by a blend of classroom instruction and laboratory experience.

Degree Requirements

The course work for the undergraduate degree can be classified into the following categories (in semester hours):

General Studies 39
Sixteen hours of HU and SB type courses must be included see page 328, General Studies, for special requirements since CHE 351 and 352 must be taken to satisfy literacy and critical inquiry elective

Engineering ore 44
CHE 461; CHM 116, 331, 441, 442; ECE 105, 210, 301, 313, 333, 384, 385, MAT 274, 291 or 271 and 272)

Maj r 50
CHE 311, 312, 331, 332, 333, 342, 432, 442, 451, 462, CHM 113, 332 335, 343, 12 hours technical electives

The technical electives must be selected from among CHE upper division or graduate-level courses or technical courses in other departments with advisor's approval. One elective course must have chemical content and be selected from CHE 458, CHM 361, or any three semester hour 400 level CHM course.

To fulfill accreditation requirements and to prepare adequately for the advanced chemistry courses, Chemical Engineering majors are required to take the CHM 113 and 116 introductory chemistry sequence (CHM 117 and 118 are acceptable substitutes . Other freshman chemistry courses are *not acceptable* and transfer students who have taken another chemistry course may be required to enroll in CHM 113 and 116.

The Department of Chemical, Bio and Materials Engineering also offers graduate programs leading to the M S.E., M.S , and Ph D. degrees. These programs provide a blend of classroom instruction and research. A wide variety of topical and relevant research projects are available for thesis topics. Students interested in these programs should contact the department for up to-date descriptive literature.

Chemical Engineering Areas of Emphasis

Students who wish to specialize may develop an area of interest through the use of technical electives and selective substitutions for required

courses. Substitutions must be approved by the advisor and the Department Standards Committee and must be consistent with ABET accreditation criteria. No substitution of CHE 462 is allowed. The following are possible elective areas of emphasis with suggested courses A student may choose electives within the general department guidelines and does not have to select one of the areas listed.

Biomedical Students who are interested in biomedical engineering but wish to maintain a strong, broad chemical engineering base should select from:

Chemical content elective: CHM 361, 461.

Technical electives: BME 318, 414, 416, 435, CHE 411, 412, 413.

Pre medical Students planning to attend medical school should select courses from those listed under the biomedical emphasis. In addition, BIO 181 and 182 must be taken to satisfy medical school requirements but are not counted toward the Chemical Engineering bachelor's degree.

Biochemical. Students wishing to prepare for a career in biotechnology, pharmaceuticals, fermentation, food processing, and other areas within biochemical engineering should select from:

Chemical content elective: CHM 361, 461.

Technical electives: AGB 425, 426; CHE 475, 476, 477.

Environmental Students interested in the management of hazardous wastes and air and water pollution should select from:

Chemical content elective: CEE 361; CHM 361, 461, 481

Technical electives: CEE 362, 561, 563, 564; CHE 494, 533, 552, 553; EEE 461.

Materials. Students interested in the development and production of new materials such as ceramics, polymers, semiconductors, composites, superconductors, and alloys should select from:

Chemical content elective: CHE 458; CHM 438, 453, 471.

Technical electives: BME 318, ECE 350, 352; MSE 431, 470, 471, 472.

Semiconductor processing Students who are interested in the deve opment and manufacturing of semiconductor and other electronic devices should select from:

Chemical-content elective: CHE 458.

Technical electives: ECE 352, EEE 435, 436, MSE 472.

Process engineering The engineering core and required chemical engineering courses serve as a suitable background for students intending to enter the traditional petrochemical and chemical process industries. Students can build on this background by selecting courses with the approval of their advisor. Examples:

Energy conversion and conservation. CHE 552, 553, 554, 556; MAE 436, 437, 438.

Plant administration and management: CHE 528, 553, IEE 300, 431.

Simulation, control, and design: CHE 527, 528, 556, 562, 563.

Chemical Engineering
Program of Study
Typical Four-Year Sequence
First Year

First Semester			Semester Hours
CHE	496	Professional Seminar	0
CHM	113	General Chemistry	4
ECE	105	Introduction to Languages of Engineering	3
ENG	101	First-Year Composition	3
MAT	290	Calculus I	5
General Studies Elective HU or SB)*			3
		Total	18

Second Semester			
CHE	496	Professional Seminar	0
CHM	116	General Chemistry	4
ECE	106	Introduction to Computer Aided Engineering	3
MAT	291	Calculus II	5
PHY	121	University Physics I· Mechanics	3
PHY	122	University Physics Laboratory I	1
		Total	16

Second Year

First Semester			
CHE	311	Material Balances	3
CHE	496	Professional Seminar	0
CHM	331	General Organic Chemistry	3
CHM	335	General Organic Chemistry Laboratory	1
ENG	102	First Year Composition	3
MAT	274	Elementary Differential Equations	3
PHY	131	University Physics II Electricity and Magnetism	3
PHY	132	University Physics Laboratory II	1
		Total	17

Second Semester

CHE	312	Introduction to Thermodynamics	3
CHE	331	Transport Phenomena I: Fluids	3
CHE	496	Professional Seminar	0
CHM	332	General Organic Chemistry	3
ECE	210	Engineering Mechanics I. Statics	3
ECE	384	Numerical Analysis for Engineers I	2
General Studies Elective (HU or SB *			3
Total			17

Third Year

First Semester

CHE	332	Transport Phenomena II: Energy Transfer	3
CHE	342	Applied Chemical Thermodynamics	3
CHM	343	Physical Chemistry Laboratory	1
CHE	351	Measurements Laboratory	2
CHE	496	Professional Seminar	0
CHM	441	General Physical Chemistry	3
ECE	385	Numerical Analysis for Engineers II	2
General Studies Elective HU or SB *			4
Total			18

Second Semester

CHE	333	Transfer Phenomena III: Mass Transfer	3
CHE	352	Transport Laboratories	2
CHE	496	Professional Seminar	0
CHM	442	General Physical Chemistry	3
ECE	301	Electrical Networks I	4
ECE	313	Introduction to Deformable Solids	3
General Studies Elective (HU or SB)*			3
Total			18

Fourth Year

First Semester

CHE	432	Principles of Chemical Engineering Design	3
CHE	442	Chemical Reactor Design	3
CHE	451	Chemical Engineering Laboratory	2
CHE	461	Process Control	3
CHE	496	Professional Seminar	0
Technical Elective			6
Total			17

Second Semester

CHE	462	Process Design	3
CHE	496	Professional Seminar	0
ECE	333	Electrical Instrumentation	3
ECE	400	Engineering Communications	3
General Studies Elective HU or SB *			3
Technical Elective			6
Total			18

Degree Requirements 133 semester hours plus English proficiency

* See pages 58–88 for requirements and approved list

Bioengineering—B.S.E.

PROFESSORS:
CHEN, DORSON, GUILBEAU
ASSOCIATE PROFESSOR:
TOWE
ASSISTANT PROFESSORS:
PIZZ CONI, SWEENEY WINTERS, YAMAGUCHI

Bioengineering (synonyms: biomedical engineering, medical engineering) is the discipline of engineering that applies principles and methods from engineering, the physical sciences, the life sciences, and the medical sciences to understand, define, and solve problems in medicine, physiology, and biology. Bioengineering bridges the engineering, physical, life, and medical sciences. More specifically, the bioengineering program at ASU educates engineering students to use engineering principles and technology to develop instrumentation, materials, diagnostic and therapeutic devices, artificial organs, and other equipment needed in medicine and biology and to discover new fundamental principles regarding the functioning and structure of living systems. The multidisciplinary approach to solving problems in medicine and biology has evolved from exchanges of information between specialists in the concerned areas.

Because a depth of knowledge from at least two diverse disciplines is required in the practice of bioengineering, students desiring a career in bioengineering should plan for advanced study beyond the bachelor's degree. The bioengineering major at ASU is especially designed for students desiring advanced study in bioengineering in graduate programs, a career in the medical device industry, a career in biomedical research, a career in biotechnology research, or entry into a medical college.

Graduate degree programs in Bioengineering are now offered at ASU at both the master's and doctoral levels. For more information concerning these degree programs, consult the *Graduate Catalog*.

Academic Requirements

In addition to the General Studies requirements, CHM 116 Chemistry and BIO 181 General Biology (basic science elective) must be selected in the engineering core. Other engineering core requirements are outlined in the area of emphasis descriptions. The following courses are required in the undergraduate bioengineering major. They

have been selected to meet all university require ments and ABET accreditation requirements:

			Sem e ter H ur
AGB/BME	435	Animal Physiology I	4
BIO	182	Genera Biology	4
BME	318	Biomaterials	3
BME	331	Transport Phenomena I Fluids	3
BME	334	Heat and Mass Transfer	3
BME	411	Biomedical Engineering I	3
BME	412	Biomedical Engineering II or CHM 331 General Organ c Chemistry (3	3
BME	413	Physiological Instrumentation	3
BME	417	Biomedical Engineering Design	3
BME	423	Physiological Instrumentation Laboratory	1
BME	490	Biomedical Engineering Projects	1 5
BME	496	Professional Seminar	0
CHM	113	General Chemistry	4
Technical Electives			15
		Total	51

Bioengineering Areas of Emphasis

Students interested in a career in bioengineering may elect to emphasize either biochemical, bio electrical, biomechanical, bionuclear, biosystems, or pre-medical engineering. Although organic chemistry and biochemistry are not required in he bioelectrical, biomechanical, bionuclear, and biosystems engineering areas of emphasis, stu dents selecting these areas are encouraged to in clude organic and biochemistry in their advanced degree programs of study.

Biochemical engineering This emphasis is de signed to strengthen the student's knowledge of chemistry and transport phenomena and is par ticularly well suited for students interested in bio-technology. The following courses are required in the engineering core: CHE 461; ECE 333, 340, 350. Technical electives must include· CHM 331, 332, and 361 (or 461 or 462). ECE 312 is not required in the engineering core The remain ing technical electives must be upper division en gineering courses of suitable engineering science and design content.

Bioelectrical engineering. This emphasis is de signed to strengthen the student's knowledge of electrical systems, signal processing, and medical imaging. It emphasizes bioelectrical phenomena, medical instrumentation, noninvasive imaging, and electrophysiology The following courses are required in the engineering core: ECE 333, 340, 352, a microcomputer elective. ECE 312 is not required in the engineering core Technical elec tives must include BME 414, ECE 334, and EEE 302 and 303. Remaining technical electives are selected from BME 412, 419, and 520, and any 400 level EEE course with acceptable engineer ing science and design content

Biomechanical engineering. This emphasis is designed to strengthen the student's knowledge of mechanics, materials science, control theory and mechanical design. It emphasizes the design of orthopedic load bearing joint replacement de vices, orthotic devices, and other mechanical de-vices important in the practice of medicine. It also provides the fundamentals for the study of neuromuscular control and the study of human motion. The following courses are required in the engineering core ECE 333, 340, 350, 384; MAE 305 Technical electives may be selected from one of the following two groups·

Biomechanics: BME 416; MAE 404 (or MSE 440), 422, 441

Biocontrols BME 416, 419; MAE 317, 417 (or 447).

Bionuclear engineering. This emphasis is de signed to strengthen the student's knowledge of radiation interactions and shielding, health phys ics, radiation biology, and nuclear instrumenta tion. It emphasizes radiological imaging, medical physics, nuclear medicine, radiotherapy, and ra-diation protection. The following courses are re quired in the engineering core: ECE 334, 340, 352, a microcomputer elective. ECE 312 is not required in the engineering core. Technical elec tives include: BME/EEE 461, 465; PHY 361. Remaining technical electives are selected from BME 414 (or any 400-level BME, MAE [nuclear] or EEE courses with acceptable engineering sci-ence and design content) and EEE 464.

Biosystems engineering This emphasis is de signed to strengthen the background of students interested in physiological systems analysis and design of artificial organs and medical devices that are based on chemical reactions and include momentum, heat, or mass transfer phenomena. Ana yzing or designing flowing and reacting sys tems requires a background in transport phenom-ena, thermodynamics, and reaction engineering. Whether the system involves the microcirculation and physiological events or an artificial organ and extracorporeal circulation, there is a core of bio-engineering sciences and design common to both applications. The following courses are required in the engineering core. CHE 461, CHM 441, 442; ECE 313, 333. Technical electives must in clude. BME 419; CHE 311, 312, 342; ECE 312

Pre medical engineering This emphasis is designed to meet the needs of students desiring entry into a medical or dental school The course sequence provides an excellent background for advanced study leading to a career in research in the medical or life sciences. The following courses are required in the engineering core: ECE 333, 340, 350. ECE 312 is not required in the engineering core. Technical electives must include CHM 331, 332, 335, and 336 Remaining technical electives must consist of BME prefix courses plus biology or biochemistry courses, which must meet engineering science and design content requirements.

Bioengineering Program of Study

Typical Four-Year Sequence

First Year

			Semester Hours
First Semester			
BME	496	Professional Seminar	0
CHM	113	General Chemistry	4
ECE	105	Introduction to Languages of Engineering	3
ECN	111	Macroeconomic Principles	3
ENG	101	First Year Composition	3
MAT	290	Calculus I	5
		Total	18
Second Semester			
BME	496	Professional Seminar	0
CHM	116	General Chemistry	4
ECE	106	Introduction to Computer Aided Engineering	3
MAT	291	Calculus II	5
PHY	121	University Physics I Mechanics	3
PHY	122	University Physics Laboratory I	1
		Total	16

Second Year

First Semester			
BIO	181	General Biology	4
BME	496	Professional Seminar	0
ENG	102	First Year Composition	3
MAT	274	Elementary Differential Equations	3
PHY	131	University Physics II Electricity and Magnetism	3
PHY	132	University Physics Laboratory II	1
General Studies Elective HU or SB			3
		Total	17
Second Semester			
BIO	182	General Biology	4
BME	496	Professional Seminar	0
ECE	210	Engineering Mechanics I: Statics	3
ECE	301	Electrical Networks I	4
General Studies Elective HU or SB			3
Literacy and Critical Inquiry Elective			3
		Total	17

Third Year

First Semester			
BME	331	Transport Phenomena I: Fluids	3
BME	435	Animal Physiology I	4
BME	496	Professional Seminar	0
ECE	312	Engineering Mechanics II: Dynamics or Technical Elective	3
ECE	313	Introduction to Deformable Solids	3
ECE	340	Thermodynamics or CHM 441 General Physical Chemistry 3	3
ECE	384	Numerical Analysis for Engineers I or ECE 386 Part a Differential Equations for Engineers 2 or MAT 242 Elementary Linear Algebra 2	2
		Total	18
Second Semester			
BME	318	Biomaterials	3
BME	334	Heat and Mass Transfer	3
BME	496	Professional Seminar	0
ECE	333	Electrical Instrumentation or ECE 334 Electronic Devices and Instrumentation 4	3
ECE	350	Structure and Properties of Materials or CHM 442 General Physical Chemistry 3) or ECE 351 Engineering Materials 3) or ECE 352 Properties of Electronic Materials 3)	3
General Studies Elective (HU or SB			3
Technical Elective			3
		Total	18

Fourth Year

First Semester			
BME	411	Biomedical Engineering I	3
BME	413	Physiological Instrumentation	3
BME	423	Physiological Instrumentation Laboratory	1
BME	490	Biomedical Engineering Projects	1 5
BME	496	Professional Seminar	0
CHE	461	Process Control or IEE 463 Computer Aided Manufacturing and Control (3 or MAE 305 Measurements and Microcomputers 4	3
Technical Electives			6
		Total	18
Second Semester			
BME	412	Biomedical Engineering II or CHM 331 General Organic Chemistry (3	3
BME	417	Biomedical Engineering Design	3
BME	496	Professional Seminar	0
ECE	383	Probability and Statistics for Engineers	2
ECE	400	Engineering Communications	3

General Studies Elective (HU or SB)[1] 3
Technical Elective 3

Total 17

Graduation requirements 133 semester hours plus English proficiency

[1] See pages 58–88 for the requirements and the approved list of courses
[2] See page 328 for special requirements and selection of an LI elective

Materials Science and Engineering—B.S.E.

REGENTS' PROFESSOR:
WAGNER
PROFESSORS:
CARPENTER, JACOBSON, STANLEY
ASSOCIATE PROFESSORS:
HENDRICKSON, KRAUSE, SHIN
ASSISTANT PROFESSOR:
DEY

Materials science is the engineering and scientific discipline that is concerned with the study of fundamental relationships between the structure of materials and their properties. The program provides students with the knowledge necessary to make decisions concerning the optimum utilization of existing materials or to develop and process new materials.

Essentially all major industries and research laboratories are involved to some extent with the selection, utilization, and development of materials in designing and producing engineered systems. Students who major in Materials Science and Engineering find employment opportunities in a variety of industries and research facilities associated with aerospace, solid state electronics, energy conversion, transportation, manufacturing and chemical processing. The responsibilities of a materials scientist or materials engineer include research and development of materials to meet some new demand brought about by advancing technology or to select the best choice of existing materials for a specific application. Materials scientists also develop new techniques for processing materials to reduce costs of products or to create new products. Also, they are often responsible for analyzing data on field tested materials to determine the effects of the environment on materials performance.

The tools of a materials scientist include highly sophisticated analytical equipment. Since a considerable emphasis in materials science is placed on the microscopic world, instruments such as transmission and scanning electron microscopes, X ray diffractometers, and Auger spectrometers are a necessary part of the field.

Degree Requirements

The undergraduate curriculum requires that students take a series of interdisciplinary courses of fundamental importance to an understanding of all materials.

The courses for the undergraduate degree can be classified into the following categories (in semester hours).

General Studies 37
See pages 328–329 for School of Engineering requirements.

Engineering core 44
CHM 116, 441, ECE 105, 210 or PHY 321), 301, 313, 333 (or 312 or PHY 322), 350, 383 or 384 or 386), IEE 463 or MAE 305; MAT 242, 274, 291 or 271 and 272); PHY 361

Major 52
CHE 311; CHM 113, MAE 351, 441; MSE 355, 420, 430, 440, 450, 470, 471, 472, 476, 482, 490

In addition, six hours of electives must be selected from one of the areas of emphasis listed below

Materials Science and Engineering Areas of Emphasis

Technical electives may be selected from one or more of the following areas. A student may, with prior approval of the department, select a general area or a set of courses that would support a career objective not covered by the following categories.

Chemical processing and energy systems. CHE 432, 442, 451; MAE 371, 372, 388, 430, 437, 438; MSE 530, 531, 533

Electronic materials. CHE 458, 548, 558; CHM 471; EEE 435, 539, MAE 437, 438; MSE 520, 521, 550, 562, 573; PHY 471, 481.

Manufacturing and materials processing. MAE 372, 403, 415, 422, 441, 442; MSE 441, 540, 549, 560.

Mechanical metallurgy. MAE 305, 415, 422, 441, 442, 520, 522, 524, 527, 557; MSE 431, 441, 480, 520, 521, 540, 549, 550, 558, 560.

Physical metallurgy CHM 471, MAE 372, 388, 422; MSE 431, 441, 480, 520, 521, 550, 558, 559, 560, 561, 573; PHY 361, 362, 471, 481.

Polymers and composites CHM 331, 332, 438, 471; MAE 372, 520, 527; MSE 570.

Materials Science and Engineering
Program of Study
Typical Four-Year Sequence

First Year

			Semester Hours
First Semester			
CHM	113	General Chemistry	4
ECE	105	Introduction to Languages of Engineering	3
ENG	101	First Year Composition	3
MAT	270	Calculus with Analytic Geometry I	4
MSE	496	Professional Seminar	0
General Studies Elective HU or SB			3
		Total	17
Second Semester			
CHM	116	General Chemistry	4
ECE	106	Introduction to Computer Aided Engineering	3
ENG	102	First Year Composition	3
MAT	271	Calculus with Analytic Geometry II	4
MSE	496	Professional Seminar	0
PHY	121	University Physics I: Mechanics	3
PHY	122	University Physics Laboratory I	1
		Total	18

Second Year

First Semester			
CHE	311	Material Balances	3
ECE	210	Engineering Mechanics I: Statics or PHY 321 Newtonian Mechanics 3	3
MAT	272	Calculus with Analytic Geometry III	4
MAT	274	Elementary Different a Equations	3
MSE	496	Professional Seminar	0
PHY	131	University Physics II Electricity and Magnetism	3
PHY	132	University Physics Laboratory II	1
		Total	17
Second Semester			
ECE	301	Electrical Networks I	4
ECE	312	Engineering Mechanics II Dynamics or ECE 333 Electrical Instrumentation 3 or PHY 322 Analytical Mechanics 3	3
ECE	313	Introduction to Deform able Solids	3
ECE	350	Structure and Propert es of Materials	3
MSE	496	Professional Seminar	0
General Studies Elective (HU or SB)			3
Literacy and Critical Inquiry Elective[2]			3
		Total	19

Third Year

First Semester			
CHM	441	General Physical Chemistry	3
IEE	463	Computer Aided Manufacturing and Control or MAE 305 Measurements and Microcomputers (4)	3
MAT	242	Elementary Linear Algebra	2
MSE	355	Introduction to Materia Science and Engineering	3
MSE	496	Professional Seminar	0
PHY	361	Introductory Modern Physics	3
General Studies Elective HU or SB[1]			3
		Total	17
Second Semester			
ECE	383	Probability and Statistics for Engineers or ECE 384 Numerical Analysis for Engineers I 2 or ECE 386 Partial Differential Equations for Engineers 2	2
MAE	351	Manufacturing Processes Survey	3
MAE	441	Des gn Theory and Techniques	3
MSE	420	Physical Metallurgy	4
MSE	496	Professional Seminar	0
General Studies Elect ve HU or SB)[1]			3
Technical Elective			3
		Tota	18

Fourth Year

First Semester			
MSE	430	Thermodynam cs of Materials	3
MSE	450	X Ray and Electron Diffraction	3
MSE	470	Polymers and Composites	3
MSE	471	Introduction to Ceramics	3
MSE	482	Materials Engineering Design	3
MSE	496	Professiona Seminar	0
General Studies Elective HU or SB			3
		Total	18
Second Semester			
ECE	400	Engineering Communications	3
MSE	440	Mechanical Properties of Solids	3
MSE	472	Integrated Circu t Materials Science	3
MSE	476	Nonmetallic Materials Laboratory	2
MSE	490	Capstone Design Project	3
MSE	496	Professional Seminar	0
Technical Elective			3
		Total	17

Degree requirements 133 semester hours plus English proficien y

[1] See pages 58 88 for the requirements and the ap proved l st

[2] See page 328 for special requirements and selection of an L1 elective

CHEMICAL ENGINEERING

CHE 311 Material Balances. (3 F, S
Pr nc ples of phys cs and chem stry app ied to the formu a t on of materia ba ances Prerequ s tes CHM 116, ECE 106, MAT 271 or 291

312 Introduction to Thermodynamics. 3 F S
Energy ba ance calcu at ons and ntroduct on of thermody namic princip es. Prerequ s te CHE 311.

331 Transport Phenomena I: Fluids. 3 F, S
Transport phenomena, w th emphas s on f u d systems Cross-listed as BME 331 Prerequ s tes· CHE 311 (ex cept BME majors MAT 274, PHY 131

332 Transport Phenomena II: Energy Transfer. 3 F S
Cont nuat on of transport pr nc p es w th emphas s on en ergy transport n stat'onary and f u d systems Prerequ sites CHE 312, 331 Pre or corequ site ECE 385.

333 Transport Phenomena III: Mass Transfer. 3) F, S
The app cat on of transport phenomena to mass transfer The des gn of mass transfer equ pment, nc ud ng staged processes Pre or corequ s tes CHE 332 342

342 Applied Chemical Thermodynamics. 3 F S
Energy relat ons and equ brium convers ons based on chem cal potent a s and phase equ ibr a Prerequ s tes CHE 312; ECE 384.

351 Measurements Laboratory. 2 F
ntroduct on to aboratory pract ces and the use of meas urement dev ces. Prerequ s tes· CHE 311, ENG 102 Pre or corequisites. CHE 312 or ECE 340, CHM 335. *[Satis fies General Studies Requ rement· L1 (f taken w th CHE 352)]*

352 Transport Laboratories. (2) S
The demonstrat on of transport phenomena pr nc p es w th exper ments n f u d f ow, heat, and mass transfer Pre requ s tes: CHE 331 351 Corequ s te CHE 332 *[Satis fies General Studies Requirement· L1 (if taken w th CHE 351)]*

411 Biomedical Engineering I. 3 F
Rev ew of d agnost c and prosthet c methods us ng engi neer ng methodo ogy Introduct on to transport metabol c, and autoregu atory processes in the human body Cross sted as BME 411 Prerequis te instructor approva

412 Biomedical Engineering II. 3 S
Review of e ectrophys o ogy and nerve pac ng app ca t ons, ntroduct on to biomechan cs and jo nt/ mb rep ace ment techno ogy, card ovascu ar and pu monary f u d me chan cs, and the appl cat on of mathemat ca mode ng. Cross sted as BME 412. Prerequ's te nstructor ap proval.

413 Physiological Instrumentation. 3 S
Prob ems, concepts, and techn ques of b omed ca nstru mentat on in static and dynam c env ronments. Cross 'sted as BME 413 Prerequ's tes· AGB BME 435; ECE 333 or 334.

432 Principles of Chemical Engineering Design. 3 F
Mu ticomponent d sti at on eng neer ng econom cs equipment s z ng and costs, p ant operat on econom cs and s mu at on and opt m zat on techn ques Prerequis tes CHE 333 342.

442 Chemical Reactor Design. 3 F S
App cat on of k netics to chem ca reactor des gn Pre requ s te CHE 342. Pre or corequ s te CHE 333

451 Chemical Engineering Laboratory. (2 F
Operation, contro and des gn of experimental and ndus tria process equ pment ndependent research projects 6 hours ab Prerequis te· CHE 352. Corequ s tes CHE 432 442.

458 Semiconductor Material Processing. (3) N
Introduct on to the process ng and characteriz at on of e ectron c materials for sem conductor app cat ons. Pre requ s tes· CHE 333 342.

461 Process Control. 3 F
Process dynamics nstrumentat on and feedback appl ed to automat c process contro Lecture, ab Prerequ s te: ECE 301 *[Sat sfies General Studies Requ rement N3]*

462 Process Design. 3) S
App cat on of econom c pr nc p es to opt m ze equ pment select on and des gn deve opment and des gn of process systems Prerequ s tes CHE 432 442.

475 Biochemical Engineering. 3 N
App cat on of chem cal eng neer ng methods mass trans fer thermodynam cs, and transport phenomena to indus tria b otechno ogy. Prerequ s te instructor approva .

476 Bioreaction Engineering. 3) N
Pr nc ples of ana ys s and des gn of reactors for process ng w th ce s and other b o og ca y act ve mater a s, appl cat ons of react on eng neer ng n b otechno ogy. Pre requ site: nstructor approva .

477 Bioseparation Processes. 3 N
Pr nc p es of separat on of b o og cal y act ve chem ca s the app cat on sca eup, and design of separat on proc esses n b otechno ogy Prerequ s tes nstructor approva .

490 Chemical Engineering Projects. 1 5 F, S SS
nd v dual projects n chem ca eng neering operat ons and des gn Prerequ s te instructor approva

496 Professional Seminar. 0 F S
Profess onal and eth ca aspects w th a d scussion of em p oyment opportun t es and respons b t es Lectures f e d tr ps

501 Introduction to Transport Phenomena. 3 F, S
Transport phenomena w th emphas s on f u d systems. Prerequ s te· trans t on student w th nstructor approval

502 Introduction to Energy Transport. 3 F S
Cont nuation of transport pr nc p es w th emphas s on en ergy transport n stat onary and f u d systems Prerequ s te. trans t on student w th nstructor approva

503 Introduction to Mass Transport. 3 F, S
The app cat on of transport phenomena to mass transfer The des gn of mass transfer equ pment, nc ud ng staged processes Prerequ s te trans t on student w th nstructor approva

504 Introduction to Chemical Thermodynamics. 3 F S
Energy re at ons and equ br um convers ons based on chem ca potent a s and phase equ br a Prerequ s te: trans t on student w th nstructor approva

505 Introduction to Chemical Reactor Design. 3) F S
App cat on of k net cs to chem ca reactor de gn Pre requ s te: trans t on student w th nstructor approval.

515 Biomedical Transport Processes. 3 N
Pr nc p es of momentum heat and mass transport w th app cat ons to medical and b o og ca systems and med ca dev ce des gn Cross sted as BME 515 Prerequ s te nstructor approval.

517 Medical Transport Devices I. (3 N
Heat mass, and momentum transfer concepts are devel oped from f rst pr nc p es and app ed to the des gn and app cat on of med ca dev ces Emphas s s an extracor porea treatment of b ood w th channel d mens ons wh'ch great y exceed ce u ar d mens ons Cross sted as BME 517. Prerequ s tes: part a d fferent a equat ons, at least 1 course n heat, mass or momentum transfer

518 Introduction to Biomaterials. 3 F
Top cs nc ude structure property re at onsh ps for syn thetic and natura b omater a s b ocompat b ty and uses of mater als to rep ace body parts Cross sted as BME 518 Prerequ s te ECE 313 or nstructor approva

527 Advanced Applied Mathematical Analysis in Chemical Engineering. 3 F
Formu at on and so ut on of comp ex mathemat ca re a t onsh ps resu t ng from the descr pt on of phys ca prob ems n mass, energy, and momentum transfer and chem ca k net cs.

528 Process Optimization Techniques. 3) S
Method for opt m z ng eng neering processes Exper men ta des gn and ana ys s near and non near regress on methods, c ass ca search and dynam c programm ng a gor thms

533 Transport Processes I. 3 F
Un'f ed treatment of momentum heat and mass transfer from mo ecu ar theory and cont nuum po nts of view. Con t nuum equations of m croscop c and macroscop c sys tems and mu t component and mu t phase systems Cross sted as BME 533

534 Transport Processes II. 3 S
Cont nuat on of CHE BME 533, emphas z ng mass trans fer Cross sted as BME 534 Prerequ s te BME/CHE 533

535 Turbulent Mixing. 3 N
Turbu ence and m x ng n mu t component systems w th w thout chem ca react ons Computat ona mode s app ed to chem ca processes Prerequ s te CHE 533

536 Convective Mass Transfer. 3 N
Turbu ent f ow for mu t component systems, nc ud ng chem ca react ons with appl cat o s n separat ons and a r po ution Prerequ s te CHE 533 or MAE 571.

543 Thermodynamics of Chemical Systems. 3 F
C ass ca and stat st ca thermodynam cs of non dea phys cochem ca systems and processes pred ct on of opt mum operat ng cond t ons Cross sted as BME 543

544 Chemical Reactor Engineering. 3 S
React on rates, thermodynam cs, and transport pr nc p es appl ed to the des gn and operat on of chem ca reactors Cross isted as BME 544 Prerequ s te BME CHE 543.

548 Topics in Catalysis. 3 N
Eng neer ng cata ys s emphas z ng adsorpt on k net cs character zat on, d ffus ona cons derat ons and reactor des gn Other top cs nc ude mechan sms, surface ana y ses and e ectron c structure.

552 Industrial Water Quality Engineering. 3 N
Water po utants qua ty cr ter a and contro chem ca treatment process ng and system des gn Case stud es Prerequ s te CHE 331 or equ va ent

553 Air Quality Control. 3 N
A r po utant or g ns effects and control. Phys ca and chem ca processes nclud ng d spers on, combust on, samp ng, contro equ pment des gn and spec a top cs Prerequ s te CHE 331 or equ va ent

554 New Energy Technology. 3 N
Gas f cat on quefact on pyro ys s and combust on proc esses for coa wastes and other raw mater a s. n s tu processes for coa o sha e and geotherma energy En v ronmenta qua ty ssues

556 Separation Processes. 3 N
Top cs n b nary mu t component separat on, rate gov erned and equ brat on processes, mass transfer cr ter a, energy requ rements separat ng agents and dev ces, and staged operat ons

558 Electronic Materials. 3 N
Process ng and character zat on of e ectron c mater a s for sem conductor type uses. Thermodynam cs and transport phenomena phase equ br a and structure, mass transfer, and d ffus on and therma propert es.

561 Advanced Process Contro . 3 S
Dynam c process representat on near opt ma contro , opt ma state reconstruct on and parameter and state est mat on techn ques for cont nuous and d screte t me sys tems

562 Chemical Systems Engineering. 3 N
Process dynam cs, systems ana ysis computer app ca t ons and process contro

563 Chemical Engineer'ng Design. 3 N
Computat ona methods the des gn of chem ca p ants and processes.

Omnibus Courses: See pages 50 51 for omn bus courses that may be offered.

BIOENGINEERING

BME 202 Global Awareness within Engineering Design. 3 F
Strateg es for ntegrat ng ong term env ronmental eco nom c and eth ca cons derat ons nto eng neer ng des gn B omed ca , env ronmental, b otechno og ca and mater a s eng neer ng case stud es Lecture cr t cal d scourse. Cross sted as STE 202 Prerequ s tes ECE 106· ECN 111 or 112 ENG 102 *[Sat sf es Genera Stud es Re qu rement L1]*

318 Biomaterials. 3 A
Mater a propert es of natura and art f c a b omater a s T'ssue and b ood b ocompat b ty Uses of mater als to re p ace body parts Prerequ s te ECE 313.

331 Transport Phenomena I: Fluids. 3 F S
Transport phenomena, w th emphas s on f u d systems Cross sted as CHE 331. Prerequ s tes: CHE 311 ex cept BME majors , MAT 274 PHY 131.

334 Heat and Mass Transfer 3 A
Appl cat on of the pr nc p es of heat and mass transfer phenomena to so ut on of prob ems 'n medic ne and medi ca dev ce des gn Prerequ s tes MAT 274 PHY 131

411 Biomedical Engineering I. 3 F
Rev ew of d agnost c and prosthet c methods us ng eng' neering methodo ogy Introduct on to transport, metabo c, and autoregu atory processes n the human body Cross sted as CHE 411 Prerequ s te nstructor approva

412 Biomedical Engineering II. 3 S
Rev ew of e ectrophys o ogy and nerve pac ng app ca t ons ntroduct on to b omechan cs and jo nt/ mb rep ace ment techno ogy card ovascu ar and pu monary f u d me chan cs, and the app cat on of mathemat ca mode ng. Cross sted as CHE 412 Prerequ s te nstructor ap prova

413 Physio ogical Instrumentation. 3 S
Prob ems concepts and techn ques of b omed ca nstru mentat on n stat c and dynam c env ronments Cross sted as CHE 413. Prerequ s tes AGB BME 435; ECE 333 or 334

414 Biomedical Instrumentation. 3 F
E ectr cal phys ca and mechan ca pr nc p es govern ng the operat on of modern b omed ca nstrumentat on, n c ud ng b osensors EEG ECG recorders u trason c mag ng, and d agnost c dev ces. Prerequ s tes ECE 334 MAT 274

415 Biomedical Transport Processes. 4 A
Pr nc ples of momentum heat, and mass transfer w th ap pl cat ons to med ca and b o og ca systems and med ca dev ce des gn Prerequ s tes· MAT 274 PHY 131

416 Biomechanics. 3 S
Mechan ca propert es of bone, musc e and soft t ssues. Static and dynam c ana ys s of human movement tasks such as ocomot on Prerequ s te ECE 313 Corequ s te ECE 312.

417 Biomedical Engineering Design. (3 A
Techn ca regu atory econom c ega , soc a and eth ca aspects of med ca dev ce systems eng neer ng des gn Prerequ s te sen or stand ng in B oeng neer ng or nstruc tor approva

419 Biocontrol Systems. 3 F
App cat on of near and non near contro systems tech- n ques toward ana ys s of neuromuscu oske etal card o vascu ar, therma and mass transfer systems of the body Prerequis tes ECE 301 MAT 274

423 Physiological Instrumentation Laboratory. 1 F
Laboratory exper ence w th prob ems concepts, and tech n ques of biomed ca nstrumentat on n stat c and dynam c env ronments Lab Prerequ s tes AGB BME 435, ECE 333 or 334 Corequ s te: BME/CHE 413.

435 Animal Physiology I. 4 F
Contro and funct on of the nervous muscu ar card ovas cular resp ratory and rena systems of domest c an ma s Lecture, ab Cross sted as AGB 435. Prerequ s tes B O 181 CHM 113

436 Animal Physiology II. (3 N
Control and funct on of the endocr ne, d gest ve and re product ve systems of domest c an ma s Princ p es of adaptat on of an ma s to the r env ronment Prerequ s te· BME 435 or ZOL 360.

437 Animal Physiology Laboratory. 1 N
Se ected phys o og ca exper ments to accompany BME 436 Lab Corequ s te. BME 436.

461 Health Physics Principles and Radiation Measure- ments. (3 S
Sources character st cs dos metry sh e d ng and meas urement techn ques for cosmogen c terrestr a and an- thropogen c rad at on ion z ng and non on z ng radiat on theory ALARA concept Emphas s on nstrumentat on detectors and env ronmenta mon tor ng Lecture ab. Cross isted as EEE/NUC 461 Prerequ s te ECE 301

465 Clinical Nuclear Eng'neering I. 3 N
Fundamenta s of c n ca nuc ear eng neer ng and med ca hea th phys cs pract ce. Rad at on b o ogy dos metry and sh e d ng for rad otheraphy and diagnost c procedures Prerequ s te nstructor approva .

490 Biomedical Engineering Projects. 1 5 F S SS
nd v dua projects n med ca systems or med ca dev ce des gn and deve opment

496 Professional Seminar. 0 F, S
Profess ona and eth ca aspects w th a d scuss on of em p oyment opportun t es and respons b t es Lecture f e d tr ps

511 Biomedical Engineering. 3 A
D agnostic and prosthet c methods us ng eng neer ng methodo ogy Transport, metabo c and autoregu atory processes n the body

512 Biomedical Engineering II. 3 A
Electrophys o ogy and nerve pac ng app cat ons ntroduc t on to b omechan cs and jo nt/ mb rep acement techno ogy, card ovascu ar and pu monary f u d mechan cs and mathemat ca model ng.

513 Physiological Instrumentation I. 3 A
Prob ems concepts and techn ques of b omed ca instru- mentat on n stat c and dynam c env ronments.

514 Biomedica Instrumentation. 3 F
E ectr ca phys ca and mechan ca pr nc p es govern ng the operat on of modern b omed ca nstrumentat on. Pre requ s tes· ECE 334, MAT 274

515 Biomedical Transport Processes. 3 N
Pr nc p es of momentum heat and mass transport w th app cat ons to med ca and b o og ca systems and med ca dev ce des gn Cross sted as CHE 515 Prerequisite nstructor approva

516 Topics in Biomechanics. 3 S
Mechan ca propert es of bone musc e and soft t ssues Stat c and dynam c ana ys s of human movement tasks nc ud ng n depth project Prerequ s tes ECE 312 and 313 *or* nstructor approva

517 Medical Transport Devices i. 3 N
Heat mass and momentum transfer concepts are deve oped from f rst pr nc p es and app ed to the des gn and app cat on of med ca dev ces Emphas s s an extracor- porea treatment of b ood w th channe d mens ons wh ch great y exceed ce u ar d mens ons Cross sted as CHE 517 Prerequ s te part a d fferent a equat ons at east 1 course n heat mass or momentum transfer

518 Introduction to Biomaterials. 3 F
Top cs nc ude structure property re at onsh ps for syn thet c and natura b omatena s b ocompat b ty and uses of mater a s to rep ace body parts Cross sted as CHE 518 Prerequ s te· ECE 313 or nstructor approval.

519 Topics in Biocontrol Systems. 3 F
L near and non near contro systems ana ys s of neu romuscu oske eta , card ovascu ar therma and mass transfer systems of the body, nc ud ng n depth pro ect Prerequ s te MAT 274

520 Bioelectric Phenomena. 3 N
Study of the or g n propagat on and nteractions of b o e ectr c ty n v ng th ngs, vo ume conductor prob em mathemat ca ana ys s of b oe ectr c nteract ons and uses n med ca d agnost cs

521 Neuromuscular Control Systems. 3 S
Overv ew of sensor motor bra n structures. App cat'on of non near adapt ve opt ma , and superv sory contro the- ory to eye head hand coord nat on and ocomot on

522 Biosensor Design and App ication. 3 A
Theory and princ p es of b osensor des gn and app cat on n med c ne and b o ogy Pr nc p es of measurements w th b osensors Prerequ s te nstructor approva

523 Physiological Instrumentation Lab. 1 F
Laboratory exper ence w th prob ems, concepts, and tech n ques of b omed ca 'nstrumentat on n stat c and dynam c env ronments Lab Prerequ s tes AGB BME 435 ECE 333 or 334 Corequ s te: BME CHE 413

524 Fundamentals of Applied Neural Control. 3 A
Fundamental concepts of e ectr ca st mu at on and re cord ng n the nervous system w th the goa of funct ona contro restorat on. Corequ s te BME 435 or nstructor approva

532 Prosthetic and Rehabilitation Engineering. 3 A
Ana ys s and cr t ca as essment of des gn and contro strateg es for state of the art med ca dev ces used n re hab tat on eng nee ng Prerequ s tes BME 416 or PED 610 435, ECE 312 313 Corequ s te BME 419

533 Transport Processes I. 3 F
Un f ed treatment of momentum heat and mass transfer from mo ecu ar theory and cont nuum po nts of v ew Co t n um equat ons of m croscop c and macroscop c sys tems and mu t component and mu t phase systems Cross sted as CHE 533

534 Transport Processes II. 3 S
Cont nuat on of BME CHE 533 emphas z ng mass trans fer Cross sted as CHE 534 Prerequ s te BME/CHE 533

543 Thermodynam cs of Chemical Systems. 3 F
Class ca and stat st ca thermodynam cs of non dea phys cochem ca system and proce ses pred ct on of opt mum operat ng cond t ons Cross l sted as CHE 543

544 Chemical Reactor Engineering. 3 S
React on rates thermodynam cs and transport pr nc p es app ed to the des gn and operat on of chem ca reactors Cross sted as CHE 544 Prerequ s te BME/CHE 543

566 Medical Imaging Instrumentation. 3 N
Des gn and ana ys s of mag ng systems and nuc ear de v ces for med ca d agnos s therapy and research Labo ratory exper ments us ng d agnostic rad o ogy f uoro copy u trasound and CAT scann ng Lecture, ab Pre requ s te BME EEE/NUC 465 or nstructor approva

567 Radiation Shielding and Transport. 3) F
Sh eld ng for rad at on therapy, d agnost c rad o ogy cyc o trons, and nuc ear rea tors Monte Car o and emp r ca computat ona methods regu at on and des gn prob ems Cross sted as EEE/NUC 567 Prerequ s te BME/ EEE NUC 465

568 Medical Tomography. 3 S
CT, SPECT PET and MRI 3 d men ona *in v vo* meas urements nstrument de gn phys o og ca mode ng c n ca protoco s, reconstruct on a gor thms and quant ta t on ssues Prerequ s te EEE NUC 465

569 Radiochemistry and Rad'opharmaceutical Production. 3 N
Advanced pr nc p es of cyc otron des gn targetry opera t on, and ut zat on Novel synthes s tracer preparat on qua ty contro and b od str but on stud es Prerequ s te BME EEE NUC 465.

Omnibus Courses: See pages 50 51 for omn bus courses that may be offered

MATERIALS SCIENCE AND ENGINEERING

MSE 355 Introduction to Materials Science and Engineering. 3 F
E ements of the structure of meta s and a oys measure ment of mechan ca propert es and opt ca meta ography Lecture ab f e d tr ps Prerequ s te CHM 114 or 116

420 Physical Metallurgy. 4 F
Crysta structure and defects Phase d agrams meta o graphy, so d f cat on and cast ng deformat on, and an nea ng Lecture ab Prerequ site ECE 350

430 Thermodynamics of Materials. 3 N
Pr nc ples of stat st ca mechan cs stat st ca thermody nam cs of s ng e crysta s so ut ons phase equ br um free energy of react ons free e ectron theory and thermo dynam cs of defects Prerequ s te CHE 312 or ECE 340

431 Corrosion and Corros'on Control. 3 S
Introduct on to corros on mechan sms and methods of pre vent ng corros on Top cs nc ude the fo ow ng e ectro chem stry po ar zat on corros on rates ox dat on coat ngs, and cathod c protect o P e equ s te ECE 350

440 Mechanical Properties of Solids. 3) S
Effects of env ro menta and m crostructural var ab es of mechan cal propert es, nc ud ng p ast c deformat on fa t gue creep br tt e fracture, and nternal fr ct on Prerequ s te ECE 350

441 Analysis of Material Failures. 3 S
dent f cat on of types of fai ures Ana yt ca techn ques Fractography SEM ondestruct ve inspect on and meta ography Mechan ca and e ectron c components Pre requ s te ECE 350

450 X-Ray and Electron Diffraction. 3 F
Fundamentals of X ray d ffract on transm ss on e ectron m croscopy and scann ng e ectron m croscopy Tech n ques for study g surfaces nterna m crostructures and f ourescence Lecture demo strat ons Prerequ s te ECE 350

470 Polymers and Composites. 3 F
Relat onsh p between chem stry, structure, and propert es of eng neer ng po ymers Des gn propert es, and behav or of f ber compos te systems Cross sted as MAE 455 Prerequ s te ECE 350

471 Introduction to Ceramics. 3 F
Pr nc ples of structure and property re at ons n ceram c mater a s Process ng techn ques App cat ons n me chan ca e ectron c and superconduct ng systems Pre requ s te ECE 350

472 Integrated Circuit Materials Science. 3 N
Pr nc p es of mater a s sc ence app ed to sem conductor processing and fabr cat on n meta s, ceram cs po ymers, and sem conductors Prerequ s te ECE 350

476 Nonmetallic Materials Laboratory. 2 S
Exper menta measurement of propert es of po ymeric, ce ram c and e ectron c mater a s Structure character za t on Lecture ab Prerequ s tes ECE 350 MSE 355

480 Manufacturing Engineering. 3 F
Ana ys s and opt m zat on of manufacturing processes. Prerequ s te ECE 350

482 Materials Engineering Design. 3 F S
Pr nc ples of the des gn process Feas b ty and opt m za t on Manufactur ng processes mater a s se ect on fa ure ana ys s and econom cs Prerequ s tes ECE 313 350.

490 Capstone Design Project. 1 3 F S
For sma groups n fundamenta or app ed aspects of en g neer ng mater a s emphas s on exper menta prob ems and des gn Prerequ s tes MSE 430 440, 450

496 Professional Seminar. (0 F S
Profess onal and eth ca aspects w th a d scuss on of em p oyment opportun t es and respons b t es Lectures, f e d trips

510 X-Ray and Electron Diffraction. 3 F
Fundamenta s of X ray d ffract on transm ss on e ectron m croscopy and s ann ng electron m croscopy Tech n ques for study ng surfaces nterna m crostructures and f u rescence Lecture demonstrat ons Prerequ s te trans t on student w th nstructor approva

511 Corrosion and Corrosion Control. 3 S
ntroduct on to corros on mechan sms and methods of pre vent ng corros on Top cs nc ude the fo ow ng: e ectro chem stry po ar zat on, corros on rates, ox dat on coat ngs, and cathod c protect on Prerequ s te· trans t on stu dent w th nstructor approva

512 Analysis of Material Failures. 3) S
dent fication of types of fa ures Ana yt cal techn ques Fractography SEM nondestruct ve nspect on, and meta - lography Mechan ca and e ectron c components. Pre requ s te· trans t on student w th nstructor approva

513 Polymers and Composites. 3 F
Relat onsh p between chem stry structure and propert es of eng neer ng polymers Des gn, propert es and behav or of f ber compos te systems.

514 Physical Metallurgy. 4) F
Crysta structure and defects Phase d agrams, meta o graphy so d f cat on and cast ng and deformat on and annea ng. Lecture, ab Prerequ s te transit on student with nstructor approva

515 Thermodynamics of Materials. 3 N
Pr nc p es of stat st ca mechan cs stat st ca thermody- nam cs of s ng e crysta s so ut ons phase equ br um, free energy of react ons, free e ectron theory, and thermo- dynam cs of defects. Prerequis te. trans t on student w th instructor approva

516 Mechanical Properties of Solids. (3 S
Effects of env ronmenta and m crostruct ona variab es of mechan ca propert es nc ud ng p ast c deformat on, fa t gue creep br tt e fracture, and nterna fr ct on Pre- requ s te· trans t on student w th nstructor approva

517 Introduction to Ceramics. 3 F
Pr nc p es of structure property relat ons n ceram c mate r als Process ng techn ques App cat ons n mechan ca e ectron c and superconduct ng systems Prerequist te trans t on student w th nstructor approva .

518 Integrated Circuits Materials Science. 3 N
Pr nc ples of mater als sc ence app ed to sem conductor process ng and fabr cat on n meta s, ceram cs polymers and sem conductors Prerequ s te: trans t on student with 'nstructor approva

520 Theory of Crystalline Solids. 3) F
An sotrop c propert es of crysta s; tensor treatment of e as t c, magnet c e ectr c and thermal propert es and crysta ography of Martens t c transformations

521 Defects in Crystalline Solids. (3 S
Introduct on to the geometry nteract on and equ bnum between dis ocat ons and po nt defects Re at ons be tween defects and propert es w be d scussed Prerequ site: ECE 350 or nstructor approva .

530 Materials Thermodynamics and Kinetics. 3 S
Thermodynam cs of a oy systems, d ffusion n so ds, k net cs of prec p tat on, and phase transformat ons n so ds Prerequ s tes CHE 312 or ECE 340 ECE 350

531 Statistical Thermodynam cs. 3 N
K net c and quantum theory Stat st ca mechan cs en semb e theory. Structure and thermodynam cs of non in teract ng and nteract ng part c es Boltzmann ntegro-d f ferent a equat on Cross sted as MAE 582. Prerequ s te: MAE 581

533 Direct Energy Conversion. 3) N
Advanced se ected top cs n d rect energy convers on, the ory des gn and app cat ons Cross- sted as MAE 537. Prerequisite: MAE 581

540 Fracture, Fatigue, and Creep. 3 F
Re at onsh p between m crostructure and fracture fat gue and creep propert es of mater a s Env ronmenta effects and recent deve opments Current theor es and experi- mental resu ts. Prerequ s te MSE 440 or equ va ent

549 Manufacturing Analysis. 3 S
Analys s and opt m zat on of manufactur ng processes. Prerequ s te: MSE 480.

550 Advanced Materials Characterization. 3 N
Ana yt ca nstrumentat on for characterizat on of materi a s SEM S MS, Auger ana yt ca TEM and other ad vanced research techn ques

556 Electron Microscopy Laboratory. 3 F
Laboratory support for MSE 558 Cross- sted as SEM 556. Pre or coreq u s te MSE SEM 558.

557 Electron Microscopy Laboratory. (3 S
Lab support for MSE 559 Cross sted as SEM 557 Pre- or coreq u s te: MSE SEM 559.

558 Electron Microscopy I. 3) F
Microana ys's of the structure and compos t on of materi- a s us ng mages d ffract on and X ray and energy oss spectroscopy Know edge of e ementary crysta ography, rec proca att ce stereograph c project ons and complex variab es s requ red. Cross sted as SEM 558 Prerequi- s te nstructor approval.

559 Electron Microscopy II. 3 S
M'croana ys s of the structure and compos t on of materi- a s us ng mages d ffract on and X ray and energy oss spectroscopy Know edge of e ementary crysta lography, rec proca att ce stereograph c project ons, and comp ex var ab es 's requ red. Cross sted as SEM 559 Prerequ - s te nstructor approva .

560 Strengthening Mechanisms. 3 S
Deformat on of crysta ne materia s. Propert es of d sloca t ons. Theor es of stra n harden ng so d so ut on, prec p tat on and transformat on strengthen ng. Prerequ s te: ECE 350 or equ valent

561 Phase Transformation in Solids. 3 N
Heterogeneous and homogeneous prec p tat on react ons, shear d splac ve react ons, and order d sorder transforma t on.

562 Ion Implantation. 3 S
nc udes defect product on and annea ng. General zed treatment nc ud ng on mp antat on, neutron rrad at'on damage and the nteract on of other nc dent beams. Pre requ s'te: MSE 450.

570 Polymer Structure and Properties. 3) F
Re at onsh ps between structure and propert es of syn- thet c po ymers nc ud ng g ass trans t on, mo ecu ar re- axat ons crysta ne state v scoe ast c ty, morpho og ca character zat on, and process ng.

571 Ceramics. 3 A
Inc udes ceram c process ng, cast ng mold ng, f ring s n- ter ng, crysta defects mechan ca , e ectron c, and phys ca propert es w be nc uded Prerequ s tes MSE 521 561

572 Semiconductor Phase D agrams. (3) A
Ana ys s of b nary and ternary phase d agrams and appl - cat on to sem conductor growth and vapor and iqu d phase ep taxy Prerequ s te MSE 521

573 Magnetic Materials. 3 A
Emphas s on ferromagnet c and ferr magnet c phenom ena Doma ns magnet c anisotrophy, and magnetastr c t on Study of commerc a magnet c mater a s Prerequ s te. MSE 520 or equ va ent

Omnibus Courses: See pages 50 51 for omn'bus courses that may be offered

Civil Engineering

PROFESSORS:
MAYS ECG 136A BETZ, W. HOUSTON
MAMLOUK MATTH AS, O'BANNON, RUFF,
SINGHAL TUMA

ASSOCIATE PROFESSORS:
DUFFY FAF T S, HAUSER, H NKS
S HOUSTON, RAJAN
UPCHURCH ZANIEWSK

ASSISTANT PROFESSORS:
BAAJ FOX

PROFESSORS EMERITI:
BLACKBURN, BORGO, KLOCK
LUNDGREN, P AN

Civil engineers are involved in some of the most critical and visible problems facing modern soci ety. Civil engineers are technical problem solvers, meeting such challenges as providing efficient transportation systems, energy and water conser vation and development, urban planning, and flood and earthquake damage reduction.

Civil engineering is primarily concerned with the public domain. The profession involves analysis, planning, design, construction, and maintenance of many types of buildings for gov ernment, commerce and industry for example, high rise office towers, factories, schools, air ports, tunnels and subway systems, dams, canals, and water purification and environmental protec- tion facilities such as solid waste and wastewater treatment systems. Civil engineers are concerned with the impact of their projects on the public and the environment, and they attempt to coordinate the needs of society with technical and economic feasibility.

Entrance Requirements

Entering freshmen into the Civil Engineering pro gram must have completed one year of high school chemistry and one year of high school physics with grades of "B" or better in each sub ject. Students who do not meet these require- ments must take CHM 113 and 116 in lieu of CHM 114 and must take PHY 105 as a prerequi site to PHY 121 and 122. For international stu dents, an official TOEFL score of 550 is required.

Degree Requirements

Requirements for the bachelor's degree include the completion of the civil engineering core courses and 18 semester hours of design and tech nical electives with an average grade of "C" or better Course selections are made by the student with the advisor's approval. Up to two of the graduate courses listed under the elective areas may, with appropriate approvals, be taken for un dergraduate credit by students whose cumulative GPA is 2.80 or better for the last two years of un dergraduate study.

Except for CEE 296 and 321, civil engineering core courses may not be taken without permission from the department until all engineering core courses, except ECE 400, have been completed with an average grade of "C" or better and all of the following courses have been completed with minimum grades of "C": ECE 210, 312, 313; MAT 274; MAT 290 and 291 *or* 270 and 271 and 272.

Civil Engineering Core

The following courses are required as a part of the engineering core (only ECE 333 Electrical In- strumentation may be deleted)·

			Semester Hours
CEE	400	Microcomputer Applications in Civil Engineering	3
ECE	351	Engineering Materials	3

The additional requirements for science, engi neering sciences, and design specified in the engi neering core are satisfied within the civil engi neering core

			Seme ter Hours
CEE	296	Introduction to Civil Engineering	1
CEE	321	Structural Analysis	3
CEE	322	Steel Structures	3
CEE	323	Concrete Structures	3
CEE	34	Hydraulic Engineering	4
CEE	351	Soil Mechanics	4
CEE	361, 362	Environmental Engineering	6
CEE	372	Transportation Eng neering	4
CEE	496	Topics in Civil Engineering Pract ce	1
IEE	300	Econom c Analysis for Eng neers	3
MAE	371	F uid Mechanics	3
		Total	35

Civil Engineering Designated Design Electives

Two courses are required

			Semester Hours
CEE	423	Structural Design	3
CEE	441	Water Resources Engineering	3
CEE	452	Foundat ons	3
CEE	466	Sanitary Systems Design	3
CEE	475	Highway Geometric Design	3

Civil Engineering Technical Electives

Eleven hours are required.

A maximum of six hours may be selected outside civil engineering. Only one construction course may be used for technical elective credit.

Civil Engineering Elective Areas of Emphasis with Suggested Courses

Construction engineering. CON 344, 383, 495, 496. Only one course may be selected.

Environmental engineering. Water treatment, industrial and domestic waste treatment and disposal, public health engineering, industrial hygiene. CEE 466, 563; CHM 231; MIC 220 (or 205 and 206).

Geotechnical engineering. Assessment of engineering properties and design utilizing soils and rocks as engineering materials. CEE 452, 550, 552, 553, 554.

Structural engineering. Analysis and design of structures for buildings, bridges, space frames, structural mechanics. CEE 423, 432, 521, 531.

Transportation engineering. Analysis and design of transportation facilities, transportation planning and economics, transportation in the urban environment. CEE 412, 471, 475, 512, 573, 574, 575, 576.

Water resources engineering. Planning and design of facilities for collection, storage and distribution of water, water systems management, estimating availability of water resources. CEE 441, 540, 541, 542, 543, 545, 546.

Civil Engineering Program of Study

Typical Four-Year Sequence

Freshman Year

First Semester			Semester Hours
CEE	296	Introduction to Civil Engineering	1
CHM	114	General Chemistry for Engineers	4
ECE	105	Introduction to Languages of Engineering	3
MAT	290	Calculus I	5
PHY	121	University Physics I: Mechanics	3
PHY	122	University Physics Laboratory I	1
		Total	17
Second Semester			
ECE	106	Introduction to Computer Aided Engineering	3
ENG	101	First Year Composition	3
MAT	291	Calculus II	5
PHY	131	University Physics II: Electricity and Magnetism	3
PHY	132	University Physics Laboratory II	1
Social and Behavioral Sciences Elective[1]			3
		Total	18

Sophomore Year

First Semester			
ECE	210	Engineering Mechanics I: Statics	3
ECE	301	Electrical Networks I	4
ECN	111	Macroeconomic Principles	3
ENG	102	First Year Composition	3
IEE	300	Economic Analysis for Engineers	3
MAT	274	Elementary Differential Equations	3
		Total	19
Second Semester			
ECE	312	Engineering Mechanics II Dynamics	3
ECE	313	Introduction to Deformable Solids	3
ECE	340	Thermodynamics	3
ECE	383	Probability and Statistics for Engineers	2
Basic Science Elective			3
Humanities and Fine Arts Elective			3
		Total	17

Junior Year

First Semester			
CEE	321	Structural Analysis	3
ECE	351	Engineering Materials	3
ECE	384	Numerical Analysis for Engineers I	2
MAE	371	Fluid Mechanics	3
Humanities and Fine Arts Elective[1]			3
Literacy and Critical Inquiry Elective[2]			3
		Total	17
Second Semester			
CEE	322	Steel Structures	3
CEE	341	Hydraulic Engineering	4
CEE	351	Soil Mechanics	4
CEE	361	Environmental Engineering	3
CEE	372	Transportation Engineering	4
		Total	18

Senior Year

First Semester			
CEE	323	Concrete Structures	3
CEE	362	Environmental Engineering	3
CEE	400	Microcomputer Applications in Civil Engineering	3
CEE	496	Topics in Civil Engineering Practice	1
Design Elective			3
Technical Elective			3
		Total	16
Second Semester			
ECE	400	Engineering Communications	3
Design Elective			3

Social and Behavioral Science Elective	3
Technical Elective	8
Total	17

See pages 58 88 for the requirements and the ap proved list.

[2] See page 328 for special requirements and selection of an L1 elective.

Concurrent Studies in Architecture and Civil Engineering

Undergraduate. Qualified lower division students interested in combining studies in architecture and civil engineering may prepare for upper division and graduate courses in both programs by taking courses listed in option "B" of the School of Architecture (page 212).

Graduate. Qualified students may develop a program of study that leads to the concurrent degrees Master of Architecture and M S.E. with a focus in Civil Engineering. The student's program of study is developed in conjunction with advisors in both departments. For specific details consult with advisors in both departments.

CIVIL ENGINEERING

CEE 296 Introduction to Civil Engineering. 1 F, S
Introduction to the profess on Descript on of areas of specia zat on Degree requirements academic stand ng, and adv s'ng procedures Introduct on to ab fac t es Pre requ s te freshman stand ng.

310 Testing of Materials for Construction. (3) F S
Structural and behav ora character st cs eng neer ng propert es, measurements and app cat on of construct on mater als Lecture lab Not open to eng neer ng students. Prerequis te: CON 323.

321 Structural Analysis. 3) F S
Stat cal y determ nate and ndeterm nate structures by c ass ca and matr x methods such as trusses, beams, and frames. 2 hours ecture 2 hours rec tat on Prerequ s te ECE 313.

322 Steel Structures. (3 F
Behav or of structura components and systems Des gn of steel members and connect ons Load and res stance fac tor des gn methods Lecture, rec tat on Prerequis tes CEE 321 complet on of eng neer ng core (except ECE 400) m n mum core grade requirements sat sf ed

323 Concrete Structures. (3) F S
Behav or of concrete structures and the des gn of re n forced and prestressed concrete members nc ud ng foot ngs Part a des gn of concrete bui d ng system Lecture, rec tat on Prerequ s tes CEE 321, comp et on of eng neer ng core (except ECE 400) m n mum core grade re quirements sat sf ed.

340 Hydraulics and Hydrology. (3 F, S
App cat'on of hydrau c eng neering pr nc p es to flow of quids in p pe systems and open channe s· hydrostatics; characterist cs of pumps and turb nes ntroduct on to hydrology Not open to eng neer ng students. Lecture ab. Prerequ s te CON 221

341 Hydraulic Engineering. (4 F, S
Fundamenta pr'nciples and methods of fluid mechan cs form ng ana yt cal basis for water resources engineering. F ow n conduits and open channe s ntroduct on to hy dro ogy Lecture ab. Prerequ s tes MAE 371 comp e t on of eng neer ng core except ECE 400), m n mum core grade requ rements sat sf ed

351 Soil Mechanics. 4) F S
ndex propert es and eng neer ng character st cs of so s Compaction, permeab l ty and seepage compress b ty and sett ement and shear strength Lecture ab. Pre requ s tes CEE 321 comp et on of eng neer ng core (ex cept ECE 400) min mum core grade requ'rements satis f ed

361 Environmental Engineering. 3) F S
Natura environment, water resources hydro og c cyc e, chem stry of natura waters, qua ity requ rements and wa ter treatment and water d str but on systems. Corequisite CEE 341

362 Environmental Engineering. (3) F S
Natura environment the carbon cyc e and b ochem stry of wastes princ ples of waste treatment, and dra nage sys tems Prerequ s te CEE 361

371 Introduction to Urban Planning. 3) N
Theoret ca and pract cal aspects of c ty p ann ng nterre at onsh ps among phys ca p ann ng, env ronment gov ernment and soc ety Not acceptab e as a techn ca e ec t ve for CEE students

372 Transportation Engineering. (4 F S
H ghway ra water, and a r transportat on. Operat ona character st cs and traff c contro dev ces of each transport mode mpact on urban form. Prerequ s tes: CEE 321, comp et on of engineer ng core (except ECE 400) m n mum core grade requ rements sat sfied

400 Microcomputer Applications in Civil Engineering. 3 F, S
Deve opment of m crocomputer teracy n civi eng neering app cat ons Prerequ s tes: CEE 351, 361 372 ECE 106 *[Sat sf es General Stud es Requ rement N3]*

412 Pavement Analysis and Design. 3) F
Des gn of f ex b e and rig'd pavements for h ghways and a rports Surface base, and subgrade courses Cost ana ys s and pavement se ect on Prerequ sites· CEE 351, ECE 351

423 Structural Design. 3 F
Ana ys s and des gn of re nforced concrete steel, masonry, and t'mber structures. Lecture lab. Prerequ s tes CEE 322 323

432 Matrix and Computer Applications in Structural Engineering. (3) S
Matr x and computer app cat ons to structura eng neering and structura mechan cs St ffness and f ex b ty meth ods, f nite e ements and d fferences Prerequisite CEE 321.

441 Water Resources Engineering. 3 S
App cat on of the pr nc p es of hydrau cs and hydro ogy to the eng neer ng of water resources projects, des gn and operat on of water resources systems; water qua ty Pre requ s te. CEE 341

450 Soil Mechanics in Construction. (3) F, S
So mechan cs as app ed to the construct on fie d nc ud ng foundat ons, h ghways, reta n ng wal s, and s ope sta b ty. Re at onsh p between so characteristics and geo logic formations Not open to eng neering students. Lec ture ab. Prerequ site CON 323

452 Foundations. (3) F S
App cat ons of so mechan cs to foundat'on systems bear ng capac ty atera earth pressure and slope stab - ty Prerequ s te CEE 351

466 Sanitary Systems Design. 3 F
Capac ty, plann ng and design of water supp y domest c and storm dra nage, and so d waste systems Prerequ s te: CEE 361

471 Planning and Design of Urban Systems. 3 F
For students n c ty p ann ng urban systems c v eng neer ng and re ated areas work ng as interd sc p nary p ann ng and des gn teams Effect of econom c base em p oyment, and popu at on on urban land use requ rements Locat on and requ red capac ty of urban systems to serve urban and uses Lecture ab Prerequ s te sen or stand ng

475 Highway Geometric Design. 3 S
Design of the v s b e e ements of the roadway Fundamen a des gn contro s w th app cat on to rura roads at grade ntersect ons, freeways, and interchanges. Lecture, rec ta t on Prerequ s te: CEE 372

496 Topics in Civil Engineering Practice. 1 F S
Profess ona eng neer ng pract ce nterv ew ng and résumé wr t ng profess o a reg strat on requ rements cont nu ng educat on graduate study f nanc a p ann ng and emp oyment Prerequ s te: sen or stand ng

512 Pavement Performance and Management. 3 S
Pavement management systems nclud ng data co ec t on eva uat on opt m zat on, econom c ana ys s and computer app cat ons for h ghway and a rport des gn Pre requ s te: CEE 412

514 Bituminous Materials and Mixture. 3 F
Types of b tum nous mater a s used n pavement m xtures Chem ca compos t on and phys ca propert es des rab e aggregate characteristics and opt mum asphalt contents Lecture ab. Prerequ s te ECE 351

515 Design and Behavior of Portland Cement Concrete M xtures. 3 S
Propert es of cements and aggregates M x des gn for strength and durab ty requ rements. Fa ures caused by chem ca react on weather ng and oad ng. Prerequ s te ECE 351

521 Stress Analysis. 3 F
Advanced top cs n the ana yt ca determ nat on of stress and stra n Prerequ s te CEE 321

524 Advanced Steel Structures. 3 S
Strength propert es of stee and the r effects on structura behav or Elast c des gn of stee structures P ast c ana y s s and des gn of beams frames and bents P ast c de- f ect ons P ast c des gn requ rements Mult story bu d ngs Prerequ s te CEE 322

526 Finite Element Methods in Civil Engineering. 3 F
F n te element formu at on for so ut ons of structura ge otechn ca and hydrau c prob ems Prerequ s te CEE 432

527 Advanced Concrete Structures. 3 F
U t mate strength des gn. Comb ned shear and tors on. Serv ceab ty P ast c ana ys s Spec a systems Pre requ s te: CEE 323

528 Stability of Structures. 3) F
E ast c and ne ast c buck ng of ro ed and co d formed co umns and beams Stab ty of p ates r g d frames and trusses Prerequ s tes CEE 322, nstructor approva

529 Complex Structures. 3 S
Class cal and numer ca nvest gat ons of near and non near structures composed of f at and curved surfaces and near or curv near e ements Prerequ site· nstructor approva

530 Prestressed Concrete. 3 S
Mater a s and method of prestress ng Ana ys s and de s gn for f exure, shear and tors on Prestress osses due to fr ct on, creep shr nkage and anchorage set Statica y ndeterm nate structures. Des gn of f at s abs br dges, and compos te beams Prerequ s te CEE 323

531 Theory of Structures. 3 F
Genera theorems re at ng to e ast c systems deflect on of trusses and beams, stat ca y ndeterm nate trusses, beams r ngs, arches and frames by cons stent deforma t on, east work, and e ast c center hor zonta y curved members n bend ng and tors on Prerequ s te CEE 321

533 Applied Optimal Design. 3 S
L near and non near programm ng Prob em formu at on Des gn sensit v ty ana ys s FEM based opt ma des gn of structura and mechan ca ystems Prerequ s te graduate stand ng or nstructor approva

536 Structural Dynamics. 3 S
Structures and structura members sub ected to dynam c oad ngs, response spectra theory app cat ons to br dges and power p ants nvest gat ons of the responses of mu t degree of freedom structures and matr x and numer ca methods of ana ys s Lecture rec tat on Prerequ s tes CEE 321; nstructor approva

537 Topics in Structural Engineering. 1 3 F
Advanced top cs nclud ng, w nd eng neer ng earthquake eng neer ng, probab st c concepts and br dge and bui d ng eng neer ng Prerequ s te nstructor approva

540 Groundwater Hydrology. 3 F
Phys ca propert es of aqu fers, groundwater exp orat on we construct on and pump ng subsurface f ow mode ng, and subs dence, groundwater po ut on, and water r ghts Prerequ s te CEE 341 or nstructor approva

541 Surface Water Hydrology. 3 S
Hydro og c cyc e and mechan sms nc ud ng prec p tat on evaporat on and transp rat on hydrograph ana ys s, f ood rout ng stat st ca methods n hydro ogy and hydro og c des gn Prerequ s te CEE 341 or nstructor approva

542 Water Resources Systems Planning. 2 S
Ph osophy of water resources p ann ng econom c soc al, and eng neer ng nteract on ntroduct on to the theory and app cat on of quant tat ve p ann ng methodo og es 'n wa ter resources p ann ng Guest ecturers case stud es. Prerequ s te nstructor approva

543 Water Resources Systems I 3 F
Theory and app cat on of quant tat ve p ann ng method- o og es for the des gn and operat on of water resources systems, c ass projects us ng a computer case stud es. Pre or corequ s te CEE 542 or nstructor approva

544 Water Resources Systems II. 3 F
Advanced computer or ented workshop n the app cat on of quant tat ve p ann ng techn ques to the des gn and op- erat on of water resources systems Prerequ site CEE 543

545 Foundations of Hydraul c Engineering. 2 S
Rev ew of ncompress b e f u d dynam cs F ow n p pes and channe s· unsteady and var ed f ows wave mot on. Prerequ s te CEE 341

546 Free Surface Hydraulics. 2 F
Der vat on of 1 d mens ona equat ons used n open chan ne f ow ana ys s computat ons for un form and nonun form f ows unsteady f ow and f ood rout ng Mathemat ca and phys ca mode s Prerequ s te CEE 341

547 Princ ples of River Engineering. 2 S
Uses of r vers, study of watershed, and channe proc esses Sed ment sources y e d and contro hydro og c ana ys s Case stud es Prerequ s te CEE 341 or nstruc tor approva

548 Sedimentation Eng'neering. 2 F
ntroduct on to the transportation of granu ar sed mentary mater a s by mov ng f u ds Degradat on aggregat on and oca scour n a uv a channe s Mathemat ca and phys ca mode s Prerequ s te CEE 547 or nstructor approva

550 Soil Behavior. 3 S
Phys cochem ca aspects of so behav or stab zat on of so s and eng neer ng propert es of so s Prerequ s te CEE 351

551 Advanced So l Mechan cs Laboratory. 3 F
Odometer tr ax a stat c and cyc c back pressure satu rated and unsaturated samp es pore pressure measure ments resonant co umn automat c data acqu s t on and n s tu test ng Lecture abs Prerequ s te CEE 351.

552 Geological Engineer ng. 3 S
Geo og ca nvest gat ons for eng neer ng purposes case h stor es geo og c structure weather ng remote sens ng geophys cs and a r photo nterpretat on for eng neer ng s te ocat ons. Lecture, f e d tr ps Pre equ s te CEE 351

553 Advanced So l Mechan cs. 3 S
App cat on of theor es of e ast c ty and p ast c ty to so s theor es of conso dat on fa ure theor es and response to stat c and dynam c oad ng. Prerequ s te: CEE 351

554 Shear Strength and Slope Stability. 3 F
Shear strength of saturated and unsaturated so s strength deformat on re at onsh ps t me dependent strength parameters effects of samp ng and advanced s ope stab ty Prerequ s te: CEE 351.

555 Applied Soil Mechanics. 3 S
Deep foundat ons, braced excavat ons, anchored bu k heads re nforced earth underp nn ng, and dewater ng Prerequ s te CEE 452

556 Seepage and Earth Dams. 3 F
Trans ent and steady tate f u d f ow through so conf ned and unconf ned f ow pore water pressures and app ca t on to earth dams Prerequ s te CEE 351

557 Top cs in Geotechnical Engineer ng. 3 F S
New and deve op ng techno ogy geotechn ca eng neer ng Prerequ s tes graduate stand ng nstructor ap prova .

558 Numer cal Methods. 3 F
Const tut ve re at ons for so s and numer ca techn ques app ed to geotechn ca eng neer ng, nc ud ng compute app cat ons Prerequ s tes CEE 351 computer program m ng graduate stand ng

559 Earthquake Engineering. 3 F
Character st cs of earthquake mot o s se ect on of des gn earthquakes s te response ana yses se sm c s ope stab ty and quefact on Prerequ s tes CEE 351 graduate stand ng

561 Phys cal-Chemical Treatment of Water and Waste. 3 F
Theory and des gn of phys ca and chem ca processes for the treatment of water and waste waters Prerequ s te CEE 361

562 Environmental Biochemistry and Waste Treatment. 3 S
Theory and des gn of b o og ca waste treatment systems Po ut on and env ronmenta ass m at on of wastes Pre requ s te CEE 362

563 Environmenta Chem stry Laboratory. 3 S
Ana ys s of water domest c and ndustr a wastes abora tory procedures for po ut on eva uat on and the control of water and waste treatment processes Lecture ab. Pre requ s te: CEE 361 or 362

564 Industr al Hygiene. 3 N
Survey methods and ega and phys o og ca aspects of occupat ona hea th hazards Methods of measurement and ana ys s and phys'o og ca act ons of such contam nants as tox c gases m nera dusts, meta s, and the compounds and ndustr a so vents

573 Traffic Eng neering. 3 F
Dr ver veh c e and roadway character st cs, aws and or d nances traff c contro dev ces traff c eng neer ng stud es and Transportat on System Management measures Prerequ s te CEE 372

574 Highway Capacity. 3 S
H ghway capac ty for a funct ona c asses of h ghways Traff c s gna zat on nc ud ng traff c stud es warrants cyc e ength, t m ng phasing and coord nat on Prerequ s te CEE 372.

575 Traffic Flow Theory and Safety Analysis. 3 F
Traff c f ow theory, d str but ons que ng, de ay mode s and car fo ow ng H ghway safety acc dent records sys tems acc dent ana ys s dent fy ng prob em ocat ons, and acc dent countermeasures Prerequ s te CEE 573 or 574.

576 Airport Engineering. 3 F
P ann ng and des gn of a rport fac t es Effect of a rcraf character st cs a r traff c contro procedures and a rcraf demand for runway and passenger hand ng fac it es on s te select on, runway conf gurat on, and term na des gn Prerequ s te CEE 372

577 Urban Transportation P anning. 3 S
App cat on of land use parameters traff c generat on the ory traff c d str but on and ass gnment mode s trans't ana ys s and econom c factors to the so ut on of the urban transportat on prob em. Prerequ s te· CEE 372

578 H ghway Engineering, Planning, and Economics. 3 S
H ghway transportat on nc ud ng des gn, operat on, p an n ng env ronmenta mpact econom c feas b ty and f nanc ng H ghways as a reg ona system Prerequ site: CEE 372

Students enro ed n CEE 580 590 592 599 792 and 799 are requ red to attend g aduate student sem nars at the t mes shown n the Schedu e of C asses *Each se mester every graduate student enro ed for more than e ght semester hours s to enro for at east one semeste hour of CEE 592, 599 792, or 799 Each c v eng neering graduate student hold ng an appo ntment as a teach ng or research ass stant o assoc ate s to enro for one semes ter hour of CEE 580 such cred t does not app y toward graduat on*

Omnibus Courses: See pages 50 51 for omn bus courses that may be offered

Computer Science and Engineering

PROFESSORS:
BARNHILL (ECG 252 ASHCROFT, BLACKLEDGE, F NDLER LEWIS, N ELSON, J. URBAN WADGE WOODFILL
ASSOCIATE PROFESSORS:
COLLOFELLO DASGUPTA, FALTZ, FAR N FAUST N , FOLEY, GOLSHANI, HUEY, L NDQU ST, MILLER, O'GRADY PHEAN S ROCKWOOD
ASSISTANT PROFESSORS:
CALL SS D ETRICH ELGOT DRAPK N, SEBAN SEN, S URBAN
INSTRUCTOR:
HOUSTON
PROFESSOR EMERITUS:
ROBB NS

Computers have a significant impact on our daily lives, and this impact is likely to be even greater in the future as computer professionals continue to develop more powerful, smaller, and less expensive computing systems. Computer science and computer engineering deal with the study, design, development, construction, and application of modern computing machinery. Other important topics include computing techniques and appropriate languages for general information processing, for scientific computation, for the recognition, storage, retrieval, and processing of data of all kinds, and for the automatic control and simulation of processes.

The curricula offered by the Department of Computer Science and Engineering prepare the student to be a participant in this rapidly changing area of technology by presenting in depth treatments of the fundamentals of computer science and computer engineering. The department offers two undergraduate degrees: a B.S. in Computer Science and a B S.E. in Computer Systems Engineering.

Degree Requirements

Minimum Scholastic Requirements. In addition to the requirement for a cumulative GPA of 2.00 or higher, all computer science and computer engineering students must obtain a minimum grade of "C" in all CSE courses used for degree credit.

Computer Science—B.S.

The Department of Computer Science and Engineering offers a B.S. degree that prepares the student for a career in computer science. A student pursuing a B.S. degree must complete the General Studies requirements described below, an English proficiency requirement, the computer science core courses, a senior level breadth requirement in the major, and a set of technical electives.

		Semester Hours
English Proficiency		
ENG 101, 1 2	First Year Composition	6
	or ENG 105 Advanced First-Year Composition 3 See page 289 for English requirements	
General Studies		
Humanities and Fine Arts		
*Social and Behavioral Sciences**		
(18 semester hours		
These courses must include at least one upper division course at least two courses from the same department, and courses from at least two departments.		
Humanities and Fine Arts		6–12
Social and Behavioral Sciences		12–6
*Literacy and Critical Inquiry**		
6 semester hours		
ECE 400	Engineering Communications	3
One course chosen from the university approved list. In general this course is sophomore level and includes a series of formal, graded, and written or spoken assignments in composing critical discourse		3
Numeracy		
7 semester hours		
CSE 355	Introduction to Theoretical Computer Science	3
MAT 270	Calculus with Analytic Geometry I	4
	or MAT 290 Calculus I 5	
Natural Science		
14 semester hours		
PHY 121	University Physics I Mechanics	3
PHY 122	University Physics Laboratory I	1
PHY 131	University Physics II Electricity and Magnetism	3
PHY 132	University Physics Laboratory II	1
Any physics course requiring PHY 131 as a prerequisite or any laboratory science satisfying the S1 or S2 General Studies requirements except PHY 101, 105, 111, 112		6
Total		45

NOTE: One course in the area of global awareness* and one course in historical awareness* *must* appear in the final list of courses in the student's graduation program of study. These can be included in the humanities and fine arts, social and behavioral sciences course selections.

* See pages 58–88 for the requirements and the approved list.

Computer Science Core			Semester Hours
CSE	100	Introduction to Computer Science I	3
CSE	101	Introduction to Computer Science II	3
CSE	120	Digital Design Fundamentals	3
CSE	201	Application Languages Programming Laboratory	1–2
CSE	202	Functional Languages Programming Laboratory	2–1
CSE	225	Assembly Language Programming Motorola	3
		or CSE 226 Assembly Language Programming Intel	3
CSE	310	Data Structures	3
CSE	325	System Design with Microprocessors (Motorola)	3
		or CSE 326 System Design with Microprocessors (Intel)	3
CSE	330	Computer Organization	3
CSE	340	Structure of Programming Languages	3
ECE	383	Probability and Statistics for Engineers	2
		or STP 326 Intermediate Probability	3
MAT	243	Discrete Mathematical Structures	3
MAT	271, 272	Calculus with Analytic Geometry II, III	8
		or MAT 291 Calculus II	5
MAT	342	Linear Algebra	3
		Total Computer Science Core	43
Computer Science Breadth Requirement			18
Each student must complete 18 hours of CSE 400 level courses			
Technical Electives			9
Each student must complete 9 hours of courses chosen from the computer science technical elective list and approved by the student's advisor			
Unrestricted Electives			7
		Total Degree Requirements	128

Computer Science Program of Study
Typical Four-Year Sequence

Freshman Year

First Semester			Semester Hours
CSE	100	Introduction to Computer Science I	3
ENG	101	First Year Composition	3
MAT	270	Calculus with Analytic Geometry I	4
General Studies Elective (HU or SB)*			3
Laboratory Science S1*			3
		Total	16
Second Semester			
CSE	101	Introduction to Computer Science II	3
CSE	120	Digital Design Fundamentals	3
ENG	102	First Year Composition	3
MAT	271	Calculus with Analytic Geometry II	4
Laboratory Science S2*			3
		Total	16

Sophomore Year

First Semester			
CSE	201	Application Languages Programming Laboratory	1
CSE	202	Functional Languages Programming Laboratory	1
MAT	243	Discrete Mathematical Structures	3
MAT	272	Calculus with Analytic Geometry III	4
PHY	121	University Physics I: Mechanics	3
PHY	122	University Physics Laboratory I	1
General Studies Elective (HU or SB)*			3
		Total	16
Second Semester			
CSE	225	Assembly Language Programming Motorola	3
CSE	310	Data Structures	3
PHY	131	University Physics II: Electricity and Magnetism	3
PHY	132	University Physics Laboratory II	1
General Studies Elective (HU or SB)*			3
Literacy and Critical Inquiry Elective*			3
		Total	16

Junior Year

First Semester			
CSE	201	Application Languages Programming Laboratory	1
CSE	325	System Design with Microprocessors (Motorola)	3
CSE	340	Structure of Programming Languages	3
MAT	342	Linear Algebra	3
General Studies Elective (HU or SB)*			3
Unrestricted Elective			3
		Total	16

Second Semester

CSE	330	Computer Organization	3
CSE	355	Introduction to Theoretical Computer Science	3
ECE	383	Probability and Statistics for Engineers	3
General Studies Elective HU or SB *			3
Technical Elective			3
Unrestricted Elective			2
		Total	16

Senior Year

First Semester

ECE	400	Engineering Communications	3
400 level CSE Computer Science Breadth Electives			9
Technical Elective			3
Unrestricted Elective			1
		Total	16

Second Semester

General Studies Elective HU or SB)*			3
400 level CSE Computer Science Breadth Electives			9
Technical Elective			3
Unrestricted Elective			1
		Total	16

* See pages 58 88 for the requirements and the approved list.

Computer Systems Engineering—B.S.E.

The Department of Computer Science and Engineering offers a B.S.E degree that prepares the student for a career in computer systems engineering. This degree program provides training in both engineering and computer science. The degree requirements for the School of Engineering show the requirements for English proficiency and General Studies for the B.S E. degree. The following list specifies the remaining requirements for the B.S E. degree.

Engineering Core			*Semester Hours*
CHM	114	General Chemistry for Engineers or CHM 116	4
CSE	225	Assembly Language Programming (Motorola) or CSE 226 Assembly Language Programming Intel	3
ECE	105	Introduction to Languages of Engineering	3
ECE	210	Engineering Mechanics I: Statics	3
ECE	301	Electrical Networks I	4
ECE	312	Engineering Mechanics II: Dynamics	3
ECE	333	Electr cal Instrumentation	3
ECE	340	Thermodynamics	3
ECE	352	Properties of Electronic Materials	3
ECE	383	Probability and Statistics for Engineers	2
MAT	274	Elementary Differential Equations	3
MAT	291	Calculus II or MAT 271 (4) and 272 (4)	5
MAT	342	Linear Algebra	3
PHY	361	ntroductory Modern Physics (Basic Science Elective	3
		Total	45

Computer Science Core			*Semester Hours*
CSE	120	Digital Design Fundamentals	3
CSE	200	Concepts of Computer Science	4
CSE	201	Application Languages Programming Laboratory	1
CSE	202	Functional Languages Programming Laboratory	1
CSE	310	Data Structures	3
CSE	325	System Design with Microprocessors (Motorola) or CSE 326 System Design with Microprocessors (Intel	3
CSE	330	Computer Organization	3
CSE	340	Structure of Programming Languages	3
CSE	355	Introduction to Theoretical Computer Science	3
CSE	421	Microprocessor System Des gn I	4
CSE	422	Microprocessor System Design II	4
CSE	423	Microcomputer System Hardware	3
MAT	243	Discrete Mathematical Structures	3
Area of Emphasis Technical Electives			13

The student selects technical electives from an approved list with approval of an advisor.

Total 51

The student selects technical electives from an approved list with approval of an advisor.

Computer Systems Engineering
Program of Study
Typical Four-Year Sequence
Freshman Year

First Semester			*Semester Hours*
CHM	114	General Chemistry for Engineers	4
ECE	105	Introduction to Languages of Engineering	3
ENG	101	First Year Composition	3
MAT	290	Calculus I	5
General Studies Elective HU or SB			3
		Total	18

Second Semester

CSE	120	Digital Design Fundamentals	3
CSE	200	Concepts of Computer Science	4
ECE	106	Introduction to Computer-Aided Engineering	3
ENG	102	First-Year Composition	3
MAT	291	Calculus II	5
		Total	18

Sophomore Year

First Semester

CSE	201	Application Languages Programming Laboratory	1
CSE	225	Assembly Language Programming (Motorola)	3
ECN	111	Macroeconomic Principles	3
MAT	243	Discrete Mathematical Structures	3
MAT	274	Elementary Differential Equations	3
PHY	121	University Physics I: Mechanics	3
PHY	122	University Physics Laboratory I	1
		Total	17

Second Semester

CSE	202	Functional Languages Programming Laboratory	1
CSE	310	Data Structures	3
CSE	325	System Design with Microprocessors (Motorola)	3
ECE	210	Engineering Mechanics I: Statics	3
PHY	131	University Physics II: Electricity and Magnetism	3
PHY	132	University Physics Laboratory II	1
Literacy and Critical Inquiry Elective[2]			3
		Total	17

Junior Year

First Semester

CSE	330	Computer Organization	3
CSE	340	Structure of Programming Languages	3
ECE	312	Engineering Mechanics II: Dynamics	3
ECE	383	Probability and Statistics for Engineers	2
PHY	361	Introductory Modern Physics	3
General Studies Elective (HU or SB)[1]			3
		Total	17

Second Semester

CSE	355	Introduction to Theoretical Computer Science	3
CSE	421	Microprocessor System Design I	4
ECE	301	Electrical Networks I	4
MAT	342	Linear Algebra	3
General Studies Elective (HU or SB)[1]			3
		Total	17

Senior Year

First Semester

CSE	422	Microprocessor System Design II	4
ECE	333	Electrical Instrumentation	3
ECE	340	Thermodynamics	3
ECE	400	Engineering Communications	3
Technical Elective			4
		Total	17

Second Semester

CSE	423	Microcomputer System Hardware	3
ECE	352	Properties of Electronic Materials	3
General Studies Elective (HU or SB)[1]			3
Technical Electives			9
		Total	18

[1] See pages 55–87 for the requirements and the approved list.

[2] See page 314 for special requirements and selection of an L1 elective.



COMPUTER SCIENCE AND ENGINEERING

CSE 100 Introduction to Computer Science I. 3 F S SS
Concepts of prob em so v ng, a gor thm des gn, structured programm ng fundamenta a gor thms and techn ques, and computer systems concepts Prerequ s te MAT 118

101 Introduction to Computer Science II. 3 F S SS
Advanced pr gramm ng techn ques f e proces ng m plementat on of arrays stacks queues nked sts and binary search trees arge program deve opment team programm ng Prerequ s te CSE 100 *[Sat sf es Genera Stud es Requ rement N3]*

120 Digital Design Fundamentals. 3 F S SS
Number systems convers on methods b nary and com p ement ar thmet c boo ean and sw tch ng a gebra, c rcu t m'n'm zat on ROMs PLAs, f pf ops, synchonous sequen t a circu ts, and reg ster transfer design Lecture ab Cross sted w th EEE 120 Prerequ s te CSE 100 or ECE 105

180 Computer Literacy. 3 F S, SS
ntroduct on to genera prob em so v ng approaches us ng w de y ava ab e software too s such as database pack ages wo'd processors spreadsheets, and report genera tors Nonmajors on y *[Sat sfies Genera Stud es Requ re ment N3]*

181 Applied Problem Solv'ng with BASIC. 3 F S SS
Introduct on to systemat c def n t on of prob ems so ut on formu at on and method va dat on Computer so ut on us ing BASIC required for projects Lecture ab Nonmajors only Prerequ s te MAT 117 *[Sat sf es Genera Stud es Requ rement: N3]*

183 Applied Problem Solving with FORTRAN. 3 F S
A human or ented, systems approach to prob em def n t on, formu at on and so ut on us ng FORTRAN Com puter solut on requ red for projects Nonmajors on y Pre requ s te MAT 118 *[Sat sf es General Stud es Requ re ment N3]*

200 Concepts of Computer Science. 4 A
Accelerated coverage of fundamenta concepts of com puter sc ence us ng Pasca for students w th a strong background n at east one other h gh eve programm ng anguage. Prerequ s te ECE 105 or equ va ent *[Satisf es General Stud es Requ rement N3]*

201 Application Languages Programming Laboratory. 1) F, S, SS
Each modu e ntroduces a programm ng anguage such as C FORTRAN PL/1, or COBOL. nc udes programm ng exerc ses. May be repeated for d fferent anguages Pre requ s te· CSE 101 or 200

202 Functional Languages Programming Laboratory. 1 F S SS
Each modu e ntroduces a programm ng anguage such as APL, L SP or PROLOG nc udes programm ng exerc ses May be repeated for d fferent anguages Prerequ s te CSE 101 or 200.

225 Assembly Language Programming (Motorola). 3 F, S SS
Assemb y anguage programm ng reg ster eve computer organ'zat on, data structure and address ng modes as semb ers and nkers Motoro a based ass gnments Cross sted w th EEE 225 Prerequ s te CSE EEE 120 *[Sat sfies General Stud es Requ rement· N3]*

226 Assembly Language Programming (Intel). 3 F S SS
Assemb y anguage programm ng, reg ster ieve computer organ zat on data structure and address ng modes, as semb ers and nkers Inte based ass gnments Cross sted w th EEE 226. Prerequ s te CSE EEE 120 *[Sat's f es Genera Stud es Requ rement. N3]*

304 Introduction to Cobol. 3 N
Fundamenta concepts of the Cobo programm ng an guage Emphas s on structured programm ng. Prerequ s te: CSE 100 or 200

305 Introduction to PL/I 3 N
Bas c concepts of the programm ng anguage PL/ Pre requ s te CSE 100 or 200

310 Data Structures. 3 F S SS
Data representat on, advanced treatment of arrays stacks queues, sts, dynam c storage a oca on n ary trees str ngs graphs AVL trees and data abstract on Prerequ s tes CSE 101 or 200 MAT 243

325 System Design w th Microprocessors (Motorola) 3 F, S, SS
CPU Memory management per phera dev ce nterfaces and programm ng M crocontro ers standard system buses ser a and para e O d rect memory access de v ces and commun cat ons Lecture ab Cross sted as EEE 325 Prerequ s te CSE EEE 225

326 System Design with M croprocessors (Intel). (3) F S SS
CPU Memory management/per phera dev ce nterfaces and programm ng M crocontro ers standard system buses ser a and para e I O d rect memory access de v ces, and f oat ng po nt processors Lecture ab Cross sted as EEE 326 Prerequ s te CSE EEE 226

330 Computer Organization. 3 F S SS
Instruct on set des gn, m crocontro p pe n ng, memory med a organ zat on and management· networks and commun cat ons. Prerequ s te CSE EEE 225 or CSE EEE 226

340 Structure of Programming Languages. 3 F S
Forma spec f cat ons for anguage syntax and dynamic runt me env ronments and an ntroduct on to anguage trans at on Prerequ s tes CSE 201 or 202 , 225 or 226 310.

355 Introduction to Theoretical Computer Science. (3) F S
ntroduct on to forma anguage theory and automata, Tur ng mach nes dec dab ty undec dab ty, recurs ve func t on theory and ntr duct on to comp ex ty theory Pre requ s te CSE 310

383 Appl'ed FORTRAN Programming. 3 F S
Advanced FORTRAN nc ud ng character hand ng ma ch ne dependency, sort ng and merg ng p ott ng, tapes, d sks t me shar ng te m na s and brary programs Lec ture ab. Nonmajors on y Prerequ s te CSE 183

408 Introduct on to Scene Analysis. 3 A
mage ana ys s and format on ow eve process ng object segmentat on texture ana ys s stereo v s on, and mot on, h gher eve nterpretat on act ve sens ng Prerequ s te CSE 310 or nstructor approva

410 Information Process ng. 3) A
Pr mary and secondary f e access organ zations Mu t at tr bute ndex ng. F e process ng ntroduct on to database management and document retr eval. Prerequ s te CSE 310

412 Database Management. 3 S
ntroduct on to DBMS concepts Data mode s and an guages Re at ona database theory Database secur ty in tegr ty and concurrency. Prerequ s te CSE 310

420 Comparison of Computer Architectures. 3 A
Evo ut on of ma n ne arch tectures nstruct on sets ad dress ng modes and contro structures Character zat on of computer arch tectures. Performance eva uat on Pre requ s te CSE 330 or 423

421 Microprocessor System Design I. 4 F S
Hardware software and assemb y anguage programm ng of a m crocomputer system are used as veh c es to teach fundamenta s of d g ta system des gn Lecture ab Prerequ s te CSE 325 or 326

422 Microprocessor System Design II. 4 F S
Des gn of m crocomputer systems us ng contemporary og c and m crocomputer system components Requ res assemb y anguage programm ng Prerequ s te CSE 421

423 Microcomputer System Hardware. 3 S
nformat on and techn ques presented n CSE 422 are used to deve op the hardware des gn of a mu t processor, mult programm ng m croprocessor based system Pre requ s te CSE 422

428 Computer-A ded Processes. 3 A
Hardware and software cons derat'ons for computer zed manufacturng systems Spec f c concentrat on on auto mat c nspect on numer ca contro robot cs and nte grated manufactur ng systems Prerequ s te CSE 330

430 Elementary Concepts of Operating Systems. 3 F S
Des gn and mp ementat on of supervisory system compo nents nput/output methods process management mu t - programmmg and mu t process ng systems, storage man agement, and f e systems Prerequ s tes CSE 330, 340

438 Systems Programming. 3 A
Des gn and mp ementat on of systems programs nc ud ng text ed tors, f e ut t es, mon tors assemb ers re ocat ng nk ng oaders, O hand ers, schedu ers etc Pre requ s te: CSE 421 or nstructor approva

440 Compiler Construction I. 3 F
ntroduction to programm ng anguage mp ementat on mp ementat on strateg es such as comp at on, nterpreta t on and trans at on Major comp at on phases such as ex ca ana ys s semant c ana ys s opt m zat on and code generat on Prerequ s te· CSE 340

450 Analysis of Algorithms. 3 F
Des gn and ana ys s of computer a gor thms us ng ana yt ca and emp r ca methods, complex ty measures, des gn methodo og es and survey of mportant a gor thms Pre requ s te CSE 310

451 Switching Theory. 3 N
Comb nat ona og c funct ona decompos t on NAND (NOR c rcu t ana ys s and synthes s og c arrays terat ve networks, fau t d agnos s sequent a c rcu t representa t on, and memory dev ces Prerequ s te CSE 325 or 326

457 Theory of Formal Languages. 3 A
Theory of grammar methods of syntact'c ana ys s and spec'f cat on types of art f c a anguages re at onsh p be tween forma anguages and automata. Cross sted as MAT 401 Prerequ s te CSE 355

459 Logic for Computing Scientists I. 3 F
Propos t ona og c syntax and semant cs proof theory vs mode theory soundness cons stency and comp eteness, first order og c og ca theories automated theorem prov ng, ground reso ut on pattern match ng un f cat on and resolut on, D jkstras og c proof ob gat ons and program prov ng Prerequ s te CSE 355.

460 Software Project Management and Development I. 3 F S
Software ife cyc e ana ys s· programm'ng teams; project documentat on and m estones requ rements and spec f cat ons, des gn, test ng and ma ntenance too s and tech- n ques Prerequ s te: sen or stand ng

470 Computer Graph cs. 3 F, S
D sp ay dev ces data structures transformat ons nterac t ve graph cs 3 d mensional graph'cs, and h dden ne prob em Prerequ s tes: CSE 310 MAT 342.

471 Introduction to Artificia Intelligence. 3 F S
State space search heur st c search games know edge representat on techn ques, expert systems, and auto mated reason ng Prerequ s te CSE 202 LISP and PROLOG 310

473 Nonprocedural Programming Languages. 3) S
Funct ona and og c programm ng us ng anguages ke Luc d and Pro og Typ ca appl cat ons wou d be a Screen Ed tor and an Expert System Prerequ s te CSE 355

474 Modeling for Computer Simulat on. 3 A
Mathemat ca descr pt on of genera dynam c systems d s- crete event, d screte t me, and cont nuous n forms su t ab e for computer mp ementat on. Prerequ s tes. CSE 310 ECE 383

475 Simulation Theory and Languages. 3 A
Stat st ca background for s mu at on. Mode construct on and va dat on, and the analys s of resu ts. Languages that support s mu at on Prerequ s'te: CSE 474

476 Introduction to Natural Language Processing. (3) F
Pr nc p es of computat ona 'ngu st cs, forma syntax and semant cs as app ed to the des gn of software w th natu ra human anguage O. Prerequ s te CSE 310 or n structor approva

477 Introduction to Computer-Aided Geometric Design. 3 F, S
ntroduct on to parametr c curves and surfaces Bez er and B sp ne nterpo at'on and approx mat on techn ques. Pre requ s tes CSE 101 or 200, MAT 342

508 Digital Image Processing I. (3 F
D g ta mage fundamenta s, mage transforms mage en hancement and restorat on techn ques, mage encod ng, and segmentat on methods Prerequ s te EEE 303 or n- structor approva

509 Digital Image Processing II. 3 S
Advanced ana yt ca techn ques app ed to d g ta mage process ng computer v sion, and app 'cat ons nc uding robot cs Prerequ s te: CSE 508.

512 Distributed Databases. 3 F
Fragmentat on des gn Query opt m zat on Distributed jo ns Concurrency contro D str buted dead ock detec t on Prerequ sites CSE 410, 412.

513 Database Machines. 3 N
Nonnumer c process ng Von Neumann bott enecks Par- a e and assoc at ve processors Database mach nes: survey theory software, and performance Advanced top- cs n database arch tectures Prerequ s tes CSE 330, 410 or 412

515 Information Storage and Retrieval. 3 N
Concepts of nformat on storage and retr eva such as the- ory, app cat ons and case stud es. Prerequ s te CSE 410

516 Digital Testing and Reliab lity. 3) A
Fau t mode ng test generation, and s mulat on for combi nat ona and sequent a c rcu ts memory test ng self

check ng og c fau t to erant og c and re ab ty ana ys s. Prerequ s tes: CSE 330 or 423 355 or 451

517 Digital Design Automation. 3 N
Typ ca computer a ded des gn system S mu at on tech n ques, test generat on m croprogrammed contro des gn a ds and spec f cat on sheet ana ys s App cat ons Pre requ s'te CSE 520 or 524

518 Hardware Design Languages. 3 N
ntroduct on to hardware design anguages (HDL s HDL descr pt on of ntegrated c rcu t components and systems HDL descr pt on of computer organ zat ons Prerequ s te CSE 30

520 Computer Architecture II. 3 A
Theoret'ca structure of computer and computat ons, per formance trade-offs, contro un ts memory h erarch es n put/output nterconnect on networks and operat ng sys tem support Prerequ s te CSE 430

521 Microprocessor Applications. 4 S
M croprocessor techno ogy and its app cat on to the de s gn of pract ca d g ta systems Hardware assemb y an guage programm ng and nterfac ng of m croprocessor based systems Lecture ab Prerequ s te CSE 421.

522 Microprogramming. 3 A
Theory pract ce and applicat on of m croprogramm ng Prerequ s te· CSE 330

523 Microcomputer Systems Software. 3 F
Deve op ng system software for a mu t processor mu tipro gramm ng, m croprocessor based system us ng nforma· t on and techn ques presented n CSE 421 422 Prerequ s te CSE 422

524 Multiprogramming Architectures. 3) N
Ma n ne computer arch tectures mu t programm ng t'meshar ng mu t process ng hardware software trade offs, memory h erarch es nput/output structures and commun cat ons Prerequis te CSE 330 or 423

526 Parallel Processing. (3 N
Rea and apparent concurrency Hardware organ zat on of *mu t processors mu t p e computer systems sc ent f c at* tached processors, and other para e systems Prerequ s te CSE 330 or 423.

527 High-Level-Language Machines. 3 N
Advantages and d sadvantages of high level anguage mach nes Languages su tab l ty M croprogramm ng and nterpret ve execut on O operat ons Examp es Pre requ site CSE 520 or 524

529 RISC Design Methodology. 3 N
Opt mal computer arch tecture des gn methodo ogy based on the symb ot c re at onsh p of hardware and software d sc p nes Prerequ s te CSE 330 or 423

530 Operating System Case Study. 3 F
Study of the des gn and mp ementat on of a t meshared mu t programm ng operat ng system, w th emphas s on the UN X operat ng system Prerequ s tes CSE 430 knowl· edge of C anguage

531 Distributed Operating Systems. 3 N
Interprocess commun cat ons concurrency contro f e system anguage constructs arch tecture, and network cons derat ons n d str buted operat ng and mu t processor systems Case stud es Prerequ s te CSE 530 or nstruc tor approva .

532 Security in Computing Systems. 3) A
In depth deve opment of the concepts of computer secu r ty mpact on computer hardware and software and on the user Prerequ s te CSE 430

534 Computer Networks. (3 N
Computer network protoco s hardware e ements and software a gor thms Error hand ng, routing, f ow contro , host to host commun cat'on and oca area networks Pre requ s te CSE 325 or 326

535 Performance Evaluation. 3 S
Top cs n computer system measurement and eva uat on inc ud ng hardware software mon tors, work oad charac ter zat on, program behav or, adaptive schedu ng s mu a t on mode s and measurement nterpretat on Prerequ s te CSE 430

536 Theory of Operating Systems. 3 F
Forma methods of contro of concurrent processes proc ess schedu ng memory and aux ary storage manage ment Network operat ng systems Operat ng system de s gn Prerequ s te CSE 430

540 Compiler Construction II. 3 S
Forma pars ng strateg es opt m zat on techn ques code generat on extensib ty and transportab ty cons dera t ons, and recent deve opments Prerequ s te CSE 440

545 Programming Language Design. 3 N
Language constructs, extens b ty and abstract ons and runt me support. Language des gn process. Prerequ s te: CSE 440

550 Combinatorial Algorithms and Intractability. 3 N
Comb nator a a gor thms nondeterm n st c a gor thms c asses P and NP NP hard and NP comp ete prob ems and ntractab ty Des gn techn ques for fast comb nator al a gor thms Prerequ s te CSE 450

554 Advanced Switching Theory. 3 S
Latt ces, Boo ean a gebras post a gebras, Boo ean d ffer ent a ca cu us, mu t va ued og c fuzzy og c and f n te state mach nes Prerequ s te CSE 451

555 Automata Theory. 3 N
F n te state mach nes pushdown automata l near bounded automata Tur ng mach nes reg ster mach nes rams and rasps re at onsh ps to computab ty and formal anguages Prerequ s te CSE 355.

556 Expert Systems. 3 S
Knowledge acqu s t on and representat on, ru e based systems frame based systems va dat on of know edge bases nexact reason ng and expert database systems

560 Software Project Management and Development II. 3 F S
Software project management, cost est mat on conf gura t on management, and qua ty assurance Advanced soft· ware eng neer ng fe cycle top cs Prerequ site: CSE 460

563 Software Requirements and Specification. 3 F
Exam nat on of the def n t ona stage of software deve op· ment, ana ys s of spec f cat on representat ons and tech n ques emphas z ng mportant appl cat on ssues. Pre requ s te CSE 460

564 Software Design. 3 S
Exam nat on of software des gn ssues and techn ques. Inc udes a survey of des gn representat ons and a com par son of design methods. Prerequ s te CSE 460.

565 Software Validation. 3 F
Software re ab ty mode s and measures program test ng theory, fau t to erant software program ver f cat on re ab e software des gn and deve opment and regress on test ng Prerequ s te CSE 460

566 Software Maintenance. 3 S
Survey of software ma ntenance prob ems too s metr cs and management approaches mp cat ons of software

maintenance on software development. Prerequisite: CSE 460.

570 Advanced Computer Graphics I. (3) F
Hidden surface algorithms, lighting models, and shading techniques. User interface design. Animation techniques. Fractals and stochastic models. Raster algorithms. Prerequisite: CSE 470.

571 Artificial Intelligence. (3) S
Definitions of intelligence, computer problem solving, game playing, pattern recognition, theorem proving, and semantic information processing; evolutionary systems; heuristic programming. Prerequisite: CSE 471.

572 Pattern Recognition. (3) N
Pattern classification by distance functions and likelihood functions, deterministic and statistical approaches to trainable pattern classifiers, and syntactic pattern recognition. Prerequisite: ECE 383 or STP 326.

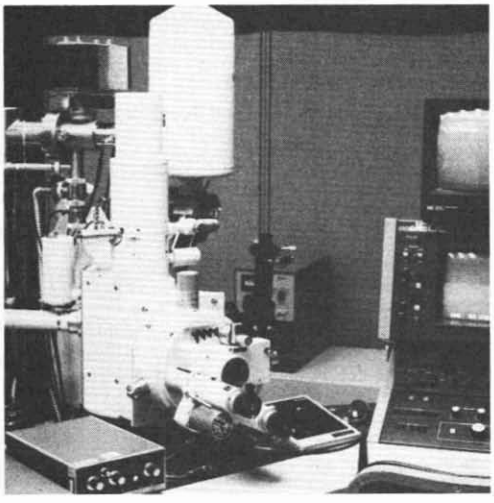
573 Advanced Computer Graphics II. (3) S
Modelling of natural phenomena: terrain, clouds, fire, water, and trees. Particle systems, deformation of solids, antialiasing, and volume visualization. Lecture, lab. Prerequisite: CSE 470.

576 Topics in Natural Language Processing. (3) S
Comparative parsing strategies, scoping and reference problems, non-first-order logical semantic representations, and discourse structure. Prerequisite: CSE 476 or instructor approval.

577 Advanced Computer-Aided Geometric Design I. (3) F
General interpolation; review of curve interpolation and approximation; spline curves; visual smoothness of curves; parameterization of curves; introduction to surface interpolation and approximation. Prerequisites: CSE 470 and 477 *or* instructor approval.

578 Advanced Computer-Aided Geometric Design II. (3) S
Coons patches and Bezier patches; triangular patches; arbitrarily located data methods; geometry processing of surfaces; higher dimensional surfaces. Prerequisites: CSE 470 and 477 *or* instructor approval.

Omnibus Courses: See pages 50–51 for omnibus courses that may be offered.



Electrical Engineering

REGENTS' PROFESSOR:
FERRY (ECG 127)

PROFESSORS:
AKERS, BACKUS, BALANIS, BOSE, CROUCH, DeMASSA, HADEN, HIGGINS, KARADY, KAUFMAN, KELLY, LUDERER, McKLVEEN, PALAIS, ROEDEL, SCHRODER, SIRKIS, WANG

ASSOCIATE PROFESSORS:
DAVIS, GREENEICH, GRONDIN, MARACAS, SHEN, SKROMME, TYLAVSKY

ASSISTANT PROFESSORS:
ABERLE, COCHRAN, CHAKRABARTI, CROW, EL-GHAZALY, EL-SHARAWY, GORUR, HASHEMI-YEGANEH, HOLBERT, KOZICKI, MORRELL, RODRIGUEZ, SPANIAS, SPECTOR, TSAKALIS

PROFESSORS EMERITI:
AX, BARKSON, DONNELLY, RUSSELL, SCHWUTTKE, STEINMANN, THOMPSON, TICE, WELCH, ZIMMER

The professional activities of electrical engineers directly affect the lives of most of the world's population every day. They are responsible for the design and development of radio and television transmitters and receivers, telephone networks and switching systems, computer systems, and electric power generation and distribution. Within the broad scope of these systems, the electrical engineer is concerned with a challenging and diverse array of design and development problems.

Electrical engineers design minuscule semiconductor integrated circuits that contain many thousands of elementary devices. They design systems for automatically controlling mechanical devices and a variety of processes. They are responsible for the design of satellite communication links as well as patient monitoring systems for hospitals. The development of the microprocessor has expanded the opportunities for electrical engineers to improve the design of familiar products since these devices are now incorporated in automobiles, consumer and office products, entertainment systems, and a vast variety of test and measurement instruments and machine tools.

Students who earn a B.S.E. degree majoring in Electrical Engineering will be involved in a variety of electrical and electronic problems in the course of their careers. To ensure the necessary

breadth of knowledge, the Electrical Engineering curriculum includes basic (core engineering courses and courses in networks and electronic circuits, electromagnetic fields and waves, microprocessors, communication and control systems, solid state electronics, electrical power systems, and other specialty courses.

Electrical Engineering—B.S.E.

The curriculum in Electrical Engineering builds upon the base provided by the engineering core. Beyond the engineering core, the curriculum includes a number of required electrical engineering and technical elective courses. Approved technical elective courses serve to provide students with an opportunity either to broaden their background in electrical engineering or to study, in greater depth, technical subjects in which they have special interests. Successful completion of the curriculum leaves the student prepared to embark on a career in electrical engineering or to pursue advanced education in graduate school.

Degree Requirements

Electrical Engineering Core

Students in Electrical Engineering fulfill the requirements of the engineering core by taking ECE 334 and 352 and EEE 225 or 226. No credit is given for ECE 333. Students may replace ECE 210 and 312 with PHY 321 and 322. Only ECE 313 may be deleted. The mathematics and basic science electives are met by taking the following courses:

			Semester Hours
MAT	342	Linear Algebra	3
MAT	362	Advanced Mathematics for Engineers and Scientists I	3
PHY	361	Introductory Modern Physics	3

In addition, the following courses are required to fulfill the electrical engineering core:

			Semester Hours
EEE	120	Digital Design Fundamentals	3
EEE	302	Electrical Networks II	3
EEE	303	Signals and Systems	3
EEE	325	System Design with Microprocessors (Motorola)	3
		or EEE 326 System Design with Microprocessors (Intel)	3
EEE	340	Electromagnetic Engineering I	3
EEE	341	Electromagnetic Engineering II	4
EEE	360	Energy Conversion and Transport	4
EEE	396	Professional Seminar	0
EEE	490	Senior Design Laboratory	3
		Total	26

Technical Electives in Electrical Engineering

The program in Electrical Engineering requires a total of 23 hours of technical electives. To ensure breadth of knowledge, students *must* select from the courses indicated not less than three of the following five areas:

Area	Course
Communications	EEE 455
Control	EEE 480
Electronics Circuits	EEE 405 or 425 or 433
Power Systems	EEE 470 or 471 or 473
Solid State Electronics	EEE 436

Of the remaining technical electives, at least half must be electrical engineering (EEE) 400 level courses. With approval of the faculty advisor, computer science (CSE) 400 level courses may be used as an alternative to meet this requirement.

With faculty advisor approval, qualified students may choose technical electives from other courses in engineering, mathematics, and the sciences at or above the 300 level, including graduate courses. Students must have a GPA of not less than 3.00 and approval of the instructor to enroll in EEE graduate level courses. In addition, up to six semester hours of technical electives may be chosen from the approved list of courses from the College of Business.

Electrical Engineering Program of Study

Typical Four-Year Sequence

Freshman Year

			Semester Hours
First Semester			
CHM	114	General Chemistry for Engineers	4
		or CHM 116 General Chemistry	4
ECE	105	Introduction to Languages of Engineering	3
ENG	101	First Year Composition	3
MAT	290	Calculus I	5
PHY	121	University Physics I: Mechanics	3
PHY	122	University Physics Laboratory I	1
		Total	19
Second Semester			
ECE	106	Introduction to Computer Aided Engineering	3
EEE	120	Digital Design Fundamentals	3
ENG	102	First Year Composition	3
MAT	291	Calculus II	5
PHY	131	University Physics II: Electricity and Magnetism	3
PHY	132	University Physics Laboratory II	1
		Total	18

Sophomore Year

First Semester

ECE	210	Engineering Mechanics I: Statics	3
ECE	301	Electrical Networks I	4
EEE	225, 226	Assembly Language Programming	3
MAT	274	Elementary Differential Equations	3
MAT	342	Linear Algebra	3
		Total	16

Second Semester

ECE	312	Engineering Mechanics II: Dynamics	3
EEE	302	Electrical Networks II	3
EEE	325, 326	System Design with Microprocessors	3
MAT	362	Advanced Mathematics for Engineers and Scientists I	3
PHY	361	Introductory Modern Physics	3
General Studies Elective (HU or SB [1]			3
		Total	18

Junior Year

First Semester

ECE	334	Electronic Devices and Instrumentation	4
ECE	352	Properties of Electronic Materials	3
ECN	111	Macroeconomics	3
EEE	303	Signals and Systems	3
EEE	340	Electromagnetic Engineering I	3
EEE	396	Professional Seminar	0
Literacy and Critical Inquiry Elective[2]			3
		Total	19

Second Semester

ECE	340	Thermodynamics	3
EEE	341	Electromagnetic Engineering II	4
EEE	360	Energy Conversion and Transport	4
General Studies Elective HU or SB)[1]			6
		Total	17

Senior Year

First Semester

EEE	490	Senior Design Laboratory	3
General Studies Elective (HU or SB)[1]			3
Technical Electives			11
		Total	17

Second Semester

ECE	400	Engineering Communications	3
Technical Electives			12
		Total	15

See pages 58 88 for the requirements and the ap proved list

[2] See page 328 for special requirements and selection of an L1 elective.

Graduation Requirements

The attention of the student is directed to the re tention and graduation requirements of the uni versity and the School of Engineering. In addition to those requirements, a student must earn a grade of "C" or better in the mathematics and physics courses listed in the program of study. The student must also have an overall GPA of at least 2.00 for the following group of courses: ECE 301, 334, 352; all courses with an EEE prefix, all other courses used as technical electives.

Special Program

For those students interested in microelectronics manufacturing engineering, nuclear engineering sciences, and systems engineering, these options are available under the Engineering Special Programs. See pages 378–382 for details and course requirements

ELECTRICAL ENGINEERING

EEE 120 Digital Design Fundamentals. (3 F S, SS
Number systems convers on methods b nary and com p ement arithmet c boolean and switch ng a gebra circu t min mizat on ROMs PLAs f pf ops synchronous se- quent a circu ts, and reg ster transfer design Lecture ab Cross l sted as CSE 120 Prerequ s te CSE 100 or ECE 105

225 Assembly Language Programming (Motorola). (3) F, S SS
Assemb y anguage programm ng reg ster eve computer organ zat on data structure and address ng modes, as semb ers, and nkers Motorola based ass gnments Cross sted with CSE 225 Prerequ s te CSE/EEE 120 *[Sat sfies General Studies Requirement. N3]*

226 Assembly Language Programming (Intel). (3) F, S, SS
Assembly anguage programming, register eve computer organ zat on data structure and address ng modes as semb ers and l nkers Inte based ass gnments Cross sted w th CSE 226 Prerequ sites CSE/EEE 120. *[Satis fies General Studies Requirement. N3]*

302 Electrical Networks II. (3) F S SS
Ana ys s of near and non inear networks Ana yt ca and numer cal methods Prerequis te ECE 301

303 Signals and Systems. (3) F S SS
ntroduct on to continuous and d screte time s gna and system ana ysis L near systems, Four er, and z trans- forms. Prerequ site. EEE 302. Pre or corequisite: MAT 342.

325 System Design with Microprocessors (Motorola). (3) F, S, SS
CPU Memory management/periphera device nterfaces and programm ng M crocontro ers, standard system buses, sena and para e l O, d rect memory access de- v ces, and commun cat ons. Lecture, lab Cross- sted as CSE 325. Prerequis te: CSE EEE 225

326 System Design with Microprocessors (Intel). 3 F, S, SS
CPU Memory management/peripheral devices interfaces and programming. Microcontrollers, standard system buses serial and parallel I/O direct memory access devices and floating point processors. Lecture/lab. Cross listed as CSE 326. Prerequisite: CSE/EEE 226.

340 Electromagnetic Engineering I. 3 F, S, SS
Static and time varying vector fields, boundary value problems; dielectric and magnetic materials. Maxwell's equations; boundary conditions; uniform plane waves. Prerequisites: MAT 362, PHY 131.

341 Electromagnetic Engineering II. 4 F, S
Coaxial and waveguide transmission lines, matching techniques; plane waves in lossy media, polarization, reflection and refraction, electromagnetic system concepts, radiation. Lecture, lab. Prerequisites: ECE 105 and 301 and EEE 340 *or* equivalents.

360 Energy Conversion and Transport. 4 F, S
Three phase circuits. Energy supply systems. Magnetic circuit analysis; synchronous generators, transformers, induction machines, and dc circuits. Load flow and short circuit calculations. Lecture/lab. Prerequisite: ECE 301.

396 Professional Seminar. 0 F, S
Topics of interest to upperclass electrical engineers. 1 hour lecture. Prerequisite: junior standing.

405 Filter Design. 3 F
Principles of active and passive filter design. Time and frequency domain approximations. Prerequisite: EEE 303 or equivalent.

406 Computer-Aided Design. 3 N
Principles and application of modern CAD techniques to solve engineering problems; includes independent project. Prerequisite: EEE 303 or equivalent.

407 Digital Signal Processing. 4 F
Time and frequency domain analysis, difference equations, z transform, FIR and IIR Digital Filter Design, Discrete Fourier Transform, FFT, and random sequences. Lecture, lab. Prerequisites: EEE 303, MAT 342.

425 Digital Systems and Circuits. 4 F, S
Digital logic gate analysis, propagation delay times, figures of merit and noise margins. Application of MOS and bipolar logic families, including NMOS, CMOS, standard and advanced TTL and ECL, regenerative logic circuits, memories and VLSI circuits, computer simulations using PSPICE. Lecture/lab. Prerequisite: ECE 334.

433 Analog Integrated Circuits. (3 S
Analysis, design and applications of modern analog circuits using integrated bipolar and field effect transistor technologies. Prerequisite: ECE 334.

434 Quantum Mechanics for Engineers. (3 F
Probability, Schroedinger equation, eigenfunctions, harmonic oscillator, periodic potentials, superposition, angular momentum, scattering, tunneling and perturbation theory. Prerequisite: EEE 340.

435 Microelectronics. 3 S
Practice of solid state device fabrication techniques, including thin film and integrated circuit fabrication principles. Lecture/lab. Prerequisite: EEE 436 or equivalent.

436 Fundamentals of Solid State Devices. (3 F, S
Metal-semiconductor contacts, PN junctions, light interacting devices, Schottky diodes, bipolar and field effect *transistors, planar and thin film integrated circuits, IC devices.* Prerequisite: ECE 352.

439 Semiconductor Facilities and Cleanroom Practices. 3 F
Microcontamination, cleanroom concepts, operational considerations, ultrapure water, process materials, safety practices, introduction to industrial hygiene and emergency response. Mandatory for users of CEAS cleanroom.

443 Antennas. 3) S
Fundamental parameters; engineering principles and radiation integrals; near wire antennas, loops and arrays, numerical computations, measurements. Prerequisite: EEE 341 or equivalent.

445 Microwaves. 4 F
Waveguides; circuit theory for waveguiding systems, microwave devices, systems and energy sources, striplines and microstrips; impedance matching transformers, measurements. Lecture/lab. Prerequisite: EEE 341 or equivalent.

448 Fiber Optics. 4 F
Principles of fiber optic communications. Lectures/labs. Prerequisites: EEE 303, 340.

451 Error-Correcting Codes. (3 S
Application of modern algebra to the analysis and synthesis of random error detecting and error-correcting block codes. Prerequisite: CSE/EEE 120.

454 *Random Signal Theory I.* 3 F, S
Application of statistical techniques to the representation and analysis of electrical signals and to communications systems analysis. Prerequisite: EEE 303.

455 Communication Systems. (4 F, S
Signal analysis techniques applied to the operation of electrical communication systems. An introduction to and overview of modern digital and analog communications. Lecture/lab. Prerequisite: EEE 303.

459 Data Communication Systems. 3 S
System characteristics. Communication media. Communication codes. Data validity checking. Line protocols, terminals and system configurations. Examples. Prerequisite: EEE 303.

460 Nuclear Concepts for the 21st Century. (3) F
The world energy situation and the role of nuclear power. Nuclear fission and fusion theory. The nuclear fuel cycle. Ultrasafe reactor designs. Radiation damage to electronics including soft errors and space radiation. Current and future applications in nuclear medicine, radiology and food preservation. Cross-listed as NUC 460. Prerequisite: PHY 361.

461 Health Physics Principles and Radiation Measurements. 3) S
Sources, characteristics, dosimetry, shielding and measurement techniques for cosmogenic, terrestrial and anthropogenic radiation. Ionizing and nonionizing radiation theory. ALARA concept. Emphasis on instrumentation, detectors, and environmental monitoring. Lecture, lab. Cross listed as BME/NUC 461. Prerequisite: ECE 301.

462 Reactor Safety Analysis. (3 N
Power reactor safety and censing methodologies. Reactor transient and accident analysis. Time dependent solution to neutron diffusion equation. Use of industry codes to assess fission product build up, emergency core cooling behavior, reactivity, offsite releases and dose calculations. Cross listed as NUC 462. Prerequisite: EEE/NUC 460.

463 Electrical Power Plant. 3 F
Nuc ear, foss and so ar energy sources Analys s and des gn of steam supp y systems e ectr ca generat ng systems and aux ary systems Power plant eff c ency, op erat on and costs and ana yses Cross- sted as NUC 463. Prerequ s tes· ECE 301 340

464 Nuclear Engineering Experiments. 3 F
Theory and appl ed concepts n reactor des gn nstrumen tat on, e ectron cs and sh'e d ng Exper menta measure ments of nuc ear parameters us ng subcr t ca reactors and fus on neutron generator Fast and thermal act vat on analys s Mossbauer spectrometry Lecture ab Cross sted as NUC 464 Corequ s te. EEE/NUC 460

465 Radiation Dosimetry and Instrumentation 3 F 92
Rad ation dos metry and nstrumentat on used at nuc ear power plants Ca cu at on of externa and nterna rad a t on doses Rad at on b o ogy Sh e d ng ca cu at ons. Cross- sted as NUC 465 Prerequis te BME EEE NUC 461

470 Electric Power Devices. 3 F
Ana ys s of dev ces used for short c rcu t protect on n clud ng c rcuit breakers, re ays current and vo tage transducers, etc Protect on aga nst sw tch ng and ght n ng over voltages nsu at on coord nat on Lectures Prerequis te: EEE 360

471 Power System Analysis. (3) S
Rev ew of transm ss on ne parameter ca cu at on Zero sequence mpedance, symmetr ca components for fau t analys s short c rcu t calcu at on rev ew of power f ow analys s power system stab ty and power system con tro concepts D str but on system ana ys s feeder des gn, vo tage drop capacitor p acement and substat on oca tion Prerequ s te EEE 360

473 Electrical Machinery. 3 S
Ana ys s and des gn of transformers and rotat ng ma ch nes, inc ud ng dc nduct on, and synchronous ma ch nes. Pr nc p es of motor drives; thyr'stor m croprocessor contro . Prerequ s te: EEE 360

480 Feedback Systems. 4 F S
Analys s and des gn of near feedback systems. Fre quency response and root ocus techn ques ser es com pensat on, and state var ab e feedback Lecture, ab. Pre requ s te EEE 303

482 Introduction to State Space Methods. 3 F
D screte and cont nuous systems n state space form such as near systems E ements of rea zat on observer and stab zat on theory App cat ons to d g ta computer s mu at on Prerequis te. EEE 303

490 Senior Design Laboratory. 3 F S
Project oriented aboratory Each student w comp ete *severa des gn projects dur ng the semester Lecture, ab*
Prerequis tes: ECE 334, EEE 303, sen or status or nstruc tor approva

506 Digital Spectral Analysis. 3 S
Pr nc ples and app cat ons of d g ta spectra ana ysis east squares random sequences parametr c and non parametr c methods for spectral est mat on Prerequ s tes· EEE 407 454

525 VLSI Design. 3 S
Ana ys s and des gn of Very Large Sca e Integrated VLS Circu ts. Phys cs of sma devices, fabr cation regu ar structures, and system t m ng. Open on y to graduate stu dents

531 Semiconductor Device Theory I. 3 F
Transport and recomb nat on theory, pn and Schottky bar r er d odes, b po ar and junct on f e d effect trans stors and MOS capac tors and trans stors Prerequ s te· EEE 436 or equ va ent

532 Semiconductor Device Theory II. 3 S
Advanced MOSFETs, charge coup ed dev ces so ar ce s photodetectors ght em tt ng d odes, microwave dev ces and modu at on doped structures Prerequ s te: EEE 531.

533 MOS Integrated Circuit Engineering. 3 N
MOS dev ce phys cs, ntegrated c rcu t fabr cat on, CMOS, ana og and d g ta c rcuit des gn s mu at on and ayout and y e d and re ab ty mode s Prerequ s te. EEE 436 or equ va ent

534 Semiconductor Transport. 3 F
Carr er transport n sem conductors Ha effect h gh elec tric f e d, Bo tzmann equat on corre ation funct ons, and carr er carrier nteract ons Prerequ s te· EEE 436 or equ va ent.

535 Solar Cells. 3 F
Photovo ta c dev ces inc ud ng homo unctions and hetero unct ons Photogenerat on of carr ers spectra re- sponse e ectr cal character st cs and eff c ency Pre requ s te· EEE 436 or equiva ent

536 Semiconductor Characterization. 3) S
Measurement techn ques for sem conductor matena s and dev ces. E ectr ca opt ca phys ca and chem ca charac ter zat on methods Prerequ s te EEE 436 or equ va ent

537 Semiconductor Optoelectronics I. (3 N
E ectronic states n sem conductors quantum theory of rad at on absorpt on processes rad at ve processes, nonrad at ve processes photo um nescence and photon c dev ces. Prerequ s te EEE 434.

538 Semiconductor Optoelectronics II. 3 N
Materia and dev ce phys cs of sem conductor asers ight em tt ng d odes photodetector etc Emerg ng mater al and dev ce techno ogy n I V sem conductors Prerequ s te EEE 537

539 Introduction to Solid State Electronics. 3 S
Crysta att ces, rec proca att ces quantum stat st cs at t ce dynam cs equ' br um and nonequ br um processes in sem conductors Prerequ s te EEE 434.

541 Electromagnetic Fields and Guided Waves. (3 F
Po anzat on and magnet zat on, d electr c, conduct ng an sotrop c and sem conduct ng med a, dua ty, un queness and mage theory, p ane wave funct ons, wavegu des resonators and surface gu ded waves Prerequ s te: EEE 341 or equiva ent.

542 Selected Microwave Devices. 3) S
Use of ferr te, sem conductor, and p ezoe ectric mater als in m crowave systems Prerequ s tes ECE 352 and EEE 445 *or* equ va ents

543 Antenna Analysis and Design. 3 F
Impedances broadband antennas frequency ndepend ent antennas m n atur zat on aperture antennas, horns ref ectors ens antennas, and cont nuous sources des gn techn ques Prerequ s te EEE 443 or equ va ent

544 High Resolution Radar. 3 F
Fundamenta s w deband coherent des gn, waveforms, and process ng stepped frequency· synthet c aperture ra dar SAR nverse synthet c aperture radar (ISAR mag· ng Prerequ s tes EEE 303 and 340 *or* equ va ents

545 Microwave Circuit Design. 3 N
Ana ys s and des gn of m crowave attenuators, n phase and quadrature phase power d v ders, mag c tee s, d rec t ona coup ers phase sh fters DC b ocks, equa zers etc Prerequ s te EEE 445 or nstructor approva

546 Advanced Fiber-Optics. 3 N
Theory of propagat on n fibers, frequency modu at on of ght f ber-opt c heterodyne rece vers, f ber opt c sensors, and b refr ngence n f bers. Prerequ s te EEE 448 or n structor approva .

547 Microwave Solid State Circuit Design I. 3 N
App cat on of sem conductor character st cs to pract ca des gn of m crowave m xers detectors m ters sw tches, attenuators mu t p ers phase sh fters and amp f ers Prerequ s te. EEE 545 or nstructor approva

548 Coherent Optics. 3 N
D ffract on enses, opt ca process ng ho ography e ec tro-opt cs and asers Prerequ s te EEE 341

549 Lasers. (3 N
Theory and des gn of gas so d and sem conductor a sers. Prerequ s te EEE 448 or nstructor approva .

550 Transform Theory and Applications. 3 F
App cations of comp ex var ab es to Four er, Lap ace, and z transforms. Or ented to app cat ons n co tro network commun cat on and near system theory. Prerequ s te: EEE 303.

551 Information and Coding Theory. 3 N
Fundamenta theorems of nformat on theory for sources and channe s convo ut ona and burst codes Prerequ s tes EEE 451 454

552 Coherent Communications. 3 N
Systems analys s and des gn of te ecommun cat on sys tems us ng phase ocked oops Prerequ s te EEE 454.

555 Random S'gnal Theory II. 3 S
Process ng of s gna s in the presence of no se Random s gna s correlat on frequency spectra est mat on, f ter ng, no se pred ct on and trans ents Prerequ s te EEE 454

556 Detection and Estimation Theory. 3 N
Comb nat on of the c ass ca techn ques of stat st ca nfer ence and the random process characterizat on of comm n cation, radar, and other modern data process ng sys tems Prerequ s tes· EEE 454 455.

558 Modulation Theory. 3 N
No se performance of ana og and d g ta modu at on sys tems Emphas s on modern d g ta techn ques n terrestr a and sate ite commun cat ons systems Prerequ s tes EEE 454, 455

566 Nuclear Instrumentation. 3 N
De sgn and ana ys s of imag ng systems for nuc ear sc ences app cat ons and research Laboratory experiments us ng computer zed mult channe ana yzer systems who e body count ng systems and computer zed tomography. Lecture ab. Cross sted as BME/NUC 566 Prerequ s te. EEE/NUC 465 or nstructor approva .

567 Radiation Shielding and Transport. 3 F
Sh e d ng for radiat on therapy d agnost c rad o ogy cyc o trons and nuc ear reactors Monte Car o and emp rica computat onal methods, regu at ons, and des gn prob ems Cross sted as BME NUC 567 Prerequ s te BME/ EEE/NUC 465

569 Radiochemistry and Advanced Nuclear Instrumentation. 3 N
Advanced concepts in env ronmenta and power p ant ra d ochem stry Chem ca separat ons for od ne, stront um rad um and uran um Advanced detect on concepts n a pha gamma spectrometry and l qu d sc nt at on Lec ture ab. Cross sted as NUC 569. Prerequ te BME 465 or EEE/NUC 465.

571 Power System Transients. 3 N
Ana ys s of trans ent currents and vo tages generated by d sturbances n power networks EMTP method. Trav- e ng waves Trans ents n transformers and generators Protect on aga nst trans ents Prerequ s te. EEE 471.

572 Power Electronics. 3 N
Ana ys s of dev'ce operat on 'nc ud ng thyr stors gate turn off thyr stors and trans stors. Des gn of rectif er and nverter c rcu ts App cat ons such as var ab e speed dr ves, HVDC motor contro and un nterruptab e power supp es Prerequ s te: EEE 471.

573 Power System Control. 3 N
Concepts of econom c and secure operat on of power sys- tems oad frequency contro econom c d spatch unit comm tment state est mat on and cont ngency ana ys s Prerequ s te EEE 471

574 Computer Solution of Power Systems. 3 N
A gor thms for d g ta computat on for power f ow fault and stab ty ana ys s. Sparse matr x and vector program m ng methods opt m zat on, and stochast c methods Pre- requ s te EEE 471

577 Power System Planning. 3 F
Power f ow and trans ent stab ty ana ys s oad forecast ng methods and re ab ty concepts. Transm ss on p an n ng oss of oad probab ty and product on cost ana ys s, and opt ma network and generat on expans on. Prerequ s te EEE 470

579 Power Transmission and Distribution. 3 S
H gh vo tage tran m ss on ne des gn such as conduc tors corona and R and TV no se dc transm ss on D str but on system ana ys s nc ud ng oad character st cs feeder vo tage drop and capac tor app cat ons Prerequ s te EEE 471

581 Random Processes in Control Systems. 3 N
Stat st ca f ter ng est mat on and contro w th emphas s on the Ka man f ter and ts app cat ons and computat ona prob ems Prerequ s tes EEE 454 482 550

582 Linear System Theory. 3 S
Contro ab ty observab ty and rea zat on theory for mu t var ab e cont nuous t me systems Stab zat on and asymptot c state est mat on D sturbance decoup ng non nteract ng contro Prerequ s te EEE 482

585 Digital Control Systems. 3 N
Ana ys s and des gn of d g ta and samp ed data control systems, nc ud ng samp ng theory, z transforms, the state trans t on method stab ty, des gn, and synthes s Prerequ s tes· EEE 482 550

586 Nonlinear Control Systems. 3 N
Stab ty theory nc ud ng phase p ane descrb ng func t on L apunov s method and frequency doma'n cnter a for cont nuous and d screte non near and t me vary ng sys tems P erequ s te EEE 482.

587 Optimal Control Systems. 3 N
App cat on of ca cu us of var at ons Pontryag n's pr n- c'p e, and dynam'c programm ng to contro prob ems. Computat ona techn ques for so v ng opt ma contro prob- lems. Prerequ s te EEE 482

631 Heterojunctions and Superlattices. 3 N
Princ p es of heterojunct ons and quantum we structures band ne ups optica and e ectr cal properties ntroduc t on to heterojunct on dev ces

641 Advanced Electromagnetic Field Theory. 3 N
Cy ndr ca wave funct ons wavegu des, and resonators, spher ca wave funct ons and resonators· 'ntegra equa t ons scatter ng and rad at on; perturbat onal and var at ona methods P erequ s te EEE 541 or equ va ent

643 Advanced Topics in Electromagnetic Radiation. 3 N
H gh frequency asymptot c techn ques, geometr ca and phys ca theor es of d ffract on GTD and PTD , moment method MM rada cross sect on RCS predict on Four er transforms n rad at on and synthes s methods Prerequ s te EEE 543

645 Microwave Filter Design. 3 N
Ana y s and des gn of m crowave ow pass h gh pass band pass and band stop f lters and m crowave d p exers mu t p exers Prerequ s te EEE 545 or nstructor ap prova

647 Microwave Sol d State Circuit Des gn II. 3 N
Pract ca des gn of m crowave free runn ng and vo tage contro ed osc ators us ng Gunn and mpatt d odes and trans stors ana ys s of no se character st cs of the osc a tor. Prerequ s tes EEE 545 547

731 Small MOS Devices. 3 S
Subthresho d current, thresho d vo tage modulat on, sca ng and other sma s ze m tat ons Prerequ s te EEE 532

732 Advanced Bipolar Dev ces and Circuits. 3 F
Cr t ca exam nat on of new b po ar dev ce and c rcu t tech no g es Performance trade offs sca ng effects and mode ng techn ques Prerequ s te EEE 531

770 Advanced Topics n Power Systems. 3 N
Power system prob ems of current nterest approached at an advanced techn ca eve , for mature students Pre requ s tes EEE 5 7 and 579 *or* equ va ents nstructor ap prova

Omn bus Courses: See pages 50 51 for omn bus courses that may be offered

Industrial and Management Systems Engineering

PROFESSORS:
WOLFE ECG 303), BA LEY BEDWORTH MONTGOMERY, SM TH

ASSOCIATE PROFESSORS:
ANDERSON, COCHRAN, DEAN ELL OTT, KEATS, MACKULAK, MOOR ROLL ER SHUNK

ASSISTANT PROFESSORS:
BEAUMAR AGE, HUBELE, NUNO, ROBERTS, RUCKER

PROFESSORS EMERITI:
HOYT, KNIGHT, YOUNG

The industrial engineer (IE provides leadership for American organizations in productivity im provement and in reestablishing competitiveness in the domestic and international marketplaces. This gives IE's a v ide range of interests and re sponsibilities. In a manufacturing enterprise, for example, the common goal of American industry and the IE) is both to modernize and migrate the organization toward the concept of the factory of the future (FOF).

Information technologies are of major interest to the industrial engineer. Information technol ogy makes it possible to integrate people, mate rial, machines, money, and other resources into productive enterprises. Information systems in cluding networks, database models, and computer hardware and softw are that tie people and re sources together symbolize the essence of "inte gration" from a systems perspective.

Technology integration includes the integration of mechanical, electrical, chemical, structural, and biological systems to create synergistic higher-level systems and subsystems. Other dis ciplines tend to take vertical cuts deep into their areas of specialty while IEs take horizontal cuts across multiple areas of technology

A distinguishing feature of industrial engineer ing is the emphasis on people In fact, industrial engineering is often referred to as the "people-ori ented profession." It is a primary function of the IE to integrate people and technology oriented systems. IEs are active in the fields of human factors and ergonomics. With the development of the field of artificial intelligence and expert sys tems, the IE is being called upon to lead the movement from muscle based work to knowl edge-based work. Industrial engineering is the only engineering discipline offering course work in quality assurance, so critical in today's com petitive environment.

The IE is not only the developer of people and technology integrated systems but also a prime candidate for all levels of management, especially those in high tech organizations, because of the IE's background in technology integration, organ izational theory, management practice, and engi neering economics. This is evidenced by the fact that more than half of all practicing IEs are in some level of management.

The demand for IEs is growing in direct pro portion to the exponential increase in integration, modernization, and automation activities. It has been predicted that the demand growth rate for industrial engineers will be considerably higher than average for the foreseeable future.

Industrial Engineering—B.S.E.

Degree Requirements

The following courses are required as a part of the engineering core, mathematics requirement and the microcomputer elective (only ECE 313

Introduction to Deformable Solids may be deleted from the engineering core):

			Semester Hours
ECE	383	Probability and Statistics for Engineers	2
IEE	463	Computer Aided Manufacturing and Control	3

In addition, the following courses are required for the Industrial Engineering major:

			Semester Hours
ASE	485	Engineering Statistics	3
IEE	300	Economic Analysis for Engineers	3
IEE	330	Microcomputer Applications in Industrial Engineering	3
IEE	367	Methods Engineering and Facilities Design	4
IEE	374	Quality Control	3
IEE	422	Information Systems Design	3
IEE	431	Engineering Administration	3
IEE	461	Integrated Production Control	3
IEE	475	Introduction to Simulation	3
IEE	476	Operations Research Techniques Applications	4
IEE	488	Industrial Engineering Analysis	3
IEE	490	Project in Design and Development	3
MET	343	Material Processes	4
Area of Emphasis technical electives)			10
Total			52

Technical Electives in Industrial Engineering

In consultation with an advisor, technical electives may be selected from one or more of the following areas of emphasis. A maximum of two courses are allowed outside the School of Engineering The graduate courses listed under these areas may, with departmental approval, be taken for undergraduate credit provided the student has a GPA greater than or equal to 3.00.

Computer aided manufacturing CHE 461; IEE 464; MET 346, 443, 451, 452, 453.

Engineering management BLW 306; IEE 411, 510, 531.

Information systems CSE 304, 305, 410, 412; IEE 464, 577.

Quality control reliability. AET 409; IEE 569, 570, 571, 573; MAE 441, 442.

With departmental approval, technical electives may also be chosen from other courses in engineering, mathematics, the sciences, and business administration at or above the 300 level. A minimum of six hours of technical electives must be taken from this department.

Industrial Engineering Program of Study

Typical Four-Year Sequence

Freshman Year

First Semester			Semester Hours
CHM	114	General Chemistry for Engineers[1]	4
ECE	105	Introduction to Languages of Engineering	3
ENG	101	First Year Composition	3
MAT	270	Calculus with Analytic Geometry I	4
General Studies Elective (HU or SB)[2]			3
Total			17

Second Semester			
ECE	106	Introduction to Computer Aided Engineering	3
ENG	102	First-Year Composition	3
MAT	271	Calculus with Analytic Geometry II	4
PHY	121	University Physics I: Mechanics	3
PHY	122	University Physics Laboratory I	1
Literacy and Critical Inquiry Elective[3]			3
Total			17

Sophomore Year

First Semester			
ECN	111	Macroeconomic Principles or ECN 112 Microeconomic Principles (3)	3
IEE	300	Economic Analysis for Engineers	3
MAT	242	Elementary Linear Algebra	2
MAT	272	Calculus with Analytic Geometry III	4
PHY	131	University Physics II Electricity and Magnetism	3
PHY	132	University Physics Laboratory II	1
Total			16

Second Semester			
ECE	210	Engineering Mechanics I: Statics	3
ECE	383	Probability and Statistics for Engineers	2
IEE	330	Microcomputer Applications in Industrial Engineering	3
MAT	274	Elementary Differential Equations	3
Basic Science Elective[4]			3
General Studies Elective (HU or SB[2])			3
Total			17

Junior Year

First Semester			
ASE	485	Engineering Statistics	3
ECE	301	Electrical Networks I	4
ECE	312	Engineer ng Mechanics II. Dynamics	3
ECE	340	Thermodynamics	3
General Studies Elective (HU or SB[2])			3
Technical Elective			2
Total			18

Second Semester

ECE	333	Electrical Instrumentation	3
ECE	350	Structure and Properties of Materials	3
IEE	367	Methods Engineering and Facilities Design	4
MET	343	Material Processes	4
General Studies Elective HU or SB [2]			3
Technical Elective			2
		Total	19

Senior Year

First Semester

IEE	374	Quality Control	3
IEE	422	Information Systems Design	3
IEE	431	Engineering Administration	3
IEE	461	Integrated Production Control	3
IEE	463	Computer Aided Manufacturing and Control	3
IEE	475	Introduction to Simulation	3
		Total	18

Second Semester

ECE	400	Engineering Communications	3
IEE	476	Operations Research Techniques Applications	4
IEE	488	Industrial Engineering Analysis	3
IEE	490	Project in Design and Development	3
Technical Electives			6
		Total	19

Graduation requirements 33 semester hours minimum plus English proficiency

[1] Students who have taken no high school chemistry should take CHM 113 and 116.

[2] See pages 58 88 for the requirements and the approved list

[3] See page 328 for special requirements and selection of an LI elective

[4] Must be an earth science or life science course; if physics or chemistry, the course must be of a more advanced level than PHY 131

Manufacturing Engineering

Manufacturing engineering is concerned with the application of the principles of science to increase productivity in industry. This involves the design of systems that allow for the best utilization of man, machines, material, and money. Modern manufacturing engineering is concerned with the application of technology, including computers, robots, graphics, mathematical and digital models, information and database systems, microtechnology, and systems theory.

Emphasis is placed on management and economics as well as technology. Graduates of the program are well qualified to participate in the introduction of CAD CAM CIM and factory automation technology to industry.

The following courses are required as part of the engineering core, mathematics requirement and the microcomputer elective (only ECE 333 Electrical Instrumentation may be deleted from the engineering core):

			Semester Hours
ECE	350	Structure and Properties of Materials	3
ECE	383	Probability and Statistics for Engineers	2
IEE	463	Computer Aided Manufacturing and Control	3

The basic science elective may be selected from BIO 181, CHM 331, GLG 100, PHY 361, and ZOL 201.

In addition, the following courses are required:

			Semester Hours
IEE	300	Economic Analysis for Engineers	3
IEE	330	Microcomputer Applications in Industrial Engineering	3
IEE	374	Quality Control	3
IEE	422	Information Systems Design	3
IEE	431	Engineering Administration	3
IEE	464	Computer Integrated Design	3
IEE	490	Project in Design and Development	3
MAE	317	Dynamic Systems and Control	4
MET	331	Design for Manufacturing I	3
MET	343	Materia Processes	4
MET	438	Design for Manufacturing II	4
MET	443	N C Computer Programming	3
MET	451	Introduction to Robotics	3
Technical Electives one course of engineering science c ntent required			10
		Total	52

INDUSTRIAL AND MANAGEMENT SYSTEMS ENGINEERING

IEE 300 Economic Analysis for Engineers. 3 F S
Economic evaluation of alternatives for engineering decisions emphasizing the time value of money Prerequ'site: MAT 270

330 Microcomputer Applications in Industrial Engineering. 3 F, S
Concepts related to development of operational capability in the use of microcomputer hardware software and networking as related to industrial engineering applications Prerequisite ECE 105 *[Satisfies General Studies Requirement. N3]*

367 Methods Engineering and Facilities Design. 4 F S
Analysis and design of work systems, productivity motion and time study techniques, human factors Analysis and design of facilities for automated and manmachine systems emphasis on process design materials handling, layout design and facilities location Lecture, lab Prerequisites EE 300, 330 or equivalent

374 Quality Control. 3 F
In depth ana ys s of contro chart and other stat'st ca process contro techn ques Organ zat on and manager a aspects of qua ty assurance Attr bute and var ab e ac ceptance samp ng p ans Prerequ s te ECE 383

411 Engineering Economy. 3 S
Equ pment rep acement ana ys s treatment of nf at on in cash f ow stud es, and cons derat on of r sk and uncer ta nty Prerequ s te. EE 300

422 Information Systems Design. 3 F, SS
Emphas s on the app cat on of system ana ys s and de s gn to nformat on systems M croprocessor M S project requ red. Prerequ s te. EE 330 or equ va ent

431 Engineering Administration. 3 F SS
Eng neering organ zat on and adm n strat on ntroduct on to dec sion mak ng quant tat ve and qua tat ve ap proaches to management and eng neer ng adm nistrat on

437 Human Factors Engineering. 3 F
Study of people at work· des gn ng for human perform ance effect veness and product v ty Cons derat ons of human phys o og ca and psycho og ca factors Prerequ s te EE 367

461 Integrated Production Control. 3 F S
Product'on contro techn ques for the p ann ng ana ys s contro , and eva uat on of operat ng systems T me ser es forecast ng, network p ann ng schedu ng and contro Prerequ'sites ECE 383 EE 330 or equ va e t

463 Computer-Aided Manufacturing and Control. 3 F, S
Emphas s on computer contro n manufactur ng rea t me concepts C M NC group techno ogy and process p an n ng, and robot cs Prerequ s te· IEE 330 or equ va ent *[Sat sf es Genera Stud es Requ rement. N3]*

464 Computer-Integrated Design. 3 F S
Use of CAD too s to create geometr c objects and ayout des'gns. Des gn nterfac ng through database structure w th manufactur ng p ann ng contro funct ons nc udes open shop des'gn ab ass gnments n add t on to c ass room work Prerequ s tes ECE 106 IEE 330 or equ va ent. *[Sat sf es General Stud es Requ rement N3]*

475 Introduction to Simulat on. 3 F S
Use of s mulat on n the ana ys s and des gn of network and d screte systems Methods for us ng a s mulat on lan guage Introduct on to stat st ca aspects to s mu at on Prerequ s tes. ECE 383 IEE 330 or equ va ent. *[Sat sfies Genera Stud es Requirement N3]*

476 Operations Research Techniques Applications. 4) F S
Top cs nc ude near programm ng network opt m zat on dynam c programm ng Markov processes and queue ng mode s Emphas s on the des gn and deve opment of mode s for so v ng dec s on prob ems n ndustr a sys tems Prerequ s tes ECE 383 MAT 242. *[Sat sf es Gen eral Stud es Requ rement· N2]*

488 Industria Engineering Analysis. 3 S
Labor mater al and overhead cost ana ys s, parametric cost estimat ng r sk ana ys s nvo v ng budget m tat ons assurance of est mates qua ty cost systems and fe cyc e cost ana ys s nc ud ng effects on eng neer ng de sign, re ab ty ma nta nab ty, serv ceab ty, testab ty, and ava ab ty. Prerequ s tes: ECE 383 IEE 300

490 Project in Design and Development. 3 F S
nd v dua project n creat ve des gn and synthes s Pre requ s te sen or stand ng

501 Foundations of Industrial Engineering I. 3 F
Techn ques for the ana ys's and des gn of man mach ne systems. Emphas s on work p ann ng, methods measure ments materia hand ng, and fac ty des gn Not ava able for .E graduate credit

502 Foundations of Industrial Engineering II. (3) S
ntroduct on to quant tat ve product on contro techn ques, nc ud ng p ann ng forecast ng inventory contro and MRP and schedul ng nf uence of CAD CAM and auto mation on product on contro process Not ava ab e for E graduate cred t Prerequ s te ECE 383 or 500

503 Economic Analysis for Engineers. 3 F, S
Econom c eva uat on of a ternat ves for eng neer ng dec s ons emphas z ng the t me value of money. Not avai ab e for E graduate cred t Prerequ s te MAT 270

504 Math Tools Industrial Engineers. 3 F, S
ntroduct on to, and extens on of, fundamenta mathemat ca techn ques Extens ve use of a comprehensive com puter based mathemat ca env ronment to both exp ore and ver fy mathemat ca theorems and problems linear a gebra probab ty stat st cs opt m zat on transform the ory and og c.

510 Measurement of Productivity. 3 F 92
The eng neering econom c aud t and ts use w th app ica t ons to break even ana ys s var ab e budget control cost ana ys s and product pr c ng Prerequis tes ECE 383 or 500, EE 330 or equ va ent

511 Analysis of Decision Processes. (3 S
Methods of mak ng decis ons n comp ex env ronments and stat st cal dec s on theory, effects of risk uncerta nty and strategy on engineer ng and manager a decisions Prerequ s te ECE 383 or 500

520 Ergonomics Design. 3 F 91
Human phys o og ca and psycho og ca factors in the de s gn of work env ronments and n the emp oyment of peop e n man mach ne systems Open shop lab ass gn ments n add t on to c ass work Prerequ s te· IEE 437 or 547

531 Topics in Engineering Administration. 3 S 93
Cons derat on g ven to ph osoph ca psycho og cal, po ti ca and socia mp cat ons of adm n strat ve dec sions Prerequ s te EE 431 or 541

532 Management of Technology. 3 F
Top cs nc ude des gn ng a techn ca strategy, techno og ca forecasting; nterfac ng market ng eng neering and manufactur ng des gn ng and manag ng nnovat on sys tems· creat v'ty app cat on of bas c management pr n c p es to techno ogy management Prerequ site· EE 431 or nstructor approva .

533 Scheduling and Network Analysis Models. (3) S 92
App cat on of schedu ng and sequenc ng a gorithms de term n st c and stochast c network ana ys s, and flow a go nthms Prerequ s tes· ECE 383 or 500, EE 476 or 546

540 Engineering Economy. 3 S
Equ pment replacement ana ys s, treatment of nflat on n cash f ow stud es and cons derat on of r sk and uncer ta nty Open on y to students w thout prev ous cred t for EE 411. Prerequ s te: EE 300 or 503

541 Engineering Administration. (3 F SS
Eng neering organ zat on and adm n strat on, ntroduct on to decis on mak ng· quantitat ve and qua tat ve ap proaches to management and eng neering adm n strat on. Open on y to students w thout prev ous cred t for EE 431

542 Information System Design. 3 F SS
Emphas s on the app cat on of system analys s and de sign to nformation systems. M croprocessor MIS project requ red Open on y to students w thout prev ous cred t for IEE 422 Prerequ s te. EE 330 or equ va ent

543 Computer-Aided Manufacturing and Control. 3 F, S
Emphasis on computer contro n manufactur ng rea t me concepts CIM NC group techno ogy and process p an n ng and robot cs. Open only to students w thout prev ous cred t for IEE 463 Prerequ s te. EE 330 or equ va ent

544 Computer-Integrated Design. 3 F, S
Use of CAD too s to create geometr c objects and ayout des gns Des gn nterfac ng through database structure w th manufactur ng p ann ng contro funct ons. ncludes open shop des gn ab ass gnments n addit on to c ass room work Open on y to students without prev ous cred t for EE 464 Prerequ s tes ECE 106, IEE 330 or equ va ent.

545 Introduction to Simulation. 3 F S
Use of s mulat on n the ana ys s and des gn of network and d screte systems Methods for us ng a s mu at on an guage. ntroduct on to stat stica aspects of s mu ation. Open on y to students w thout prev ous cred t for EE 475 Prerequisites ECE 383 or 500, EE 330 or equ va ent

546 Operations Research Techniques Applications. (4 F, S
Top cs nc ude near programm ng network opt m zat on dynam c programm ng Markov processes and queue ng mode s Emphas s on the des gn and deve opment of mode s for so v ng dec s on prob ems n ndustr a sys tems Open on y to students w thout prev ous cred t for IEE 476 Prerequ s tes ECE 383 or 500, MAT 242

547 Human Factors Engineering. 3 F
Study of peop e at work; des gn ng for human perform ance effect veness and product v ty Cons derat ons of human phys o og ca and psycho og ca factors Open only to students w thout prev ous cred t for EE 437 Prerequ s te. EE 367 or equ va ent

548 Industrial Engineering Analysis. 3 S
Labor mater a and overhead cost ana ys s parametr c cost estimat ng r sk ana ys s nvo ving budget m tat ons assurance of est mates qua ty cost systems and fe cycle ana ys s nc ud ng effects on eng neer ng des gn re l ab ity, ma nta nab ity, serv ceab l ty testab ty, and ava ab ty Open on y to students w thout prev ous cred t for EE 488 Prerequ s tes: ECE 383 or 500; IEE 300 or 503.

560 Database Concepts for Industrial Management Systems. (3 S
Applicat on of data base concepts to ndustr al systems prob ems Topics nc ude conceptua model ng data struc tures database software, and perspect ves from expert and know edge base systems Prerequ s tes ECE 383 or 500, EE 422 or 542

561 Production Control Information Systems. 3) F
Deve opment of nformat on system des gns for product on contro Topics nc ude MRP , MRP schedu ng, se quenc ng, and nventory contro On l ne des gn concepts are covered. Prerequ sites ASE 485 or 500 IEE 461 MAT 242

563 Systems Analysis for Distributed Systems. 3 S
Ana ysis and des gn of d str buted systems for computer ntegrated manufactur ng and nformation process ng Concepts of host dr ven m croprocessors to co ect store and commun cate data Prerequ s tes ECE 383 or 500 EE 422 or 542

564 Planning for Computer-Integrated Manufacturing. 3 F
Theory and use of IDEF methodology n p ann ng for f ex b e manufactur ng robot cs and rea t me contro . S mu a t on concepts app ed to computer ntegrated manufactur ng p ann ng. Prerequisite EE 463 or 543

565 Computer-Integrated Manufacturing Research. 3 S
Determ nat on and eva uat on of research areas n com puter ntegrated manufactur ng nc ud ng rea t me soft ware manufactur ng nformat on systems, f ex b e and n tegrated manufactur ng systems, robot cs and computer graph cs Prerequ s te EE 564

566 Simulation in Computer-Integrated Manufacturing Planning. 3 S
Use of s mulat on n the p ann ng of computer ntegrated manufactur ng p ann ng re ated to robot cs f ex b e and ntegrated manufactur ng systems Use of computer graph cs comb ned w th s mu at on ana ys s for C M dec s on support Prerequ s te IEE 475 or 545

567 System S'mulation. 3 S
Use of s mu at on n the ana ys s a d des gn of systems nvo v ng cont nuous and d screte processes s mu at on anguages stat st'ca aspects of s mu at on Prerequ s te EE 475 or 545

569 Advanced Statistical Methods. 3 S
App cat on of stat st ca nference procedures based on ranks to eng neer ng prob ems Eff c ent a ternat ves to c ass cal stat st ca nference constra ned by norma ty assumpt ons Prerequ s te· ASE 485 or 500

570 Advanced Quality Control. 3 F
Econom c based acceptance samp ng mu t attr bute ac ceptance samp ng, narrow m t gaug ng n nspector error and attr butes acceptance samp ng, princ p es of qua ty management and se ected top cs from current terature Prerequ s tes ASE 485 or 500 IEE 374

571 Quality Management. 3 F
Tota qua ty concepts qua ty strateg es qua ty and com pet t ve pos t on, qua ty costs, vendor re at ons the qua ty manua and qua ty n the serv ces Prerequ s te EE 431 or 541

572 Design of Engineering Experiments. 3) F, S
Ana ys s of var ance and exper menta des gn Top cs n c ude genera des gn methodo ogy ncomp ete b ocks confound'ng fract ona rep cat on, and response surface methodology Prerequ s te ASE 485 or 500

573 Reliability Engineering. 3 S
Top cs inc ude the nature of re ab ty t me to fa ure den s t es, espec a y the exponent a and We bu ser es paral e standby systems comp ex system re ab ity Bayes an re ab ty ana ys s and sequent a re ab ty tests Pre requ s te ECE 383 or 500

574 Applied Deterministic Operations Research Models. 3 F
Formu at on, so ut on, ana ys s, and app cat on of deter m n st c mode s n operat ons research nc ud ng those of near programm ng nteger programm ng and non near programm ng Prerequ s te IEE 476 or 546

575 Applied Stochastic Operations Research Models. 3 S
App cat on of stochast c mode s nc ud ng nventory the ory queue ng theory, Markov processes stochastic pro gramm ng and renewa theory. Prerequ s tes· ASE 485 or 500

576 Applications of Operations Research. (3) F
Case studies of application of linear and nonlinear models and general types of search techniques. Prerequisite: IEE 574 or instructor approval.

577 Decision and Expert Systems Methodology. (3) F
Systems approach to the analysis, design, and implementation of decision support systems. Emphasis on development of databases, model bases dialogs, and systems architecture as well as systems effectiveness. Introduction to expert systems as decision aid included. Term project required. Prerequisite: IEE 422 or 542.

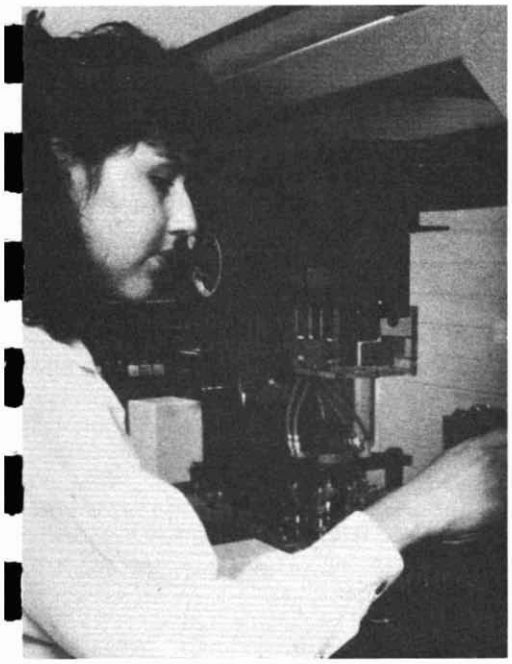
579 Time Series Analysis and Forecasting. (3) F
Forecasting time series by the Box-Jenkins and exponential smoothing techniques; existing digital computer programs are utilized to augment the theory. Prerequisites: ASE 485 or 500; IEE 461.

582 Response Surfaces and Process Optimization. (3) S
An introduction to response surface method and its applications. Topics include steepest ascent, canonical analysis, designs, and optimality criteria. Prerequisite: IEE 572.

678 Advanced Decision Theory. (3) S
Advanced decision theory techniques for industrial systems. Topics include conjugate families of distributions, value theory, decisions with multiple objectives, and goal programming. Prerequisite: IEE 511.

681 Reliability, Availability, and Serviceability. (3) F
Includes organizing for RAS, hardware and software RAS, integrity and fault-tolerant design, maintenance design and maintenance strategy, Markov models for RAS, fault-tree analysis, and military standards for RAS. Prerequisite: ECE 383 or 500.

Omnibus Courses: See pages 50–51 for omnibus courses that may be offered.



Mechanical and Aerospace Engineering

PROFESSORS:
BOYER (ECG 346C), BEAKLEY, BICKFORD, CHEN, DAVIDSON, EVANS, FLORSCHUETZ, HIRLEMAN, JACOBSON, JANKOWSKI, KRAJCINOVIC, LOGAN, METZGER, NELSON, ROY, SARIC, SCHMIDT, SO, TONG, WALLACE, WOOD, YAO

ASSOCIATE PROFESSORS:
FERNANDO, KUO, LAANANEN, LIU, PECK, RANKIN, REED, SHAH, WIE

ASSISTANT PROFESSORS:
BLECHSCHMIDT, CHATTOPADHYAY, HENDERSON, KOURIS, MAJUMDAR, McNEILL, MIGNOLET, NATSIAVAS, WELLS

PROFESSORS EMERITI:
ALLEN, AVERY, DITSWORTH, FRY, KAUFMAN, PRICE, RICE, SHAW, THOMPSON, TURNBOW, WILCOX, WOOLDRIDGE

The Department of Mechanical and Aerospace Engineering is the administrative home for two undergraduate majors: Aerospace Engineering and Mechanical Engineering.

Both majors build on the broad exposure to the engineering, chemical, and physical sciences and the mathematics embodied in the General Studies and engineering core courses required of all engineering students.

The *Aerospace Engineering* major provides students an education in technological areas critical to the design and development of aerospace vehicles and systems. Aerospace Engineering graduates are typically employed at government laboratories (e.g., NASA) and in a wide range of aerospace industries. The *Mechanical Engineering* major is perhaps one of the most broadly applicable programs in engineering, providing education for a wide variety of employment opportunities.

The two majors, discussed in more detail below, can serve as entry points to immediate professional employment or to graduate study. The emphasis in all fields is on development of fundamental knowledge that will have long-lasting utility in our rapidly changing technical society. Employers' desire for this emphasis is a strong point in favor of these choices of curricula over technology or special programs that emphasize

primarily current applications or specific industries.

Degree Requirements

All degree programs in the department require that students attain a minimum GPA of 2.00 in the engineering core and major in order to be eligible for graduation. Also, the department may require additional or remedial work for those students who have demonstrated a trend of academic difficulty.

Engineering Core Options

Among the options listed on pages 330 and 331 as part of the engineering core requirements, students in the Department of Mechanical and Aerospace Engineering are required to select the following:

			Semester Hour
ECE	210	Engineering Mechanics I. Statics	3
ECE	312	Engineering Mechanics II. Dynamics	3
ECE	313	Introduction to Deformable Solids	3
ECE	340	Thermodynamics	3
ECE	350	Structure and Properties of Materials	3
MAE	305	Measurements and Micro computers	4

Aerospace Engineering—B.S.E.

The primary concern of aerospace engineers is the design and development of a wide variety of aircraft and space vehicles and systems. The current challenges to the aerospace engineer include the design of a new generation of high efficiency transport aircraft, the development of the next generation of space transports, and the design of large space systems. In addition to the design of vehicles, the aerospace engineer is involved in the further development of the many spin offs of the aerospace industry These include contributions to communications, air and water pollution monitoring, management of the earth's resources, and the understanding and control of weather Future contributions are anticipated in the area of zero gravity manufacturing of high purity materials and medicines, and the design of solar power satellites.

The undergraduate curriculum includes the study of flight mechanics, aerospace structures and materials, aerodynamics and propulsion. These subjects provide the foundation necessary for design of aircraft and space vehicles.

Aerospace Engineering Major

Aerospace Engineering students are required to select the following courses in the engineering core.

			Semester Hours
ECE	386	Partial Differential Equations for Engineers	2
MAT	342	Elementary Linear Algebra	3
PHY	361	Introductory Modern Physics	3

The Aerospace Engineering major consists of the following courses:

			Semester Hours
MAE	317	Dynamic Systems and Control	4
MAE	361	Aerodynamics I	3
MAE	413	Spacecraft Dynamics and Control	3
MAE	415	Vibration Analysis	4
MAE	425	Aerospace Structures I	3
MAE	426	Aerospace Structures II	4
MAE	441	Design Theory and Techniques	3
MAE	460	Gas Dynamics	3
MAE	461	Aerodynamics II	3
MAE	462	Dynamics f Flight	3
MAE	463	Propulsion	3
MAE	464	Aerospace Laboratory	2
MAE	467	Aircraft Performance	3
MAE	468	Aerospace Systems Design	3
Area of Emphasis (Technical Electives			6
Total			50

Aerospace Engineering Areas of Emphasis

Technical electives may be selected from among any of the courses listed below or from courses listed under the Mechanical Engineering areas of emphasis. The courses are grouped so that the student may select an elective package of closely related courses. A student may, with prior approval of the advisor and department, select a general area and a corresponding set of courses not listed below that would support a career objective not covered by the following categories.

Aerodynamics. MAE 434, 466, 471, 490; MAT 466.

Aerospace materials. ECE 383; MAE 455; MSE 355, 420, 440, 441, 450, 470.

Aerospace structures ECE 383; MAE 404, 455, 490.

Computer methods. ASE 485; CSE 310, 320, 422, 428; ECE 383; IEE 463, 464, 475; MAE 403, 404, 406, 471, 541; MAT 464, 465, 466.

Design MAE 341, 403, 404, 406, 435, 442, 446, 455, 466, 490; MSE 440, 441.

Mechanical. Any courses listed under Mechanical Engineering Areas of Emphasis.

Propulsion. MAE 382, 434, 436, 465, 489, 490.

System dynamics and control CSE 428; ECE 383; EEE 480, 482; MAE 417, 447, 490.

Aerospace Engineering
Program of Study
Typical Four-Year Sequence

The first two years are usually totally devoted to the General Studies and engineering core requirements. Thus, all the degree programs in the department share essentially the same course schedule for that period of time. A typical schedule is given below:

Program of Study
Typical Four-Year Sequence

Freshman Year

First Semester			Semester Hours
CHM	114	General Chemistry for Engineers	4
		or CHM 116 General Chemistry (4	
ECE	105	Introduction to Languages of Engineering	3
ENG	101	First Year Composition	3
MAT	290	Calculus I	5
General Studies Elective (HU or SB)			3
		Total	18

Second Semester			
ECE	106	Introduction to Computer Aided Engineering	3
ENG	102	First-Year Composition	3
MAT	291	Calculus II	5
PHY	121	University Physics I: Mechanics	3
PHY	122	University Physics Laboratory I	1
General Studies Elective HU or SB)[1]			3
		Total	18

Sophomore Year

First Semester			
ECE	210	Engineering Mechanics I· Statics	3
MAT	274	Elementary Differential Equations	3
MAT	342	Elementary Linear Algebra	3
PHY	131	University Physics II Electricity and Magnetism	3
PHY	132	University Physics Laboratory II	1
Literacy and Critical Inquiry Elective[2]			3
		Total	16

Second Semester			
ECE	301	Electrical Networks I	4
ECE	312	Engineering Mechanics II: Dynamics	3
ECE	313	Introduction to Deformable Solids	3
ECE	340	Thermodynamics	3
ECE	350	Structure and Properties of Materials	3
ECE	386	Part al Differential Equations for Engineers	2
		Total	18

Junior Year

First Semester			Semester Hours
MAE	361	Aerodynamics I	3
MAE	305	Measurements and Micro-computers	4
MAE	413	Spacecraft Dynamics and Control	3
MAE	425	Aerospace Structures I	3
PHY	361	Introductory Modern Physics	3
General Studies Elective HU or SB [1]			3
		Total	19

Second Semester			
MAE	317	Dynamic Systems and Control	4
MAE	426	Aerospace Structures II	4
MAE	441	Design Theory and Techniques	3
MAE	460	Gas Dynamics	3
MAE	467	Aircraft Performance	3
		Total	17

Senior Year

First Semester			
MAE	415	Vibration Analysis	4
MAE	461	Aerodynamics II	3
MAE	462	Dynamics of Flight	3
MAE	463	Propulsion	3
General Studies Elective (HU or SB)			3
		Total	16

Second Semester			
ECE	400	Engineering Communications	3
MAE	464	Aerospace Laboratory	2
MAE	468	Aerospace Systems Design	3
General Studies Elective (HU of SB [1]			3
Technical Electives			6
		Total	17

See pages 58 88 for the specific requirements and the approved list

- See page 328 for special requirements and selection of an L1 elective

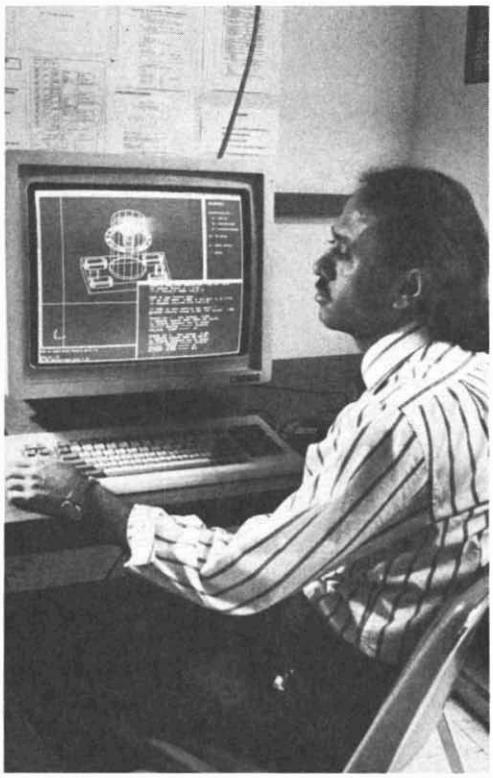
Mechanical Engineering—B.S.E.

Mechanical engineering is a creative discipline that draws upon a number of basic sciences to design the devices, machines, processes, and systems that involve mechanical work and its conversion from and into other forms. It includes: the conversion of thermal, chemical, and nuclear energy into mechanical energy through various engines and power plants; the transport of energy via devices like heat exchangers, pipelines, gears,

and linkages; the use of energy to perform a variety of tasks for the benefit of society, such as in transportation vehicles of all types, manufacturing tools and equipment, and household appliances. Furthermore, since all manufactured products must be constructed of solid materials and because most products contain parts that transmit forces, Mechanical Engineering is involved in the structural integrity and materials selection of almost every product on the market.

Mechanical engineers are employed in virtually every kind of industry. They are involved with seeking new knowledge through research, with doing creative design and development, and with the construction, control, management, and sales of the devices and systems needed by society. Therefore, a major strength of a mechanical engineering education is the flexibility it provides in future employment opportunities for its graduates.

The undergraduate curriculum includes the study of: the principles governing the use of energy; the principles of design, instruments and control devices; the application of these studies to the creative solution of practical, modern problems.



Mechanical Engineering Major

Mechanical Engineering students are required to select the following in the engineering core:

			Semester Hours
ECE	386	Partial Differential Equations for Engineers	2
MAT	242	Elementary Linear Algebra	2
PHY	361	Introductory Modern Physics	3

The Mechanical Engineering major consists of the following courses:

			Semester Hours
ECE	384	Numerical Analysis for Engineers I	2
MAE	317	Dynamic Systems and Control	4
MAE	371	Fluid Mechanics	3
MAE	372	Fluid Mechanics	4
MAE	382	Thermodynamics	3
MAE	388	Heat Transfer	3
MAE	415	Vibration Analysis	4
MAE	422	Mechanics of Materials	4
MAE	441	Design Theory and Techniques	3
MAE	442	Mechanical Systems Design or MAE 446 Thermal Systems Design (3)	3
MAE	443	Engineering Design	3
MAE	490	Projects in Design and Development	2
MAE	491	Experimental Mechanical Engineering	3
Area of Emphasis (Technical) Electives			10
Total			51

Mechanical Engineering Areas of Emphasis

Technical electives may be selected from among any of the courses listed below or from courses listed under the Aerospace Engineering areas of emphasis. The courses are grouped so that the student may select an elective package of closely related courses. A student may, with prior approval of the advisor and department, select a general area and a corresponding set of courses not listed below that would support a career objective not covered by the following categories.

Aerospace. Any courses listed under Aerospace Engineering areas of emphasis.

Biomechanical. BME 411, 412, 416, 419, 517 (recommended); EEE 302, 434.

Computer methods. ASE 485; CSE 310, 422, 428; ECE 383; IEE 463, 464, 475; MAE 403, 404, 406, 471, 541; MAT 464, 465, 466.

Control and dynamic systems. CSE 428; ECE 383; EEE 360; IEE 463; MAE 413, 417, 462, 467.

Design. MAE 341, 351, 403, 404, 406, 417, 434, 435, 438, 442, 446, 447.

Energy systems. EEE 360, MAE 430, 434, 435, 436, 437, 438, 446

Engineering mechanics MAE 341, 402, 404, 413, 426, 442, 460, 461, 471; MAT 464, 466.

Manufacturing. CSE 428; IEE 300, 374, 411, 461, 463; MAE 341, 351, 403, 404, 442, 447, 455; MSE 355, 420, 431, 440.

Stress analysis, failure prevention and materials ECE 383; MAE 341, 404, 426, 447, 455; MSE 355, 420, 431, 440, 450.

Thermosciences MAE 336, 430, 434, 435, 436, 437, 446, 460, 463, 471.

Mechanical Engineering Program of Study Typical Four-Year Sequence

Freshman Year

First Semester			Semester Hours
CHM	114	General Chemistry for Engineers	4
		or CHM 116 General Chemistry (4)	
ECE	105	Introduction to Languages of Engineering	3
ENG	101	First Year Composition	3
MAT	290	Calculus I	5
General Studies Elective (HU or SB [1]			3
		Total	18

Second Semester			
ECE	106	Introduction to Computer Aided Engineering	3
ENG	102	First Year Composition	3
MAT	291	Calculus II	5
PHY	121	University Physics I. Mechanics	3
PHY	122	University Physics Laboratory I	1
General Studies Elective (HU or SB [1]			3
		Total	18

Sophomore Year

First Semester			Semester Hour
ECE	210	Engineering Mechanics I Statics	3
MAT	242	Elementary Linear Algebra	2
MAT	274	Elementary Differential Equations	3
PHY	131	University Physics II Electricity and Magnetism	3
PHY	132	University Physics Laboratory II	1
General Studies Elective (HU or SB)[1]			3
Literacy and Critical Inquiry Elective[2]			3
		Total	18

Second Semester			
ECE	301	Electrical Networks I	4
ECE	312	Engineering Mechanics II Dynamics	3
ECE	313	Introduction to Deformable Solids	3
ECE	340	Thermodynamics	3
ECE	350	Structure and Properties of Materials	3
ECE	386	Partial Differential Equations for Engineers	2
		Total	18

Junior Year

First Semester			Semester Hours
ECE	384	Numerical Analysis for Engineers I	2
MAE	305	Measurements and Micro computers	4
MAE	371	Fluid Mechanics	3
MAE	382	Thermodynamics	3
MAE	422	Mechanics of Materials	4
PHY	361	Introductory Modern Physics	3
		Total	19

Second Semester			
MAE	317	Dynamic Systems and Control	4
MAE	372	Fluid Mechanics	4
MAE	388	Heat Transfer	3
MAE	441	Design Theory and Techniques	3
General Studies Elective (HU or SB [1]			3
		Total	17

Senior Year

First Semester			
MAE	415	Vibration Analysis	4
MAE	442	Mechanical Systems Design or MAE 446 Thermal Systems Design (3)	3
MAE	491	Experimental Mechanical Engineering	3
Technical Electives			6
		Total	16

Second Semester			
ECE	400	Engineering Communications	3
MAE	443	Engineering Design	3
MAE	490	Projects in Design and Development	2
General Studies Elective (HU or SB)[1]			3
Technical Electives			4
		Total	15

[1] See pages 58–88 for the requirements and the approved list

[2] See page 328 for special requirements and selection of an L1 elective.

Special Programs

An engineering mechanics option is available under the Engineering Special Programs. See pages 376–377 for details and course requirements

MECHANICAL AND AEROSPACE ENGINEERING

MAE 305 Measurements and Microcomputers. 4 F, S
Sc ence of measurements m crocomputer arch tecture and fundamenta s and nterfac ng m crocomputers to aboratory exper ments sensors and data acqu s t on Lecture, ab Prerequ s tes ECE 301 MAE 422

317 Dynamic Systems and Control. 4 F S
Mode ng and representat ons of dynam c phys ca sys tems nclud ng transfer funct ons b ock d agrams and state equat ons Trans ent response Pr nc p es of feed back contro and near system ana ys s nc ud ng root o- cus and frequency response Lecture ab. Prerequ s tes ECE 301 312 Pre- or corequ s te ECE 386

336 Air Conditioning and Refr geration. 3 F
Refr gerat on cyc es refr gerant proper t es heat ng and cool ng oads psychrometry and pur f cat on, temperature and hum d ty contro Prerequ s te MAE 382 or MET 432 or nstructor approva

341 Mechanism Ana ysis and Design. 3 F
Pos t ons ve oc t es and acce erat ons of mach ne parts cams, gears, f ex b e connectors and ro ng contact ntro duct on to synthes s Prerequ s te ECE 312

351 Manufacturing Processes Survey. 3 F, S
Product'on techn ques and equ pment. Cast ng and mo d ng pressure form'ng, mater a remova jo n ng and as semb y processes automat on and mater a hand ng Lecture rec tat on Prerequ s te ECE 350

361 Aerodynamics I. 3 F S
F u d stat cs conservat on pr nc p es, stream funct on ve oc ty potent a vort c ty nv sc d f ow Kutta Joukowsk th n-a rfo l theory, and pane methods. Prerequ s tes ECE 312, 340

371 Flu d Mechanics. 3 F S
ntroductory concepts of f u d mot ons, f u d stat cs contro vo ume forms of bas c pr nc p es ntroduct on to oca pr n c p es Prerequ s tes. ECE 312 340

372 Fluid Mechanics. 4 F S
App cat on of bas c pr nc p es of f u d mechan cs to prob ems n v scous and compress b e f ow Lab exper menta t on, demonstrat ons Prerequ s tes ECE 384 386 MAE 371.

382 Thermodynamics. 3 F S
App ed thermodynam cs· gas m xtures, psychrometr cs property re at onsh ps power and refr gerat on cyc es and react ve systems Prerequ s te ECE 340.

388 Heat Transfer. 3 F S
Steady and unsteady heat conduct on nc ud ng numer ca so ut ons therma boundary ayer concepts and app ca t ons to free and forced convect on Therma rad at on concepts

402 Introduct on to Continuum Mechanics. 3 S
App cat on of the pr nc p es of cont nuum mechan cs to such f e ds as f ow n porous med a b omechan cs e ectromagnet c cont nua and magneto flu d mechan cs. Prerequ s tes ECE 313 MAE 361 or 371 MAT 242

403 CAD Systems Development. 3 S
Des gn and mp ementat on of CAD System, user nterface des gn computer graph cs data structures and extens ve code deve opment Prerequ s tes. ECE 105 or equ va ent jun or stand ng n program

404 Finite Elements in Engineering. 3 S
Introduct on to deas and methodo ogy of f n te element ana ys s App cat ons to so d mechan cs heat transfer f u d mechan cs and v brat ons Prerequ s tes. ECE 313 MAT 242

406 CAD CAM Applications in MAE. 3 F
So ut on of eng neer ng prob ems w th the a d of state of the art software too s n so d mode ng eng neer ng ana y s s, and manufactur ng se ect on of mode ng parameters; re ab ty tests on software Prerequ s te nstructor ap- prova

413 Spacecraft Dynamics and Control. 3 F, S
K nemat cs of part c es and r g d bod es, Eu er s moment equat ons sate te orb ts and maneuvers and spacecraft att tude dynam cs and contro Prerequ s tes ECE 312, MAT 242

415 Vibration Analysis. 4 F S
Free and forced response of s ng e and mu t p e degree of freedom systems cont nuous systems app cat ons in mechan ca and aerospace systems numer cal methods Lecture ab Prerequ s tes· ECE 312 MAE 305 422 MAT 242 or 342.

417 Control System Design. 3 S
Too s and methods of contro system des gn and compen- sat on nc ud ng s mu at on response opt m zat on, fre quency doma n techn ques state var ab e feedback, and sens t v ty ana ys s ntroduct on to non near and d screte t me systems Prerequ s te MAE 317

422 Mechanics of Materials. 4 F S
Fa ure theor es energy methods f n te e ement methods, p ates, tors on of nonc rcu ar members unsymmetr ca bend ng shear center and beam co umn. Lecture ab. Prerequ s tes ECE 313 MAT 242. Pre or corequ s te ECE 386

425 Aerospace Structures I. 3 F S
Stab ty, energy methods tors on curved bars f n te e e ments c rcu ar p ates and unsymmetr ca bend ng Pre requ s tes ECE 313; MAT 242

426 Aerospace Structures II. 4 F, S
F ght veh c e oads, sem monocoque structures buck- ng, fat gue, aerospace mater a s compos tes jo nts and f n te e ement app cat ons Lecture, ab Prerequ s te: MAE 425.

430 Introduction to Nuclear Engineering. 3 F
Neutron nteract ons w th matter Pr nc p es of neutron cha n react ng systems Neutron d ffus on and moderat on Heat remova from nuc ear reactors Po nt reactor k net cs Prerequ s te PHY 361

434 Interna Combustion Engines. 3 S
Performance character st cs combust on, carburet on and fue n ect on and the coo ng and contro of nterna com bust on eng nes. Computer mode ng Lab. Prerequ s te MAE 382.

435 Turbomachinery. 3 S
Des gn and performance of turbomach nes nclud ng steam gas and hydrau c turb nes centr fuga pumps compressors fans, and b owers Corequ s te MAE 372 or 461

436 Combustion. 3 N
Thermochem ca and react on rate processes combust on of gaseous and condensed phase fue s App cat ons to propu s on and heat ng systems Po utant format on. Prerequ s te. MAE 382

437 Direct Energy Conversion. 3 N
Unconvent ona methods of energy convers on; fue ce s, thermoe ectr cs therm on cs photovo ta cs, and magne- tohydrodynam cs. Prerequ s tes ECE 340, 350

438 Solar Energy. 3 S
So ar rad at on and nstrumentat on des gn and test ng of co ectors, performance ana yses of systems, therma stor age, photovo ta cs mater a s and econom c ana ys s Prerequ s tes: MAE 382, 388

441 Design Theory and Techniques. 3 F S
The des gn process nc ud ng prob em def n t on, concep tua des gn form and funct on dec s on mak ng mater a se ect on manufacturab ty, modes of fa ure fat gue pro- fess ona sm and eth cs Prerequ s tes ECE 106 350 MAE 422 or 425

442 Mechanical Systems Design. 3 F, S
App cat on of des gn pr nc p es and techniques to the syn thes s, mode ng, and opt m zat on of mechan ca e ectro mechan ca and hydrau c systems. Prerequ s te MAE 441

443 Engineering Design. 3 F S
Group projects to des gn eng neer ng components and systems Prob em def n t on deat on mode ng, and ana ys s dec s on mak ng and documentat on act v t es emphas zed 6 hours ab Prerequ site MAE 442 or 446

446 Thermal Systems Design. 3 F
App cat on of eng neer ng pr nc p es and techn ques to the mode ng and ana ys s of therma systems and compo nents Opt m zat on techn ques are presented and the r use demonstrated Prerequ s te MAE 441

447 Robotics and Its Influence on Design. 3) S
Robot app cat ons conf gurat ons s ngu ar pos t ons and work space modes of contro , v s on, programm ng exer- c ses· des gn of parts for assemb y. Prerequ s te MAE 317

455 Polymers and Composites. 3 F
Relat onsh p between chem stry structure, and propert es of eng neer ng po ymers Des gn propert es and behav or of f ber compos te systems Cross- sted as MSE 470 Prerequ s te ECE 350

460 Gas Dynamics. 3 F S
Compress b e f ow at subson c and superson c speeds duct f ow, norma and ob que shocks, perturbat on theory, and w nd tunne des gn Prerequ s te. MAE 361 or 371

461 Aerodynamics II. 3 F S
Transon c/hyperson c f ows w ng theory Nav er Stokes, am nar turbu ent shear f ows pressure drop n tubes, separat on drag, v scous nv sc d nteract on and w ng design Prerequ s te· MAE 460

462 Dynamics of Flight. 3 F S
Aerodynam c forces and moments stat'c stab ty and con tro equat ons of mot on stab ty der vat ves and atera and ong tud na mot on and contro . Prerequ s tes MAE 413 467

463 Propulsion. 3 F, S
App cat on of gas dynam c and thermodynam cs to a r breath ng eng nes and rockets emphas s on turbojet tur bofan, and turboprop eng nes Corequ s te· MAE 460

464 Aerospace Laboratory. 2 F, S
Measurements of aerodynam c parameters n both sub son c and superson c f ows f ow over a rfo s and bod es of revo ut on. F ow v sua zat on. Computer a ded data acqu s t on and process ng Lecture ab Prerequ s tes MAE 305 460 Pre or coreqU s te MAE 461

465 Rocket Propulsion. 3 S
Rocket f ght performance nozz e des gn, combust on of l qu d and so d prope ants component des gn, advanced propuls on systems nterp anetary m ss ons test ng Pre requ site MAE 460

466 Rotary Wing Aerodynamics and Performance. (3) F, S
Introduct on to he copter and prope er ana ys's tech niques Momentum b ade e ement, and vortex methods. Hover and forward f ght Ground effect autorotat on and compress b ty effects. Prerequ s tes ECE 386 MAE 361 or nstructor approva

467 Aircraft Performance. 3 F S
Techn ca aspects of f ght, ntegrat ng aerodynam c prin- c p es re at ng to ft drag and thrust w th power operat ng character st cs, performance of an a rp ane ana yzed as a system Prerequ s te MAE 361 Pre· or coreqU s te MAE 441.

468 Aerospace Systems Des gn. 3 F S
Group projects re ated to aerospace vehic e des gn, work ng from m ss on def n t on and cont nu ng through pre m nary des gn; dec s on mak ng and communicat on act v t es emphas zed Prerequ s tes: MAE 426, 441 462.

471 Computational Fluid Dynamics. 3 F
Numer ca so ut ons for se ected prob ems n f u d me- chan cs Prerequ s te MAE 372 or 461

489 Thermophysics. 3 F
Bas c pr nc p es of heat transfer and the r app cat on to aerospace systems; propu s on dev ces spacecraft ther rna control, and waste heat reject on systems. Prerequ - s te. ECE 340.

490 Projects in Design and Development. 2 F, S
Capstone pro ects n fundamenta or app ed aspects of eng neer ng. Prerequ s tes for Mechan ca Eng neering majors MAE 441 491 Prerequ s te for Eng neering Spe c a Programs eng neer ng mechan cs majors MAE 422

491 Experimental Mechanical Engineering. (3 F, S
Exper menta and ana yt ca stud es of phenomena and performance of f u d f ow heat transfer thermodynam cs refr gerat on and mechan ca power systems 6 hours ab. Prerequ s tes: MAE 305, 372 382, 388

498 Pro-Seminar. 1 3 N
Spec a top cs for advanced students App cat on of the eng neer ng d sc p nes to des gn and ana ys s of modern techn ca dev ces and systems. Prerequ s te nstructor approva

504 Laser Diagnostics. 3) S
Fundamenta s of opt cs and the nteract on of ight w th matter Laser sources aser spectroscopy, ve oc metry, part c e s z ng and surface character zat on

505 Perturbation Methods in Mechanics. 3 N
Non near osc at ons, stra ned coord nates renorma za t on mu t p e sca es boundary ayers matched asymptot c expans ons turn ng po nt prob ems and WKBJ method

506 Advanced System Modeling, Dynam cs, and Contro . 3 S
Lumped parameter mode ng of phys ca systems w th ex amp es State var ab e representat ons and dynam c re sponse ntroduct on to modern contro Prerequ s te ASE 582 or MAT 442

507 Optimal Control Theory and Application. 3 F
Opt ma contro of phys ca systems Ca cu us of var at ons Pontryag n s pr nc p e, m n mum t me fue prob ems near quadrat c regulator and numer ca methods Prerequ s te. MAE 506

510 Dynamics and Vibrations. 3 F
Lagrange s and Ham ton's equat ons r g d body dynam cs, gyroscop c mot on and sma osc at on theory.

511 Acoustics. 3 F
Pr nc ples under y ng the generat on transm ss on, and recept on of acoust c waves App cat ons to no se contro arch tectura acoust cs random v brat ons and acoustic fat gue

512 Random Vibrations. 3 S
Rev ew of probab ty theory random processes stat onar ty, power spectrum wh te no se process random re sponse of s ng e and mu t p e DOF systems and Markov processes s mu at on Prerequ s te MAE 510 or nstruc tor approva

515 Structural Dynamics. 3 S
Free v brat on and forced response of d screte and con t nuous systems exact and approx mate methods of so u t on f n te e ement mode ng, and computat ona tech n ques Prerequ s te MAE 510 or nstructor approva .

517 Nonlinear Oscillations. 3 F
Ex stence stab ty and b furcat on of so ut ons of non n ear dynam ca systems Methods of ana ys s of regu ar and chaot c responses Pre equ s te: MAE 510 or nstruc tor approva

518 Dynamics of Rotor-Bearing Systems. 3 S
Natura wh r frequency cr t ca speed and response ana ys s of r g d and f ex b e rotor systems Bear ng nf u ence and representat on Stab ty ana ys s Methods of ba anc ng

520 Solid Mechanics. 3 F
Introduct on to tensors k nemat cs k net cs, and const tu t ve assumpt ons ead ng to e ast c p ast c and v scoe as t c behav or App cat ons

522 Variational Principles of Mechan cs. 3 S
V rtua work stat onary, and comp ementary potent a en erg es Ham ton s pr nc p e App cat on of these and d rect methods to v brations e ast c ty and stab ty Pre requ s te MAE 520 or equ va ent

523 Theory of Plates and Shells. 3 F
L near and non near theor es of p ates Membrane and bend ng theor es of she s She s of revo ut on Prerequ s te. MAE 520

524 Theory of Elasticity. 3 S
Formu at on and so ut on of 2 and 3 d mens ona bound ary va ue prob ems Prerequ s te MAE 520

527 Fin te Element Methods in Eng neering Science. 3 F
D scret zat on nterpo at on e ementa matr ces, assem b y and computer mp ementat on App cat on to so d and f u d mechan cs heat transfer and t me dependent prob ems. Prerequ s te ASE 582

529 Theory of Elastic Stability. 3 S
Stab ty of d screte and cont nuous mechan ca systems Stab ty of conservat ve and nonconservat ve systems. Dynam c nstab ty Prerequ s te MAE 523

536 Combustion. 3 N
Thermodynam cs chem ca k net cs of combust on Ex p os on and gn t on theor es React ve gas dynam cs Structure propagat on and stab ty of f ames Exper menta method Prerequ s te. MAE 436 or nstructor ap prova

537 Direct Energy Convers'on. 3 N
Advanced se ected top cs n d rect energy convers on, the ory des gn and app cat ons Cross sted as MSE 533 Prerequ s te· MAE 581

541 CAD Tools for Engineers. 3 F
E ements of computer techn ques requ red to deve op CAD software. Data structures nc ud ng sts trees and graphs. Computer graph cs, nc ud ng 2 and 3 d men s ona a gor thms and user nterface techn ques

542 Geometric Modeling in CAD CAM. 3 S
Geomet r c and so d mode ng, curve and surface des gn, CAD database arch tectures and ntegrat on of so d mod e ng nto eng neer ng processes Prerequ s te MAE 541 or nstructor approva

544 Mechanical Design and Fa'lure Prevention. (3 F
Modes of mechan ca fa ure app cat on of pr nc p es of e ast c ty and p ast c ty n mu t ax a state of stre s to de s gn synthes s fa ure theor es fatigue c eep, mpact Prerequ s te MAE 443

546 CAD CAM Applications in MAE. 3 F
So ution of eng neer ng prob ems w th the a d of state of the art software too s n so d mode ng eng neer ng analy s s, and manufactur ng se ect on of mode ing parameters, re ab ty tests on software Open on y to students w thout prev ous cred t for MAE 406 or w th nstructor approva

547 Mechanical Design and Control of Robots. 3 N
Homogeneous transformat ons, 3 d me s ona k nemat cs, geometry of mot on forward and nverse k nemat cs, workspace and mot on tra ector es, dynam cs contro and stat c forces

548 Mechanism Synthesis and Analysis. 3 S
A gebra c and graph ca methods for exact and approx mate synthes s of cam, gear, and nkage mechan sms des gn opt m zat on methods of p anar mot on analys s; character st cs of p ane mot on, spat a k nemat cs

557 Mechanics of Composite Materials. 3 S
Ana ys s of compos te mater a s and app cat ons Mi cromechan ca and macromechan ca behav or C ass cal am nat on theory deve oped w th nvest gat on of bend ng-extens on coup ng

560 Propulsion Systems. 3 N
Des gn of a r breath ng gas turb ne eng nes for a rcraft propu s on m ss on a a ys s cyc e ana ys s eng ne s z ng; component des'gn

561 Computational Aerodynam'cs. 3 S
F n te d fference and f n te vo ume techn ques for so v ng the subson c transonic and superson c f ow equat ons. The method of character st cs Numer ca gr d generat on techn ques Prerequ s te MAE 571 or nstructor approva .

562 Transonic Flow 3 F
Transon c f ow non near sma d sturbance equat ons and m xed f ow w th shock waves Ana yt cal and numeri ca treatments for a rfo s App cat ons to w ngs bod es, and turbomach nery Prerequ s te MAE 460 or 461

563 Unsteady Aerodynamics. 3 S
Unsteady ncompress b e and compress b e f ow W ngs and bod es n osc atory and trans ent mot ons. Kerne funct on approach and pane methods Aeroe ast c appl cat ons Prerequ s tes MAE 460 or 461 562

564 Advanced Aerodynamics. 3 F
Perturbat on method. L near zed subso c and superson c f ows Th n w ng s ender body theor es L ft ng surface theory Pane method computat on Prerequ s te· MAE 460 or 461

565 Turbomachinery. 3 N
Des gn and performance of turbomach nes nc ud ng tur b nes compressors pumps, fans and b owers

571 Fluid Mechanics. 3 F
Bas c k nemat c dynam c and thermodynam c equat ons of the f u d continuum and their app cat on to bas c f u d models

572 Inviscid Fluid Flow. 3) S
Mechan cs of f uids for f ows n wh ch the effects of viscos ity may be gnored Potent al f ow theory waves and n viscid compress ble f ows Prerequ s te· MAE 571

573 Viscous Fluid Flow. 3 F
Mechan cs of f u ds for f ows in wh ch the effects of v scos ty are s gn f cant Exact and approx'mate so ut ons of the Nav er Stokes system, am nar f ow at low and h gh Rey no ds number. Prerequ s te MAE 571

574 Viscous, Compressible Fluid Flow. 3 N
Mechan cs of f u ds for f ows in wh ch the effects of com pressib ity and v scos ty are s gn f cant Compress b e boundary layers free shear ayers, shock waves and nterna f ows Prerequ s te MAE 572

575 Turbulent Shear Flows. 3 F
Homogeneous sotrop c and wa turbu ence Exper men ta resu ts. Introduct on to turbulent f ow ca cu at ons Pre requis te: MAE 571

577 Turbulent Flow Modeling. (3 S
Reynolds equat ons and the r c osure Mode ng of s mp e and comp ex turbu ent flows ca cu at ons of nterna and externa f ows and app cat on to eng neer ng prob ems Prerequ site MAE 571.

581 Thermodynamics. 3 F
Bas c concepts and aws of c ass cal equ br um thermo dynam cs App cat ons to eng neer ng systems

582 Statistical Thermodynamics. 3 N
K net c and quantum theory. Stat st ca mechan cs en semb e theory Structure and thermodynam cs of non n teracting and nteract ng part c es Bo tzmann ntegro d f ferentia equat on Cross sted as MSE 531 Prerequ' site. MAE 581

585 Conduction Heat Transfer. 3 F
Bas c equat ons and concepts of conduct on heat transfer Mathemat ca formu at on and so ut on ana yt ca and nu mer ca of steady and unsteady 1 and mult d mensiona heat conduct on and phase change prob ems Prerequ s tes· ECE 386 MAE 388

586 Convection Heat Transfer. (3) S
Bas c concepts and govern ng equat ons Analys s of am nar and turbu ent heat transfer for nterna and externa flows Natura and m xed convect'on. Prerequis te· MAE 388

587 Radiation Heat Transfer. 3 F
Advanced concepts and solut on methodolog es for rad a- t on heat transfer inc ud ng exchange of therma rad at on between surfaces rad at on n absorb ng em tt ng and scatter ng med a and rad ation comb ned w th conduct on and convect on Prerequ s te MAE 388

588 Two-Phase Flows and Boiling Heat Transfer. 3 S
Poo and flow bo' ng heat transfer condensat on heat transfer var ous mode s of vapor qu d m xture f ows, gas so d m xture f ows, and exper menta measurement tech n ques

589 Heat Transfer. 3 F
Bas c concepts, phys ca and mathemat ca mode s for heat transfer App cat ons to conduct ve convect ve, ra diat ve and combined mode heat transfer Prerequ s te MAE 388

594 Graduate Research Conference. 1 F S
Top cs n contemporary research Requ red every semes- ter of al departmenta graduate students reg stered for 9 or more semester hours Not for degree credit

598 Special Topics. 1 3 F S
Spec a top cs courses nclud ng the fo low ng, wh ch are regu ar y offered, are open to qua f ed students
a Boundary Layer Stab ty
b Po ymers and Compos tes
c) Hydrodynam c Stab ity
(d Advanced Spacecraft Contro
e P ast c ty
(f Aeroe ast c ty
(g Aerospace Veh c e Gu dance and Contro

Omnibus Courses: See pages 50–51 for omn bus courses that may be offered

Programs in Engineering Special and Interdisciplinary Studies

George C. Beakley Jr., Ph.D., Director

The following degree programs are administered by the Office of the Dean of the College of Engi neering and Applied Sciences·

B S E Engineering Special Programs
- Engineering Mechanics (see pages 376–377
- Engineering Synergy (see pages 377 378)
- Manufacturing Engineering (see page 364
- Microelectronics Manufacturing Engineering see pages 378 379
- Nuclear Engineering Science (see pages 379 380)
- Pre medical Engineering see pages 380–382)
- Systems Engineering see page 382)

B S Engineering Interdisciplinary Programs
- Engineering Business and Pre law (see pages 382 383
- Geological Engineering (see page 383

Descriptions of these majors and options, with their respective program requirements, can be found on the pages indicated.

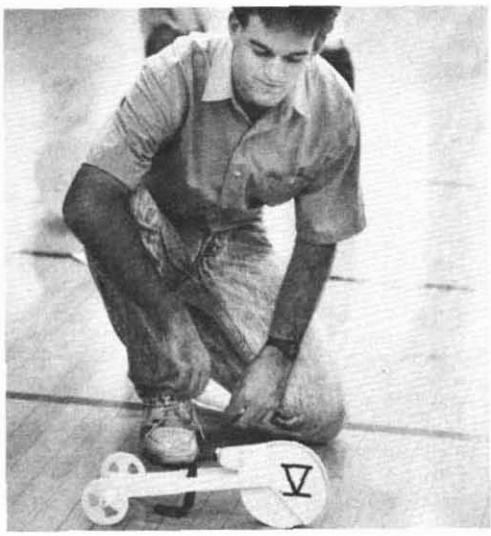
Purpose

The majors of Engineering Special Programs and of Engineering Interdisciplinary Programs accommodate students whose educational objectives re quire more intensity of concentration on a par ticular subject or more curricular flexibility within an engineering discipline than the tradi

tional departmental majors generally permit. These majors are School of Engineering programs. Unlike the departmental major areas, however, there is not a separate faculty. The faculty teaching and advising in these programs are from the School of Engineering.

For many students, engineering studies form the basis of preparation for professional engineering work where proficiency in the application of science and the physical and social technologies is brought to bear on problems of a large scope. The necessary breadth that these students seek often is not obtainable in traditional engineering fields. Rather, specially designed programs of course work that merge the required principles and approaches drawn from all fields of engineering and other pertinent disciplines are desired. As an answer to this need, two types of course arrangements are available: (1) the Bachelor of Science in Engineering (B.S.E.) degree with a major in Engineering Special Programs and (2) the Bachelor of Science (B.S.) degree with a major in Engineering Interdisciplinary Programs.

The B.S.E. in Engineering Special Programs is designed primarily for students intending to pursue engineering careers at a professional level in industry or graduate studies. The B.S. in Engineering Interdisciplinary Programs accommodates those students who desire the integrity of an engineering education but who plan to enter professions other than engineering or particularly to serve society in socially relevant activities. Both are developed beyond the General Studies and the engineering core.



The curricula leading to both the B.S.E. and the B.S. have been accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET).

Engineering Special Programs—B.S.E.

Engineering Mechanics. The curriculum of the engineering mechanics option is intended for individuals interested in pursuing a more basic and theoretical education than is provided by typical curricula in aerospace, civil, or mechanical engineering. This curriculum is particularly suited for individuals whose goals are an increased depth of understanding in the fundamentals of mechanics and the pursuit of an advanced engineering degree, with the ultimate career goal of an academic or research position. Thus, it is strongly recommended that a GPA of at least 3.00 be maintained by all engineering mechanics students.

The engineering mechanics option is based on increased course work in mathematics and the broad field of engineering mechanics, the latter of which includes three interrelated areas: dynamics, fluid mechanics, and solid mechanics. Each of these areas is related to a variety of important and challenging technological problems. Examples include vibration control in space vehicles at launch, optimal design of composite structures, crystal growing in a microgravity environment, fluid transition to turbulence on swept wings, and computer-aided modeling of structures ranging from surgical implants to space satellites. The fundamental emphasis of the engineering mechanics program provides the flexibility and understanding that is required to cope with rapidly occurring changes in technology and the needs of society.

This option is administered by the Department of Mechanical and Aerospace Engineering.

Engineering mechanics students are required to select the following in the engineering core:

			Semester Hours
ECE	333	Electrical Instrumentation	3
		or ECE 334 Electronic Devices and Instrumentation	(4)
ECE	384	Numerical Analysis for Engineers I	2
ECE	386	Partial Differential Equations for Engineers	2
MAE	305	Measurements and Microcomputers	4
PHY	361	Introductory Modern Physics[1]	3

In addition, the following courses are required:

		Semester Hours
MAE 371	Fluid Mechanics	3
MAE 372	Fluid Mechanics	4
MAE 388	Heat Transfer	3
MAE 402	Introduction to Continuum Mechanics	3
MAE 404	Finite Elements in Engineering	3
MAE 413	Spacecraft Dynamics and Control	3
MAE 415	Vibration Analysis	4
MAE 422	Mechanics of Materials	4
MAE 441	Design Theory and Techniques	3
MAE 490	Projects in Design and Development	2
MAT 342	Linear Algebra	3
MAT 371	Advanced Calculus I	3
	or MAT 460 Applied Real Analysis	3
MSE 440	Mechanical Properties of Solids	3
Area of Emphasis (Technical Electives[2]		6–7
	Total	47–48

[1] Basic science elective.

[2] Must include two courses of engineering design type.

Technical electives may be selected from one or more of the following areas. A student may, with prior approval, select a general area or a set of courses that would support a career objective not covered by the following categories.

Biomechanics. BME 411, 412, 416, 419; EEE 434; MAE 341

Dynamics MAE 462 505, 510, 511, 512, 515, 517, 518

Engineering mathematics ASE 485, 582, 586; ECE 383, 385; MAT 371, 460, 461, 462; STP 421.

Fluid mechanics MAE 435, 460, 463, 471, 571.

Solid mechanics. MAE 426, 520, 522, 523, 524, 529.

Engineering Mechanics Program of Study
Typical Last Two-Year Sequence
Junior Year

First Semester		Semester Hours
ECE 333	Electrical Instrumentation	3
	or ECE 334 Electronic Devices and Instrumentation (4	
MAE 371	Fluid Mechanics	3
MAT 371	Advanced Calculus I	3
	or MAT 460 Applied Real Analysis 3)	
MSE 440	Mechanical Properties of Solids	3
PHY 361	Introductory Modern Physics	3
General Studies Elective HU or SB *		3
	Total	18

Second Semester		
ECE 384	Numerical Analysis for Engineers I	2
MAE 305	Measurements and Micro computers	4
MAE 372	Fluid Mechanics	4
MAE 413	Spacecraft Dynamics and Control	3
MAE 422	Mechanics of Materials	4
	Total	17

Senior Year

First Semester		
MAE 388	Heat Transfer	3
MAE 402	Introduction to Continuum Mechanics	3
MAE 404	Finite Elements in Engineering	3
MAE 415	Vibration Analysis	4
MAE 441	Design Theory and Techniques	3
	Total	16

Second Semester		
ECE 400	Engineering Communications	3
MAE 490	Projects in Design and Development	2
General Studies Elective HU or SB)*		3
Technical Electives		7
	Total	15

* See pages 58 88 for the requirements and the approved list

Engineering Synergy. Engineering synergy is the concept of bringing together diverse disciplines, some outside engineering, that interact in an enhanced fashion. This program accommodates those students with broad interests who wish to pursue an individualized engineering degree program that is interdisciplinary in its design and yet provides the proper prerequisites for graduate study in a chosen major. Students may apply for admission to the professional program if they are admitted to the University Honors College or have completed at least 45 semester hours at ASU with a GPA of 3 25 or higher. The application for admission to the program must be accompanied by an essay describing the student's reasons for pursuing a synergistic degree program. The program requirements include those of General Studies, the engineering core, and the individualized major, as described under the School of Engineering on pages 328 330. The major requirements are determined and approved by an advisory committee consisting of three faculty appointed by the director of the Engineering Spe-

cial and Interdisciplinary Studies. The student is expected to demonstrate progression in the selected course work. The courses chosen must contain at least 12 hours of engineering science and 14 hours of engineering design content. The total program of 133 semester hours (excluding university English requirements) must also include at least 50 upper division hours.

Manufacturing Engineering. This program is administered by the Department of Industrial and Management Systems Engineering (see page 364).

Microelectronics Manufacturing Engineering. This engineering special programs option has been established to prepare a student for a challenging and rewarding career as a microelectronics manufacturing engineer and is administered by the Department of Electrical Engineering.

The successful demonstration of the first integrated electronic circuit in 1958 led to the creation of a new industry to manufacture these remarkable electronic devices. Today, microelectronic circuits are essential components in products that range from inexpensive, mass produced consumer goods to extremely sophisticated limited production electronic systems.

Microelectronics manufacturing engineers are vitally important participants in every project to develop commercially viable microelectronic products from design prototypes. Their professional participation begins with the design of the production product and continues through all phases of the manufacturing process until the completed product is delivered to the purchaser. Typical responsibilities include device design and evaluation, process design and characterization, equipment procurement and acceptance, quality control, production schedules, resource allocation, and engineering support of production personnel in the manufacturing facility.

Because the responsibilities of a microelectronics manufacturing engineer are so diverse, an interdisciplinary undergraduate program that provides concurrent education in several engineering disciplines, mathematics, and the physical sciences is essential to prepare a student for a career in microelectronics manufacturing engineering. This engineering special programs option provides the necessary concurrent education within the context of a curriculum that meets all ABET accreditation criteria.

The following courses are required as part of the engineering core and mathematics electives.

			Semester Hours
CHM	441	General Physical Chemistry	3
CSE/EEE	225	Assembly Language Programming Motorola or CSE/EEE 226 Assembly Language Programming (Intel)	3
ECE	334	Electronic Devices and Instrumentation	4
ECE	352	Properties of Electronic Materials	3
ECE	383	Probability and Statistics for Engineers	2
MAT	242	Elementary Linear Algebra	2
PHY	241	University Physics III Thermodynamics, Optics and Wave Phenomena	3

Only ECE 313 Introduction to Deformable Solids may be deleted from the engineering core.

In addition, the following courses are required:

			Semester Hours
CHE	461	Process Control	3
CHM	331	General Organic Chemistry or PHY 361 Introductory Modern Physics 3	3
CSE/EEE	120	Digital Design Fundamentals	3
CSE/EEE	325	System Design with Microprocessor Motorola or CSE/EEE 326 System Design with Microprocessor (Intel)	3
EEE	302	Electrical Networks II	3
EEE	435	Microelectronics or UET 418 Hybrid Integrated Circuit Technology 4	3
EEE	436	Fundamentals of Solid State Devices	3
EEE	439	Semiconductor Facilities and Cleanroom Practices	3
IEE	300	Economic Analysis for Engineers	3
IEE	374	Quality Control or MET 401 Statistical Process Control 3	3
IEE	463	Computer Aided Manufacturing and Control or MET 416 Applied Computer Integrated Manufacturing 3	3
UET	432	Semiconductor Packaging and Heat Transfer	3
UET	437	Integrated Circuit Testing	3
One of the following Senior Design Projects			3
ASE	490	Project in Design and Development 3	
CHE	490	Chemical Engineering Projects (3)	
EEE	490	Senior Design Laboratory (3	
IEE	490	Project in Design and Development (3	
MSE	490	Capstone Design Project 3	

UET 415 Electronic Manufacturing Engineering Principles (3
Technical Electives 8 9

Total 51

Nuclear Engineering Science. The curriculum of the nuclear engineering science option encourages an individualized program based on the student's own career interests and objectives. The program provides a strong foundation in basic engineering, nuclear, and radiation health physics concepts. Electives are generally taken during the junior and senior years and must be approved by a designated faculty advisor. The electives should focus on a technical or environmental area associated with (1) the discovery, development, or utilization of energy or (2) the materials or products that use, release, or may be affected by radiation.

Individual elective programs may also be aligned with a traditional discipline such as chemical, civil, electrical, and mechanical engineering. They may be tailored toward specific energy resources such as those associated with fission, fusion, solar, geothermal, fossil fuels, or synthetic fuels such as oil shale. They may be structured for specific high demand areas such as radiation health physics, power systems engineering, corrosion and radiation effects on materials, radiation damage to electronics, computer aided operation and accident analysis at power generation facilities, and designing better man-machine interfaces. Finally, there are opportunities to pursue selected areas such as waste disposal, radiation effects on electronics in space, biomedical applications, nuclear applications in forensics, low level radiation measurements of our natural radiation environment, and anomalies from trace amounts of natural radioactivity in computer microprocessing circuits.

Motivated students who have demonstrated scholastic excellence are encouraged to participate in summer research programs at national laboratories or with an industry or in the ASU Nuclear Sciences summer exchange programs at national laboratories or at overseas facilities in Australia, Austria, France, Israel, Japan, and Switzerland. In addition, students may elect an independent study or senior research project. The exercise provides an opportunity to assemble and apply the newly acquired engineering knowledge and laboratory skills to an in depth investigation of a real world problem.

The following courses are required as a part of the engineering core (only ECE 313 Introduction to Deformable Solids may be deleted).

			Semester Hours
ECE	312	Engineering Mechanics II Dynamics	3
ECE	333	Electrical Instrumentation	3
		or ECE 334 Electronic Devices and Instrumentation (4	
ECE	340	Thermodynamics	3
ECE	350	Structure and Properties of Materials	3
		or ECE 352 Properties of Electronic Materials (3)	
MAE	305	Measurements and Microcomputers	4
		or CHE 461 Process Control (3	

The mathematics and basic science electives are met by taking the following courses:

			Semester Hours
MAT	342	Linear Algebra	3
MAT	362	Advanced Mathematics for Engineers and Scientists I	3
PHY	361	Introductory Modern Physics	3

In addition, the following courses are required:

			Semester Hour
ECE	384	Numerical Analysis for Engineers I	2
EEE	490	Senior Design Laboratory	3
EEE/NUC	460	Nuclear Concepts for the 21st Century	3
		or MAE 430 Introduction to Nuclear Engineering 3)	
EEE/NUC	461	Health Physics Principles and Radiation Measurements	3
EEE/NUC	462	Reactor Safety Analysis	3
EEE/NUC	463	Electrical Power Plant	3
EEE/NUC	464	Nuclear Engineering Experiments	3
EEE/NUC	465	Radiation Dosimetry and Instrumentation	3
IEE	300	Economic Analysis for Engineers	3
MAE	317	Dynamic Systems and Control	4
		or EEE 480 Feedback Systems 4)	
MAE	371	Fluid Mechanics	3
		or EEE 302 Electrical Networks II (3	
MAE	382	Thermodynamics	3
		or EEE 303 Signals and Filters (3)	
Technical Electives			12 14
Total			48 50

NUCLEAR ENGINEERING SCIENCE

NUC 460 Nuclear Concepts for the 21st Century. 3 F The world energy situation and the role of nuclear power Nuclear fission and fusion theory. The nuclear fuel cycle. Ultrasafe reactor designs. Radiation damage to electronics, including soft errors and space radiation Current and future applications in nuclear medicine radiology and food preservation. Cross listed as EEE 460 Prerequisite PHY 361

461 Health Physics Principles and Radiation Measurements. 3) S
Sources, characteristics, dosimetry, shielding, and measurement techniques for cosmogenic, terrestrial, and anthropogenic radiation ionizing and nonionizing radiation theory ALARA concept. Emphasis on instrumentation detectors, and environmental monitoring Lecture, ab Cross-listed as BME/EEE 461. Prerequisite: ECE 301.

462 Reactor Safety Analysis. 3 N
Power reactor safety and censing methodologies Reactor transient and accident analysis. Time dependent solution to neutron diffusion equation. Use of industry codes to assess fission product build up emergency core cooling behavior, reactivity, offsite releases and dose calculations Cross listed as EEE 462 Prerequisite EEE/NUC 460.

463 Electrical Power Plant. (3 F
Nuclear, fossil, and solar energy sources. Analysis and design of steam supply systems, electrical generating systems, and auxiliary systems. Power plant efficiency, operation, and costs and analyses Cross listed as EEE 463 Prerequisites: ECE 301, 340.

464 Nuclear Engineering Experiments. (3) F
Theory and applied concepts in reactor design, instrumentation electronics and shielding Experimental measurements of nuclear parameters using subcritical reactors and fusion neutron generator Fast and thermal activation analysis. Mossbauer spectrometry Lecture lab. Cross listed as EEE 464 Corequisite EEE/NUC 460.

465 Radiation Dosimetry and Instrumentation 3) F '92
Radiation dosimetry and instrumentation used at nuclear power plants Calculation of external and internal radiation doses Radiation biology. Shielding calculations Cross listed as EEE 465 Prerequisite. BME/EEE/NUC 461

566 Nuclear Instrumentation. 3 N
Design and analysis of imaging systems for nuclear sciences applications and research Laboratory experiments using computerized multichannel analyzer systems whole body counting systems and computerized tomography Lecture lab. Cross listed as EEE/NUC 566 Prerequisite EEE/NUC 465 or instructor approval.

567 Radiation Shielding and Transport. 3 F
Shielding for radiation therapy diagnostic radiology cyclotrons, and nuclear reactors. Monte Carlo and empirical computational methods regulations, and design problems Cross-listed as BME/EEE 567 Prerequisite: BME/EEE/NUC 465

569 Radiochemistry and Advanced Nuclear Instrumentation. 3) N
Advanced concepts in environmental and power plant radiochemistry Chemical separations for iodine, strontium, radium and uranium. Advanced detection concepts in alpha gamma spectrometry, and quality control. Lecture, ab Cross listed as EEE 569 Prerequisite BME 465 or EEE/NUC 465

Omnibus Courses: See pages 50–51 for omnibus courses that may be offered.

Pre-medical Engineering. In the past decade, the interrelation between engineering and medicine has become vigorous and exciting Our rapidly expanding technology dictates that engineering will continue to become increasingly involved in all branches of medicine As this develops, so will the need for physicians trained in the engineering sciences medical men and women with a knowledge of computer technology, transport phenomena, biomechanics, bioelectric phenomena, operations research, and cybernetics. This option is of special interest to students desiring entry into a medical college and whose medical interests lie in research, aerospace and undersea medicine, artificial organs, prostheses, biomedical engineering, or biophysics. Since both engineering and medicine have as their goal the well-being of humans, this program is compatible with any field of medical endeavor.

Academic Requirements. In addition to the General Studies requirement, BIO 181 General Biology and CHM 116 General Chemistry (basic science elective) must be selected in the engineering core. Other engineering core requirements are outlined in the area of emphasis descriptions. The following courses required in the pre medical engineering program and have been selected to meet all university and ABET accreditation requirements:

			Semester Hours
AGB/BME	435	Animal Physiology I	4
BIO	182	General Biology	4
BME	331	Transport Phenomena I: Fluids	3
BME	334	Heat and Mass Transfer	3
BME	411	Biomedical Engineering I	3
BME	412	Biomedical Engineering II	3
BME	413	Physiological Instrumentation	3
BME	417	Biomedical Engineering Design	3
BME	423	Physiological Instrumentation Laboratory	1
BME	490	Biomedical Engineering Projects	2
BME	496	Professional Seminar*	0
CHM	113	General Chemistry	4
CHM	331	General Organic Chemistry	3
CHM	332	General Organic Chemistry	3
CHM	335	General Organic Chemistry Laboratory	1
CHM	336	General Organic Chemistry Laboratory	1
Engineering		Technical Electives to be selected from an area of emphasis)	8–10
		Total	49 51

* Students must register for BME 496 each semester.

Students interested in pre medical engineering may elect to emphasize either general bioengineering or computer science.

General bioengineering This emphasis is designed to strengthen the student's knowledge of bioengineering. It emphasizes biomedical research. The following courses are required in the

engineering core: ECE 333, 340, 350; MAE 305. ECE 312 is not required in the engineering core. The 10 hours of technical electives may be selected from engineering, biology, or chemistry upper division courses, but these courses must include adequate engineering science and design content.

Computer science. This emphasis is designed for students interested in the application of modern computer technology for medical information processing and medical scientific computation and for the recognition, storage, retrieval, and processing of medical data. The following courses are required in the engineering core: CSE/EEE 225 or 226, ECE 334, 340, and 352 and MAT 242. ECE 312 is not required in the engineering core. Technical electives must include CSE 310, one advanced computer programming course selected from CSE 383 or 470, and upper division engineering courses of engineering science and design content.

Pre-medical Engineering Program of Study

Typical Four-Year Sequence

First Year

First Semester			*Semester Hours*
BME	496	Professional Seminar	0
CHM	113	General Chemistry	4
ECE	105	Introduction to Languages of Engineering	3
ECN	111	Macroeconomic Principles	3
ENG	101	First-Year Composition	3
MAT	290	Calculus I	5
		Total	18

Second Semester			
BME	496	Professional Seminar	0
CHM	116	General Chemistry	4
ECE	106	Introduction to Computer Aided Engineering	3
MAT	291	Calculus II	5
PHY	121	University Physics I: Mechanics	3
PHY	122	University Physics Laboratory I	1
		Total	16

Second Year

First Semester			
BIO	181	General Biology	4
BME	496	Professional Seminar	0
ENG	102	First-Year Composition	3
MAT	274	Elementary Differential Equations	3
PHY	131	University Physics II: Electricity and Magnetism	3
PHY	132	University Physics Laboratory II	1
General Studies Elective (HU or SB)*			3
		Total	17

Second Semester			
BIO	182	General Biology	4
BME	496	Professional Seminar	0
CHM	331	General Organic Chemistry	3
CHM	335	General Organic Chemistry Laboratory	1
ECE	210	Engineering Mechanics I: Statics	3
ECE	301	Electrical Networks I	4
Literacy and Critical Inquiry Elective*			3
		Total	18

Third Year

First Semester			
BME	331	Transport Phenomena I Fluids	3
BME	435	Animal Physiology I	4
BME	496	Professional Seminar	0
CHM	332	General Organic Chemistry	3
ECE	312	Engineering Mechanics II: Dynamics or Technical Elective	3
ECE	313	Introduction to Deformable Solids	3
ECE	340	Thermodynamics or CHM 441 General Physical Chemistry (3)	3
		Total	19

Second Semester			
BME	334	Heat and Mass Transfer	3
BME	496	Professional Seminar	0
CHM	336	General Organic Chemistry Laboratory	1
ECE	333	Electrical Instrumentation or ECE 334 Electronic Devices and Instrumentation 4)	3
ECE	350	Structure and Properties of Materials or CHM 442 General Physical Chemistry 3 or ECE 351 Engineering Materials 3) or ECE 352 Properties of Electronic Materials (3)	3
ECE	384	Numerical Analysis for Engineers I or ECE 386 Partial Differential Equations for Engineers (2) or MAT 242 Elementary Linear Algebra (2)	2
General Studies Elective HU or SB *			3
Technical Elective			3
		Total	18

Fourth Year

First Semester			
BME	411	Biomedical Engineering I	3
BME	413	Physiological Instrumentation	3
BME	423	Physiological Instrumentation Laboratory	1
BME	490	Biomedical Engineering Projects	2
BME	496	Professional Seminar	0

MAE	305	Measurements and Micro computers	4
		or CHE 461 Process Control (3) or CSE/EEE 225 Assembly Language Programming Motorola) (3 or CSE/ EEE 226 Assembly Language Programming (Intel) (3) or IEE 463 Computer Aided Manufacturing and Control 3	
General Studies Elective HU or SB)*			3
Technical Elective			3
Total			19

Second Semester

BME	412	Biomedical Engineering II	3
BME	417	Biomedical Engineering Design	3
BME	496	Professional Seminar	0
ECE	383	Probability and Statistics for Engineers	2
ECE	400	Engineering Communications	3
General Studies Elect ve (HU or SB)*			3
Total			14

Degree requirements 130 semester hours plus English proficiency

* See pages 58 88 for the requirements and the ap proved list of courses.

Systems Engineering. Systems engineering deals with the integration of diverse components into a functioning whole. The curriculum of this option combines studies in electrical, mechanical, and computer engineering with contemporary analytical and computer skills. Graduates are pre pared for a broad variety of career opportunities in research and development and systems engi neering within today's industry.

After completing a basic core of fundamental courses in mathematics, physical sciences, and engineering sciences, each systems engineering student undertakes a major set of courses that in cludes further fundamental courses in systems analysis together with courses in the design of control systems, mechanical systems, and com puter (microprocessor) systems.

Technical electives are selected to allow the student to achieve concentrated knowledge in a wide variety of areas offered in the School of En gineering

The following courses are required as a part of the engineering core and mathematics electives:

			Semester Hours
CSE/EEE	225	Assembly Language Programming (Motorola or CSE/EEE 226 Assembly Language Programming (Intel 3)	3
ECE	210	Engineering Mechanics I Statics	3
ECE	312	Engineering Mechanics II Dynamics	3
ECE	313	Introduction to Deformable Solids	3
ECE	334	Electronic Devices and Instrumentation	4
ECE	340	Thermodynamics	3
ECE	352	Properties of Electronic Materials	3
		or ECE 350 Structure and Properties of Materials (3)	
ECE	383	Probability and Statistics for Engineers	2
MAT	274	Elementary Differential Equations	3
MAT	342	Linear Algebra	3
PHY	361	Introductory Modern Physics	3
		(Basic Science Elective)	

In addition, the following courses are required:

			Semester Hours
ASE	490	Project in Design and Development	3
CSE	120	Digital Design Fundamentals	3
CSE/EEE	325	System Design with Microprocessors (Motorola or CSE/EEE 326 System Design with Micro processors (Intel) 3)	3
CSE	330	Computer Organization	3
EEE	302	Electrical Networks II	3
EEE	303	Signa s and Filters	3
EEE	455	Communication Systems	4
EEE	480	Feedback Systems	4
IEE	300	Economic Analysis for Engineers	3
IEE	461	Integrated Production Control	3
IEE	475	Introduction to Simulation	3
IEE	476	Operations Research Techniques Applications	4
Technical Electives			8
Total			47

Engineering Interdisciplinary Programs—B.S.

Engineering Business and Pre-law. This option accommodates especially those engineer ing students whose primary intent is to earn a Ju ris Doctor (J.D.) or a Master of Business Admini stration (M.B.A.). The success with which engi-neers have risen to positions of leadership in busi-ness and government is well established. It is predicted that, with the rapid increase in techno logical advance on every hand, opportunities for engineers to enter business and legal careers will be enhanced to an even greater degree in the fu ture.

In addition to ECN 111, ECN 112 Microeconomic Principles is required as a part of the social and behavioral sciences requirement.

The following courses are required as a part of the engineering core and mathematics electives:

			Semester Hours
ECE	383	Probability and Statistics for Engineers	2
IEE	463	Computer-Aided Manufacturing and Control	3
MAT	242	Elementary Linear Algebra	2

The course to be deleted from the engineering core depends on the student's chosen engineering electives (area of emphasis) and is subject to approval of the advisor.

In addition, the following courses are required:

			Semester Hours
ACC	211	Introductory Financial Accounting	3
ACC	212	Introductory Managerial Accounting	3
ASE	485	Engineering Statistics	3
BLW	305	Legal Environment of Business	3
FIN	300	Fundamentals of Finance	3
IEE	300	Economic Analysis for Engineers	3
IEE	367	Methods Engineering and Facilities Design	4
		or IEE 422 Information Systems Design (3)	
IEE	461	Integrated Production Control	3
IEE	476	Operations Research Techniques/ Applications	4
IEE	490	Project in Design and Development	3
MGT	301	Management and Organization Behavior	3
MKT	300	Principles of Marketing	3
Engineering Technical Electives		(including three courses of engineering science and one of engineering design type content)	14
		Total	52

Geological Engineering. This option incorporates the joint application of engineering and geological principles to the planning, analysis, and design of engineering projects directly related to the earth, its materials, structures, and forces. The goal of the program is to investigate the physical properties of the shallow portions of the earth's crust that influence the design and construction of engineering structures such as foundations, excavations, dams, highways, and sites for waste disposal. Additionally, the geological factors associated with land use planning and with the development of water, petroleum, and mineral deposits are encompassed within the program.

The following courses are required as a part of the engineering core (only ECE 333 Electronic Instrumentation may be deleted):

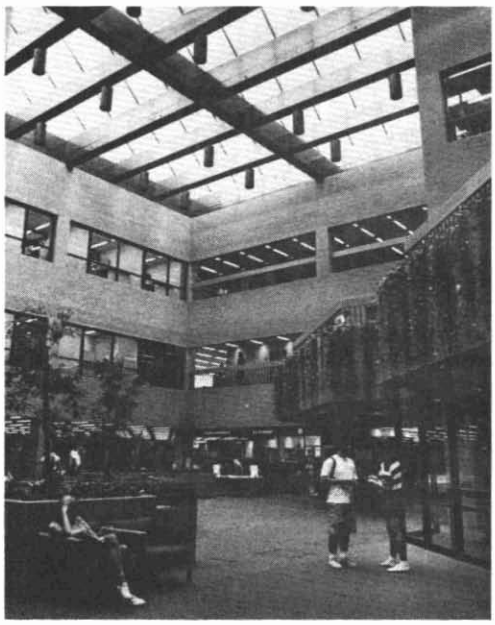
			Semester Hours
CEE	400	Microcomputer Applications in Civil Engineering	3
ECE	210	Engineering Mechanics I: Statics	3
ECE	312	Engineering Mechanics II: Dynamics	3
ECE	351	Engineering Materials	3
GLG	101	Introduction to Geology I (Physical)[1]	3

In addition, the following courses are required:

			Semester Hours
ASE	490	Project in Design and Development	3
CEE	351	Soil Mechanics	4
CEE	452	Foundations	3
CEE	552	Geological Engineering	3
GLG	103	Introduction to Geology I–Laboratory	1
GLG	310	Structural Geology	3
GLG	321	Mineralogy	3
GLG	322	Mineralogy Laboratory	2
GLG	362	Geomorphology	3
GLG	424	Petrology-Petrography	4
MAE	371	Fluid Mechanics	3
Engineering Technical Electives[2]			20
		Total	52

[1] Basic science elective.

[2] Includes two courses of engineering science and three courses of engineering design type content. An approved summer engineering-geology field course is also highly recommended.



College of Fine Arts

Seymour L. Rosen, B.A.
Dean

Purpose

The College of Fine Arts provides for preprofessional and professional education in the several arts disciplines and also an opportunity for non majors to become culturally literate through participation and involvement in the creative and performing arts

The college, through its programs in art, dance, music, and theatre, reflects a wide range of challenges facing the artist and scholar in the 20th century. The arts, as an integral part of our curriculum and of human expression, offer the student a rewarding educational development balanced and strengthened by studies in related fine arts areas, the humanities, social sciences, and the sciences.

In addition to professional curricula offered in each department or school, the college makes available courses designed to meet the specific educational needs of students pursuing majors in other colleges. The cultural life of the university community is further enriched by study opportunities offered at off campus sites. The College of Fine Arts also offers community audiences many hours of cultural enjoyment through myriad concerts, art exhibitions, music and dance concerts, dramatic productions, opera, lectures, and seminars.

Organization

The college houses the School of Art, the Department of Dance, the School of Music, and the Department of Theatre An average of 2,000 students per semester enroll as majors in various degree programs offered through these units. The college also houses the ASU Art Museum.

Admission

Students meeting basic admission standards of Arizona State University may matriculate in the College of Fine Arts. Separate admissions procedures and approvals are required for some programs within the college Students must contact specific departments or schools for details.

Transfer of Community College Credits. Credits transferred from any accredited junior or community college may be accepted up to a maximum of 64 semester hours. A community college student planning to transfer at the end of his or her first or second year should plan to take community college courses that meet the requirements of the ASU curriculum selected. Students attending Arizona community colleges are permitted to follow the degree requirements specified in the ASU *General Catalog* in effect at the time they begin their community college work, providing their college attendance has been continuous

Courses transferred from community colleges are not accepted as upper-division credit at ASU. Arizona students are urged to refer to the *Arizona Higher Education Course Equivalency Guide* for transferability of specific courses from Arizona community colleges. Copies of the guide are available in counselors' offices. In choosing courses at a community college, students should be aware that a minimum of 50 hours of work taken at the university must be upper division credits While attending a community college, it is suggested that students elect General Studies and lower division courses in the major field.

General Transfer Credit. Direct transfer of courses from other accredited institutions to the College of Fine Arts are subject to (1) the exis-

ence of parallel and equal courses in the college's curriculum and (2) departmental or school evaluation of studio courses with respect to performance standards. A minimum of 30 semester hours earned in resident credit courses at ASU is required of every candidate for the bachelor's degree. Transfer students enrolled in the College of Fine Arts must complete a minimum of 15 semester hours of resident credit in the major as approved by the faculty.

Advisement

Advisement is handled as a decentralized activity within the college. To offer personalized attention, each academic unit establishes its own graduation advisement procedures. Students are encouraged to make appointments through the central office of their major disciplines.

Degrees

MAJOR FIELD	DEGREE	DEPARTMENT/SCHOOL
Baccalaureate Degrees		
Art Emphases: art history, photographic studies, studio art	B.A.	School of Art
Art Concentrations: art education, ceramics, drawing, fibers, graphic design, intermedia, metals, painting, photography, printmaking, sculpture, wood	B.F.A.	School of Art
Choral–General Music	B.M.	School of Music
Dance	B.A.	Dance
Dance Concentrations: dance education, performance and choreography	B.F.A.	Dance
Instrumental Music Concentrations: instrumental, string	B.M.	School of Music
Music	B.A.	School of Music
Music Therapy	B.M.	School of Music
Performance Concentrations: guitar, jazz, keyboard, music theatre, orchestral instrument, piano accompanying, voice	B.M.	School of Music
Theatre	B.A.	Theatre
Theatre Concentrations: performance/production (acting, design/technology), theatre education	B.F.A.	Theatre
Theory and Composition Concentrations: composition, theory	B.M.	School of Music

Degrees

MAJOR FIELD	DEGREE	DEPARTMENT/SCHOOL
Graduate Degrees		
Art Concentrations: art education, art history	M.A.	School of Art
Art Concentrations: ceramics, drawing, fibers, intermedia, metals, painting, photography, printmaking, sculpture, wood	M.F.A	School of Art
Choral Music Concentrations: choral music, general music	M.M.	School of Music
Choral Music	D.M.A.	School of Music
Dance Concentration: performance and choreography	M F A.	Dance
Instrumental Music	M.M., D.M.A.	School of Music
Music History and Literature	M.A.	School of Music
Performance Concentrations: music theatre musical direction, music theatre performance, performance pedagogy, piano accompanying, solo performance (instrumental, keyboard, voice)	M.M.	School of Music
Secondary Education* Concentrations: art education, choral music, general music or instrumental music, music education, theatre education	Ed.D	
Solo Performance	D.M.A.	School of Music
Theatre	M.A.	Theatre
Theatre Concentrations: scenography, theatre for youth	M F.A.	Theatre
Theory and Composition Concentrations: composition, theory	M.M.	School of Music

* The Ed.D. degree is administered through the College of Education.

Baccalaureate Degrees

The three baccalaureate degrees differ in curricula with respect to the amount of specialization permitted in the major field. The Bachelor of Arts degree provides a broad, scholarly, humanistic program, while the other two programs place greater emphasis upon the major field. General Studies play an integral role within the educational mission of the university and as such constitute an important component of all undergraduate degrees in the College of Fine Arts. See pages 387 388 for General Studies requirements.

In cooperation with the College of Education, certification is available at the secondary level in the disciplines of art, dance, music, and theatre for students preparing for a teaching career in the public schools. Students should, with the advice and counsel of their arts education advisors, fulfill the requirements for the appropriate area of specialization under the Bachelor of Fine Arts or Bachelor of Music degrees. In addition, a student wishing to be admitted to the Professional Teacher Preparation Program (PTPP) in the College of Education (leading to teaching certification) must obtain an advisor from the Office of Student Affairs in the College of Education before making application for the PTPP. Students must have completed 56 hours with a minimum GPA of 2.50 and also have passed the three Pre-Professional Skills Tests in order to be eligible for the program. Further detail on admission requirements and procedures for the PTPP can be found on pages 260 and 261 under the College of Education.

Graduate Degrees

Master's programs range from 30–60 semester hours, depending upon the degree chosen. Doctoral programs vary in scope and curricula. See the *Graduate Catalog* for specific requirements for the M.A., M.F.A., M.M., D.M.A., Ed.D., and Ph.D. degrees.

Degree Requirements

In addition to the general information given below, consult the sections of this catalog listed under School of Art, Department of Dance, School of Music, or Department of Theatre for specific degree requirements.

Bachelor of Arts Degree (B.A.) The Bachelor of Arts degree requires 45–60 semester hours for the major. Depending on the major, 18–24 hours must be selected from upper division courses (300 or 400 level). The semester-hour requirements in the major are distributed between a field of specialization (30–45 hours) and one or more related fields (an additional 15 hours). The exact content of the major is selected by a student in consultation with his or her advisor under rules and regulations of the department or school concerned.

Bachelor of Fine Arts Degree (B.F.A.) The Bachelor of Fine Arts degree requires 65–85 semester hours for the major. At least 30 of these hours, depending on the major, must be selected from upper division courses (300 or 400 level). The curriculum for the major is designed as preprofessional study in art, dance, or theatre. Auditions and/or interviews are required for admission to the B.F.A. program in Dance or Theatre. Consult these departments for specific information.

Bachelor of Music Degree (B.M.) The Bachelor of Music degree requires 84 semester hours for the major. The required number of upper-division courses (300 or 400 level) is dependent on the area of specialization. The curriculum for the major is designed to provide a broad yet concentrated preparation with a choice of specialization among the areas of music performance, music theatre, jazz, music therapy, piano accompanying, theory–composition, instrumental music, and choral–general music. An entering undergraduate music student, regardless of the area of specialization, must perform an entrance audition in his or her primary performing medium (voice or instrument).

General Studies Requirements

To meet the General Studies requirement, a minimum of 35 semester hours must be completed in the General Studies areas. Six semester hours must also be completed in the awareness areas. A course may concurrently satisfy a core area requirement and an awareness area requirement. Neither courses in the major nor related field area courses may be cross listed in fulfillment of both major and General Studies core or awareness requirements with the exception of concurrent listings in the numeracy (computer applications) and literacy (upper division) areas, as specified by the University General Studies guidelines.

	Semester Hours
Core Areas:	
Literacy and Critical Inquiry	6
Numeracy	6
* Humanities and Fine Art	6 or 9
(Fine arts majors must take at least six semester hours of fine arts course work in areas outside of the major school or department. These may be courses in art, dance, music, or theatre. A student may concurrently fulfill this requirement and the humanities and fine arts General Studies requirement by selecting approved courses as indicated in the *Schedule of Classes*. This requirement may also be met by taking *any* College of Fine Arts course outside of the student's major and listing it under General Studies electives.)	
* Social and Behavioral Sciences	6 or 9
Natural Sciences	8
Awareness Areas:	
Global Awareness	3
Historical Awareness	3

* 15 hours total

Refer to pages 58–61 of this catalog for a description of the University General Studies requirements. General Studies courses are regularly reviewed. To determine whether a course meets one or more General Studies course credit requirements, see the listing of courses, pages 62 88. General Studies courses are also identified following course descriptions according to the following key:

Key to General Studies Credit Abbreviations

L1	Literacy and Critical Inquiry Core Courses (Intermediate level
L2	Literacy and Critical Inquiry Core Courses (Upper division)
N1	Numeracy Core Courses (Mathematics)
N2	Numeracy Core Courses (Statistics and Quantitative Reasoning)
N3	Numeracy Core Courses (Computer Applications)
HU	Humanities and Fine Arts Core Courses
SB	Social and Behavioral Sciences Core Courses
S1	Natural Sciences Core Courses (Introductory)
S2	Natural Sciences Core Courses (Additional Courses)
G	Global Awareness Courses
H	Historical Awareness Courses

Graduation Requirements

Several programs require additional General Studies electives that may be selected from anthropology, architecture, biology, botany, chemistry, communication, economics, English (except ENG 101, 102, 105, 107, and 108), foreign languages, geography, geology, history, humanities, interdisciplinary studies in liberal arts (LIA), journalism and telecommunication, philosophy, physical education (except activity courses), physical science, physics, political science, psychology, religious studies, sociology, zoology, and any College of Fine Arts course outside the student's major to meet the minimum number required for a particular degree program. Additional electives to complete the total of 126 semester hours may be taken in any area of the university.

In addition, the student must meet the university English proficiency requirement: ENG 101 and 102 (six hours) or ENG 105 (three hours). Foreign students may satisfy this requirement by taking ENG 107 and 108.

All Bachelor of Arts degrees require the equivalent of 16 semester hours in one foreign language. (Exception: the Bachelor of Arts degrees in Dance, Theatre, and Art with an emphasis in studio art strongly recommend but do not require foreign language study.) Course work may be selected in any language and must follow the sequence of language courses 101, 102, 201, and 202. This requirement may be fulfilled at the secondary school level or by examination. If acquired in secondary school, two years of instruction in one foreign language is considered the equivalent of one year of college instruction. Transfer students are placed in language study at the level above completed work. Candidates for the Bachelor of Music degree in voice performance and piano accompanying have specific foreign language requirements. These are stated in each of the degree requirements (pages 404–407). There is no foreign language requirement for other areas of specialization of the Bachelor of Fine Arts or Bachelor of Music degrees.

The minimum graduation requirement is the completion of 126 semester hours with a minimum cumulative GPA of 2 00. Of these 126 semester hours, at least 50 must be selected from upper-division courses. Many professional programs within the College of Fine Arts require additional semester hours for graduation and a higher cumulative GPA of their majors. To be acceptable as graduation credit, all course work in

the major discipline must show an earned grade of "C" (2.00) or higher.

Academic Standards

The terms of disqualification, reinstatement, and appeals are consistent with those set forth by the university on page 56 of this catalog, except for Theatre. For the B.F.A. in Theatre, a student must have a minimum GPA of 3.00 in the major to enroll in upper division courses and to remain in good standing. In addition, a student disqualified in any program is normally not eligible for reinstatement for two semesters.

Special Programs

Together with faculty, visiting scholars, and artists in residence, students in all fields of the College of Fine Arts participate in dynamic, innovative programs. The creative energy that infuses the visual and performing arts finds expression in research and study.

The School of Art is one of the largest organizations of its kind in the country and offers students unique opportunities for study in the visual arts. In computer graphics, students may work with software for "painting," solid modeling, and three dimensional animation While computer graphics makes use of the latest technology, other areas preserve and revitalize established media. The Graphic Design Workshop provides students a professional working environment, and the internship program offers the opportunity to work with leading design studios. Women's studies in the visual arts examines contemporary and historical issues and trends in the context of students' artistic and scholarly pursuits. The Children's Art Workshop is an on campus program for the Phoenix metropolitan area taught by students in art education. In the emerging field of photographic studies student are trained in photographic history, criticism, and exhibition management. The School of Art publishes the student authored *The History of Photography Monograph Series* and sponsors the teaching gallery, Northlight, which hosts exhibitions of well known photographers. The visiting artists and guest lecturer program brings prominent artists and scholars to the campus community. Students participate in workshops and presentations by key figures in their fields.

The Visual Arts Research Studios, in the School of Art, conduct research in historical and contemporary technologies in the visual arts. The Studios bring together artists, master printers, and photographers to encourage collaboration and research. Students are appointed to assist VARS personnel in the planning and production of projects in the Print Research facility, the Photography Collaborative facility, and the Pyracantha Press.

Recognized as offering some of the top programs in the country, the Department of Dance emphasizes the choreography, performance, and theory of modern dance. The artist-in-residence program brings major figures and companies to campus each year. The department was selected as one of five in the United States to participate for three years in the Curriculum Development Project of the Dance Notation Bureau in important research on labanotation. Students work closely with visiting artists, artists-in-residence, and researchers investigating labanotation and the possibilities of video and computer technology in dance and dance music composition. At the American College Dance festivals for the past several years, graduate students have taken top honors at both the regional and national levels.

An ambitious performance program offers to the public several concerts each year, some with works created and performed by graduate and undergraduate students and others featuring works by faculty and visiting artists. Dance Arizona Repertory Theatre (DART) gives graduate and undergraduate students the opportunity to perform and tour in the metropolitan area, the region and the state.

Faculty in the School of Music include a wide range of performers, teachers, conductors, composers, and scholars who are recognized both nationally and internationally. Students have the opportunity to participate in comprehensive degree programs that provide for wide and divergent opportunities in performance and course work. Student performing organizations are recognized as being some of the finest in the nation, and ASU students regularly compete successfully in national competitions. The broad scope of degree options allows students excellent choices in gaining depth and breadth in the musical field.

The Department of Theatre takes special pride in its scenography and theatre for youth programs. The theatre for youth program enjoys an international reputation, provides comprehensive training, and attracts students, scholars, and visitors from around the world. Students are challenged to excel in every aspect of theatrical training They have opportunities to act in and direct mainstage and touring shows, to conduct research, and to teach on and off campus. The pro-

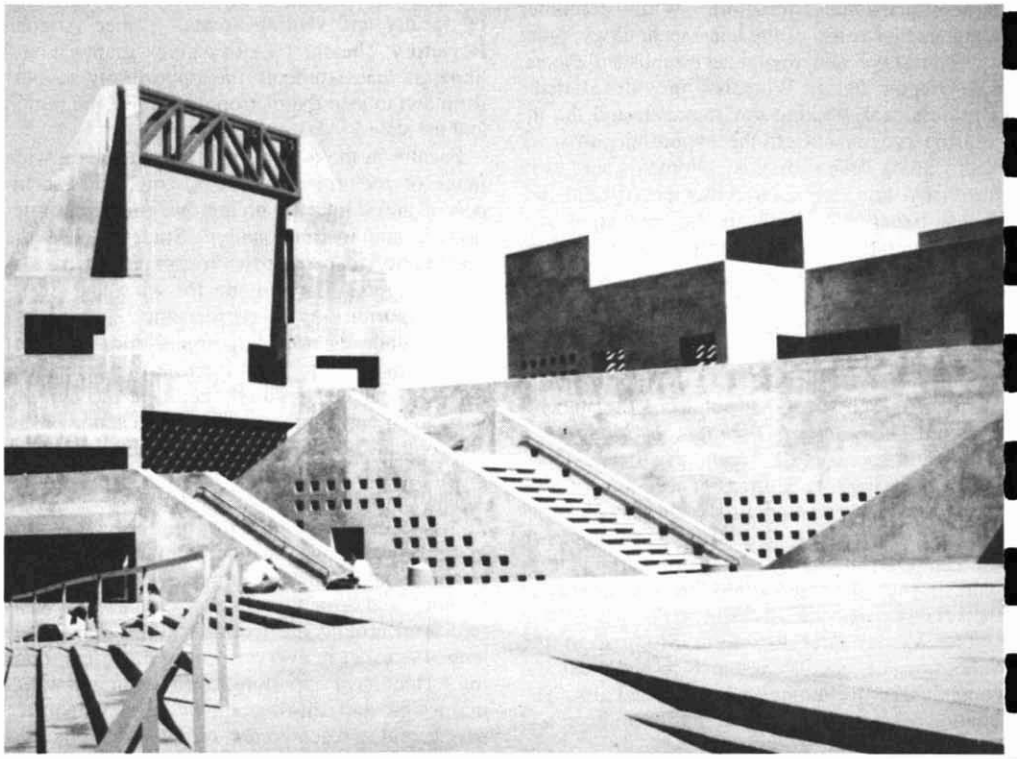
gram has developed Hayden Library's Child Drama Special Collection, which includes rare books, plays, and personal and national association archives. It is the most complete and extensive collection of its kind in the English-speaking world. Students in the scenography program are actively involved in all aspects of design and technology for mainstage and studio productions and receive regional and national awards for their work on a regular basis. A multiethnic theatre program provides opportunities for students to view and work with professional and semiprofessional multiethnic productions on campus. And the experimental theatre program allows students to work with resident and professional actors while providing a venue for original and exciting performance pieces.

A playwright-in-residence works with both undergraduate and graduate students, creating and showcasing original scripts from students and faculty. An interdisciplinary M.F.A. in Creative Writing encourages graduate students to work closely with writers of drama, fiction, and poetry and with directors and producers from the Departments of English and Theatre. Faculty in the Departments of Theatre and English offer students a unique opportunity to tailor a course of study to fit individual needs, talents, and goals.

General Information

Undergraduate Credit for Graduate Courses. To enable interested students to benefit as much as possible from their undergraduate studies, the Graduate College and the College of Fine Arts extend to seniors with a GPA of at least 2.50 the privilege of taking 500-level graduate courses for undergraduate credit. Application for admission to a graduate course for undergraduate credit must be completed in advance of the regular registration period. The application must be approved by the instructor of the class, the student's advisor, the chair or director of the department or school, and dean of the college in which the course is offered.

Preprofessional Programs. Students preparing for admission to professional graduate schools should obtain information regarding admission requirements by writing directly to schools in which they may be interested.



School of Art

Julie F. Codell, Ph.D., Director

PROFESSORS:
CODELL (ART 102), BRECKENR DGE, CHOU, ERICKSON, GASOWSKI GILLINGWATER, JAY, LEHRER, L NDERMAN MAGENTA, MEISSINGER, PILE, PIMENTEL, STULER, SWEENEY, J.R. TAYLOR, WOODS

ASSOCIATE PROFESSORS:
ALQUIST BR TTON, COCKE, DeMATT ES, DETRIE, ECKERT, FAHLMAN FRONSKE, GULLY, HAJICEK, JENK NS, KAIDA, KROEGER, KRONENGOLD, PATEL, P TTSLEY RAB NER, RISSEEUW, ROWLEY SCHMIDT, SHARER, STOKROCK UMBERGER, WEISER, WHITE, B. YOUNG, J. YOUNG

ASSISTANT PROFESSORS:
COLL NS, DUNCAN, HULICK, MAXWELL, SANFT, SCHLEIF SCHOEBEL, SCHUTTE, SERWINT, SH PP, VERSTEGEN

PROFESSORS EMERITI:
BROADLEY FARNESS, FINK GOO, GRIGSBY HAHN, HALE, HELLER JACOBSON, KELLY, SCHAUMBURG, J J. TAYLOR, WAGNER, WATSON, WOOD

Major Requirements

For advisement purposes, all students registering in a School of Art degree program enroll through the College of Fine Arts Each degree program and area of specialization has its own check sheet, which describes the particulars of course sequence and special requirements. Check sheets are available in the School of Art office.

Bachelor of Arts Degree

The School of Art offers three emphases for Art majors in the program Bachelor of Arts program: studio art, photographic studies, and art history. These emphases are intended to give the student a broadly based general education in the field with some more specialized work at the upper division level.

Studio Art

This emphasis consists of a minimum of 45 semester hours as approved by the student's advisor. It requires 30 semester hours in studio, including ART 111, 112, 113, and 115, and 15 hours in a related field(s), including ARS 101 and 102. Normally the related field is art history. At least 18 of the 45 hours must be upper division credit. All credit applied to the emphasis must be with a "C" or better. The foreign language requirement of the B.A. degree is optional but strongly recommended.

Art History

This emphasis consists of a minimum of 45 semester hours as approved by the student's advisor It requires 33 semester hours of art history courses and 12 in a related field(s). Normally the related field is studio art. At least 18 of the 45 hours must be upper division credit. All credit applied to the major must be with a "C" or better. The art history areas of ancient, medieval, Renaissance, baroque, modern, and non Western art must each be represented with at least one course. Satisfactory completion of ARS 480 Research Methods is required before the senior year Other requirements are ARS 101 and 102, one lower division ARS (non Western) course, one ARS 498 Pro Seminar and ART 111, 112, and 115. Knowledge in at least one foreign language is required, equivalent to the level obtained through the completion of two years' study at the college level. For specific courses, see the Department of Foreign Languages section.

Photographic Studies

This emphasis consists of a minimum of 48 semester hours as approved by the student's advisor. Required courses include ARS 450, 451, and 454, ART 409, one upper-division ARS course in modern art, and one upper-division ARS course in criticism. Knowledge in at least one foreign language is required, equivalent to the level obtained through the completion of two years of study at the college level. For specific courses, see the Department of Foreign Languages section.

Bachelor of Fine Arts Degree

Art

This major consists of 75 semester hours, with a concentration in one area selected on the basis of the student's interests. The following concentrations are available to the student: art education, ceramics, drawing, fibers, graphic design, intermedia, metals, painting, photography, printmaking, sculpture, and wood.

All students in this degree program follow the same pattern of courses in art for the first two semesters: ARS 101, 102; ART 111, 112, 113, 115.

At least 30 upper-division semester hours must be earned within the major, with a minimum of 12 semester hours within the concentration.

All course work counted in the major must be with a "C" or better. The specific requirements for the concentration are recommended by the faculty advisors of the area and are listed on School of Art check sheets.

Courses from other departments, when approved by the advisor and the School of Art, may be applied to the major if deemed appropriate to the student's program of study.

Graphic Design

This concentration requires a special application procedure. The application procedure for new and transfer students is separate from and in addition to the required admission to ASU. Acceptance is determined by the graphic design faculty and is based on an application, test, and portfolio. Applications must be made between February 15 and March 15 for admission for the following fall semester. Students are accepted for entry into the graphic design program in the fall semester only of each academic year. Selection of applicants is made by April 1. Due to space limitations, not all qualified applicants can be accommodated, and the admission process is necessarily selective. For application forms and further information, contact the School of Art.

Art Education

The concentration in art education consists of 75 semester hours, including ARS 101 and 102 and two ARS upper-division electives (including one in art during the 20th century and one in non Western art); ART 111, 112, 113, 115, 201, and 223, one three-dimensional course (either ART 231, 261, 272, 274, or 276) The following art education courses are required: ARE 350, 450, 470, 480, 486, 494, and 496. In addition a minimum of 21 hours, including 12 hours of upper division credit, must be taken in a specific area of art proficiency approved by an advisor of art education. The art proficiency can be in art history, ceramics, drawing, fibers, intermedia, metals, painting, photography, printmaking, sculpture, or wood. Teaching experience is provided in the Children's Art Workshop, which is an on-campus art history based studio program for children ages five to 15. Participation in the workshop is part of the requirements for ARE 486. ARE 486 meets the state certification requirements for the elementary methods class, and ARE 496 meets the requirements for the secondary methods class in the subject area. Both of these courses have prerequisites.

A student pursuing a B.F.A. in Art with a concentration in art education may also choose to become certified for teaching art K 12. If certification is elected while pursuing the art education undergraduate degree, additional hours are required in the College of Education. Students must make special application to the professional education program in the College of Education at the beginning of the junior year. To be considered for admission to the professional program students must have successfully completed the Pre-Professional Skills Test (PPST) during the sophomore year. In addition, as part of the certification process, students must meet the U.S. and Arizona constitution requirement. Certification may also be pursued after receiving an undergraduate degree in art through the postbaccalaureate program in the College of Education Interested students should contact an advisor in the College of Education and in art education for admission requirements to the postbaccalaureate program. Art education courses for this program are ARE 450, 480, 486, and 496.

The B.F.A. in Art with a concentration in art education and the postbaccalaureate program for certification in art have special art education application procedures. This procedure is separate from, and in addition to, the admission requirements of ASU. Acceptance is determined by the art education faculty and is based on a application, a 2.50 GPA, a three- to five page paper describing and historically interpreting a work of art, a portfolio of studio work, and a grade of B or better in ARE 350 (undergraduates only). Undergraduates pursuing the concentration in art education and postbaccalaureate students pursuing certification in art need to have completed the foundations courses and 12 credit hours of art history including at least one course in art of the 20th century before or during the semester in which they apply. The application for the undergraduate concentration must be submitted while enrolled in ARE 350 before October 1 for the following spring and before March 1 for the following fall. Application for postbaccalaureate certification in art must be submitted before October 1 for the spring semester and occurs in only the fall semester. In addition, the student should check deadlines for the admission to the College of Education professional program.

Student teaching in art education occurs in only the spring semester. To be accepted into student teaching, a student must be recommended in writ-

ing by the art education faculty and must have completed all art education classes except for ARE 496, which should be taken concurrently with student teaching. Students who are not recommended may complete the B.F.A in Art with a concentration in art education without certification or may reapply after meeting deficiencies in knowledge and/or skills related to the teaching of art.

Graduate Programs

The School of Art offers programs leading to the Master of Arts degree with a major in Art, including an emphasis in art education or art history, and the Master of Fine Arts degree with an emphasis in ceramics, drawing, fibers, intermedia, metals, painting, photography, printmaking, sculpture, or wood. In cooperation with the College of Education, the degrees of Master of Arts in Education, Doctor of Education, and Doctor of Philosophy are offered with a concentration in art education. Consult the *Graduate Catalog* for requirements for all graduate degrees.

STUDIO CORE CURRICULUM

ART 111 Drawing I. 3 F, S, SS
Fundamental, technical and perceptual skills using common drawing media and their application to pictorial organization. 6 hours a week

112 Two-dimensional Design. 3 F, S, SS
Fundamentals of pictorial design 6 hours a week.

113 Color. (3 F, S, SS
Principles of color theory as related to the visual arts 6 hours a week Prerequisites. ART 111, 112

115 Three-dimensional Design. (3) F, S, SS
Fundamentals of three-dimensional form 6 hours a week. Prerequisites: ART 111 112

DRAWING

ART 211 Drawing II. (3 F, S SS
Continued development of technical and perceptual skills Emphasis on materials and pictorial content 6 hours a week. Prerequisites ART 113, 115

214 Life Drawing I. 3 F, S, SS
Development of skill and expressiveness in drawing the basic form construction, and gesture from the human figure 6 hours a week. Prerequisites ART 113 115

311 Drawing III. 3 F S
Emphasis on composition, exploration of drawing media. 6 hours a week. Prerequisites ART 211, 214; instructor approval

314 Life Drawing II. (3 F, S
Drawing from the model with greater reference to structural graphic and compositional concerns 6 hours a week Prerequisite: ART 214 or instructor approval

315 Life Drawing III. 3) F S
The human figure as the subject for drawing Emphasis on conceptual alternatives and management of materials. 6 hours a week. Prerequisite ART 314 or instructor approval

411 Advanced Drawing. 3 F S
Visual and intellectual concepts through problem solving and independent study. Emphasis on the individual creative statement 6 hours a week. May be repeated for credit Prerequisites ART 311; instructor approval

414 Advanced Life Drawing. 3) F, S
Various media and techniques on an advanced level. The human figure as an expressive vehicle in various contexts 6 hours a week May be repeated for credit Prerequisite. ART 315 or instructor approval

415 Art Anatomy. (4) N
Study of human anatomical structures as applied to the practice of figure oriented art 3 hours lecture 5 hours studio a week Prerequisite ART 214.

PAINTING

ART 223 Painting I. 3 F S SS
Fundamental concepts and materials of traditional and experimental painting media Emphasis on preparation of painting supports, composition, and color 6 hours a week. Prerequisites: ART 113, 115

227 Watercolor I. 3 F S
Fundamental concepts materials and techniques of watercolor Emphasis on problem solving, basic skills composition and color. 6 hours a week Prerequisites: ART 113, 115

323 Painting II. (3 F, S
Development of competency in skills and expression Assigned problems involve light, space, color form and content 6 hours a week Prerequisite: ART 223 or instructor approval

324 Painting III. (3 F, S
Continuation of ART 323 6 hours a week Prerequisite ART 323 or instructor approval

325 Figure Painting. (3) F S
The human figure clothed and nude as the subject for painting in selected media. 6 hours a week. Prerequisites ART 314 323

327 Watercolor II. 3 A
Explorations of personal expression in watercolor. Continued development of watercolor skills using traditional and experimental materials and techniques. 6 hours a week. Prerequisite ART 227.

421 Painting Materials and Techniques. (3 A
Traditional and modern materials and techniques of painting. Experimental problems in tempera encaustic, casein emulsions, Maroger's Medium, and synthetic media 6 hours a week Prerequisite instructor approval

423 Advanced Painting. 3 F, S
Continuation of ART 324. 6 hours a week May be repeated for credit. Prerequisite: ART 324

425 Advanced Figure Painting. (3 F S
Continuation of ART 325 6 hours a week. May be repeated for credit Prerequisites. ART 315 324, 325

427 Advanced Watercolor. (3 F S
Continuation of ART 327 6 hours a week May be repeated for credit Prerequisite ART 327.

INTERMEDIA

ART 340 Intermedia. (3) F, S
Exper menta conceptual, and nterd sc p nary studio art w th emphas s on new med a and techno ogies 6 hours a week May be repeated once for cred t Prerequ s tes ART 113, 115; 6 hours add tional stud o requ rements; or nstructor approva

341 Mixed Media. (3) A
Exp oring v sual effects by combining trad t onal and non trad tiona methods, techn ques and concepts. 6 hours a week. May be repeated once for cred t Prerequ'sites ART 113, 115 6 hours add t ona stud o requ rements, or instructor approva

440 New Media Concepts. (3 F S
Continued exper ments w th new med a and nterdisc pl nary concerns in art. 6 hours a week May be repeated for cred t Prerequ s'te: ART 340.

441 Video Art. 1) F S
Ut l z ng v deo and aud o equ pment essent a to the pro duction of broadcast qua ty v deo art 2 hours a week May be repeated for credit Corequ s tes· ART 340 341 or 440 nstructor approva .

PHOTOGRAPHY

ART 201 Photography I. 3) F S
Development of sk s and techn ques of b ack and white photography. Emphas s on camera work and darkroom procedures 2 hours ecture 3 hours lab

301 Photography II. (3) F, S
Photography as an art med um w th add tional explorat on nto persona photograph c aesthet cs 6 hours a week Prerequ s tes· ART 113 115, 201 or nstructor approval

304 Advanced Photography. (3) F, S
nterpretat on and man pu at on of ght as a too n the per formance of express ve photography 6 hours a week Prerequisite ART 301 or nstructor approval

305 Color Photography I. (3) F, S
App cat on of co or transparenc es and prints to photo graph c art 6 hours a week Prerequ s te· ART 304 or n structor approva

306 Photo Techniques. (3 F S
Exp orat on of camera and darkroom techn ques with em phas s on creative contro for the we crafted b ack and white print. 6 hours a week. Prerequ s te: ART 301 or n structor approva

401 Nonsilver Photography. (3) F, S
Recogn t on of the nherent characterist cs of nons lver processes and the use of these processes n the commu n cat on of deas 6 hours a week May be repeated for cred t Prerequis te. ART 306 or nstructor approval.

403 Black and White Photography. (3) F S
Advanced exp orat on of experimenta nterpretive and straight photography 6 hours a week May be repeated for cred t Prerequ s te ART 304 or nstructor approval.

404 Portraiture Photography. (3) F, S
Photograph ng peop e. Critical discuss ons and s de ec tures on ssues n portra ture 6 hours a week May be repeated for cred t Prerequ s tes ART 304 306· or n structor approva

405 Advanced Color Photography. (3) F S
Intens ve use of subtract ve co or process n photograph c print ng 6 hours a week May be repeated for credit Prerequ s te ART 305 or nstructor approva

409 Photographic Exhibition. (3) A
Care of photographic prints, pr nt presentat on and exh bi t on Pract ca experience n ga ery operations 6 hours a week May be repeated for credit Prerequ s te ART 304 or nstructor approva

PRINTMAKING

ART 252 Lithography I. (3) F, S
B ack and wh te p anograph c printmak ng ut l z ng stone and a um num p ate processes 6 hours a week. Prerequi sites: ART 113 115

351 Intaglio I. (3) F, S
ntroduct on to contemporary and trad t ona deve opmen ta techn ques for b ack and wh te pr nts 6 hours a week. Prerequ site nstructor approval.

352 Lithography II. 3) F, S
Cont nuation of ART 252 ntroduct on to co or techn ques and advanced mage-formation processes 6 hours a week. Prerequisite: ART 252 or nstructor approva

354 Screen Printing I. 3) A
Var ous methods and app cat ons nc uding the photo graphic stenc l, and transfer techn ques. 6 hours a week. Prerequ s te: nstructor approva

355 Photo Process for Printmaking I. (3) A
Introduct on to photograph c princ ples and sk s for photo mechan cal pr ntmak ng processes inc ud ng pho tos kscreen photo tho and photoetch ng 6 hours a week Prerequ site nstructor approval.

451 Advanced Intaglio. (3) F S
Var ous contemporary and trad t onal methods of print ng to ach eve co or prints. 6 hours a week May be repeated for cred t Prerequ s te. nstructor approva .

452 Advanced Lithography. (3) F S
Cont nuat on of ART 352 6 hours a week. May be re peated for cred t Prerequ s te: nstructor approva

454 Advanced Screen Printing. (3) A
Cont nuat on of ART 354. 6 hours a week May be re peated for cred t Prerequ s te: nstructor approva

455 Advanced Photo Processes for Printmaking. (3) A
A cont nued study of photomechanica techn ques and app cat ons to printmaking or photograph c processes Prerequ s te ART 355 or nstructor approva

456 Fine Printing and Bookmaking I. 3) A
Letterpress pr nting and typography as f ne art Study of h story, a phabets mechanics of hand typesetting press work and var ous forms of printed matter Prerequisite nstructor approva

457 Fine Printing and Bookmaking II. (3) A
Continuat on of ART 456 Bookb nd ng, book des gn and print ng advanced typography, theory, and presswork May be repeated for cred t. Prerequ s tes: ART 456, n structor approva .

458 Papermaking. 3) F, S
H story, theory demonstrat ons sheet form ng co lage treatments and 3 d'mens ona approaches 6 hours a week May be repeated for cred t Prerequis te· nstructor approva

459 Monoprinting. 3) F, S
The nonmu t ple pr nted mage us ng a var ety of techn cal approaches. 6 hours a week May be repeated for cred t Prerequis tes ART 311 323 or any 300-level printmak ng c ass nstructor approval.

SCULPTURE

ART 231 Sculpture I. 3 F, S, SS
Exp orat on and expression of scu ptura form through deas and concepts re ated to bas c mater a s stud o safety. 6 hours a week Prerequ s tes ART 113, 115

331 Sculpture II. 3 F, S
Cont nuation of ART 231 6 hours a week. Prerequ s te ART 231

332 Advanced Sculpture. 3) F S
Sculptural prob ems re ated to arch tecture and man s environment. Exp orat on n a l media Co or re at onsh ps as appl ed to scu pture 6 hours a week Prerequ s te ART 331

333 Experimental Sculpture. (3 N
An exper menta approach to form-materia re at onsh p toward atmospheric k net c aud o e ectron c and earth works 6 hours a week Prerequ s te ART 332 or nstruc tor approva

431 Special Problems in Sculpture. 3 F S
Deve opment of a persona approach to scu pture, empha s s on form, nd v dua prob ems and re ated co or technol ogy. Profess ona pract ces and presentat on. 6 hours a week. May be repeated for cred t Prerequ s tes: ART 332 nstructor approval.

432 New Directions in Sculpture. (3) A
Exam nat on of environment as resource for mages and deas. Experimentat on n nontrad t ona methods and nterre at ng d sc p nes. 6 hours a week. May be re peated for cred t Prerequ s te ART 332 or nstructor ap prova .

436 Architectural Sculpture. 3) N
Scu ptura concepts as re ated to arch tecture and other man made env ronments Scale draw ng mode s, and re ief sculpture 6 hours a week May be repeated for cred t Prerequ s te ART 332 or nstructor approva

437 Non-Permanent Sculpture. (3 N
Art of a temporary nature nc ud ng sequent a and con ceptual works Attitudes may be presented in f ms or other v sua med a 6 hours a week May be repeated for cred t Prerequ s te nstructor approva .

438 Experimental Systems in Sculpture. 3) N
Systems and concepts for phase changes of materia s temperature pressure f e d t me compress on extension, and e ectron c act vat on of d mens ona forms 6 hours a week May be repeated for cred t Prerequ s te nstructor approva

CERAMICS

ART 260 Ceramics for Non-majors 3 F S, SS
Handbu d ng methods, whee throw ng g aze and decora t ve processes Raku and stoneware f r ngs 6 hours a week

261 Ceramic Survey. 3 F S SS
Handform ng methods throw ng on the whee decorat ve processes and g aze app cat on 6 hours a week Pre requ s tes: ART 112 115

360 Ceramic Throwing. 3) F S
Des gn ana ys s and product on of funct ona pottery Em phas s on throw ng techniques surface enr chment, and g aze app cat on. 6 hours a week. May be repeated once for cred t. Prerequ s te ART 261.

364 Ceramic Handbuilding I. (3) F
Search for form us ng handbu d ng techn ques K n f nng and related prob ems. Prerequ site: ART 261

365 Ceramic Handbuilding II. 3) S
Cont nuat on of ART 364 with an add t ona focus on arge sca e works surface treatments and g aze decorat on with re ated k n fir ng app cat ons Prerequ s te ART 364 or nstructor approva

460 Ceramic Clay. 3 A
Research nto various c ay body formu at ons oca natura mater a s s p g azes, and engobes. 6 hours a week Prerequ s tes ART 360 364· or nstructor approva

463 Ceramic Glaze. 3 A
G aze formu at on and calcu at on us ng var ous glaze sur faces and co ors. 6 hours a week Prerequ s te ART 460 or instructor approva .

466 Special Problems in Ceramics. 3 F S, SS
Emphas s on persona express on w th n structure of sem nars crit ques and stud o work Profess ona methods of presentat on documentat on of work. 6 hours a week. May be repeated for cred t Prerequ s te ART 364 or n structor approval

FIBERS

ART 276 Fiber Arts I. 3 F, S
Structural use of f ber ut z ng a var ety of techn ques. Surface treatment nc ud ng bat k b ock pr nt ng, fo d and t e dye. 6 hours a week.

376 Fibers: Loom Techniques. 3 A
nvest gat on of oom contro ed techn ques. P a n weave, doub e weave, tapestry w be exp ored 6 hours a week Prerequ s tes· ART 113 276, or nstructor approval

377 Fibers: Surface Design. 3 A
Surface des gn techn ques. s k screen ng, pa nt ng stamp ng, and dye ng on fabric w be exp ored. Prerequ s tes ART 113, 276, or nstructor approva

476 Advanced Fibers. 3 F S
Exper mentat on w th advanced techniques n f ber and fabr c May be repeated for credit 6 hours a week. Pre requ sites· ART 376 nstructor approva .

METALS

ART 272 Jewelry I. 3 F S
Emphas s on fabr cat on n jewe ry mak ng. Bas c tech n ques of form ng, cutting and p erc ng, forg ng and so der ng 6 hours a week

372 Jewelry II. 3 F, S
Fabr cated approach to ewe ry making Techn ques n stone sett ng and surface embe shment 6 hours a week. Prerequ s tes ART 113, 115 272 or nstructor approva .

373 Metalworking I. 3 A
Compress on, d e and stretch form ng as app ed to hol low form construct on Hot and co d forg ng techn ques as app ed to sm th ng 6 hours a week Prerequis tes ART 113 115, 272· or nstructor approva .

472 Advanced Jewelry. 3 F S
Jewe ry mak ng w th emphas s on develop ng personal statements and craftsmansh p 6 hours a week May be repeated for cred t Prerequ s tes· ART 372 nstructor ap prova

473 Advanced Metalworking. 3 A
Forg ng and form ng techn ques n nd v dua zed d rec t ons 6 hours a week May be repeated for cred t Pre requ s tes: ART 373; nstructor approva .

WOOD

ART 274 Wood I. 3 F S
Fundamenta woodwork ng techn ques to produce creat ve funct ona 3 dimens ona objects 6 hours a week

374 Wood II. 3 F S
Ind v dua and d rected prob ems n wood related to the product on of un que funct ona art objects. 6 hours a week. Prerequ s tes ART 113, 115 274, or nstructor ap prova

378 Furniture I. 3 A
Des gn and bu d ng of contemporary furniture Exp ora t on n the techn que of jo nery am nat on carv ng and f n sh ng procedures 6 hours a week Prerequ s tes ART 113 115, 274 or instructor approva

474 Advanced Wood. 3) F S
Extended exper ence and advanced techn ques n the use of wood to create funct ona works of art 6 hours a week May be repeated for cred t Prerequ s tes ART 374 n structor approva

478 Advanced Furniture. 3 A
Form concepts are exp ored n construct on of invent ve furn ture. Emphas s on med a exper mentat on 6 hours a week May be repeated for cred t Prerequ s te ART 378

GRAPHIC DESIGN

ART 283 Letterforms I. 3 F
Drawing of etterforms w th focus on proportion and struc ture ntroduct on to etterform nomenc ature and c assif cat ons 6 hours a week Prerequ s tes ART 113 115 acceptance nto graph c des gn program Corequ s te: ART 284

284 Visual Communication I. 3 F
Theoret ca and app ed stud es n shape draw ng and co or 6 hours a week Prerequ s tes ART 113, 115 ac ceptance nto graphic des gn program Corequ s te ART 283

286 Visual Communication II. 3 S
Trans t on from theoret cal to app ed prob ems Emphas s on ref nement of v sua sk l s. 6 hours a week Prerequ s tes: ART 283 284, acceptance nto graphic des gn pro gram Corequ site. ART 287

287 Letterforms II (3 S
Continuat on of Letterforms w th an emphas s on Lower case letters, bas cs of pen wr t ng and font des gn 6 hours per week. Prerequ s tes ART 283 284. Corequi s te ART 286

382 Graphic Representation. (3 F
Stud o pract ce n draw ng w th an app cat on towards graph c commun cat on 6 hours a week. May be re peated once for cred t Prerequis tes ART 284 instructor approval.

383 Typeset I. 3 S
Theoret ca exerc ses n spat a and textura qua t es of type. Prob ems n tens on activat on and ba ance Exer c ses n s mp e typograph ca app cations 6 hours a week Prerequ s tes ART 283 284, 386 acceptance nto graph c des gn program

385 Typeset II. 3 F
Prob ems n compos t on choice, and comb nat ons of type faces formats and their app cat on to a var ety of des gn projects. 6 hours a week Prerequ s te: ART 286 Corequis te ART 386

386 Visual Communication III. 3 F
Problems n spec f c des gn app cat ons such as poster, packag ng pub cat ons etc Emphas s on deve opment of concepts visual commun cat ons 6 hours a week Prerequ s te: ART 286 Corequ s te: ART 385

387 Visual Communication IV. 3) S
C ent or ented projects Prob ems w be mu t faceted and the emphases w l be on cont nu ty of des gn n more than one med um and format 6 hours a week Prerequ s te ART 386.

481 Visual Communication V. 3 F S
Stud o prob ems w th an emphas s on ana ys s, prob em so v ng and profess ona portfo o preparat on 6 hours a week Prerequ s tes ART 387 nstructor approva

482 Visual Communication VI. (3 S
nd v dua and group projects w th outs de c ents A proj ects cu m nate in an exh b t 6 hours a week. Prerequ s te. ART 481

485 Graphic Design Preprofessional Program. (3) F S SS
Preprofess ona c ent/designer s tuat ons from concept to pr nted work Stud o workshop and nternsh ps for se ected students 6 hours a week May be repeated once for cred t. Prerequ s te. nstructor approva

SPECIAL STUDIO ART

ART 444 Computer Art I. 3 F S
A study of PC hardware and software for creat ng art Emphas s on computer graph cs h story hardware soft ware conf gurations DOS pr nc p es of 2- and 3-d men s ona graph cs 2 hours ecture, 2 hours stud o Pre requ s tes ART 111 112 or equ va ent, instructor approva *[Sat sf es General Stud es Requirement N3]*

446 Computer Art II. 3 A
Three d mensiona mode ng ght ng surface attr butes, and spec a effects for art app cat ons Emphas s on ex p icit commands. Stud o. Prerequisite ART 444 or in structor approva

540 Advanced Computer Art. 3 A
Study of mot on for 3 d mens onal mode s, ght sources, and surface effects Course assumes students have a comprehens on of complex mode ng, mapp ng and ight ng. Stud o Prerequ s te ART 446 or nstructor approva

621 Studio Problems. (3 F S SS
Advanced study n the fo ow ng areas

a	Draw ng	f	Ceram cs
b	Pa nt ng	g)	Meta s
c	Photography	h	Wood
d)	Printmak ng	i	F ber Art
e)	Scu pture	(j)	Stud o Art

6 hours a week each sect on May be repeated for cred t. Prerequ s te nstructor approva .

680 Practicum: M.F.A. Exhibition. 1 15 F, S SS
Stud o work n preparat on for requ red M F A exh b t on Pub c exh bit to be approved by the student's superv sory comm ttee and accompan ed by a f na ora exam nat on Photograph c documentat on and wr tten statement of prob em Prerequ s te approva of the student's superv sory comm ttee

Omnibus Courses: See pages 50 51 for omn bus courses that may be offered.

ART EDUCATION

ARE 301 Art in the Elementary School. (3) F S
The study of ch dren's v sua art work from ear y ch d-hood to ear y ado escence 1 hour lecture 4 hours stud o For nonmajors on y

350 Art Education and Design. 3 F S
Profess on of art educat on pnnc p es of visua organ za tion, des gn as a trad t on n art and art educat on, se quenc ng des gn instruction 2 hours ecture, 2 hours stu d o Prerequ s tes ART 113, 115 ARS 101 102; or n-structor approva

420 Crafts for the Elementary School Teacher. (3 A
Pract ca laboratory experiences stress ng a var ety of med a and activ t es for c assroom teach ng Not for M A. cred t n art educat on 1 hour ecture, 4 hours stud o

450 Studio Art: Art History I. (3) A
Art trad t ons pr or to the 20th century as a bas s for stud o and art h story nstruction. 2 hours ecture 2 hours stud o. Pre or corequ s te: ARE 350.

470 Art Criticism: Aesthetics. 3 S
Trad tions of aesthet cs and art cr t cism conceptual is sues n contemporary art educat on n the v sua arts. 2 hours ecture, 2 hours studio Prerequ s te ARE 450 Corequ's te· ARE 480 recommended

480 Studio Art: Art History II. 3 S
Art tradit ons of the 20th century as a bas s for studio and art h story nstruct on 2 hours ecture 2 hours stud o Must be taken before enro ment in ARE 486 Prerequ - s te. ARE 450 Corequ s te: ARE 470 recommended.

486 Art Education: Strategies and Applications. 3 F
The imp ementat on and eva uat on of art instruct on for K 12 popular on nc udes teach ng of Saturday classes n the Ch dren's Art Workshop Prerequ s te ARE 480.

496 Methods and Assessment of Learning in Art 3) A
Ind v dual or group research on the assessment of art earning ncorporat ng theory and pract ce Prerequ s tes· ARE 470 486, or nstructor approva

510 Art Education Colloquium. 3) F
H stonca foundations of art educat on and faculty presen-tation of pos t ons regard ng teach ng and research re ated to the v sua arts Must be taken n the f rst 6 hours of study

515 Art Foundations of Art Education. (3) A
Foundat ons of art educat on, w th an emphas s on psy cho og ca ph losoph ca and h stor ca frames of refer ence

520 Issues in Teaching Art History. 3) A
Cr t ca exam nat on of ssues concerning teach ng art his tory to d fferent popular ons of students H stor cal and ph osoph ca foundations and emphas s on deve op ng n qu ry nto h stor ca and cu tura contexts for art Recom mended to be taken w th ARE 525

525 Research on Teaching Art History. 3 A
Rev ew of emp r ca and h stor ca research, research methods earn ng theory, and assessment of earn ng in art h story. Deve opment of instruct ona resources and p ot studies of how these mater a s affect earn ng. Recom mended to be taken w th ARE 520

530 Issues in Teaching Studio Art. (3 A
Crit cal exam nation of issues concerning teach ng stud o art to d fferent popu at ons of students. H stor ca and phi osophical foundat ons, emphas's on how concepts for representation are deve oped Recommended to be taken with ARE 535.

535 Research on Teaching Studio Art. 3) A
Review of emp rical and h stor cal research methods, earning theory and assessment of earn ng n stud o art nc ud ng deve opmental stud es and the r mitations De-ve opment of nstruct ona resources and p lot studies. Recommended to be taken w th ARE 530

540 Integrating Studio Art and Art History. (3) A
H stor ca and emp rical foundat ons for re at ng studio art and art h story Emphas s on the deve opment of nstruc t ona resources and p lot stud es of how art h stonca n-format on nf uences earn ng n stud o art.

550 Aesthetic Inquiry. (3 A
L terature on aesthetics methods of nqu ry and imp ca-t ons for art educat on

570 Analyzing Works of Art. 3 N
The cr t ca exam nat on of art or statements about art and the deve opment of ways for gu d ng th s exam nat on

610 Issues and Trends in Art Education. (3) N
Doctora eve nvestigat on of h stor ca and contemporary issues re ated to teach ng and research n art educat on

611 Curriculum Development in Art Education. 3 N
Doctora eve nqu ry into the ph osophica , psycho og cal, and soc o og ca foundat ons of curricu um development.

Omnibus Courses: See pages 50–51 for omn bus courses that may be offered

ART HISTORY

ARS 100 Introduction to Art. 3) F, S, SS
Deve opment of understand ng and enjoyment of art and ts re at onsh p to everyday fe through the study of pa nt ng scu pture, arch tecture and des gn May not be taken for cred t by student who has comp eted ARS 300, nor used as art h story cred t by Art majors *[Satisf es General Stud es Requ rements: HU, H]*

101 Art of the Western World I. (3) F S
H story of Western art from the Pa eo th c period to the M dd e Ages *[Sat sf es General Stud es Requ rements HU, H]*

102 Art of the Western World II. (3) F S
H story of Western art from the Rena ssance to the present *[Satisfies Genera Stud es Requirements HU, H]*

201 Art of the Non-Western World I. (3 A
H story of the art of the As an cu tures, w th an emphas s on nd a, Ch na, and Japan *[Sat sfies General Studies Requ rements· HU, G, H]*

202 Art of the Non-Western World II. 3) A
History of the art of Africa, Ocean a, and the New Wor d. *[Satisfies Genera Stud es Requ rements. HU, G, H]*

300 Introduction to Art. 3) F S
Course content same as ARS 100, but requires a h gher eve of accomp shment and comprehens on. May not be taken for cred t by student who has comp eted ARS 100 nor used as art h story cred t by Art majors *[Satisf es General Stud es Requirements: HU, H]*

325 History of Christian Art. 3) N
Chr st an art from the 4th century n Rome to the present. Mean ng and use of arch tectura paint ng scu ptura , and decorat ve art forms Prerequisites ARS 101 and 102 *or* nstructor approva *[Satisf es General Stud es Require ments HU, H]*

340 Art in America. 3) A
Amer can art from Colon al times through the second wor d war. Not ava ab e to students who have had ARS 442 443 and 444 Prerequ s tes: ARS 101 and 102 *or* instructor approva

400 History of Printmaking (3) A
H story of the pr nt as an art form and ts relat on to other modes and forms of artist c express on Prerequ sites ARS 101 and 102 *or* nstructor approva *[Sat sf es Gen era Stud es Requ rements· HU H]*

402 Ancient Near Eastern Art. 3 N
History of paint ng, scu pture, and arch tecture n Mesopo tam a Egypt and the Aegean Prerequ s tes ARS 101 and 102 *or* nstructor approva *[Sat sf es General Stud es Requirements: HU H]*

404 Greek Art. (3 A
Art and architecture of Greece and the He en st c Emp re. Prerequ s tes ARS 101 and 102 *or* nstructor approval. *[Satisfies General Stud es Requirements· HU, H]*

406 Roman Art. 3) A
Art and arch tecture of Etrur a, Rome, and the Roman Emp re Prerequisites ARS 101 and 102 *or* nstructor approva *[Satisfies General Studies Requ rements HU H]*

410 Early Christian and Byzantine Art. 3) A
Art and arch tecture of the ear y church and the Byzant ne Emp re from the 4th to the 15th century. Prerequ s tes: ARS 101 and 102 *or* nstructor approva *[Sat sf es Gen eral Stud es Requirements. HU, H]*

412 Early Medieval Art. 3 A
Arch tecture, scu pture and pa nt ng n the Lat n West from the 7th century to the end of the Ottoman Per od Prerequ s tes ARS 101 and 102 *or* nstructor approval *[Satisfies General Stud es Requirements. HU H]*

414 Romanesque Art. (3 A
Scu pture pa nt ng, architecture and m nor arts n western Europe dur ng the Romanesque per od Prerequ s tes. ARS 101 and 102 *or* nstructor approva *[Sat sf es Gen eral Stud es Requ rements. HU H]*

416 Gothic Art. 3 A
Paint ng scu pture and arch tecture n western Europe during the Gothic per od Prerequ s tes ARS 101 and 102 *or* instructor approva *[Sat sf es General Stud es Requ rements HU, H]*

418 Renaissance Art in Northern Europe. (3 A
Pa nt ng scu pture and arch tecture during the 1400s and 1500s north of the A ps Prerequ s tes ARS 101 and 102 *or* nstructor approva *[Sat sf es General Stud es Requ rements· HU, H]*

420 Early Renaissance Art in Italy. (3) A
Pa nt ng, scu pture, and arch tecture n Ita y from 1300 to 1500. Prerequ sites ARS 101 and 102 *or* nstructor approva. *[Satisfies General Studies Requirements· HU H]*

422 Italian High Renaissance Art and Mannerism. 3 A
H story of Ital an art during the 16th century nc ud ng the ach evements and nf uence of Leonardo da Vinc, Ra phae and M che ange o Prerequ'sites ARS 101 and 102 *or* nstructor approval *[Sat sf es General Stud es Requirement: HU]*

424 Italian Baroque Art. 3 A
Ital an pa nt ng, scu pture and arch tecture of the 17th century Prerequ s tes: ARS 101 and 102 *or* nstructor ap prova *[Satisf es General Studies Requ rements HU, H]*

426 Art of the 17th Century in Northern Europe. (3) A
Baroque pa nt ng, sculpture and arch tecture n F anders, the Nether ands, France, and Eng and Prerequ sites: ARS 101 and 102 *or* nstructor approva *[Satisf es General Stud es Requirements· HU H]*

428 Art of the 18th Century. (3) A
H story of pa nt ng, scu pture, architecture graph c arts and the decorat ve arts from 1700 to the French Revo u t on 1789. Prerequ s tes: ARS 101 and 102 *or* nstructor approva *[Sat sf es General Studies Requ rements· HU, H]*

430 Art of Spain and Its Colonies. (3) A
Arch tecture pa nt ng, and scu pture, from 1500 to 1800. Co on al focus on Mex co the American Southwest, and Andean South Amer ca Prerequ s tes ARS 101 and 102 *or* nstructor approva *[Satisfies General Stud es Requ re ments HU H]*

432 Art and Revolution: European Art 1780–1830. (3) A
mpact of Amer can and French Revo ut ons and the Na po eon c epoch on v sua arts Concentrat on on Goya Dav d, Gericau t, B ake, etc Prerequ s tes· ARS 101 and 102 *or* nstructor approva *[Satisf es General Stud es Re qu rement HU]*

434 Romanticism and Realism: European Art 1800–1855. (3) A
H story of the v sua arts n the f rst ha f of the 19th cen tury. Prerequ s tes: ARS 101 and 102 *or* nstructor approva *[Sat sf es Genera Studies Requ rement· HU]*

436 Impressionism and Late 19th-Century European Art. 3 A
History of pa nt ng, scu pture and graph c arts in latter ha f of the 19th century Prerequ s tes ARS 101 and 102 *or* instructor approval. *[Satisfies General Studies Require ment HU]*

438 Art of the 20th Century I. 3 A
Deve opments and d rect ons in art between 1900 and Wor d War I. Prerequ s tes: ARS 101 and 102 *or* nstruc tor approva *[Satisf es General Stud es Requirement. HU]*

439 Art of the 20th Century II. (3) A
Art since World War II w th cons deration of new concepts and experimentat on w th med a and modes of presenta t on Prerequ s tes ARS 101 and 102 and 438 *or* instruc tor approva *[Sat sf es General Studies Requirements. HU H]*

442 American Art I. (3 A
Art n the Un ted States from European sett ement to 1850. Prerequ s tes· ARS 101 and 102 *or* instructor ap proval

443 American Art II. 3 A
Art n the United States from 1850 to 1892 Prerequ s tes. ARS 101 and 102 *or* instructor approva.

444 American Art III. 3) A
Art n the Un ted States from 1892 to World War II Pre requ s tes ARS 101 and 102 *or* nstructor approva

450 19th-Century Photography. (3 A
H story of photography from the med um s preh story to 1914 persona ties processes, mages and deas Pre requ s tes ARS 101 and 102 *or* nstructor approva. *[Sat isfies General Studies Requirements· HU H]*

451 20th-Century Photography. (3 A
Persona t es processes mages and deas in photogra phy from 1914 to present. Prerequ sites ARS 101 and 102 *or* nstructor approval *[Satisf es General Studies Re quirements HU, H]*

454 Research and Writing in Photography. (3) A
Pr nc p es and practice of research and wr t ng n the h's tory and crit c sm of photography Papers requ red Pre requ s tes: ARS 450 and 451 *or* nstructor approval· ENG 101 and 102 *or* equiva ent

456 History of Art Criticism I. (3 N
History of theories of cr t c sm of the v sua arts Readings from v sua arts cr t ca terature from Plato to 18th cen tury Prerequ sites ARS 101 and 102 *or* instructor approva *[Sat sfies General Studies Requirements. HU, H]*

457 History of Art Criticism II. (3 N
Theor es of cr ticism of the v sua arts from ate 18th cen tury to present Prerequ s tes· ARS 101 and 102 *or* n structor approva *[Sat sf es Genera Stud es Require ments. HU, H]*

458 20th-Century Art Criticism. (3) N
Semina , nf uent al wr t ngs n development of modern art cr t c sm Ro e of art crit c art journals n relat on to art commun'ty Prerequ s tes ARS 101 and 102 *or* nstructor approval. *[Satisfies General Stud es Requ rement HU]*

459 Writing Art Criticism. (3 N
Trad'tional and contemporary approaches to the cr t c sm of art. Students wi wr te cr tica essays The atter ha f of the semester w stress the crit c sm of contemporary art n various media. Prerequisite: ARS 458 or nstructor approva *[Satisfies Genera Stud es Requirement HU]*

462 Precolumbian Art I. 3 A
Arch tecture scu pture ceram cs pa nt ng and other arts of Mesoamer ca before European contact. Sat sfies non Western art h story requ rement Prerequ s tes ARS 101 and 102 *or* nstructor approva *[Satisfies General Studies Requirements HU H]*

463 Precolumbian Art II. (3 A
Arch tecture scu pture, ceram cs, text les, and other art of South America prior to European contact w'th focus on the Central Andes. Sat sf es non Western art h story requ re ment. Prerequ sites· ARS 101 and 102 *or* nstructor approva *[Sat sfies General Stud es Requ rement· HU]*

465 North American Indian Art. (3) A
Nat ve Amer can art forms of the United States and Can ada from preh storic t mes to present Prerequ s tes· ARS 101 and 102 *or* instructor approva *[Satisf es General Studies Requ rement HU]*

466 Southwest Indian Art. (3) A
American Ind an art n the southwestern states from ts or g ns to the present day Satisf es non-Western art h story requ rement Prerequ s tes· ARS 101 and 102 *or* nstruc tor approva *[Satisf es General Stud es Requirements· HU, H]*

468 Shamanism and Art. 3 A
Performance arts as we as trad t ona art objects associ ated w th the shaman n S ber a and North Amer ca Sat isf es non Western art h story requ rement. Prerequ s tes· ARS 101 and 102 *or* nstructor approval. *[Sat sfies Gen eral Stud es Requirements· HU, SB, G]*

469 Mexican Art. (3) A
Art of Mexico and re ated Centra Amer can cu tures from the preh stor c to the contemporary schoo s Prerequ · sites ARS 101 and 102 *or* nstructor approva *[Satisfies General Studies Requirements HU, H]*

472 Art of China. (3) A
Study of major forms n Ch nese art r tua bronze sculp ture, ceram c ca graphy pa nting and architecture. Sat isf es non Western art history requ rement. Prerequ sites. ARS 101 and 102 *or* 'nstructor approva *[Satisf es Gen eral Studies Requirements. HU, G, H]*

473 Art of Japan. 3) A
Japanese art from the Joman period to the present Sat s- f es non Western art h story requ rement Prerequ s tes: ARS 101 and 102 *or* nstructor approva *[Satisfies Gen eral Stud es Requirements HU, G, H]*

475 Chinese Painting. (3) A
From Ku K'ai ch n to Ch Pa sh h Major artists, styles and movements n Chinese paint ng Satisf es non West ern art history requ rement Prerequisites ARS 101 and 102 *or* nstructor approva *[Sat sf es General Stud es Re qu rements: HU, H]*

480 Research Methods. (3 F, S
Methodo ogy and resource materia for art h stor ca re search Techn ques of scho arly and cr t ca wr t ng and eva uat on of b b ograph c sources Prerequ s tes· ARS 101 and 102 *or* nstructor approva .

498 Pro-Seminar. 3–6 A
Undergraduate sem nar n top cs se ected from the fo ow ng Prob ems or cr t c sm n:

a)	Ch nese Art	(f)	Modern Art
b	Anc ent Art	g	Amer can nd an Art
(c	Med eva Art	h	Pre-Columb an Art
(d)	Rena ssance Art	i	Photograph c History
(e)	Baroque Art	(j	American Art

Prerequ s te nstructor approva

591 Seminar. (3–6 A
Graduate sem nar n top cs selected from the foi ow ng. Prob ems or crit c sm n

(a)	Ch nese Art	(f)	Modern Art
b)	Anc ent Art	g)	Amer can ndian Art
c)	Med eva Art	h	Pre-Columb an Art
(d)	Renaissance Art	(i)	Photograph c History
(e	Baroque Art	(j)	American Art

Prerequ s te nstructor approva

Omnibus Courses: See pages 50 51 for omn bus courses that may be offered.

ART AUXILIARY COURSES

ARA 202 Introduction to Photo Aesthetics. 3) F, S
S de ecture course n understand ng photography as a f ne art form *[Sat sfies General Stud es Requirement: H]*

460 Gallery Exhibitions. (3) F, S
Practical exper ence in a phases of department ga lery operat ons and preparat on of ga ery pub cations May be repeated for cred t Prerequ s te nstructor approval.

485 Women's View of Art. 3) A
Study of women v sua art sts the r ves, and the soc a , po t ca aesthet c, and educat ona ssues re ated to the r art Lecture d scuss on read ngs and studio exper · ences 3 hours a week Prerequ s te nstructor approval.

488 Understanding Art. (3) F S
Understand ng art as an emergent cu tura phenomenon w th an emphas s on a crit ca exam nat on of conceptua ssues n art Wr t ng requ red Prerequ s tes ARS 101 102 or instructor approva *[Satisfies General Studies Requ rements L2 HU]*

Omnibus Courses: See pages 50–51 for omn bus courses that may be offered

Dance

PROFESSORS:
LESSARD (PEBE 107B), JONES, LUDWIG

ASSOCIATE PROFESSORS:
CHLISTOWA, KEUTER, MARION

ASSISTANT PROFESSORS:
HAZARD, KAPLAN, MATT, MOONEY

INSTRUCTOR:
VISSICARO

SENIOR LECTURER:
NAGRIN

ASSOCIATE INSTRUCTIONAL PROFESSIONAL:
ROSEN

PROFESSOR EMERITUS:
GISOLO

Departmental Major Requirements

For advisement purposes, all students registering in a Dance degree program enroll through the College of Fine Arts. Each degree program and area of specialization has its own check sheet, which describes the particulars of course sequence and special requirements. These are available in the Department of Dance office.

Placement Examinations

All students who enroll in an undergraduate Dance degree program are required to take part in a placement audition to determine their levels of technical proficiency in modern dance and ballet. Official dates for auditions are set for the orientation periods that precede the fall and spring semesters of each academic year. Transfer students who have completed music theory for dance, dance production, or choreography courses at another institution are also required to take placement examinations in these areas before enrolling in intermediate or advanced levels of course work.

Bachelor of Arts Degree

The Dance major consists of a minimum of 53 semester hours in dance, of which the following are required: DAH 190, 401, 402; DAN 121, 134, 135, 164, 171, 172, 173, 174, 210, 228, 234, 235, 264, 265, 334, 340, 341. Fifteen additional hours approved by an advisor must be in no more than two related fields. Additional requirements are listed on the departmental check sheet.

At least 50 semester hours, including 18 in the major, must be upper division. Grades in classes required for the major must be "C" or better. First-semester students should take DAH 190, DAN 134 and 135, ENG 101, MUS 100, and one General Studies requirement.

Bachelor of Fine Arts Degree

The Dance major consists of 75 to 88 semester hours with a concentration in either performance and choreography or dance education. Core courses required are: DAH 190, 401, 402; DAN 121, 134, 135, 164, 171, 172, 173, 174, 210, 211, 228, 234, 235, 264, 265, 334, 340, 341, 464, 465, 480. For the concentration in performance and choreography, additional requirements include: DAN 321, 328, 335, 371, 434; MUS 100, 347 (or 355 or 356); THP 101. For the concentration in dance education, DAN 350, 351, 357 and 359, and one hour of Jazz Dance, and MUS 100, must be completed as well as all state secondary certification requirements. Other requirements for each option are listed on the departmental check sheet.

