

COLLEGE OF SCIENCES AND ENGINEERING

COLLEGE HONORS

The College of Sciences and Engineering designates certain of its outstanding students as Honors students and provides the opportunity for advanced study under close faculty supervision.

Selection of students for admission to the College Honors Program is based on: 1) the student's academic performance, and 2) recommendation by the faculty of the student's major discipline. To be eligible for the program, students must have a minimum grade-point average of 3.00 overall at UTSA and a minimum grade-point average of 3.00 in their major at UTSA. The minimum grade-point averages must be maintained for students to receive the approval of the College Honors Committee and the discipline faculty. Students admitted to the Honors program are expected to enroll in the appropriate Honors Research course during the final two semesters in residence. The completed research paper must be approved by the supervising faculty sponsor and another college faculty member. Students interested in this program should contact their faculty advisors for additional information.

DIVISION OF EARTH AND PHYSICAL SCIENCES

The degree programs offered by this Division reflect its policy of offering the opportunity for a comprehensive education of the highest quality, individualized to the needs and interests of the student. Completion of a core curriculum allows the student to apply for entry into one of several highly specialized areas in Chemistry, Geology, or Physics. A student who has majored in any of these degree programs is eligible to apply for positions in industry and government as well as apply for entry into professional and graduate schools.

BACHELOR OF SCIENCE DEGREE IN CHEMISTRY

The Bachelor of Science Degree in Chemistry provides opportunities for preparation for careers in industry, government agencies, environmental studies, preprofessional programs, medical technology, and for graduate study in chemistry or other related fields.

The minimum number of semester hours required for this degree, including the 42 semester hours of General Education Requirements, is 133. All candidates for the degree must complete:

A. 53 semester hours of required courses in Chemistry.

- CHE 1103 Introductory Chemistry**
- CHE 1303 Chemical Principles**
- CHE 1312 Inorganic Qualitative and Quantitative Analysis**

CHE	2203	Organic Chemistry I
CHE	2242	Organic Chemistry I Laboratory
CHE	2251	Organic Chemistry I Recitation
CHE	2303	Organic Chemistry II
CHE	2342	Organic Chemistry II Laboratory
CHE	2351	Organic Chemistry II Recitation
CHE	3103	Analytical Chemistry
CHE	3204	Physical Chemistry I
CHE	3212	Physical Chemistry Laboratory
CHE	3224	Physical Chemistry II
CHE	3243	Instrumental Analysis
CHE	3264	Descriptive Inorganic Chemistry
CHE	4243	Organic Chemistry III
CHE	4253	Physical Chemistry III
CHE	4263	Inorganic Chemistry
CHE	4923	Special Project in Chemistry
or		
CHE	4913	Independent Study
CHE	4971	Proseminar

B. 6 additional semester hours of approved *elective* Chemistry at the upper-division level are required.

C. 26 semester hours of *support work* in Science and Mathematics.

1. Required courses are:

MAT	1214	Calculus I
MAT	1223	Calculus II
MAT	2213	Calculus III or CS 1723 Data Structures I
PHY	1904	Technical Physics I
PHY	1911	Technical Physics I Laboratory
PHY	1924	Technical Physics II
PHY	1931	Technical Physics II Laboratory

2. 6 additional hours of *elective work* are required in courses in the College of Sciences and Engineering, as approved by the Advisor.

D. 3 semester hours minimum in computer science.

CS	1073	Introductory Computer Programming for Scientific Applications
or		
CS	1713	Introduction to Computer Science and
CS	1711	Introduction to Computer Science Laboratory

E. 3 semester hours of *electives*.

COURSE DESCRIPTIONS
CHEMISTRY
(CHE)

- 1003 General Chemistry for Allied Health Sciences**
(3-0) 3 hours credit. Prerequisite: Concurrent enrollment in CHE 1011. Introduction to atomic structure, chemical bonding, stoichiometry, states of matter, inorganic chemical reactions, acids and bases. For majors in physical therapy, occupational therapy, prenursing, and dental hygiene. May not be applied to a major in chemistry, biology, or medical technology.
- 1011 General Chemistry Laboratory for Allied Health Sciences**
(0-4) 1 hour credit. Prerequisite: Concurrent enrollment: CHE 1003. Introduction to chemical laboratory techniques. For majors in physical therapy, occupational therapy, prenursing, and dental hygiene. May not be applied to a major in chemistry, biology, or medical technology.
- 1103 Introductory Chemistry**
(3-0) 3 hours credit. Concurrent enrollment in CHE 1122 and MAT 1013 recommended.
An introduction to descriptive inorganic chemistry and atomic-molecular structure. Including such fundamental concepts as the periodic system of elements, valency, chemical bonding, reactions and reaction mechanisms, stoichiometry, equilibria, acids and bases, thermochemistry, molecular-kinetic theory, and states of matter.
- 1122 Introductory Chemistry Laboratory Workshop**
(1-4) 2 hours credit. Prerequisite or concurrent enrollment: CHE 1103. An introduction to chemical problem solving and the basic operations of the chemical laboratory; and a survey of inorganic chemical reactions. This course consists of problem sessions, lecture-demonstrations, and/or laboratory experience.
- 1203 Elementary Organic and Biochemistry**
(3-0) 3 hours credit. Prerequisites: CHE 1003 and 1011. May not be applied to a major in chemistry.
A survey of the structures and reactions of some important functional groups of organic chemistry. The relationship of these functional groups to the chemistry of lipids, carbohydrates, nucleic acids and proteins. (Formerly CHE 2103. Credit cannot be earned for both CHE 1203 and CHE 2103.)
- 1211 Organic and Biochemistry Laboratory**
(0-4) 1 hour credit. Prerequisite or concurrent enrollment: CHE 1203. May not be applied to a major in chemistry.
Laboratory examination of the properties of some simple organic and biological chemicals; solubility, crystallization, organic reactions, titration, enzyme action, sugars and vitamins. (Formerly CHE 2111. Credit cannot be earned for both CHE 1211 and CHE 2111.)

- 1303 Chemical Principles**
(3-0) 3 hours credit. Prerequisite: CHE 1103. Primarily for science majors.
Elementary inorganic and physical chemistry: descriptive inorganic chemistry, coordination chemistry, solutions and electrolytes, redox processes, elementary thermodynamics, chemical kinetics, and elementary electrochemistry. (Formerly CHE 2003. Credit cannot be earned for both CHE 1303 and CHE 2003.)
- 1312 Inorganic Qualitative and Quantitative Analysis**
(1-5) 2 hours credit. Prerequisite or concurrent enrollment: CHE 1303. Techniques of qualitative and quantitative chemical analysis, illustrated primarily via inorganic chemical systems and their reactions. (Formerly CHE 2012. Credit cannot be earned for both CHE 1312 and CHE 2012.)
- 2203 Organic Chemistry I**
(3-0) 3 hours credit. Prerequisites: CHE 1303 and 1312. Primarily for chemistry, pre-med and science majors.
An elementary study of structure, stereochemistry, reactions, and reaction mechanisms associated with organic compounds.
- 2242 Organic Chemistry I Laboratory**
(1-5) 2 hours credit. Prerequisite or concurrent enrollment: CHE 2203. Qualitative analysis and determination of the physical constants of organic compounds. Separation, identification and elementary synthesis of organic compounds. Laboratory techniques (crystallization, distillation, chromatographic) and spectroscopic techniques (IR, NMR, MS) are emphasized.
- 2251 Organic Chemistry I Recitation**
(1-0) 1 hour credit. Prerequisite or concurrent enrollment: CHE 2203. A recitation section for discussion of problems amplifying and clarifying textual content of CHE 2203.
- 2303 Organic Chemistry II**
(3-0) 3 hours credit. Prerequisite: CHE 2203; Prerequisite or concurrent enrollment: CHE 2242.
Continuing study of fundamentals of structure, reactions and reaction mechanisms of phosphorus and sulphur; poly-functional organic compounds. A continuation of CHE 2203. (Formerly CHE 3003. Credit cannot be earned for both CHE 2303 and CHE 3003.)
- 2342 Organic Chemistry II Laboratory**
(1-5) 2 hours credit. Prerequisite: CHE 2242. Prerequisite or concurrent enrollment: CHE 2303.
Quantitative and continuing qualitative study of organic reactions and molecular structure through functional group interactions and spectroscopic techniques. Simple and multi-step syntheses of organic compounds. (Formerly CHE 3022. Credit cannot be earned for both CHE 2342 and CHE 3022.)
- 2351 Organic Chemistry II Recitation**
(1-0) 1 hour credit. Prerequisite or concurrent enrollment: CHE 2303. A recitation section for discussion of problems amplifying and clarifying textual content of CHE 2303.

3103 Analytical Chemistry

(2-5) 3 hours credit. Prerequisites: CHE 1303 and 1312.

A detailed study of wet chemical and basic instrumental analysis including gravimetric, volumetric, and spectrophotometric determinations.

3204 Physical Chemistry I

(4-0) 4 hours credit. Prerequisites: CHE 1303, 1312, MAT 1223, PHY 1924, and 1931; two semesters of organic chemistry are strongly recommended.

States of matter, gas laws, equations of state, inter-molecular interactions; thermodynamics and physical equilibria, elements of molecular-kinetic theory and statistical mechanics; physico-chemical properties of solutions, chemical equilibria, phase equilibria, and changes of state.

3212 Physical Chemistry Laboratory

(0-6) 2 hours credit. Prerequisite or concurrent enrollment: CHE 3204. Experimental study of thermodynamics and electrochemistry, spectroscopy, and reaction kinetics.

3224 Physical Chemistry II

(4-0) 4 hours credit. Prerequisite: CHE 3204.

Chemical kinetics, electrolytes and electrochemistry, elements of quantum mechanics, chemical bonds, spectroscopy, and photo-chemistry. A continuation of CHE 3204.

3243 Instrumental Analysis

(1-6) 3 hours credit. Prerequisites or concurrent enrollment: CHE 2342, 3212 and 3224.

Electrochemical methods; use of modern spectrometric and chromatographic instrumentation in separation, purification, and/or quantitative characterization of chemical systems. (Formerly CHE 3232. Credit cannot be earned for both CHE 3243 and CHE 3232.)

3264 Descriptive Inorganic Chemistry

(3-3) 4 hours credit. Prerequisites: CHE 1303 and 1312.

The basic principles of inorganic chemistry applied to the properties, reactions, and periodicity of inorganic elements and compounds. Includes the synthesis and characterization of inorganic compounds and the use of specialized laboratory techniques.

4243 Organic Chemistry III

(3-0) 3 hours credit. Prerequisites: CHE 2303, 2342, and 2351; CHE 3204 or consent of instructor.

Advanced mechanistic and/or synthetic aspects of organic reactions; additional topics such as molecular rearrangements, organic molecular orbital theory and its application to pericyclic reactions.

4253 Physical Chemistry III

(3-0) 3 hours credit. Prerequisites: CHE 2303, 3224 and 3243; or consent of instructor.

Relations between structure of molecules and physico-chemical properties of gases, liquids and solids—quantum mechanical and statistico-thermodynamical approach.

- 4263 Inorganic Chemistry**
(3-0) 3 hours credit. Prerequisites: CHE 3204 and 3264.
A study of the structure, bonding, and properties of inorganic compounds; acid-base theory, crystalline state, coordination chemistry, and other advanced topics.
- 4373 Organic Spectral Studies**
(3-0) 3 hours credit. Prerequisites: CHE 2342.
Identification of functional groups and the determination of the structure of compounds by spectral techniques including IR, NMR, mass spectroscopy and UV-Vis absorption spectroscopy; basic theory of spectral measurements with emphasis on practical applications.
- 4403 Chemistry of Heterocyclic Compounds**
(3-0) 3 hours credit. Prerequisite: CHE 2303 or consent of instructor.
The chemistry of nitrogen, oxygen, and sulfur heterocycles. Five-membered and six-membered ring systems with one and more than one heteroatom. Applications in the field of synthetic drugs.
- 4603 Synthesis and Biosynthesis of Natural Products**
(3-0) 3 hours credit. Prerequisite: CHE 4373, 4243, and/or BIO 3513 are recommended.
Comparison of chemical and biochemical formations and transformations for several classes of naturally occurring compounds such as steroids, terpenoids, alkaloids, and other natural products of chemical or biological importance.
- 4911-3 Independent Study**
1-3 hours credit. Prerequisite: Permission in writing (form available).
Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work. May be repeated for credit, but not more than 6 hours will apply to the bachelor's degree.
- 4923 Special Project in Chemistry**
3 hours credit. Prerequisite: Consent of Division Director.
A special laboratory research or library readings project under the direction of a faculty member, resulting in a report, limited to students in their final year of undergraduate study.
- 4953 Special Studies in Chemistry**
3 hours credit. Prerequisite: Upper-division standing and consent of instructor.
An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies Courses may be repeated for credit when the topics vary, but not more than 6 hours, regardless of discipline, will apply to a bachelor's degree.
- 4971 Proseminar**
(0-3) 1 hour credit. Prerequisites: CHE 2303 and 3204.
Oral reports on current publications in chemistry and chemical technology and the utilization of important chemical reference materials and periodicals. May be repeated for credit when topics vary, but only two hours may be applied towards the degree.

4993 Honors Research

3 hours credit. Prerequisite: Enrollment limited to candidates for College Honors during the last two semesters; approval by the College Honors Committee.

Supervised research and preparation of an honors thesis. May be repeated only once with approval.

BACHELOR OF SCIENCE DEGREE IN GEOLOGY

The Bachelor of Science Degree in Geology provides opportunities for preparation for careers in petroleum, mining, water resources, environmental management, governmental agencies, engineering geology, geochemistry, geophysics, and natural resources.

The minimum number of semester hours required for this degree, including the 42 semester hours of General Education Requirements, is 133.

All candidates for the degree must complete:

A. Division of Earth and Physical Science Requirement

58 semester hours in Geology minimum, 38 of which must be at the upper division level.

1. Specific Requirements: 45 Semester hours

GEO 1003	Introduction to Geology
GEO 1011	Introduction to Geology Laboratory
GEO 1023	Earth History
GEO 1031	Earth History Laboratory
GEO 2003	Mineralogy
GEO 2011	Mineralogy Laboratory
GEO 2023	Optical Mineralogy
GEO 2031	Optical Mineralogy Laboratory
GEO 3063	Paleontology
GEO 3071	Paleontology Laboratory
GEO 3043	Petrology
GEO 3052	Petrology Laboratory
GEO 3083	Stratigraphy
GEO 3103	Structural Geology
GEO 3111	Structural Geology Laboratory
GEO 3123	Sedimentary Geology
GEO 3131	Sedimentary Geology Laboratory
GEO 3943	Field Methods in Geology
GEO 4946	Field Geology

2. Additional Requirements: any 13 semester hours (maximum of 3 hours from GEO 4911-3 or 4953).

GEO 3113	Geologic Field Investigations
GEO 3143	Economic Geology
GEO 3151	Economic Geology Laboratory
GEO 3163	Oceanography
GEO 3182	Geology of Energy Resources

GEO	3191	Geology of Energy Resources Laboratory
GEO	3374	Geochemistry
GEO	3383	General Geophysics
GEO	4023	Engineering Geology
GEO	4063	Principles of Environmental Geology
GEO	4113	Geomorphology
GEO	4121	Geomorphology Laboratory
GEO	4263	Quantitative Structural Geology
GEO	4623	Groundwater Hydrology
GEO	4783	Instrumental Techniques in Petrochemistry
GEO	4803	X-Ray Crystallography
GEO	4911-3	Independent Study
GEO	4953	Special Studies in Geology
GEO	4993	Honors Research

B. Requirements within the College of Sciences and Engineering: 27 semester hours are required in the College of Sciences and Engineering, with a minimum of 18 semester hours chosen from the following courses:

1. *Specific Requirements:*

CHE	1103	Introductory Chemistry
CHE	1303	Chemical Principles
CHE	1312	Inorganic Qualitative and Quantitative Analysis
CS	1073	Introductory Computer Programming for Scientific Applications,
<i>or</i>		
CS	1713	Introduction to Computer Science <i>and</i>
CS	1711	Introduction to Computer Science Laboratory
MAT	1223	Calculus II
PHY	1924	Technical Physics II,
<i>or</i>		
PHY	1623	General Physics II
PHY	1931	Technical Physics II Laboratory,
<i>or</i>		
PHY	1631	General Physics II Laboratory

2. *Additional Requirements: any 9 semester hours minimum with consent of advisor.*

C. 6 semester hours of electives.

COURSE DESCRIPTIONS

GEOLOGY

(GEO)

1003 Introduction to Geology
 (3-0) 3 hours credit. Concurrent enrollment in GEO 1011 recommended. The Earth as a dynamic planet; relation of Earth's present day processes to its resources, structure and internal composition. Nature of minerals and rocks, the hydrosphere, tectonics, earthquakes, volcanism, and surface features of Earth.

- 1011 Introduction to Geology Laboratory**
(0-3) 1 hour credit. Prerequisite or concurrent enrollment: GEO 1003. Relation of Earth's present day processes to its resources, structure and internal composition. Field trips and laboratory study of minerals, rocks, maps, and aerial and satellite photos.
- 1023 Earth History**
(3-0) 3 hours credit. Concurrent enrollment in GEO 1031 recommended. Formation and evolution of the Earth, its life forms, and the major features of its surface.
- 1031 Earth History Laboratory**
(0-3) 1 hour credit. Prerequisite or concurrent enrollment: GEO 1023. Laboratory study of fossils and rock sequences; interpretation of Earth history.
- 2003 Mineralogy**
(3-0) 3 hours credit. Prerequisites: GEO 1003 and 1011, MAT 1093, CHE 1103, or consent of instructor. Concurrent enrollment: GEO 2011. Crystallography, chemistry, physical properties and origins of minerals.
- 2011 Mineralogy Laboratory**
(0-3) 1 hour credit. Prerequisite: Concurrent enrollment: GEO 2003. Laboratory study of crystal models, crystals and minerals.
- 2023 Optical Mineralogy**
(3-0) 3 hours credit. Prerequisites: GEO 2003 and 2011. Concurrent enrollment: GEO 2031. Principles and methods of optical mineralogy. Optical properties of minerals and microscopic determination of opaque and non-opaque minerals.
- 2031 Optical Mineralogy Laboratory**
(0-3) 1 hour credit. Prerequisites: GEO 2003 and 2011. Concurrent enrollment: GEO 2023. Use of the petrographic microscope for the identification of minerals.
- 3043 Petrology**
(3-0) 3 hours credit. Prerequisites: GEO 2023 and 2031. Concurrent enrollment: GEO 3052. Description, classification occurrence, and origin of igneous metamorphic, and sedimentary rocks. Field trips required.
- 3052 Petrology Laboratory**
(0-4) 2 hours credit. Prerequisites GEO 2023 and 2031. Concurrent enrollment: GEO 3043. Laboratory study of rocks in hand specimen and thin section.
- 3063 Paleontology**
(3-0) 3 hours credit. Prerequisites: GEO 1003, 1011, 1023, 1031, or consent of instructor. Concurrent enrollment: GEO 3071. Study of fossil animals and plants. Emphasis on invertebrate animals. Systematics, biostratigraphy, paleoecology, and evolution of fossil organisms. Field trips required. (Formerly GEO 2063. Credit cannot be earned for both GEO 3063 and GEO 2063.)

- 3071 Paleontology Laboratory**
 (0-3) 1 hour credit. Prerequisites: GEO 1003, 1011, 1023 and 1031. Concurrent enrollment: GEO 2063.
 Study of fossil specimens, collections and preparation techniques. Field trips required. (Formerly GEO 2071. Credit cannot be earned for both GEO 3071 and GEO 2071.)
- 3083 Stratigraphy**
 (3-0) 3 hours credit. Prerequisites: GEO 3063 and 3071, or consent of instructor.
 Application of geologic principles to the interpretation of rocks formed at or near the surface of the earth. Field trips required.
- 3103 Structural Geology**
 (3-0) 3 hours credit. Prerequisites: GEO 3043 and 3052. Concurrent enrollment: GEO 3111.
 Response of earth materials to natural stresses. Description and origin of geologic structures. Field trips required.
- 3111 Structural Geology Laboratory**
 (0-3) 1 hour credit. Concurrent enrollment: GEO 3103.
 Laboratory study of geologic structures using maps, cross-sections, air photos, and descriptive geometric and stereographic methods.
- 3113 Geologic Field Investigations**
 (0-6) 3 hours credit. Prerequisite: Consent of instructor.
 Field studies of areas of geologic interest; e.g., structural geologic mapping, sedimentary facies analysis, hydrologic studies, etc.
 May be repeated for credit when topics vary, but not more than 6 credit hours may be applied to the degree.
- 3123 Sedimentary Geology**
 (3-0) 3 hours credit. Prerequisite: 3083. Prerequisite or concurrent enrollment: GEO 3043 and 3052.
 Processes of erosion, transportation and deposition that form bodies of sedimentary rock. Depositional systems and modeling are a significant area of study. Field trips required.
- 3131 Sedimentary Geology Laboratory**
 (0-3) 1 hour credit. Prerequisites: GEO 3043 and 3052. Concurrent enrollment: GEO 3123.
 Laboratory studies of sedimentary processes and their products. Hand specimens, thin sections, sedimentary structures and interpretation of depositional environments. Field trips required.
- 3143 Economic Geology**
 (3-0) 3 hours credit. Prerequisites: GEO 2003 and 2011. Concurrent enrollment in GEO 3151.
 Origin of metallic ore deposits and industrial minerals, including the geology of major metallic deposits, and the uses and economics of metals. Field trips required.

- 3151 Economic Geology Laboratory**
(0-3) 1 hour credit. Prerequisites: GEO 3043 and 3052. Concurrent enrollment in GEO 3143.
Study of rock and mineral suites from important ore localities. Identification of ore minerals. Textures, structures and alteration zones associated with ore deposits.
- 3163 Oceanography**
(3-0) 3 hours credit. Prerequisite: Consent of instructor.
General oceanography, with emphasis on marine geology and especially the continental margins.
- 3182 Geology of Energy Resources**
(2-0) 2 hours credit. Prerequisites: GEO 3103 and 3111. Prerequisites or concurrent enrollment: GEO 3123 and 3131, or consent of instructor. Concurrent enrollment: GEO 3191.
Geology of petroleum, natural gas, coal, uranium; geothermal energy sources.
- 3191 Geology of Energy Resources Laboratory**
(0-3) 1 hour credit. Prerequisites: GEO 3103 and 3111. Prerequisites or concurrent enrollment: GEO 3123 and 3131 or consent of instructor. Concurrent enrollment: GEO 3182.
Laboratory studies of samples, maps, logs, and seismic data. Preparation and interpretation of subsurface maps.
- 3374 Geochemistry**
(2-4) 4 hours credit. Prerequisite: CHE 2003 or consent of instructor.
A survey of geochemical processes and the distribution of elements in the earth. Application of chemical methods and data to the solution of geologic problems. (Formerly GEO 3373. Credit cannot be earned for both GEO 3374 and GEO 3373.)
- 3383 General Geophysics**
(3-0) 3 hours credit. Prerequisites: GEO 3043 and 3052.
Physics of the earth's interior, plate tectonics, geomagnetism, gravity and heat flow.
- 3943 Field Methods in Geology**
(0-9) 3 hours credit. Prerequisite or concurrent enrollment in GEO 3123, 3131, 3103, 3111, and consent of instructor.
Use of surveying methods and topographic and aerial photo bases for geologic mapping. Description, recording, and interpretation of field relationships. Field trips required.
- 4023 Engineering Geology**
(3-0) 3 hours credit. Prerequisites: PHY 1904; or PHY 1603 and MAT 1214; or consent of instructor.
Geologic factors in construction. Geotechnical properties of minerals, rocks and soils. Case studies. Field trips required. (Formerly GEO 3023. Credit cannot be earned for both GEO 4023 and GEO 3023.)

- 4063 Principles of Environmental Geology**
(3-0) 3 hours credit. Prerequisites: GEO 1003 and 1011.
Geologic factors important to city and regional planning. Land capability studies; geologic hazards.
- 4113 Geomorphology**
(3-0) 3 hours credit. Prerequisites: GEO 1003 and 1011. Concurrent enrollment: GEO 4121.
Analysis of Cenozoic landform evolution.
- 4121 Geomorphology Laboratory**
(0-3) 1 hour credit. Prerequisites: GEO 1003 and 1011. Concurrent enrollment: GEO 4113.
Interpretation of maps and aerial photographs.
- 4263 Quantitative Structural Geology:**
(2-2) 3 hours credit. Prerequisites: GEO 3103 and 3111.
Stress analysis, strain measurement, cross-section balancing, and quantitative modeling in structural geology. Field trips may be required.
- 4623 Groundwater Hydrology**
(3-0) 3 hours credit. Prerequisites: GEO 1003, 1011, and PHY 1904; or PHY 1603 and MAT 1214.
Hydrologic cycle and the theory of underground water. Recharge and discharge of aquifers; water quality; exploration and development of ground water supplies. Field trips required.
- 4783 Instrumental Techniques in Petrochemistry**
(1-4) 3 hours credit. Prerequisite: Consent of instructor.
Instrumental techniques utilized in solving petrological and geochemical problems using exemplary case studies. Laboratory exercises permit the student to become familiar with existing laboratory facilities available for advanced petrochemical analysis.
- 4803 X-Ray Crystallography**
(3-0) 3 hours credit. Prerequisite: Consent of instructor.
The principles and applications of x-ray diffraction to crystalline materials.
- 4911-3 Independent Study**
1-3 hours credit. Prerequisites: Permission in writing (form available) of the instructor, the student's Advisor, and the Division Director and Dean of the College in which the course is offered.
Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work. May be repeated for credit, but not more than 3 hours will apply to the bachelor's degree.
- 4946 Field Geology**
(6-12) 6 hours credit. Prerequisites: GEO 3943 and consent of instructor.
Field mapping and measurements during a six-week period in summer. Field trips required.

4953 Special Studies in Geology

3 hours credit. Prerequisite: Consent of instructor.

An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies courses may be repeated for credit when the topics vary, but not more than 6 hours, regardless of discipline, will apply to the bachelor's degree.

4993 Honors Research

3 hours credit. Prerequisite: Enrollment limited to candidates for College Honors during the last two semesters; approval by the College Honors Committee. Supervised research and preparation of an honors thesis. May be repeated only once with approval.

BACHELOR OF SCIENCE DEGREE IN PHYSICS

The Bachelor of Science Degree in Physics provides the opportunities for preparation for careers in industry, government agencies, and for graduate study in physics or other related fields.

The minimum number of semester hours required for this degree option, including the 42 semester hours of General Education Requirements, is 133.

All candidates for the degree must complete:

A. Division of Earth and Physical Sciences Requirements: 46 semester hours required.

1. *31 semester hours of required courses are:*

PHY	1904	Technical Physics I
PHY	1911	Technical Physics I Laboratory
PHY	1924	Technical Physics II
PHY	1931	Technical Physics II Laboratory
PHY	3103	Modern Physics
PHY	3203	Classical Mechanics I
PHY	3346	Advanced Physics Laboratory I
PHY	3356	Advanced Physics Laboratory II
PHY	3423	Electricity and Magnetism

2. *Additional Requirements: any 15 semester hours (maximum of 3 hours from PHY 4911-3 or 4953) with consent of advisor.*

PHY	3163	Theoretical Physics
PHY	3293	Statistical Thermodynamics
PHY	3313	Solid State Physics
PHY	3433	Introduction to the Theory of Solid State Electronics
PHY	3443	Optics
PHY	3453	Lasers: Theory and Applications
PHY	4203	Classical Mechanics II
PHY	4263	Quantum Mechanics I
PHY	4423	Quantum Mechanics II
PHY	4911-3	Independent Study
PHY	4953	Special Studies in Physics
PHY	4993	Honors Research

B. Requirements within the College of Sciences and Engineering (excluding Physics): 45 semester hours required.

1. 24 semester hours of required courses are:

MAT	1214	Calculus I
MAT	1223	Calculus II
MAT	2213	Calculus III
MAT	3613	Differential Equations I
CHE	1103	Introductory Chemistry
CHE	1303	Chemical Principles
CHE	1312	Inorganic Qualitative and Quantitative Analysis
CS	1073	Introductory Computer Programming for Scientific Applications

2. Additional Requirements: any 21 semester hours minimum with consent of advisor.

COURSE DESCRIPTIONS
PHYSICS
(PHY)

- 1603 General Physics I**
(3-0) 3 hours credit. Prerequisite: Knowledge of high school algebra, trigonometry, and geometry.
Motion, forces, conservation of energy and momentum, fluids, wave motion, and heat.
- 1611 General Physics I Laboratory**
(0-3) 1 hour credit. Prerequisite or concurrent enrollment: PHY 1603.
Laboratory to accompany PHY 1603.
- 1623 General Physics II**
(3-0) 3 hours credit. Prerequisite: PHY 1603. Concurrent enrollment in PHY 1631 recommended.
Electrostatics, electromagnetism, light, sound, atomic and nuclear physics.
- 1631 General Physics II Laboratory**
(0-3) 1 hour credit. Prerequisite or concurrent enrollment: PHY 1623.
Laboratory to accompany PHY 1623.
- 1904 Technical Physics I**
(4-0) 4 hours credit. Prerequisite: MAT 1214. Concurrent enrollment: PHY 1911 recommended.
The basic concepts and methods of physics. Mechanics, heat, and fluids.
- 1911 Technical Physics I Laboratory**
(0-3) 1 hour credit. Prerequisite or concurrent enrollment: PHY 1904.
Laboratory to accompany PHY 1904.

1924 Technical Physics II

(4-0) 4 hours credit. Prerequisite: PHY 1904. Prerequisite or concurrent enrollment: MAT 1223. Concurrent enrollment in PHY 1931 is recommended.

Electricity and magnetism, wave phenomena and elements of modern physics.

1931 Technical Physics II Laboratory

(0-3) 1 hour credit. Prerequisite or concurrent enrollment: PHY 1924. Laboratory to accompany PHY 1924.

3103 Modern Physics

(3-0) 3 hours credit. Prerequisite: PHY 1924.

Special relativity, Planck's Radiation Law, elements of quantum mechanics, atomic and molecular structures and spectra. The atomic nucleus, nuclear reactions, and an introduction to elementary particles.

3163 Theoretical Physics

(3-0) 3 hours credit. Prerequisites: PHY 1924 and MAT 2213.

Methods of theoretical physics applied to problems in electromagnetism, quantum and statistical physics, with an emphasis on physical formulation and interpretation.

3203 Classical Mechanics I

(3-0) 3 hours credit. Prerequisite: PHY 1924. Prerequisite or concurrent enrollment: MAT 2213.

Kinematics and dynamics of systems of particles, rigid body motion. Applications are emphasized.

3293 Statistical Thermodynamics

(3-0) 3 hours credit. Prerequisites: PHY 1924 and 3103, and MAT 2213.

Fundamentals of thermodynamics: entropy, free energy, phase transitions and thermodynamic potentials; equilibrium Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac distribution functions; derivation of macroscopic equilibrium thermodynamics from statistical mechanics.

3313 Solid State Physics

(3-0) 3 hours credit. Prerequisite: PHY 3103.

Crystalline structures, phonons, energy bands, and semiconductor crystals.

3346 Advanced Physics Laboratory I

(0-12) 6 hours credit. Prerequisites: PHY 1924 and 1931.

Laboratory experience in the areas of optics, modern physics, solid state and surface physics. (Formerly PHY 3343. Credit cannot be earned for both PHY 3346 and PHY 3343.)

3356 Advanced Physics Laboratory II

(0-12) 6 hours credit. Prerequisite: PHY 3346.

A continuation of PHY 3346. (Formerly PHY 3353. Credit cannot be earned for both PHY 3356 and PHY 3353.)

- 3423 Electricity and Magnetism**
(3-0) 3 hours credit. Prerequisite: PHY 1924. Prerequisite or concurrent enrollment: MAT 2213.
Vector calculus, electrostatics magnetostatics, Faraday's Law and Ohm's Law.
- 3433 Introduction to the Theory of Solid State Electronics**
(3-0) 3 hours credit. Prerequisites: PHY 2403 and PHY 3313 or consent of instructor.
Principles of intrinsic and extrinsic semiconductors. The theory of solid state devices.
- 3443 Optics**
(3-0) 3 hours credit. Prerequisite: PHY 3423.
The reflection, refraction, absorption, polarization, and diffraction of light. Filters, lasers, non-linear properties, and Fourier optics.
- 3453 Lasers: Theory and Applications**
(3-0) 3 hours credit. Prerequisite: PHY 3103 or consent of instructor.
Basic principles and designs of Lasers: the Einstein A and B coefficients; the semi-classical laser theory; the phase coherent nature of the stimulated emission process; and the laser efficiency. Various applications of Lasers; e.g., Laser-induced fluorescence, light wave communications, holography, surgery, laser fusion, etc.
- 4203 Classical Mechanics II**
(3-0) 3 hours credit. Prerequisite: PHY 3203.
Advanced methods in mechanics, Langrangian and Hamiltonian formulations.
- 4263 Quantum Mechanics I**
(3-0) 3 hours credit. Prerequisites: PHY 3203 and 3423, or consent of instructor.
The Schrodinger equation, operators, and perturbation methods. Applications to the harmonic oscillator and the hydrogen atom.
- 4423 Quantum Mechanics II**
(3-0) 3 hours credit. Prerequisite: PHY 4263.
The interaction of radiation with atomic systems, laser oscillations, band theory of electrons in crystals and charge transport.
- 4911-3 Independent Study**
1-3 hours credit. Prerequisites: Permission in writing (form available) of the instructor, the student's advisor, and the Division Director and Dean of the College in which the course is offered.
Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work. May be repeated for credit, but not more than 3 hours will apply to the bachelor's degree.
- 4953 Special Studies in Physics**
3 hours credit. Prerequisite: Consent of instructor.
An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies courses may be repeated for credit when the topics

vary, but not more than 6 hours, regardless of discipline, will apply to the bachelor's degree.

4993 Honors Research

3 hours credit. Prerequisite: Enrollment limited to candidates for College Honors during the last two semesters; approval by the College Honors Committee.

Supervised research and preparation of an honors thesis. May be repeated only once with approval.

COURSE DESCRIPTIONS

ASTRONOMY

(AST)

1013 Introduction to Astronomy

(3-0) 3 hours credit.

A descriptive course including the development of astronomy, and its methods, the motions, laws and evolution of the solar system. The general properties and types of stars, unusual stellar objects such as quasars and black holes, galaxies, evolution and cosmology. Occasional evening viewing sessions are held.

1031 Introduction to Astronomy Laboratory

(0-2) 1 hour credit. Prerequisite: AST 1013 or consent of instructor.

Exercises in the use of the telescope and certain other astronomical instruments to include simple observations, measurement and photography.

COURSE DESCRIPTIONS

ENVIRONMENTAL—NATURAL RESOURCES

(ENV)

2013 Introduction to Environmental Systems

(3-0) 3 hours credit.

An introduction to the principles of man-machine-community interrelationships within the natural and built environments. General attention is given to the concepts of "growth", "processes", and "changes" occurring in ecosystems and social structures. Emphasis is placed on understanding system dynamics and how these relate to public policy formulation and natural resource utilization.

3023 Man and His Natural Resources

(3-0) 3 hours credit.

An in-depth analysis of man's dependency upon the major natural resources of the earth such as water, air, soils, forests, grasslands, minerals, fuels and wildlife, and the environmental problems that arise through societal mismanagement.

DIVISION OF ENGINEERING

The Division of Engineering offers Bachelor of Science degrees in **Civil, Electrical, and Mechanical Engineering**. Each program is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET/EAC). Individuals enrolling in these degree programs are given an opportunity to develop a strong background in the engineering sciences and to learn the analysis, design and synthesis tools necessary to function well as an active participant in many traditional, new, and emerging areas of high technology.

The Division has excellent laboratory facilities where students receive hands-on instruction by our faculty. CAD facilities including "state of the art" workstations are routinely used in all programs. Some classes are taught by adjunct faculty from local industries and, for this reason, students have the opportunity to interact with engineering professionals engaged in relevant engineering practice.

Engineering students have the opportunity to receive a quality engineering education as well as excellent instruction in the arts and humanities, integral to a well-rounded education. Successful graduates from the Division of Engineering should have excellent opportunities for employment, and those electing to continue their education are well prepared to enter graduate degree programs.

DEGREE REQUIREMENTS COMMON TO ALL PROGRAMS

Entering students **must enroll** in a specific engineering program by selecting either **Civil, Electrical or Mechanical Engineering** as a major on their initial application. Students undecided as to the appropriate program in which to enroll should select the one closest to their area of interest (refer to the following program descriptions). To assist in the decision, students may obtain further explanatory material about each program from the division office and/or a faculty advisor in the appropriate discipline. All students should note that **the first year of study is the same for all engineering programs**. Changing programs in the first year is routine and normally can be accomplished with no loss of credit. **All students are advised to enroll in EGR 1301 and 1402 in the first year of study to prevent later difficulty**. All prerequisites to CE, EE, ME and EGR courses must be completed with a grade of C or better. All students must satisfy university GER (General Education Requirements) and ABET accreditation requirements. It is strongly recommended that all students obtain recommended degree plans and ABET requirements from the office of the Division of Engineering. Requirements common to all engineering degree programs are given below.

I. General Education Requirements.

All students must satisfy a university wide 42 hour General Education Requirement (see section on university-wide Bachelor's Degree Requirements).

II. General Engineering Requirements.

All degree seeking candidates in engineering must complete the following 38 semester hours. Note: CHE 1103, MAT 1214, and CS 2073 may be used to satisfy the General Education Requirement for three hours of Science, three hours of Mathematics, and three hours of Computer Science/Logic.

CHE	1103	Introductory Chemistry
CHE	1303	Chemical Principles
CS	2073	Programming with Engineering Applications
EGR	1301	Introduction to Engineering Problems
EGR	1402	Engineering Graphical Communications
EGR	3713	Engineering Economic Analysis
MAT	1214	Calculus I
MAT	1223	Calculus II
MAT	2213	Calculus III
MAT	3253	Engineering Analysis I
PHY	1904	Technical Physics I
PHY	1911	Technical Physics I Lab
PHY	1924	Technical Physics II
PHY	1931	Technical Physics II Lab

COURSE DESCRIPTIONS ENGINEERING (EGR)

- 1203 Introduction to Science and Technology**
(3-0) 3 hours credit.
This course examines the current state and future directions of science and technology. Topics for discussion will be drawn from the biological sciences, earth and physical science, computer science, and engineering.
- 1301 Introduction to Engineering Problems**
(1-0) 1 hour credit.
Engineering as a career. Approaches to engineering problem solving through the use of engineering principles.
- 1402 Engineering Graphical Communications**
(1-3) 2 hours credit.
Technical communication, engineering graphics, and an introduction to computer-aided graphics. Introduction to engineering analysis, design synthesis, and production methods.
- 2203 Statics**
(3-0) 3 hours credit. Prerequisites: EGR 1301, EGR 1402, MAT 1223, and PHY 1904.
Vector algebra, force systems, free body diagrams. Engineering applications of equilibrium, centroids, moments of inertia.
- 2213 Engineering Mechanics**
(3-0) 3 hours credit. Prerequisites: EGR 1301, EGR 1402, MAT 1223, and PHY 1904. Not open to students majoring in civil or mechanical engineering. May not be substituted for EGR 2203 or EGR 2503.
Force systems, moments, equilibrium, kinematics and kinetics of particles and plane rigid bodies.
- 2503 Dynamics**
(3-0) 3 hours credit. Prerequisites: EGR 2203 and credit for or enrollment in MAT 2213.
Kinematics and kinetics of particles and plane rigid bodies, work and energy, impulse and momentum, and engineering applications.

3213 Mechanics of Solids

(3-0) 3 hours credit. Prerequisite: EGR 2203.

Internal forces and deformations in solids; stress, strain and their relations, stresses and deflections in beams column theory and analysis, and engineering applications.

3713 Engineering Economic Analysis

(3-0) 3 hours credit. Prerequisite: Junior standing in the Division of Engineering.

Techniques of economic analysis for engineering decisions, economic evaluation, and risk assessment. (Formerly EGR 4713. Credit cannot be earned for both EGR 4713 and EGR 3713.)

4953 Special Studies in Engineering

3 hours credit. Prerequisite: Consent of instructor.

An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies courses may be repeated for credit when topics vary, but not more than 6 hours, regardless of discipline, will apply to a bachelor's degree.

4993 Honors Research

3 hours credit. Prerequisite: Enrollment limited to candidates for College Honors during the last two semesters: approval by the College Honors Committee.

Supervised research. May be repeated once with approval but not more than 3 hours, regardless of discipline, may apply to a bachelor's degree.

BACHELOR OF SCIENCE DEGREE IN CIVIL ENGINEERING

The Bachelor of Science degree program in Civil Engineering is a broad based program designed to prepare students for careers in areas traditionally associated with Civil Engineering as well as several modern areas of high technology. Students are required to take courses in subjects related to environmental and water resources issues, structural analysis and design methodology, civil engineering materials such as reinforced concrete and steel, and geotechnical engineering. In addition, elective courses are available to provide emphasis on urban engineering, transportation systems, structures made with advanced composite materials, construction and other areas. Upon graduation from the UTSA Civil Engineering program, successful students should be prepared to seek employment in local or national companies and government agencies associated with aerospace, automotive and transportation, environmental, structural, geotechnical, and other industries.

The minimum number of hours for graduation is 134. Specific course requirements are listed below.

A. Required Courses (54 hours)

CE	2103	Civil Engineering Measurements
CE	3113	Structural Analysis
CE	3213	Reinforced Concrete Design
CE	3233	Steel Design
CE	3243	Properties and Behavior of Engineering Materials

CE	3413	Geotechnical Engineering
CE	3603	Hydraulic Engineering
CE	3633	Water and Wastewater Treatment
CE	3713	Civil Engineering Systems Analysis
CE	4603	Water Resources Engineering
CE	4653	Design of Water Pollution Control Systems
CE	4813	Civil Engineering Design
EGR	2203	Statics
EGR	2503	Dynamics
EGR	3213	Mechanics of Solids
EGR	2413	Technical Writing
GEO	4023	Engineering Geology
ME	3283	Fundamentals of Thermal Sciences

B. Civil Engineering Electives (9 hours). A minimum of 6 hours must be in Civil Engineering from the following list.

CE	4113	Transportation Systems
CE	4223	Earth Structures
CE	4323	Urban Engineering Design
CE	4413	Foundation Engineering
CE	4523	Advanced Reinforced Concrete Design
CE	4543	Construction Planning
CE	4623	Municipal & Rural Sanitation
CE	4643	Air Pollution and Industrial Hygiene

COURSE DESCRIPTIONS CIVIL ENGINEERING (CE)

- 2103 Civil Engineering Measurements**
(2-3) hours credit. Prerequisite: Upper division standing in Civil Engineering.
Application of electronic equipment to control, data acquisition and data analysis in the laboratory environment. Use of field surveying equipment. Acquisition and reduction of surveying data.
- 3113 Structural Analysis**
(3-0) 3 hours credit. Prerequisite: EGR 3213.
Forces and deflections in structural systems considering stationary and moving loads, exact and approximate methods.
- 3213 Reinforced Concrete Design**
(2-3) 3 hours credit. Prerequisite: Credit for or enrollment in CE 3113.
Ultimate strength theory and design for reinforced concrete members.
- 3233 Steel Design**
(2-3) 3 hours credit. Prerequisite: Credit for or enrollment in CE 3113.
Analysis and design of tension members, beams, columns and bolted or welded connections.
- 3243 Properties and Behavior of Engineering Materials**
(2-3) 3 hours credit. Prerequisites: EGR 3213 and ENG 2413.
Structure, properties, and behavior of engineering materials including

concrete and metals. Laboratory exercises illustrate mechanical behavior of typical materials and demonstrate selected principles of mechanics.

3413 Geotechnical Engineering

(2-3) 3 hours credit. Prerequisite: EGR 3213.

Fundamental properties of soil and rock. Flow through porous media. The effective stress principle and computation of *in-situ* stress distributions. Strength and compressibility of geotechnical materials. (Formerly CE 4213. Credit cannot be earned for both CE 4213 and CE 3413.)

3603 Hydraulic Engineering

(2-3) 3 hours credit. Prerequisite: EGR 2503.

Fluid properties, fluid statics concepts and equations of fluid flow in pipes and open channels. Flow through porous media.

3633 Water and Wastewater Treatment

(2-3) 3 hours credit. Prerequisite: Credit for or enrollment in CE 3603.

The application of chemical, biochemical, physical and mathematical processes to water treatment, wastewater treatment and pollution control. (Formerly CE 4633. Credit cannot be earned for both CE 4633 and CE 3633.)

3713 Civil Engineering Systems Analysis

(3-0) 3 hours credit. Prerequisites: MAT 3253 and EGR 3713.

Introduction to systems approach to problem solving. Application of operations research in civil engineering; mathematical modeling and analysis techniques including marginal analysis, linear programming, and dynamic programming. (Formerly CE 4713. Credit cannot be earned for both CE 4713 and CE 3713.)

4113 Transportation Systems

(3-0) 3 hours credit. Prerequisite: Credit for or enrollment in EGR 3713.

Planning, design, construction, operation and maintenance of transportation systems; concepts of various modes of transportation.

4123 Highway Engineering

(3-0) 3 hours credit. Prerequisite: Senior standing in Civil Engineering.

General characteristics of highway design. Horizontal and vertical alignment, cross sections, earthwork, drainage, pavement. Economic analysis.

4223 Earth Structures

(2-3) 3 hours credit. Prerequisite: CE 3413.

Stability, strength, and deformation characteristics of engineering structures in and on geotechnical materials.

4313 Computer-Aided Design in Civil Engineering

(2-3) 3 hours credit. Prerequisite: Senior standing in Civil Engineering.

Organization and programming of civil engineering problems for computer solutions. Application of commercially available design software.

4323 Urban Engineering Design

(2-3) 3 hours credit. Prerequisites: EGR 3713 and CE 3713.

Planning analysis and design of civil engineering systems for the urban environment, public transportation, traffic, water supply and treatment. Projection of growth patterns, financing prioritization and implementation. Integration of public and private sector facilities.

4413 Foundation Engineering

(3-0) 3 hours credit. Prerequisite: CE 3413.

Design of foundations and earth retaining structures; study of earth-pressure theories.

4513 Advanced Structural Analysis

(3-0) 3 hours credit. Prerequisite: CE 3113.

Digital computer analysis of linear structural systems. Theoretical basis for modern computer programs. Application of several standard programs for a variety of structures.

4523 Advanced Reinforced Concrete Design

(2-3) 3 hours credit. Prerequisite: CE 3213.

Design of reinforced concrete buildings by ultimate strength methods, pre-stressed concrete design.

4543 Construction Planning

(3-0) 3 hours credit. Prerequisite: Credit for or enrollment in EGR 3713.

Planning and managing, scheduling, and control of construction projects. Topics include management functions, network techniques, equipment selection, management, and operation, construction financing, bidding strategy, risk assessment, cost control, and projection.

4603 Water Resources Engineering

(2-3) 3 hours credit. Prerequisite: CE 3603.

Analysis and design of surface and subsurface water resource systems; stream and river flow; dam and reservoir design for recharge, flood control and water supply; groundwater system recharge, percolation and subterranean flow, and harbour and shore hydraulic structures.

4623 Municipal and Rural Sanitation

(3-0) 3 hours credit. Prerequisite: CE 3603.

An examination of sanitation practices in rural and urban environments including insect and rodent control, swimming pool sanitation, rural water supply, food sanitation, and disease transmission. (Formerly CE 3673. Credit cannot be earned for both CE 3673 and CE 4623.)

4643 Air Pollution and Industrial Hygiene

(2-3) 3 hours credit. Prerequisites: CHE 1303 and upper-division standing.

Discussion of the sources, quantities, effects of sampling and control of airborne pollutants in ambient air, and in urban and industrial environments. (Formerly AS 4643. Credit cannot be earned for both AS 4643 and CE 4643.)

4653 Design of Water Pollution Control Systems

(2-3) 3 hours credit. Prerequisite: CE 3633.

Analysis, synthesis, design, and system optimization of integrated processes and operations to handle and treat water and wastewater.

4813 Civil Engineering Design

(2-3) 3 hours credit. Prerequisites: CE 3213, CE 3233, CE 3413, CE 3603 and CE 3633.

Opportunity to apply design skills to execution of an integrated civil engineering design project, including field and laboratory investigations, numerical and scale modeling, design and formal oral and written presentation of results.

4911-3 Independent Study

1-3 hours credit. Prerequisite: Permission in writing (form available) of the instructor, the student's advisor, the Division Director and Dean of the College in which the course is offered.

Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 6 hours of independent study, regardless of discipline, will apply to the bachelor's degree.

4953 Special Studies in Civil Engineering

3 hours credit. Prerequisite: Consent of instructor.

An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies courses may be repeated for credit when topics vary, but not more than 6 hours, regardless of discipline, will apply to a bachelor's degree.

BACHELOR OF SCIENCE DEGREE IN ELECTRICAL ENGINEERING

The Bachelor of Science degree program in Electrical Engineering offers students the opportunity for careers in areas associated with electronics, digital systems, computer architecture and design, communications, controls and robotics, computer-aided design (CAD), instrumentation, bio-engineering, and other traditional and emerging areas of high technology. Through the proper selection of elective courses to augment required courses, successful students may develop a specialization pertinent to many of these areas which may lead to employment with electronic companies, computer based industries, and government agencies.

A. Required Courses (51 hours)**1. Electrical Engineering (45 hours)**

EE	2423	Network Theory I
EE	2513	Logic Design
EE	3113	Electrical Engineering Lab I
EE	3213	Electromagnetic Engineering
EE	3313	Electronic Circuits I
EE	3413	Analysis and Design of Control Systems
EE	3423	Network Theory II
EE	3463	Microcomputer Systems I
EE	3513	Electromechanical Systems
EE	3563	Digital Systems Design I

EE	4113	Electrical Engineering Lab II
EE	4313	Electronic Circuits II
EE	4613	Communication Systems
EE	4643	Digital Signal Processing
EE	4813	Electrical Engineering Design

2. Supporting Areas (6 hours)

EGR	2213	Engineering Mechanics
STA	3533	Probability and Random Processes

B. Electrical Engineering Electives (12 hours). A minimum of nine hours must be in Electrical Engineering.

EE	4243	Digital Systems Design II
EE	4323	Advanced Electrical Engineering Laboratory
EE	4333	Instrumentation Systems
EE	4343	Active Filter Synthesis
EE	4353	Introduction to Modern Optics
EE	4443	Discrete-Time and Computer-Controlled Systems
EE	4453	Principles of Bioengineering and Bioinstrumentation
EE	4513	LSI and VLSI Design
EE	4523	Integrated Circuit Design
EE	4573	Engineering Workstations
EE	4583	Microcomputer Systems II
EE	4623	Digital Filtering
EE	4653	Information Theory and Coding
ME	3283	Fundamentals of Thermal Sciences
ME	3323	Dynamics of Mechanical Systems

COURSE DESCRIPTION ELECTRICAL ENGINEERING (EE)

- 2112 Introductory Digital Laboratory**
(1-3) 2 hours credit. Prerequisite: Concurrent enrollment in EE 2513. Introductory digital laboratory for Computer Science students enrolled in EE 2513. Not open to EE majors.
- 2423 Network Theory I**
(3-0) 3 hours credit. Prerequisites: MAT 2213 and credit for or enrollment in PHY 1924 and MAT 3253.
Basic network principles; steady state responses to DC and AC signals; transient responses; nodal and loop analysis. Introduction to SPICE. (Formerly EE 2424. Credit cannot be earned for both EE 2424 and EE 2423.)
- 2513 Logic Design**
(3-0) 3 hours credit. Prerequisite: Credit for or enrollment in CS 2073 or Computer Science major.
Number systems, Boolean Algebra, combinational and sequential circuit design. Minimization and implementation. Introduction to CAD tools. (Formerly EE 2514. Credit cannot be earned for both EE 2514 and EE 2513.)

- 3113 Electrical Engineering Laboratory I**
(1-6) 3 hours credit. Prerequisites: EE 2423, EE 2513 and credit for or enrollment in EE 3313.
Introduction to basic measurement equipment and techniques. Use of analog and digital simulation tools, and comparison to empirical performance of simple analog communication and digital circuits using discrete devices and circuits. Simple subsystem circuit design. Laboratory technical communication.
- 3213 Electromagnetic Engineering**
(3-0) 3 hours credit. Prerequisites: PHY 1924, MAT 2213 and MAT 3253.
Review of vector calculus, Maxwell's equations, electromagnetic waves, dielectrics, boundary conditions. Selected other topics include waveguides, anisotropic crystal optics, transmission lines, fiber optics, reflection and refraction, and special relativity.
- 3313 Electronic Circuits I**
(3-0) 3 hours credit. Prerequisites: PHY 1924, CHE 1303, EE 2423 and credit for or enrollment in EE 3423 or ME 3323.
Electrical properties of semiconductors; P-N junctions; diode circuits; BJT's, FET's; application to digital and analog circuits. Use of SPICE to solve simple circuits.
- 3401 Network and Electronics Lab**
(0-3) 1 hour credit. Prerequisite: Credit for or enrollment in EE 2423.
Basic experiments with electrical networks and electronic circuits. Not open to EE majors. (Formerly EE 3502. Credit cannot be earned for both EE 3502 and EE 3401.)
- 3413 Analysis and Design of Control Systems**
(3-0) 3 hours credit. Prerequisites: EGR 2213 and EE 3423 for EE major or ME 3323 for ME major.
Modeling, analysis, and design of linear automatic control systems. Time and frequency domain techniques; stability analysis, state variable techniques, other topics. (Formerly EE 4413. Credit cannot be earned for both EE 4413 and EE 3413.)
- 3423 Network Theory II**
(3-0) 3 hours credit. Prerequisites: EE 2423 and MAT 3253.
Frequency response, two part networks, Fourier series, Fourier transforms, Dirac Delta function, Laplace transforms, convolution, use of the Laplace transform in solving network problems. Use of SPICE to solve network problems.
- 3463 Microcomputer Systems I**
(3-0) 3 hours credit. Prerequisites: EE 2513 and credit for or enrollment in EE 3563.
Introduction to assembly- and C-language programming. Architecture, peripherals, operating system interfacing principles, and development tools. Software documentation technique. (Formerly EE 4563. Credit cannot be earned for both EE 4563 and EE 3463.)

3513 Electromechanical Systems

(3-0) 3 hours credit. Prerequisites: EE 3213 and EGR 2213.
Principles of electromechanical energy conversion; polyphase circuits; dynamic analysis of energy-transfer devices; power devices.

3563 Digital Systems Design I

(2-3) 3 hours credit. Prerequisites: EE 2513, and either CS major or credit for enrollment in EE 3313. Also open to CS majors.
Introduction to switching theory. Design of complex combinational and sequential circuits. Analysis of hazards and fault detection, location, and tolerance. Design and verification of complex circuitry using Design Entry, functional modeling, physical modeling, and mixed-mode simulation.

4113 Electrical Engineering Lab II

(1-6) 3 hours credit. Prerequisites: EE 3113 and EE 4313.
Complex electronic circuit subsystem design. Improving measurement system performance. Introduction to automatic test equipment, the design process and simple system design. Technical communication.

4243 Digital Systems Design II

(2-3) 3 hours credit. Prerequisites: EE 3463 and EE 3563.
Design of advanced state machines and computer systems. Processor design. Simulation and other computer-assisted design tools. (Formerly EE 3583. Credit cannot be earned for both EE 3583 and EE 4243.)

4313 Electronic Circuits II

(3-0) 3 hours credit. Prerequisites: EE 3313, EE 3423 and EE 3563.
Multiple transistor circuits; feedback and frequency response analysis; operational amplifier analysis and design; power semiconductors; other topics. Design of analog and digital circuits. Use of SPICE to analyze complex circuits.

4323 Advanced Electrical Engineering Laboratory

(1-6) 3 hours credit. Prerequisites: Credit for or enrollment in EE 4113 and consent of instructor.
Laboratory experience in one of the following areas: controls, optics, digital systems, communications, or instrumentation.

4333 Instrumentation Systems

(2-3) 3 hours credit. Prerequisites: EE 3463; EE 3413 and credit for or enrollment in EE 4113.
Principles of instrumentation system design, transducers, power supplies, and signal conditioning. Noise analysis and reduction techniques. Standard protocol instrumentation buses.

4343 Active Filter Synthesis

(2-3) 3 hours credit. Prerequisite: EE 4313.
Analysis and design of active filter networks. Sensitivity analysis and filter design techniques. Passive synthesis, switched capacitor filters, other topics.

4353 Introduction to Modern Optics

(3-0) 3 hours credit. Prerequisite: EE 3213.

The basic principles of geometrical and physical optics. Topics include lens design, interference, diffraction, and polarization. Selected other topics which may be covered include Fourier optics, coherence theory, holography, lasers, Gaussian beams, acousto-optics and electro-optics.

4443 Discrete-Time and Computer-Controlled Systems

(2-3) 3 hours credit. Prerequisites: EE 3413 and credit for or enrollment in EE 4643.

Sampled-data techniques applied to the analysis and design of digital control systems. Stability criteria, compensation, and other topics.

4453 Principles of Bioengineering and Bioinstrumentation

(2-3) 3 hours credit. Prerequisites: EE 3213, EE 3413 and credit for or enrollment in EE 4113.

Theoretical basis for signal generation, transmission, and detection from biological systems. Modeling of biological systems. Electrodes and transducer systems; signal excitation and processing instrumentation.

4513 LSI and VLSI Design

(2-3) 3 hours credit. Prerequisites: EE 3213, EE 4313 and credit for or enrollment in EE 4243 or EE 4583.

Design of integrated digital systems. Logic simulation, standard cell libraries, circuit simulation, and other computer-aided design tools. Integrated circuit processing and device modeling.

4523 Integrated Circuit Design

(2-3) 3 hours credit. Prerequisites: EE 3213 and EE 4313.

Analysis and design of analog and digital integrated circuits. Integrated circuit technologies, computer-aided analysis, design, and other tools. Fabrication and testing.

4573 Engineering Workstations

(2-3) 3 hours credit. Prerequisites: EE 3463 and EE 3563.

Design and application of engineering workstations. Integration of components and peripherals to address specific engineering design support requirements. Networking considerations.

4583 Microcomputer Systems II

(2-3) 3 hours credit. Prerequisite: EE 3463, EE 3313 and credit for or enrollment in EE 4313.

Advanced microprocessor based system design. High-speed bus interfacing, coprocessors and other specialized input/output devices. Real-time and multi-user operating systems. High-level languages and software performance analysis.

4613 Communication Systems

(3-0) 3 hours credit. Prerequisites: STA 3533 and credit for or enrollment in EE 4313.

Fundamentals of communication systems engineering. Analog and digital techniques. Signal analysis, signal-to-noise ratio, circuit implementations.

- 4623 Digital Filtering**
(2-3) 3 hours credit. Prerequisites: EE 3463 and EE 4643.
Design and implementation of FIR and IIR filters; hardware and software. Topics from adaptive filtering, neural networks, and image processing.
- 4643 Digital Signal Processing**
(3-0) 3 hours credit. Prerequisites: EE 3423 and STA 3533.
Transform techniques for discrete signal analysis. Discrete representation and analysis of digital filters and other topics.
- 4653 Information Theory and Coding**
(3-0) 3 hours credit. Prerequisite: STA 3533.
Elements of information theory, Modulation and coding for efficient signaling and error correction, Block codes. Hardware and software implementation of encoders and decoders.
- 4813 Electrical Engineering Design**
(1-6) 3 hours credit. Prerequisites: EE 4113 and credit for or enrollment in EGR 3713.
Complex system design. Advanced ATE. Project planning, proposals, status reporting, formal oral and written technical reports, and business plan. Open-ended design project.
- 4911-3 Independent Study**
1-3 hours credit. Prerequisites: Permission in writing (form available) of the instructor, the student's advisor, and the Division Director and Dean of the College in which the course is offered.
Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 6 hours of independent study, regardless of discipline, will apply to the bachelor's degree.
- 4953 Special Studies in Electrical Engineering**
3 hours credit. Prerequisite: Consent of instructor.
An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies courses may be repeated for credit when topics vary, but not more than 6 hours, regardless of discipline, will apply to a bachelor's degree.

BACHELOR OF SCIENCE DEGREE IN MECHANICAL ENGINEERING

The Bachelor of Science degree program in Mechanical Engineering offers students the opportunity to prepare for careers in the traditional as well as the emerging high technology areas of engineering design associated with machinery and mechanism design, thermal and fluid sciences, solid mechanics of advanced metallic or polymer based composite materials, computer-aided design (CAD), vibrations and controls, robotics and bio-engineering. Through the proper selection of elective courses to augment required courses, successful students may develop a specialization pertinent to many of these areas which may lead to employment with companies or government agencies associated with aerospace, automotive, heating and air conditioning, manufacturing, and other industries.

The minimum number of semester credit hours required for this degree is 134. Specific course requirements are listed below.

A. Required Courses (51 hours)

EE	2423	Network Theory I
EE	3401	Network and Electronics Lab
EGR	2203	Statics
EGR	2503	Dynamics
EGR	3213	Mechanics of Solids
ME	3241	Materials Engineering Laboratory
ME	3243	Materials Engineering
ME	3293	Thermodynamics I
ME	3313	Measurements and Instrumentation
ME	3323	Dynamics of Mechanical Systems
ME	3513	Mechanism Design
ME	3523	Machine Element Design
ME	3663	Fluid Mechanics
ME	4293	Thermodynamics II
ME	4313	Heat Transfer and Rate Processes
ME	4522	Dynamic Systems and Control
ME	4802	Mechanical Engineering Senior Laboratory
ME	4813	ME Design Project
MAT	3263	Engineering Analysis II

B. Engineering Electives (12 hours). A minimum of 9 hours must be in Mechanical Engineering. Students must select at least two courses from the following Mechanical Engineering Application and Design List.

ME	4323	Thermal Systems Design I
ME	4333	Thermal Systems Design II
ME	4343	Heating, Air Conditioning, and Refrigeration Design
ME	4513	Mechanical Vibrations and Dynamics of Machinery
ME	4533	Mechanical Engineering Design Methodology
ME	4603	CAD Methodology
ME	4613	Power Systems Design
ME	4723	Reliability and Quality Control in Engineering Design

COURSE DESCRIPTIONS
MECHANICAL ENGINEERING
(ME)

- 3241 Materials Engineering Laboratory**
(0-3) 1 hour credit. Prerequisite: Credit for or enrollment in ME 3243. Investigation of the properties of engineering materials with emphasis on metals; sample preparation, metallography, foundry processes.
- 3243 Materials Engineering**
(3-0) 3 hours credit. Prerequisites: CHE 1303 and credit for or enrollment in EGR 3213. Fundamental aspects of the structure, properties and behavior of engineering materials.

3263 Materials Processing

(2-3) 3 hours credit. Prerequisites: ME 3243 and EGR 2503.

Casting, joining, forming and machining. Methods of processing modern engineering materials, forming and joining techniques and effects of processing on materials.

3283 Fundamentals of Thermal Sciences

(3-0) 3 hours credit. Prerequisites: CS 2073, PHY 1904, and credit for or enrollment in MAT 3253. Not open to students majoring in mechanical engineering. May not be substituted for ME 3293 or ME 4313.

Introduction to classical thermodynamics and heat transfer; thermodynamics systems, equations of state, first and second law of thermodynamics, thermodynamic cycles; modes of heat transfer, diffusion equation, application of conduction, and convection and radiation heat transfer.

3293 Thermodynamics I

(3-0) 3 hours credit. Prerequisites: CS 2073, PHY 1904, and MAT 2213.

Heat, work, kinetic theory of gases, equation of state, thermodynamics system, control volume, first and second law of thermodynamics, reversible and irreversible processes, introduction to basic thermodynamic cycles.

3313 Measurements and Instrumentation

(2-3) 3 hours credit. Prerequisites: EE 2423, EGR 2503, and MAT 3253.

Fundamentals of measurement systems; standards, treatment of data; transducers, signal conditioning; strain, force, acceleration, pressure, temperature, fluid flow.

3323 Dynamics of Mechanical Systems

(2-2) 3 hours credit. Prerequisites: EGR 2213 or EGR 2503 and MAT 3253.

Mechanical system dynamics, linear systems, modeling techniques, analytical dynamics, and vibrations.

3503 Alternative Energy Sources

(3-0) 3 hours credit. Prerequisites: ME 3293.

Solar, nuclear, wind, geothermal and tidal energy. Energy storage problems. Principles, current technology, and economic considerations.

3513 Mechanism Design

(3-0) 3 hours credit. Prerequisites: CS 2073 and EGR 2503.

Kinematic synthesis, graphical and analytical methods, displacement, velocity, and acceleration analyses; dynamics of mechanism; and cam design.

3523 Machine Element Design

(3-0) 3 hours credit. Prerequisites: EGR 3213, ME 3243, and credit for or enrollment in ME 3513.

Stress and deflection analyses, failure theories, design of machine elements for static and fatigue strength, and design of welded and bolted connections.

- 3663 Fluid Mechanics**
(3-0) 3 hours credit. Prerequisites: CS 2073, MAT 2213, and EGR 2503.
Fluid properties; fluid statics, concepts and equations of fluid flow; similitude; viscous effects; compressible fluid flow.
- 4243 Intermediate Materials Engineering**
(3-0) 3 hours credit. Prerequisites: ME 3243, ME 3241 and ME 3523.
Selected topics in ceramics, polymers; introduction to composites, fracture mechanics and corrosion, engineering design applications in material selection for control of fracture, deflection, wear and corrosion.
- 4263 Nondestructive Evaluation**
(2-3) 3 hours credit. Prerequisites: ME 3243 and ME 3313.
Defect detection, materials and defect characterization using nondestructive evaluation methods such as ultrasonics, eddy current, magnetic and electromagnetic methods, radiography, thermography.
- 4293 Thermodynamics II**
(3-0) 3 hours credit. Prerequisites: ME 3293, and credit for or enrollment in ME 3663.
Nonreactive and reactive mixtures, vapor and gas power cycles, refrigeration, and compressible flow.
- 4313 Heat Transfer and Rate Processes**
(3-0) 3 hours credit. Prerequisites: MAT 3253, ME 3293 and credit for or enrollment in ME 3663.
Generalized potential distribution and gradients; transient and steady heat conduction; forced and free convection; radiation, energy, and momentum transfers.
- 4323 Thermal Systems Design I**
(2-2) 3 hours credit. Prerequisite: Credit for or enrollment in ME 4313.
Application of basic thermodynamics, fluid mechanics, heat transfer and computer methods to the design of heat exchanger systems.
- 4333 Thermal Systems Design II**
(2-2) 3 hours credit. Prerequisite: Credit for or enrollment in ME 4313.
Design of thermal energy systems; coils, fans, pumps, and filter systems; automatic control systems.
- 4343 Heating, Air Conditioning, and Refrigeration Design**
(2-2) 3 hours credit. Prerequisite: Credit for or enrollment in ME 4313.
Heating, ventilation, and air conditioning of buildings for human comfort or industrial processes; design selection, construction and operation of air conditioning equipment and refrigeration systems.
- 4353 Gas Dynamics**
(3-0) 3 hours credit. Prerequisites: ME 3293 and ME 3663.
Application of mass, energy and force balance to compressible fluids, treatment of one-dimensional steady and transient flows, isentropic flow, adiabatic flow, flow with friction. Application to duct flows and to jet and rocket propulsion engines.

- 4363 Intermediate Heat Transfer**
(3-0) 3 hours credit. Prerequisite: ME 4313.
Multidimensional heat conduction, numerical solutions, selected topics in natural convection, boiling and condensation heat transfer, thermal storage systems.
- 4503 Intermediate Dynamics**
(3-0) 3 hours credit. Prerequisite: ME 3323.
Three-dimensional rigid-body kinetics, vector algebraic and Lagrange methods; integration of equations of motion; computer-assisted methods.
- 4513 Mechanical Vibrations and Dynamics of Machinery**
(2-2) 3 hours credit. Prerequisites: ME 3323 and MAT 3263.
Free and forced single and multiple degree of freedom systems modeled as both discrete and continuous. Applications in mechanical engineering design problems in the transmission and control of vibration.
- 4522 Dynamic Systems Control**
(1-4) 2 hours credit. Prerequisites: EE 2423, ME 3323, and MAT 3263.
Introduction to modeling and control of dynamic physical systems, analysis and design of control systems for mechanical, electrical, fluid and thermal systems. (Formerly ME 3353. Credit cannot be earned for both ME 3353 and ME 4522.)
- 4533 Mechanical Engineering Design Methodology**
(2-2) 3 hours credit. Prerequisites: ME 3323, ME 3523, ME 3663 and credit for or enrollment in ME 4313.
Mechanical systems component design methodology; creative design, analysis, synthesis, selection, design of components and systems; computer-aided design; and several short design projects. (Formerly ME 3533. Credit cannot be earned for both ME 3533 and ME 4533.)
- 4603 CAD Methodology**
(2-3) 3 hours credit. Prerequisite: ME 3523.
Advanced geometric modeling of mechanical systems and components, design case studies, and finite element applications in mechanical design.
- 4613 Power Systems Design**
(2-2) 3 hours credit. Prerequisites: ME 4293.
Application of basic fluid mechanics to the design of turbomachinery, turbines, pumps, compressors, fans, blowers, windmills, and combustion engines.
- 4663 Intermediate Fluid Mechanics**
(3-0) 3 hours credit. Prerequisite: ME 3663.
Continuation of ME 3663. Potential flow theory, analysis of laminar and turbulent flows; introduction to boundary layer theory, and application of basic equations to engineering problems.
- 4703 Computer Applications in Mechanical Engineering**
(2-3) 3 hours credit. Prerequisites: ME 3523, ME 4293, and credit for or enrollment in ME 4313.
Application of computers in mechanical and thermal design; software package development; program development includes: fluid flow and mechanical property characterization, and heat transfer determination.

- 4713 Robotics and Expert Systems**
 (2-3) 3 hours credit. Prerequisites: EE 2423; and credit for or enrollment in ME 4522 or EE 3413.
 Design and industrial application of robots; expert systems; stereometrology; machine vision, artificial intelligence.
- 4723 Reliability and Quality Control in Engineering Design**
 (3-0) 3 hours credit. Prerequisite: Senior Standing in the Division of Engineering.
 Introduction to statistical methods in reliability and probabilistic engineering design methodology; statistical quality control and inspection; life prediction and testing, and design optimization.
- 4802 Mechanical Engineering Senior Laboratory**
 (0-6) 2 hours credit. Prerequisites: ME 3313, ME 3523, ME 4293, and credit for or enrollment in ME 4313.
 An experimental laboratory concerned with fluid statics, fluid flow, heat transfer, internal combustion engines, and rotating machinery, and design of experiments.
- 4813 ME Design Project**
 (2-3) 3 hours credit. Prerequisites: EGR 3713, ME 3523, ME 4293, and ME 4313.
 Significant development of instructor-approved individual and/or group design project. Synthesis, modeling, computer-aided analysis and optimization. Industrial cooperation encouraged. Formal presentation of progress and final reports.
- 4911-3 Independent Study**
 1-3 hours credit. Prerequisite: Permission in writing (form available) of the instructor, the student's advisor, and the Division Director and Dean of the College in which the course is offered.
 Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 6 hours of independent study, regardless of discipline, will apply to the bachelor's degree.
- 4953 Special Studies in Mechanical Engineering**
 3 hours credit. Prerequisite: Consent of instructor.
 An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies courses may be repeated for credit when topics vary, but not more than 6 hours, regardless of discipline, will apply to a bachelor's degree.

DIVISION OF LIFE SCIENCES

The Division offers a Bachelor of Science Degree in Biology, with emphasis in molecular cell biology and neurobiology, as well as joint degree programs with the University of Texas Health Science Center at San Antonio, leading to the Bachelor of Science Degree in Clinical Laboratory Science, Occupational Therapy, or Physical Therapy. Degrees in these three Allied Health programs are awarded jointly by both institutions. Also available are pre-professional courses which offer the students the opportunity to prepare for admission to medical, dental, nursing, and other professional schools.²⁷

The B.S. Degree in Biology is structured around a comprehensive core curriculum and related offerings in chemistry, physics, and mathematics which lead to more highly specialized areas in the life sciences, such as biochemistry, cellular biology, developmental biology, ecology, neurobiology, genetics, microbiology, molecular biology, and physiology.

The B.S. Degree in Clinical Laboratory Science is a joint degree between the University of Texas at San Antonio and the University of Texas Health Science Center at San Antonio. The preclinical curriculum includes general education requirements, basic science lecture and laboratory courses and clinical laboratory science courses. Clinical laboratory science concepts are introduced throughout the curriculum, ending in a senior year clinical practicum at the Health Science Center. Upon completion of all requirements the student is eligible to take one of the clinical laboratory science national certification examinations.

The B.S. Degree in Occupational Therapy offers the opportunity for the student to gain a strong background in the life sciences, behavioral sciences, humanities, and special skill areas. Specific application of occupational therapy skills in laboratory and clinical settings occurs in the last two years of a student's program and includes a minimum of six months approved field work experience. Students who have completed all degree requirements and their field work are eligible to take the national examination for registration with the American Occupational Therapy Association. An additional fieldwork placement course (OCCT 40876) is optional.

The B.S. Degree in Physical Therapy offers the opportunity for students to utilize the basic sciences necessary to evaluate and treat human movement disorders. Clinical observation and field work experiences are integrated into the academic preparation during the professional phase of the program. This program is fully accredited by the American Physical Therapy Association and graduates are eligible to take the Physical Therapy licensure examination following successful completion of this joint degree program.

²⁷Specific premedical and predental programs are not offered at UT San Antonio. Admission requirements for these professional schools are outlined in the appendix of this catalog. Additional information can be obtained from the Office of the Division of Life Sciences and through the Chairman of the Health Related Professions Advisory Committee of the University of Texas at San Antonio.

BACHELOR OF SCIENCE DEGREE IN BIOLOGY

The minimum number of semester hours required for the Bachelor of Science Degree in Biology, including the 42 hours of General Education Requirements, is 126.²⁸

All candidates for the degree must complete:

- A. 48 semester hours in the *major*, 32 of which must be at the upper-division level.

1. 30 semester hours in the Biology Core Curriculum are required:

BIO 1103, 1112 Principles of Biology and Laboratory
 BIO 2313, 2322 Genetics and Laboratory
 BIO 3413, 3422 General Physiology and Laboratory
 BIO 3513, 3522 Biochemistry and Laboratory

and two of the following with laboratories:

BIO 3143, 3152 Developmental Biology
 BIO 3283, 3292 Principles of Ecology
 BIO 3713, 3722 Microbiology
 BIO 3813, 3822 Cellular Biology
 BIO 4433, 4442 Neurobiology

2. 18 additional semester hours of Biology electives are required, 12 of which must be at the upper-division level.

- B. 24 semester hours minimum of support work.

1. 13 semester hours are required in Chemistry:

CHE 1103 Introductory Chemistry
 CHE 1303 Chemical Principles
 CHE 1312 Inorganic Qualitative and Quantitative Analysis
 CHE 2203 Organic Chemistry I
 CHE 2242 Organic Chemistry I Laboratory

2. 3 semester hours minimum in addition to the 3 semester hours required under the General Education Requirements are required in Mathematics:

MAT 1214 Calculus I
 or
 STA 1993 Statistical Methods for the Life and Social Sciences

3. 8 semester hours are required in Physics:

PHY 1603, 1611 General Physics I and Laboratory
 PHY 1623, 1631 General Physics II and Laboratory

- C. 12 semester hours of electives to fulfill the overall required 126 semester hours for the degree, 7 of which must be at the upper-division level.

²⁸Thirty-nine of the total semester hours required for the degree must be at the upper-division level.

Students seeking teacher certification should consult the Undergraduate Certification Programs in Education brochure for information. Undergraduates seeking elementary teacher certification must complete the new Interdisciplinary Studies degree (see pp. 314-315).

UTSA/UTHSC JOINT BACHELOR OF SCIENCE DEGREE IN CLINICAL LABORATORY SCIENCE

Certain specific physical skills and abilities are required to successfully participate in the Clinical Laboratory Science Program. Students may wish to inquire regarding these physical requirements before seeking admission to the program or registering for specific courses in the program.

In the Joint Degree Program, clinical laboratory science courses are offered throughout the course of study, culminating in a concentrated clinical hospital experience at the University of Texas Health Science Center at San Antonio. During the sophomore and junior years students will enroll in classes on both the UTSA and UTHSC campuses. All CLSC courses are taught at the Health Science Center and appear in a separate listing.

For consideration for admission into the professional phase of the Joint Degree Program the student must complete a separate application form which may be obtained from the Registrar's Office at the University of Texas Health Science Center at San Antonio, 7703 Floyd Curl Drive, San Antonio, Texas 78284. This application should be submitted by May 15 of the student's sophomore year. Admission to the professional phase of the Joint Degree Program is on a competitive basis. Minimum requirements include 60 hours of college work, an overall GPA of 2.5, completion of at least one clinical laboratory science course and laboratory, and no grades lower than C in any basic science or clinical laboratory science course. Students will be notified of their status in the professional phase of the program during the summer semester following the sophomore year. Admission to the professional phase and successful continuation in the program will provide the student with a clinical practicum position at the Health Science Center teaching affiliates, Medical Center Hospital, the Audie Murphy Veteran's Administration Hospital, Southwest Texas Methodist Hospital, the South Texas Regional Blood Bank, Brook Army Medical Center, the Kerrville Veterans Administration Hospital, and Brooks USAF School of Aerospace Medicine.

The Clinical Laboratory Science Program is accredited by the Committee on Allied Health Education and Accreditation in cooperation with the National Accrediting Agency for Clinical Laboratory Sciences.

Upon successful completion of this joint degree program the student is eligible to take one of the national certification examinations. All students are encouraged to be counseled each semester by either the Clinical Laboratory Science Program Director or a member of the Clinical Laboratory Science faculty to ensure enrollment in appropriate course work.

The minimum number of semester hours required for this degree, including the 42 hours of General Education Requirements, is 146.

All candidates for the degree must complete:

A. 86 semester hours in the major

1. 21 semester hours are required in the biological sciences.

BIO 1103, 1112	Principles of Biology and Laboratory
BIO 2313	Genetics
BIO 3513, 3522	Biochemistry and Laboratory

BIO 3713, 3722 Microbiology and Laboratory
 BIO 4743 Immunology

2. 6 semester hours are required in Allied Health Sciences:

AHS 1883 Introduction to Medical Technology

AHS 3463 Human Physiology

3. *59 semester hours are required in Medical Technology:

a. These courses are taken prior to clinical training:

*CLSC 20351, 20252 Hematology and Laboratory

*CLSC 20301, 20202 Parasitology and Urinalysis
and Laboratory

*CLSC 30361, 30262 Immunochemistry and
Serology and Laboratory

*CLSC 30381, 30282 Clinical Chemistry and
Laboratory

*CLSC 30333, 30234 Medical Microbiology and
Laboratory

b. These courses are the senior lecture and clinical experience courses:

*CLSC 40333 Advanced Medical Microbiology

*CLSC 40383 Advanced Clinical Chemistry

*CLSC 40353 Advanced Hematology

*CLSC 40255 Advanced Immunohematology

*CLSC 40587 Chemistry Practicum

*CLSC 40567 Immunohematology Practicum

*CLSC 40557 Hematology Practicum

*CLSC 40537 Microbiology Practicum

*CLSC 40192 Education Techniques for the
Medical Technologist

*CLSC 40293 Management Techniques for Medical
Technologists

B. 24 semester hours of support work.

1. 13 semester hours are required in Chemistry:

CHE 1103 Introductory Chemistry

CHE 1303 Chemical Principles

CHE 1312 Inorganic Qualitative and Quantitative Analysis

CHE 2203 Organic Chemistry I

CHE 2242 Organic Chemistry I Laboratory

2. 8 semester hours are required in Physics:

PHY 1603, 1611 General Physics I and Laboratory

PHY 1523, 1531 General Physics II and Laboratory

3. 3 semester hours are required in Statistics.

STA 1053 Basic Statistics

UTSA/UTHSC JOINT BACHELOR OF SCIENCE DEGREE IN OCCUPATIONAL THERAPY

The joint degree program in Occupational Therapy is fully accredited by the Committee on Allied Health Education and Accreditation of the American Medical Association in collaboration with the American Occupational Therapy Association (AOTA). Upon completion of this program, students are eligible to complete the certification examination offered by the AOTA, which is necessary for licensure in Texas and most other states.

Admission to the program is made through the University of Texas Health Science Center at San Antonio. Students should seek admission to the professional program only after completing all coursework necessary to meet general education as well as pre-professional (support work) requirements for the program. These may be completed at UTSA or another accredited college or university. However non-UTSA students must be accepted for admission to the University of Texas at San Antonio prior to application to the professional program. Admission to UTSA does not assure admission to the Occupational Therapy Program. Students interested in an early admission decision should contact the program for information on the assured admission program. However, all students are encouraged to be counseled by a member of the occupational therapy faculty to ensure enrollment in appropriate pre-professional coursework. Appointments or information can be obtained by calling (210-567-3111).

Professional coursework begins in early June of each year and classes are conducted at the University of Texas Health Science Center campus. The professional program involves assignment to facilities in San Antonio and other cities for completion of supervised clinical rotations.

Application for admission to the professional phase of the program must be made by February 15th of the year admission is sought. The application process can be initiated by writing to: Registrar, the University of Texas Health Science Center at San Antonio, 7703 Floyd Curl Drive, San Antonio, Texas 78284. Students should assure that they have completed *both* general education and all but 6 hours of non-science, pre-professional (support work) requirements prior to June of the year of admission to the professional phase of the Occupational Therapy Program.. It is the responsibility of the applicant to arrange to have transcripts forwarded to the UTHSC Office of Admissions prior to February 15th of the year in which application is being made.

The minimum number of semester hours required for this degree, including General Education Requirements, is 177.

All candidates for the degree must complete:

A. 119 semester hours in the major (which includes 36 semester hours in full-time fieldwork).

1. 9-10 semester hours are required in the biological sciences:

BIO 1103, 1112	Principles of Biology and Laboratory
BIO 2123, 2132	Comparative Anatomy of Vertebrates and Laboratory

or

AHS 2083, 2091	Human Biology: Anatomy and Laboratory
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2. 74 semester hours are required at the University of Texas Health Science Center at San Antonio* plus 36 hours of Fieldwork II.

INTD 30475 Kinesiology
 OCCT 40251 Research in Occupational Therapy
 OCCT 30401 Health and Occupation
 OCCT 30331 Occupational Therapy in Physical Dysfunction
 OCCT 30291 Skills Lab in Physical Dysfunction
 OCCT 30271 Practicum in Physical Dysfunction
 OCCT 40332 Occupational Therapy for Psychosocial Dysfunction
 OCCT 40292 Skills Lab in Psychosocial Dysfunction
 OCCT 30325 Design and Fabrication Skills
 OCCT 30272 Practicum in Psychosocial Dysfunction
 OCCT 40293 Skills Lab in Developmental Dysfunction
 OCCT 30273 Practicum in Developmental Dysfunction
 OCCT 40382 Management and Consultation in Occupational Therapy
 OCCT 40326 Therapeutic Problem Solving
 OCCT 30256 Assessment of Human Performance
 OCCT 41271 Fieldwork in Physical Dysfunction
 OCCT 41273 Fieldwork in Developmental Dysfunction
 OCCT 41272 Fieldwork in Psychosocial Dysfunction
 CSBL 30616 Gross Anatomy
 PHYL 30413 Human Physiology
 INDT 30471 Human Neurosciences
 OCCT 30303 Computers in Rehabilitation
 PATH 30311 Introductory Pathology
 MEDI 30414 Clinical Medicine I
 MEDI 40212 Medical Management in Psychosocial Dysfunction

B. 19-21 semester hours of support work.

1. 4-5 semester hours are required in Chemistry:

CHE 1003, 1011 General Chemistry of Allied Health Sciences
 or
 CHE 1103, 1122 Introductory Chemistry and Laboratory Workshop

2. 9 semester hours are required in Psychology:

PSY 2013 Fundamentals of Psychology
 PSY 2503 Developmental Psychology (Life Span)
 PSY 2513 Abnormal Psychology

3. 3 semester hours are required in Statistics:

STA 1053 Basic Statistics

4. 3 semester hours are required in Physics:

PHY 1603 General Physics I
 PHY 1611 General Physics I Laboratory (optional)

*Courses to be taken at the University of Texas Health Science Center at San Antonio.

UTSA/UTHSCSA JOINT BACHELOR OF SCIENCE DEGREE IN PHYSICAL THERAPY

The joint degree Program in Physical Therapy Education is fully accredited by the Committee on Accreditation of the American Physical Therapy Association. Upon completion of this four year program, students are eligible to take the licensure examination offered by the Professional Examination Service, which is required for practice in Texas.

Application to the program must be made by December 15 prior to the summer in which the student wishes to be admitted. This application process can be initiated by writing to:

Allied Health Admissions
The University of Texas Health Science Center
at San Antonio
7703 Floyd Curl Drive
San Antonio, Texas 78284

It should be noted that admission to the Program in Physical Therapy Education is competitive, and admission to UTSA does not guarantee admission into the professional phase of the curriculum.

Each student is expected to complete all General Education Requirements for graduation from UTSA, as well as program prerequisites for Physical Therapy, by June of the year of admission to the professional phase of the Physical Therapy Program. The minimum number of semester hours required for this degree, including the 42 hours of General Education Requirements, is 152.

UTSA/UTHSCSA PROGRAM IN PHYSICAL THERAPY EDUCATION

All candidates for the degree must complete 122 semester hours of major and support work.

A. 89 semester hours in the major at the upper division level.*

UTSA/UTHSCSA PROGRAM IN PHYSICAL THERAPY EDUCATION CURRICULUM EFFECTIVE CLASS GRADUATING 1988

JUNIOR SUMMER

CSBL 30616 Gross Anatomy	6 credit hours
PHYL 30412 Human Physiology	4 credit hours
PHYT 30313 PT Patient Care & Application	3 credit hours

JUNIOR FALL

INTD 30475 Kinesiology & Application	4 credit hours
INTD 30471 Human Neuroscience	4 credit hours
PHYT 30321 Therapeutic Exercise I & Application	3 credit hours
PHYT 30315 PT Evaluation & Documentation	3 credit hours
PHYT 30335 Physical Agents & Application for PT	3 credit hours
PHYT 30202 Junior Clinical I	2 credit hours

*Courses to be taken at the University of Texas Health Science Center at San Antonio.

JUNIOR SPRING

MEDI 30211 Clinical Medicine I	2 credit hours
PATH 30311 Pathology II & Application	3 credit hours
PHYT 30322 Therapeutic Exercise II & Application	3 credit hours
PHYT 30236 Clin. Electrotherapy & Applic. for PT	2 credit hours
PHYT 30382 Administration & Management for PT	3 credit hours
PHYT 30208 Orthotics & Prosthetics for PT	2 credit hours
PHYT 30203 Junior Clinical II	2 credit hours

SENIOR SUMMER

PHYT 40323 Therapeutic Exercise III & Application	3 credit hours
PHYT 40216 Cardiopulmonary PT	2 credit hours
PHYT 40191 Independent Study for Seniors (optional)	1 credit hour
PHYT 40240 Growth & Development for PT	2 credit hours

SENIOR FALL

MEDI 40213 Clinical Medicine III	2 credit hours
PHYT 40294 Physical Therapy Research Methodology	2 credit hours
PHYT 40424 Therapeutic Exercise IV & Application	4 credit hours
PHYT 40337 Rehabilitation Management & Applic.	3 credit hours
PHYT 40671 Senior Clinical I	6 credit hours

SENIOR SPRING

PHYT 41672 Senior Clinical II	16 credit hours
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B. 33-37 semester hours of support work:

1. 4-5 semester hours of Human or Mammalian Anatomy with lab

AHS 2083, 2091	Human Biology: Anatomy and laboratory
OR	
BIO 2123, 2132	Comparative Anatomy of Vertebrates and Laboratory

2. 4-5 semester hours of Human or Mammalian Physiology with lab

AHS 2103, 2111	Human Biology: Physiology and laboratory
OR	
BIO 3413, 3422	General Physiology and laboratory

3. 8-10 semester hours of Chemistry with labs (to include an organic component)

CHE 1003, 1011	General Chemistry for AHS and laboratory
OR	
CHE 1103, 1122	Introduction to Chemistry and laboratory
CHE 1203, 1211	Elementary Organic and Biochemistry and laboratory

OR

CHE 1303, 1312 Chemical Principles and Inorganic
Qualitative and Quantitative Analysis

4. 8 semester hours of Physics with labs

PHY 1603, 1611 General Physics I and laboratory
PHY 1623, 1631 General Physics II and laboratory

5. 3 semester hours of Statistics

STA 1053

6. 3 semester hours of Psychology

PSY 2013

7. 3 semester hours of Sociology

SOC 1013

The UTSA equivalents of these courses are given. Courses completed at another institution that meet the requirements are acceptable.

UTHSCSA BACHELOR OF SCIENCE DEGREE IN NURSING

The UTHSCSA Nursing Degree program is fully accredited by the National League for Nursing. The program is composed of two phases. In Phase I students complete a minimum of 60 hours (2 years) of Prenursing Course Requirements which are available at the University of Texas at San Antonio. Phase I coursework at UTSA is approved by The Division of Life Sciences Health Professions Advisory Committee. Phase II requires students to complete 60 hours of courses in the Nursing Major through either the Generic Process or Flexible Process track at UTHSCSA School of Nursing. The minimum number of semester hours required for this degree are 120.

Admission into the First Phase must be made through the University of Texas at San Antonio. Admission into the Second Phase must be made through the University of Texas Health Science Center at San Antonio. Students who have completed 40-45 hours of Phase I courses may request an Application for Admission from Nursing Admissions at UTHSCSA. Questions about Phase I Prenursing Course Requirements and requests for admissions applications should be addressed to:

Nursing Admissions
Office of Student Services
UTHSCSA
7703 Floyd Curl Dr.
San Antonio, Texas 78284-7702
210/567-2670

Application for admission to Phase II must be made by April 1 for Fall Semester Admission and October 1 for Spring Semester Admission. Applicants must have an overall GPA of 2.0 and a GPA of 2.3 in Prenursing Course Requirements in order to be considered for admission. *Students with higher GPA's will be more competitive.*

Applicants must have passed all sections of the Texas Academic Skills Program (TASP) test and meet minimum standards (60 hours Phase I course work) before they may enroll in upper-division (Phase II) course work. No student may enroll in the upper-division nursing courses until she/he has completed the 60 hours of prerequisite courses and has been formally accepted.

Students admitted to the School of Nursing must be certified in cardiopulmonary resuscitation (CPR) prior to registration.

1. The following courses are required for completion of 60 hours of Phase I at the University of Texas at San Antonio. All courses are subject to approval by the School of Nursing when the student enters.

A. 20-25 semester hours of Natural and Physical Sciences.

Discipline and Number	Course	Credit Hours
AHS 2083/2091	Human Biology: Anatomy and Lab	4
AHS 2103/2111	Human Biology: Physiology and Lab	4
AHS 1053/1061	Introductory Microbiology (Lab strongly recommended)	3-4
CHE 1003/1011	General Chemistry for Allied Health Sciences (Lab strongly recommended)	3-4
CHE 1203/1211	Elementary Organic and Biochemistry (Lab strongly recommended)	3-4
BIO 1103/1112	Electives (Lab recommended): Principle of Biology is suggested as a prerequisite to the above AHS courses.	3-5

B. 15 semester hours in the Behavior of Sciences.

Discipline and Number	Course	Credit Hours
PSY 2013	Fundamentals of Psychology	3
PSY 2503	Developmental Psychology	3
SOC 1013	Introduction to the Study of Society	3
	*Electives	6

*See UTHSCSA School of Nursing Undergraduate Program in Nursing booklet for disciplines and courses which will fulfill this requirement.

C. 25-28 semester hours in Other Basic Requirements.

Discipline and Number	Course	Credit Hours
AHS 2043	Nutrition	3
STA 1053	Basic Statistic	3
or		
STA 1073	Statistics for Psychology	3
**	American History	6
**	Political Science	6
**	English Composition	6
	Free Electives	1-4

2. Phase II of the UTHSCSA Nursing Program is comprised of either one of two Plans.

A. Generic Plan:

The following lists those courses which comprise the Generic Process Program Plan. This plan may be taken on a full-time or part-time basis but must be completed within four years of initial enrollment in Phase II of the nursing program.

Discipline and Number	Course	Credit Hours
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First Semester (Junior Year)

NURS 30209	Introduction to Professional Nursing	2
NURS 30310	Nursing and Drug Therapy	3
NURS 30911	Nursing of Individuals with Deviations in Health Status	9

Second Semester

NURS 30812	Nursing of Families: Childbirth, Parenting, Illness	8
NURS 30522	Nursing the Client with Mental Illness	5

Third Semester (Senior Year)

NURS 40203	The Nurse as a Professional	2
NURS 40523	Nursing of Clients with Chronic Health Problems	7
NURS 40513	Community Health Nursing	5

Fourth Semester

NURS 40704	Nursing the Client with Major Health Problems	7
NURS 40504	The Nurse as Manager and Leader	5
Upper Division Electives	Three hours of electives must be in Nursing	9

B. Flexible Plan:

Only students with prior nursing experience are eligible for this plan. The following courses comprise the Flexible Process Program Plan. Although this program can be completed on a part-time basis, all work toward the degree must be completed within four years of the date of initial enrollment in Phase II of the nursing program.

Discipline and Number	Course	Credit Hours
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First Semester

(Courses offered by examination only.)

NURS 30925	Nursing of Adults with Health Problems	9
NURS 30926	Nursing of Children and Childbearing Women	9
NURS 30327	Nursing of Clients with Alteration in Mental Health	3
NURS 30624	Nursing Practice: Clinical Skills	6

Second Semester

NURS 40112	Professional Nursing: Health Assessment	1
NURS 40512	Professional Nursing: Health Promotion	5
NURS 40612	Professional Nursing: Leadership	6

Third Semester

NURS 40213	Professional Nursing: Issues and Ethics	2
NURS 40413	Professional Nursing: Family Focus	4
NURS 40613	Professional Nursing: Community Focus	6
Upper division	Three semester hours of electives must be in nursing	9
Electives		

COURSE DESCRIPTIONS
ALLIED HEALTH SCIENCES
(AHS)

- 1053** **Introductory Microbiology**
 (3-0) 3 hours credit. Prerequisite: BIO 1103 with BIO 1112 strongly recommended, or BIO 1013, or consent of instructor. May not be applied to a B.S. in Biology.
 A general study of microorganisms, their characteristics, isolation, growth, and importance in nature, industry, public health and human disease.
- 1061** **Introductory Microbiology Laboratory**
 (0-3) 1 hour credit.
 May not be applied to a B.S. in Biology.
- 1883** **Introduction to Medical Technology**
 (3-0) 3 hours credit. Prerequisite: CHE 1103 is recommended.
 Overview of the profession of medical technology including the clinical

laboratory and its functions, relationship of physiological and pathological specimens to body systems, and medical terminology and medical laboratory calculations.

- 2043 Nutrition**
(3-0) 3 hours credit. Prerequisites: BIO 1103, 1112; or AHS 2103.
An examination of human nutritional needs from infancy to adulthood.
- 2083 Human Biology: Anatomy**
(3-0) 3 hours credit. Prerequisite: BIO 1103 with BIO 1112 strongly recommended, or BIO 1013 or consent of instructor. May not be applied to B.S. in Biology.
The structure of human muscular, skeletal, nervous and organ systems.
- 2091 Human Biology: Anatomy Laboratory**
(3-0) 1 hour credit.
May not be applied to a B.S. in Biology.
- 2103 Human Biology: Physiology**
(3-0) 3 hours credit. Prerequisite: BIO 1103 with BIO 1112 strongly recommended, or BIO 1013 or consent of instructor. May not be applied to a B.S. in Biology. Physiological processes in human systems.
- 2111 Human Biology: Physiology Laboratory**
(3-0) 1 hour credit.
- 3113 Kinesiology**
(3-0) 3 hours credit. Prerequisite: AHS 2083 or 2103 or consent of instructor. Primarily designed for students majoring in physical education. A study of the principles of human motion.
- 3463 Human Physiology**
(3-0) 3 hours credit. Prerequisites: BIO 1103, 1112, CHE 1203 or 2203 or consent of instructor.
Physiological processes in human systems.
- 4783 Pathogenic Microorganisms**
(3-0) 3 hours credit. Prerequisites: BIO 3713 and 3722. A consideration of medically important microorganisms and their interaction with animal and human hosts.
- 4792 Pathogenic Microorganisms Laboratory**
(0-6) 2 hours credit.

COURSE DESCRIPTIONS

BIOLOGY

(BIO)

- 1013 Introduction to Life Sciences**
(3-0) 3 hours credit. May not be applied to a B.S. in Biology.
An introduction to the life sciences emphasizing general principles, diversity of life forms, reproduction and interrelationships between living things. Credit cannot be earned for both BIO 1013 and BIO 1103.

- 1103 Principles of Biology**
(3-0) 3 hours credit. Concurrent enrollment: BIO 1112.
An introduction to living organisms emphasizing fundamentals of organization, reproduction, growth and interrelationships between various forms of life, including a brief survey of the plant and animal groups, Required for student majoring in Biology. Credit cannot be earned for both BIO 1013 and BIO 1103.
- 1112 Principles of Biology Laboratory**
(0-6) 2 hours credit. Concurrent enrollment: BIO 1103.
- 2003 Human Sex and Reproduction**
(3-0) 3 hours credit. Prerequisite: BIO 1013 or 1103 or consent of instructor.
Human reproductive anatomy and physiology, fertility control, reproductive disease, and parameters influencing fertility patterns.
- 2123 Comparative Anatomy of Vertebrates**
(3-0) 3 hours credit. Prerequisites: BIO 1103 and 1112.
A detailed study of anatomical differences and similarities of vertebrates with reference to evolutionary changes.
- 2132 Comparative Anatomy of Vertebrates Laboratory**
(0-6) 2 hours credit.
- 2313 Genetics**
(3-0) 3 hours credit. Prerequisites: BIO 1103, 1112, CHE 1103, and MAT 1013 or equivalent.
Principles governing transmission of hereditary factors in plants and animals with emphasis on molecular biochemical and population genetics.
- 2322 Genetics Laboratory**
(0-6) 2 hours credit. Optional for non-majors.
- 3003 Introduction to Oceanography**
(3-0) 3 hours credit. Prerequisites: BIO 1103 and 1112, or BIO 1013 or consent of instructor.
General oceanography with emphasis on biological aspects and living marine resources.
- 3013 Introductory Pathology**
(3-0) 3 hours credit. Prerequisites: BIO 1103, 1112 or BIO 1013 or AHS 2103.
Concepts of disease and diagnosis of pathological conditions.
- 3023 Drugs and Society**
(3-0) 3 hours credit. Prerequisites: BIO 1103 and 1112, or BIO 1013 or consent of instructor.
An examination of drugs and their biosocial effects.
- 3033 Human Physiology and Performance**
(3-0) 3 hours credit. Prerequisites: BIO 3413 or AHS 2103.
A systematic application of physiological principles to human equipment and space to improve adaptation and performance in the work environment.

3063 Invertebrate Biology

(3-0) 3 hours credit. Prerequisites: BIO 1103 and 1112.

A course offering the opportunity for a comprehensive study of the invertebrate animals with emphasis on their taxonomy, morphology, ecology, and evolution. (Formerly BIO 2063. Credit cannot be earned for both BIO 3063 and BIO 2063.)

3083 Biosocial Genetics

(3-0) 3 hours credit. Prerequisite: Consent of instructor.

A study of human heredity and social issues with emphasis on inherited diseases, genetic problems and evolutionary change in relation to culture, diversity and mating systems.

3103 Biotechnology

(3-0) 3 hours credit. Prerequisite: BIO 1013 or 1103.

An introduction to recent advances in biology related to biotechnology. Discussion of how advances might be used to promote basic research in medicine, agriculture, and other industries.

3143 Developmental Biology

(3-0) 3 hours credit. Prerequisites: BIO 1103 and 1112.

Sequential analysis of development in vertebrates and the factors which affect fertilization, organogenesis and implantation.

3152 Developmental Biology Laboratory

(0-6) 2 hours credit.

3163 Histology and Cytology

(3-0) 3 hours credit. Prerequisites: BIO 1103 and 1112.

The cytological and histological aspects of cellular organization.

3172 Histological and Cytological Laboratory

(0-6) 2 hours credit.

3213 Animal Behavior

(3-0) 3 hours credit. Prerequisites: BIO 1103 and 1112.

A detailed study of animal behaviors and their biological determinants.

3273 Biology of Flowering Plants

(2-3) 3 hours credit.

A study of the wild flowers of Texas, emphasizing identification of the more common wild flowers, as well as family characteristics, flower anatomy, and plant morphology. Plant collecting techniques and wild flower photography will be included. Lecture, laboratory and field work will be included as part of the course.

3283 Principles of Ecology

(3-0) 3 hours credit. Prerequisites: BIO 1103 and 1112 or consent of instructor.

The opportunity to study the interaction of organisms with their environment, ecological principles, adaptations of organisms, environmental pollution and principles of conservation.

- 3292 Principles of Ecology Laboratory**
(0-6) 2 hours credit.
A field-oriented course emphasizing modern ecological techniques, including examinations of plant and animal populations, and measurement of selected chemical and physical parameters.
- 3323 Evolution**
(3-0) 3 hours credit. Prerequisite: BIO 2313.
A discussion of theories and possible mechanisms for evolutionary changes at various levels of organization.
- 3343 Plant Sciences**
(3-0) 3 hours credit. Prerequisites: BIO 1103 and 1112.
A course offering the opportunity to study the life histories and phylogenetic relationships of vascular and non-vascular plants.
- 3351 Plant Sciences Laboratory**
(0-3) 1 hour credit.
- 3413 General Physiology**
(3-0) 3 hours credit. Prerequisites: BIO 1103, CHE 2003 and PHY 1623; recommended: MAT 1093.
Fundamental properties and processes in living systems.
- 3422 General Physiology Laboratory**
(0-6) 2 hours credit.
- 3513 Biochemistry**
(3-0) 3 hours credit. Prerequisites: CHE 2203, 2242; BIO 2313 recommended.
Introduction to biochemistry; amino acids; protein structures; enzyme action; lipids and saccharides; metabolism; nucleic acids and molecular biology.
- 3522 Biochemistry Laboratory**
(0-6) 2 hours credit.
Basic biochemical laboratory techniques: titration, protein purification, enzyme kinetics, chromatography, electrophoresis and centrifugation.
- 3533 Radiation Biology**
(3-0) 3 hours credit. Prerequisite: BIO 2313 or consent of instructor.
A study of the biological effects of ionizing and non-ionizing radiation, cellular repair mechanisms and medical applications of radiation.
- 3542 Radiation Biology Laboratory**
(0-6) 2 hours credit.
- 3633 Human Environmental Physiology**
(3-0) 3 hours credit. Prerequisites: BIO 3413 or AHS 2103.
Adaptive physiological responses to unusual environmental conditions.
- 3713 Microbiology**
(3-0) 3 hours credit. Prerequisites: BIO 2313 and CHE 2203.
A comprehensive study of microorganisms including their composition, morphology, growth, metabolism, classification, ecology and significance in disease.

- 3722 Microbiology Laboratory**
(0-6) 2 hours credit.
- 3733 Industrial Microbiology**
(3-0) 3 hours credit. Prerequisites: BIO 3713 and 3722.
A study of genetic engineering of industrial microorganisms, industrial fermentation methodologies, quality control, and biotransformations used for the microbial manufacture of foods, beverages, antibiotics, enzymes, single-cell proteins and industrial chemicals.
- 3813 Cellular Biology**
(3-0) 3 hours credit. Prerequisite: BIO 3413 or 3513.
A study of cellular function with relation to structure from the microscopic to molecular level.
- 3822 Cellular Biology Laboratory**
(0-6) 2 hours credit.
- 4023 Environmental Toxicology**
(3-0) 3 hours credit. Prerequisite: BIO 3413 or 3513.
Environmental toxicants will be studied in terms of bioavailability, bioaccumulation, biodegradation; toxicity and physiological processes.
- 4043 Desert Biology**
(2-3) 3 hours credit. Prerequisites: BIO 3283 and 3292.
A study of the deserts of the world with an emphasis on U.S. deserts. Adaptations of plants and animals and their responses to desert conditions will be included, as well as examinations of desert climatic patterns, geology, and natural history. Lecture, laboratory and field work will be included.
- 4073 Law, Ethics and the Life Sciences**
(3-0) 3 hours credit. Prerequisites: BIO 1013 or BIO 1103 and 1112, or consent of instructor.
Current developments in biology such as recombinant DNA, embryo transplants, life preserving processes, reproductive and population control, and the impact of biotechnology on enactment of new legislation and ethics in general.
- 4133 Fermentation Biotechnology**
(3-0) 3 hours credit. Prerequisites: BIO 3513, 3522, 3713, and 3722.
A study of the scientific principles underlying brewing and other fermentation technology.
- 4203 Plant Ecology**
(3-0) 3 hours credit. Prerequisite: BIO 3283, 3292, or consent of instructor.
A study of the major biomes of North America and Texas, including the chemical, physical and biological factors that influence the development of these biomes.
- 4221 Plant Ecology Laboratory**
(0-3) 1 hour credit.
A course providing the opportunity for field-oriented study to examine qualitative and quantitative methods to evaluate plant communities.

- 4233 Field Biology**
(3-0) 3 hours credit. Prerequisites: BIO 1013, or BIO 1103 and 1112, or consent of instructor.
A study of the natural history of plants and animals in their native environment. Techniques for the identification of birds, mammals, reptiles, amphibians, insects, and the dominant flowering plants will be discussed.
- 4241 Field Biology Laboratory**
(0-3) 1 hour credit.
A field-oriented course offering the opportunity for practical experience observing, collecting and identifying Texas plants and animals.
- 4333 Population Genetics**
(3-0) 3 hours credit. Prerequisites: BIO 2313 and 2322.
A quantitative approach to the study of genetics systems in populations, including mutations, selection, polymorphism and mating systems.
- 4343 Molecular Genetics**
(3-0) 3 hours credit. Prerequisites: BIO 2313, 2322, 3513 and 3522.
Molecular approach to structure, replication, mutation and phenotypic expression of genetic material.
- 4353 Comparative Animal Physiology**
(3-0) 3 hours credit. Prerequisites: BIO 3413 and 3422.
A phylogenetic study of physiologic adaptation in animals.
- 4433 Neurobiology**
(3-0) 3 hours credit. Prerequisites: BIO 3413 and 3422.
Anatomy and physiology of nervous systems, the mechanisms of neuronal functions.
- 4442 Neurobiology Laboratory**
(0-6) 2 hours credit.
A laboratory course emphasizing principles presented in BIO 4433.
- 4453 Endocrinology**
(3-0) 3 hours credit. Prerequisites: BIO 3413, 3422, 3513 and 3522.
A consideration of the physiological effects of hormones on the organism in health and disease, together with a study of the gross and microscopic morphology of the glands of internal secretion.
- 4462 Endocrinology Laboratory**
(0-6) 2 hours credit.
A laboratory course emphasizing principles presented in BIO 4453.
- 4523 Intermediary Metabolism**
(3-0) 3 hours credit. Prerequisites: BIO 3513 and 3522.
A detailed consideration of metabolic pathways, energy metabolism and their regulation.
- 4603 Plant Physiology**
(3-0) 3 hours credit. Prerequisites: BIO 3343, 3351, CHE 2203 and 2242.
Principles of organization of cellular activity and molecular structure of

protoplasm; nutrition, translocation, mineral metabolism, respiration and photosynthesis.

4611 Plant Physiology Laboratory

(0-3) 1 hour credit.

A course providing qualitative and quantitative experiments in the study of plant physiology.

4723 Virology

(3-0) 3 hours credit. Prerequisite: BIO 3713.

A study of the diversity of viruses and biochemical mechanisms for their replication.

4731 Virology Laboratory

(0-3) 1 hour credit.

4743 Immunology

(3-0) 3 hours credit. Prerequisites: BIO 3513 and 3522, or 3713 and 3722.

A study of the properties of antigens and antibodies, current concepts of humoral and cell-mediated immunity and the cells involved.

4752 Immunology Laboratory

(0-6) 2 hours credit.

4763 Parasitology

(3-0) 3 hours credit. Prerequisites: BIO 3713 and 3722.

A study of the animal parasites of humans and related hosts with emphasis on their epidemiology, life cycles, pathology and control.

4772 Parasitology Laboratory

(0-6) 2 hours credit.

4813 Brain and Behavior

(3-0) 3 hours credit. Prerequisite: BIO 1013 or 1103, or consent of instructor.

Basic physiological functions of the brain and how they relate to behavior.

4911-3 Independent Study

1-3 hours credit. Prerequisites: Permission in writing (form available) of the instructor, the student's advisor, and the Division Director and Dean of the College in which the course is offered.

Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 6 hours, regardless of discipline, will apply to the bachelor's degree.

4953 Special Studies in Biology

3 hours credit. Prerequisite: Consent of instructor.

An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies courses may be repeated for credit when the topics vary but not more than 6 hours, regardless of discipline will apply to a bachelor's degree.

- 4963 Seminar in Biology**
(3-0) 3 hours credit. Prerequisite: Junior or senior standing with a minimum of 20 hours in biological sciences.
An undergraduate seminar limited to biology majors, which provides an opportunity to survey selected biological topics through presentation and discussion of relevant contemporary research and literature. May not be repeated for credit.
- 4972 MBRS-MARC Symposium**
(2-0) 2 hours credit. Prerequisite: BIO 1103 or CHE 1103, or consent of instructor.
A course involving presentations at the frontiers of chemistry, biochemistry, biophysics and biology, including genetics, microbiology, physiology, and other areas. Course may be repeated for credit, to a maximum of six semester credit hours.
- 4993 Honors Research**
3 hours credit. Prerequisite: Enrollment limited to candidates for College Honors during their last two semesters; approval by the College Honors Committee. Supervised research and preparation of an honors thesis. May be repeated once with approval.

DIVISION OF MATHEMATICS, COMPUTER SCIENCE, AND STATISTICS

The division offers a Bachelor of Science Degree in Computer Science and a Bachelor of Science Degree in Mathematics in which the student may select a concentration in Mathematics, a concentration in Statistics or a concentration in General Mathematical Studies.

BACHELOR OF SCIENCE DEGREE IN COMPUTER SCIENCE

The Bachelor of Science Degree in Computer Science requires a minimum of 126 semester hours, including the 42 hours of General Education Requirements.

All majors in computer science are required to complete with a grade of C or better all required and elective CS courses.

1. All candidates for the Bachelor of Science degree in Computer Science, must complete the following: 64 semester hours of required courses (which includes the 9 hours of General Education Requirements in Science, Computer Science, and Mathematics.

The student who is not prepared to begin MAT 1214 must take MAT 1093, Pre-calculus.

CS	1711	Introduction to Computer Science Laboratory
CS	1713	Introduction to Computer Science
CS	1723	Data Structures I
CS	2733	Introduction to Computer Organization
CS	2743	Data Structures II
CS	3233	Discrete Mathematical Structures
CS	3321	Topics in Programming Languages: C
CS	3321	Topics in Programming Languages: Ada
CS	3321	Topics in Programming Languages: Lisp
CS	3723	Programming Languages
CS	3733	Operating Systems
CS	3743	Data Base Management
CS	3773	Programming Methodology
CS	4753	Computer Architecture
EE	2513	Logic Design
MAT	1214	Calculus I
MAT	1223	Calculus II
MAT	2213	Calculus III
MAT	2233	Linear Algebra
STA	3513	Probability and Statistics
STA	3523	Statistical Methods
ENG	2413	Technical Writing
PHY	1904	Technical Physics I
PHY	1911	Technical Physics I Laboratory

2. 29 semester hours, 12 of which must be upper-division Computer Science courses, not including CS 3133 or CS 4103, and 17 of which may be electives.

BACHELOR OF SCIENCE DEGREE IN MATHEMATICS

The Bachelor of Science Degree in Mathematics is offered with three concentrations:

- | | |
|------------------|------------------------------|
| Concentration 1. | Mathematics |
| Concentration 2. | Statistics |
| Concentration 3. | General Mathematical Studies |

The minimum number of semester hours required for this degree, including the 42 hours of General Education Requirements, is 126.²⁹ Students choosing Concentration 3, should satisfy the General Education Requirements consistent with the Texas Teacher Certification Program.

All majors in mathematics must complete with a grade of C or better all required and elective MAT and STA courses.

All candidates for the Bachelor of Science degree in Mathematics, regardless of concentration, must complete the following 32 semester hours of required courses.³⁰

The student who is not prepared to begin MAT 1214 must take MAT 1093, Pre-calculus.

MAT	1214	Calculus I
MAT	1223	Calculus II
MAT	2213	Calculus III
MAT	2233	Linear Algebra
MAT	2243	Foundations of Mathematics
MAT	3213	Foundations of Analysis
STA	3513	Probability and Statistics
STA	3523	Statistical Methods
CS	1711	Introduction to Computer Science Laboratory
CS	1713	Introduction to Computer Science
CS	1723	Data Structures I

In addition, a candidate for the Bachelor of Science in Mathematics degree must complete the course requirements for the concentration declared by the candidate.

1. Concentration in Mathematics

A. Required Courses: 21 semester hours.

MAT	3223	Complex Variables
MAT	3243	Calculus for Applications
MAT	3613	Differential Equations I
MAT	3633	Numerical Analysis
MAT	4213	Real Analysis I
MAT	4223	Real Analysis II
MAT	4233	Modern Abstract Algebra I

²⁹Thirty-nine of the total semester hours required for the degree must be at the upper division level.

Students seeking teacher certification should consult the Undergraduate Certificate Programs in Education Brochure for information. Undergraduates seeking elementary teacher certification must complete the new Interdisciplinary Studies degree, refer to this section of the catalog.

³⁰CS 1713 and MAT 1214 may be used to satisfy the General Education Requirements for 3 hours of Computer Science and 3 hours of Mathematics/Statistics.

B. An additional 9 semester hours of upper division courses in the Division of Mathematics, Computer Science, and Statistics.

C. Electives, 28 semester hours.

2. Concentration in Statistics

A. Required Courses: 21 semester hours.

MAT 3633 Numerical Analysis
MAT 4213 Real Analysis I
STA 3013 Multivariate Analysis for the Life and Social Sciences
STA 3433 Applied Non-Parametric Statistics
STA 4643 Introduction to Stochastic Processes
STA 4713 Applied Regression Analysis
STA 4723 Design and Analysis of Experiments

B. 9 additional hours of approved courses in the Division of which 3 hours may be in the 2000 level. The other 6 hours must be at the 3000 level or above.

C. Electives, 28 semester hours.

3. Concentration in General Mathematical Studies.

A. Required Courses in Mathematics: 15 semester hours.

MAT 3233 Modern Algebra
MAT 4113 Computer Mathematical Topics
MAT 4263 Geometry

Any 6 approved semester hours in MAT or STA with a course number of 3000 or above.

B. Required Academic Foundations: 10 semester hours.

COM 1043 Introduction to Communication

Six semester hours of English elective.

One hour science lab associated with science course taken to fulfill general education requirements.

C. Electives: 3 semester hours

Students seeking certification should use 21 of these hours for the required certification courses. Complete information can be obtained from the Office of Teacher Certification. Other students should take an additional 15 hours of upper-division MAT or STA courses approved by the Undergraduate Advisor of Record.

Note: In addition to specific course requirements, teacher certification in Texas also requires passing scores on the Pre-Professional Skills Test (PPST) or the Texas Academic Skills Program (TASP) Test, and acceptable scores on the state-mandated exit competency test. Complete information may be obtained at the Office of Teacher Certification and Placement at UTSA.

COURSE DESCRIPTIONS COMPUTER SCIENCE (CS)

- 1043 Computer Programming for Business Applications**
(3-0) 3 hours credit. Prerequisite: MAT 1013 or the equivalent.
An introduction to the use of computers in the business professions. Topics will include the use of spreadsheets, database packages, and word processors. Problem solving skills will be emphasized. May not be applied toward a major in the Division of Mathematics, Computer Science, and Statistics.
- 1073 Introductory Computer Programming for Scientific Applications**
(3-0) 3 hours credit. Prerequisite: MAT 1063.
Introductory programming. Sorting and ranking; plotting; numerical taxonomy, solution of non-linear equations; linear regression. Solution of linear systems. May not be applied toward a major in the Division of Mathematics, Computer Science, and Statistics.
- 1711 Introduction to Computer Science Laboratory**
(0-2) 1 hour credit. Prerequisite or concurrent enrollment: MAT 1214. Concurrent enrollment: CS 1713.
Laboratory to accompany CS 1713.
- 1713 Introduction to Computer Science**
(3-0) 3 hours credit. Prerequisite or concurrent enrollment: MAT 1214. Concurrent enrollment: CS 1711.
Introduction to basic concepts of computer science. Functional components of computers, data representation, problem solving methods, algorithm development, and programming using a high-level programming language.
- 1723 Data Structures I**
(3-0) 3 hours credit. Prerequisites: CS 1711, CS 1713, and MAT 1214.
Abstract data structures (stacks, queues, lists, trees), primitive operations, and methods of data representation. Dynamic memory allocation, pointers, and recursion.
- 2033 Fundamentals of Computer Concepts**
(3-0) 3 hours credit. Prerequisites: Sophomore or higher classification, Credit cannot be earned for both CS 1043 and CS 2033.
An introduction to computers and information processing for those with no previous background; a study of the computer, its uses and social impact; introduction to computer programming. May not be applied towards a major in the Division of Mathematics, Computer Science, and Statistics.
- 2073 Computer Programming With Engineering Applications**
(3-0) 3 hours credit. Prerequisite: MAT 1214. Prerequisite or Corequisite: MAT 1223.
Algorithmic approaches to problem solving and computer program design for engineers, engineering and mathematically-oriented problem sets will be emphasized, including non-numeric applications. Searching, sorting, linked-lists, and data typing will be introduced. May not be

applied towards a major in the Division of Mathematics, Computer Science, and Statistics.

2083 Microcomputer Applications

(3-0) 3 hours credit.

Study of the uses of microcomputers. Students will have the opportunity to learn programming using the Pascal language and to investigate software packages involving word processing, data bases, and spread sheets. Course may not be applied towards a major in the Division of Mathematics, Computer Science, and Statistics.

2133 Microcomputer Programming

(3-0) 3 hours credit. Prerequisite: CS 2083.

Programming topics using the Pascal language. Course may not be applied towards a major in the Division of Mathematics, Computer Science, and Statistics.

2733 Introduction to Computer Organization

(3-0) 3 hours credit. Prerequisites: CS 1723 and concurrent enrollment in EE 2813 and EE 3813.

Introduction to computer organization with focus on the assembly language level, the conventional machine level, and the microprogramming level.

2743 Data Structures II

(3-0) 3 hours credit. Prerequisite: CS 1723.

Graphs, searching, sorting, storage device characteristics, file organizations, file access methods and memory management.

3073 Computer Graphics and Numerical Techniques.

(3-0) 3 hours credit. Prerequisites; CS 2073 and MAT 3253.

Computer graphics, numerical analysis, and advanced programming techniques with applications to engineering problems. May not be applied towards a major in the Division of Mathematics, Computer Science and Statistics.

3133 Computers and Society

(3-0) 3 hours credit. Prerequisite: Any one of the following courses: CS 1043, 1073, 1713, 2033, 2073 or consent of instructor.

Examination of some of the major issues faced by the use of computers in society including computers and the law, computers in business, computers in education, computers in science and engineering, and electronic fund-transfer and communications.

3233 Discrete Mathematical Structures

(3-0) 3 hours credit. Prerequisites: CS 1723 and MAT 2233.

Survey and development of theoretical tools suitable for describing algorithmic applications. Propositional and predicate calculus, induction, proofs, set theory, and finite state automata.

3321 Topics in Programming Languages

(1-0) 1 hour credit. Prerequisite: CS 2743.

Problem solving techniques and constructs in a particular language. Languages will vary, but Ada, C, and Lisp are required for Computer Science majors. May be repeated for credit when topics vary, but not more than 3 hours will apply to the major.

- 3413 Data Communications**
(3-0) 3 hours credit. Prerequisite: CS 2733 or consent of the instructor. Concepts, principles and terminology concerning the standards, equipment, interfaces, protocols, architectures, transmission alternatives and regulatory issues involved in the design and use of data communications systems.
- 3723 Programming Languages**
(3-0) 3 hours credit. Prerequisites: CS 2733, CS 2743, CS 3321: Lisp, and MAT 2213.
An introduction to the organization of high-level programming languages, including data types, control structures, data flow, and run-time environments. Use of formal syntax descriptions. The implications of interpretation versus compilation. Activation records and dynamic storage in block-structured languages.
- 3733 Operating Systems**
(3-0) 3 hours credit. Prerequisites: CS 2733, CS 2743, CS 3321: C, and MAT 2213.
An introduction to the functions and major techniques of a modern multi-programming operating system. Includes exposure to the fundamentals of processor management, process synchronization, memory management, and peripheral management.
- 3743 Data Base Management**
(3-0) 3 hours credit. Prerequisites: CS 2743 and MAT 2213.
Study of systems for management of large amounts of related data. Basic concepts, implementation approaches, user data models, commercially available systems.
- 3773 Programming Methodology**
(3-0) 3 hours credit. Prerequisites: CS 2733, CS 2743, CS 3321: Ada, and MAT 2213.
Software development (analysis, specifications, design, implementation and testing). Design methodologies and programming standards. Development project in small groups, including acceptance test.
- 3793 Introduction to Artificial Intelligence**
(3-0) 3 hours credit. Prerequisites: CS 2743, CS 3233, and CS 3321: Lisp.
Discussion of theorem proving by machine, computational linguistics, psychological modeling and computer games.
- 4103 Ethical and Social Issues in Computer Science**
(3-0) 3 hours credit. Prerequisite: CS 3733 or consent of instructor.
An introduction to formal ethics and its application to issues arising from the modern computer revolution. Topics include ethical problems related to specialized areas of computer science, such as large data bases, networks, artificial intelligence, and computer security. Legal issues are also covered.
- 4313 Automata, Computability and Formal Languages**
(3-0) 3 hours credit. Prerequisite: CS 3233.
Discussion of abstract machines (finite state automata, pushdown automata and Turing machines), formal grammars (regular, context-free and type 0) and the relationship among them.

- 4323 Analysis of Algorithms**
(3-0) 3 hours credit. Prerequisites: CS 2743 and CS 3233.
Analysis of the performance of algorithms and discussion of programming techniques and data structures used in the writing of effective algorithms.
- 4383 Computer Graphics**
(3-0) 3 hours credit. Prerequisites: CS 2743 and MAT 2233.
An introduction to two- and three-dimensional generative computer graphics. Display devices, data structures, mathematical transformations, and algorithms used in picture generation, manipulation, and display.
- 4633 Simulation**
(3-0) 3 hours credit. Prerequisites: CS 1723 and STA 3513.
Construction and use of simulation models on a digital computer. Monte Carlo techniques and associated statistical methods.
- 4713 Compiler Writing**
(3-0) 3 hours credit. Prerequisite: CS 3723.
An introduction to implementation of translators. Topics include formal grammars, scanners, parsing techniques, syntax-directed translation, symbol table management, code generation, and code optimization.
- 4753 Computer Architecture**
(3-0) 3 hours credit. Prerequisite: CS 2733 and EE 2513. Prerequisite or concurrent enrollment: CS 3733.
An investigation of the major concepts of computer architecture including the central processing unit, main memory, and peripheral devices.
- 4803 Microprocessor Laboratory**
(1-4) 3 hours credit. Prerequisites: EE 2513 and CS 2733.
Principles of large-scale integration and very large-scale integration. The organization and systems architecture of state-of-the-art microprocessors. The integration of microprocessors with random-access memory, programmable read-only memory, peripheral controllers and I/O devices. (Formerly SD 4803. Credit cannot be earned for both CS 4803 and SD 4803.)
- 4853 Computer Interfaces**
(3-0) 3 hours credit. Prerequisites: CS 2733 and EE 2513.
Basic characteristics and design considerations of printer, tape, and disk controllers, multiplexers and other devices for computer communications and teleprocessing. (Formerly SD 4853. Credit cannot be earned for both CS 4853 and SD 4853.)
- 4873 Computer Networks**
(3-0) 3 hours credit. Prerequisites: EE 2513. CS 2733 and STA 3513.
Discussion of standard network layers including issues of topology, error detection and recovery, congestion control, and hardware interfacing. (Formerly SD 4873. Credit cannot be earned for both CS 4873 and SD 4873.)
- 4901 Seminar in Computer Science**
(1-0) 1 hour credit. Prerequisite: Upper-division classification.
Scheduled and impromptu presentations on subjects of interest presented

by division faculty and visiting lecturers. May be repeated for credit but not more than 3 hours will apply toward the major.

4913 Independent Study

3 hours credit. Prerequisites: Permission in writing (form available) of the instructor, the student's Advisor, the Division Director, and Dean of the College in which the course is offered.

Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students needing specialized work. May be repeated for credit, but not more than 6 hours will apply to the bachelor's degree.

4953 Special Studies in Computer Science

3 hours credit. Prerequisite: Consent of instructor.

An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies courses may be repeated for credit when topics vary, but not more than 6 hours, regardless of discipline, will apply to a bachelor's degree.

4993 Honors Research

(3-0) 3 hours credit. Prerequisite: Enrollment limited to candidates for College Honors during the last two semesters; approval by the College Honors Committee.

Supervised research and preparation of an honors thesis. May be repeated one time with approval.

COURSE DESCRIPTIONS

MATHEMATICS

(MAT)

0103 TASP Review

(3-0) 3 hours credit.

A course intended for students with minimal mathematical skills who need a comprehensive review before they can successfully complete an algebra course. Topics include the Fundamental Mathematics and Geometry objectives of the Texas Academic Skills Program (TASP), with an introduction to algebra. Intensive review and maintenance of computational skills with integers, fractions, decimals, percents, ratio and proportions; reading and interpreting information presented in graphs, tables, and charts; solving word problems, elementary algebraic equations, and problems with two- and three-dimensional geometric figures; and inductive and deductive reasoning skills. Course does not count towards any degree at the University of Texas at San Antonio.

0113 Elemental Algebra

(3-0) 3 hours credit.

Introductory algebra course which includes the Texas Academic Skills Program (TASP) Algebra objectives. Operations with algebraic expressions; solve one- and two-variable equations; solve word problems involving one and two variables; graphing numbers and number relationships; solve problems involving quadratic equations. Course does not count towards any degree at the University of Texas at San Antonio.

0121 Elemental Geometry

(1-0) 1 hour credit.

Introductory course which includes the Texas Academic Skills Program (TASP) Geometry objectives. Solve problems with two- and three-dimensional geometric figures; solve problems involving right triangles using the Pythagorean Theorem; apply reasoning skills using the principles of similarity, congruence, parallelism, and perpendicularity; and using inductive and deductive reasoning. Course does not count towards any degree at the University of Texas at San Antonio.

0131 Independent TASP Review

(1-0) 1 hour credit.

Students will have the opportunity to work with Self-Paced Instructional modules or a Computerized Instructional Program to review concepts for the Texas Academic Skills Program (TASP) text. An individualized prescriptive program for each student will be developed by the TASP Mathematics Coordinator. Course does not count towards any degree at the University of Texas at San Antonio.

0133 Independent TASP Review

(3-0) 3 hours credit.

Students will have the opportunity to work with Self-Paced Instructional modules or a Computerized Instructional Program to review concepts for the Texas Academic Skills Program (TASP) text. An individualized prescriptive program for each student will be developed by the TASP Mathematics Coordinator. Course does not count towards any degree at the University of Texas at San Antonio.

1013 Fundamentals of Algebra

(3-0) 3 hours credit.

Real numbers, linear equations and inequalities, absolute inequalities, factorization of polynomials, rational expressions, negative and rational exponents, scientific notation, radicals, quadratic equations and inequalities, Cartesian coordinates, relations, functions and graphing of functions.

1033 Algebra with Calculus for Business

(3-0) 3 hours credit. Prerequisites: MAT 1013 or the equivalent.

An introduction to business calculus with an emphasis on the algebra of functions. Concentration is on the algebraic manipulations of functions and includes volume and profit functions, both linear and quadratic; root finding and graphical analysis; differentiation and integration.

1063 College Algebra

(3-0) 3 hours credit.

Algebraic expressions; equations, inequalities over the real numbers, relations, functions; polynomial and rational functions; systems of linear equations and inequalities; matrices, and determinants; complex numbers; polynomials, sequences, series, binomial expansion; mathematical induction; permutations, combinations.

1093 Precalculus

(3-0) 3 hours credit. Prerequisite: MAT 1063.

Exponential functions, logarithmic functions, trigonometric functions, complex numbers, DeMoivre's Theorem, polar coordinates.

- 1143 Essential Elements in Mathematics**
(3-0) 3 hours credit. Prerequisite: MAT 1063.
Numeration systems; properties of the systems of whole numbers, integers, rational numbers and real numbers; problem solving, geometry and measurement; probability and statistics; logic. Applies only to elementary teacher certification requirements.
- 1214 Calculus I**
(4-0) 4 hours credit. Prerequisite: MAT 1093.
An introduction to the concepts of limit, continuity and derivative, mean value theorem, and applications of derivatives such as velocity, acceleration, maximization and curve sketching; introduction to the Riemann integral and the fundamental theorem of calculus.
- 1223 Calculus II**
(3-0) 3 hours credit. Prerequisite: MAT 1214.
Methods of integration, inverse trigonometric functions, applications of the integral.
- 2213 Calculus III**
(3-0) 3 hours credit. Prerequisite: MAT 1223.
Special areas of differential and integral calculus. Taylor series, power series, convergence tests, vectors, functions of several variables, partial derivatives, and multiple integrals.
- 2233 Linear Algebra**
(3-0) 3 hours credit. Prerequisite: MAT 2213.
Vector spaces and matrix algebra, matrices and determinants, characteristic values of matrices and reduction to canonical forms. Emphasis on applications.
- 2243 Foundations of Mathematics**
(3-0) 3 hours credit. Prerequisite: MAT 1214.
Development of theoretical tools for rigorous mathematics. Topics may include; mathematical logic, propositional and predicate calculus, set theory, functions and relations, cardinal and ordinal numbers, Boolean algebras, and construction of the natural numbers, integers and rational numbers. Emphasis on theorem proving.
- 3123 Fundamentals of Geometry**
(3-0) 3 hours credit. Prerequisite: MAT 2243.
A survey of geometric concepts including axiomatic developments of advanced Euclidean geometry, coordinate geometry, non-Euclidean geometry, 3-dimension geometry and topology. Course may not be applied towards a major in the Division of Mathematics, Computer Science, and Statistics.
- 3213 Foundations of Analysis**
(3-0) 3 hours credit. Prerequisites: MAT 2213 and MAT 2243.
An opportunity for rigorous development of the foundations of real analysis; basic point set topology in \mathbb{R}^1 and \mathbb{R}^n , compactness; connectedness; convergence; cardinality. Emphasis on theorem proving and mathematical rigor.

- 3223 Complex Variables**
(3-0) 3 hours credit. Prerequisites: MAT 2213 and either MAT 3213 or consent of instructor.
An introduction to complex variables including elementary functions, line integrals, power series, residues and poles and conformal mappings.
- 3233 Modern Algebra**
(3-0) 3 hours credit. Prerequisite: MAT 2243.
Topics will include the development of groups, integral domains, fields, and number systems including the complex numbers. Divisibility, congruences, primes, perfect numbers and some other problems of number theory will be considered.
- 3243 Calculus for Applications**
(3-0) 3 hours credit. Prerequisite: MAT 2233.
Line vector differential and integral calculus, line integrals, Green's theorem, Stokes' theorem, Divergence theorem.
- 3253 Engineering Analysis I**
(3-0) 3 hours credit. Prerequisite: MAT 2213.
Ordinary differential equations, Laplace transforms, linear algebra and matrix arithmetic. May not be applied to a major in the Division of Mathematics, Computer Science, and Statistics.
- 3263 Engineering Analysis II**
(3-0) 3 hours credit. Prerequisite: MAT 3253.
Fourier series, partial differential equations and vector calculus. Topics from linear difference equations, Z-transforms and complex analysis. May not be applied to a major in the Division of Mathematics, Computer Science, and Statistics.
- 3613 Differential Equations I**
(3-0) 3 hours credit. Prerequisite or concurrent enrollment in MAT 2233.
Basic notions of differential equations, solution of first order equations and linear equations with constant coefficients, n^{th} order initial value problems, power series solutions of differential equations.
- 3623 Differential Equations II**
(3-0) 3 hours credit. Prerequisite: MAT 3613.
Continuation of MAT 3613. Stability, partial differential equations and boundary value problems.
- 3633 Numerical Analysis**
(3-0) 3 hours credit. Prerequisites: MAT 2233 and either CS 1073 or 1713.
Solution of linear and non-linear equations, curve-fitting, eigenvalue problems.
- 4113 Computer Mathematical Topics**
(3-0) 3 hours credit. Prerequisites: MAT 3233 and either MAT 3123 or MAT 4263.
Mathematical topics from consumer mathematics, algebra, geometry, number theory, and probability and statistics will be investigated using the computer. Course will also include some instruction in the BASIC programming language. May not be applied towards a major in the

Division of Mathematics, Computer Science, and Statistics other than the General Mathematical Studies concentration

4123 History of Mathematics

(3-0) 3 hours credit. Prerequisites: MAT 3233 and either MAT 3123 or MAT 4263.

Selected subjects in mathematics developed through historical perspectives and biographies. Course may not be applied towards a major in the Division of Mathematics, Computer Science, and Statistics other than the General Mathematical Studies concentration.

4213 Real Analysis I

(3-0) 3 hours credit. Prerequisite: MAT 3213.

An in-depth study of the calculus of functions of a single real variable; pointwise convergence; continuity; uniform convergence; differentiation; functions of bounded variation; Riemann-Stieltjes integration; interchange of limits.

4223 Real Analysis II

(3-0) 3 hours credit. Prerequisites: MAT 2233 and 4213.

An in-depth study of the calculus of functions of several real variables; differentiation; Jacobians; non-linear transformations; integration.

4233 Modern Abstract Algebra I

(3-0) 3 hours credit. Prerequisites: MAT 2213 and MAT 2243.

An in-depth study of groups and rings.

4253 Number Theory

(3-0) 3 hours credit. Prerequisites: MAT 2213 and MAT 2243.

The theory of primes, congruences and related subjects.

4263 Geometry

(3-0) 3 hours credit. Prerequisites MAT 2213 and MAT 2243.

Projective, affine and non-Euclidean geometry.

4273 Topology

(3-0) 3 hours credit. Prerequisites: MAT 2213 and MAT 2243.

Set theory including cardinal and ordinal numbers. Topological properties of the real line and metric spaces.

4913 Independent Study

3 hours credit. Prerequisites: Permission in writing (form available) of the instructor, the student's Advisor, and the Division Director and Dean of the College in which the course is offered.

Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit but not more than 6 hours will apply to the bachelor's degree.

4953 Special Studies in Mathematics

3 hours credit. Prerequisite: Consent of instructor.

An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies courses may be repeated for credit when the topics vary, but not more than 6 hours, regardless of discipline, will apply to a bachelor's degree.

4993 Honors Research

3 hours credit. Prerequisite: Enrollment limited to candidates for College Honors during the last two semesters; approval by the College Honors Committee.

Supervised research and preparation of an honors thesis. May be repeated one time only with approval.

**COURSE DESCRIPTIONS
STATISTICS
(STA)**

1053 Basic Statistics

(3-0) 3 hours credit. Prerequisite: MAT 1013, 1033 or 1063.

Descriptive statistics; histograms, measures of location and dispersion. Elementary probability theory. Random variables. Binomial and normal distributions. Interval estimation and hypothesis testing. Simple linear regression and correlation. Applications of the distributions.

1063 Basic Statistics for Business and Economics

(3-0) 3 hours credit. Prerequisite: MAT 1033.

Fundamental concepts and procedures of statistics and probability with business applications. Includes descriptive statistics, estimation, hypothesis testing, and simple linear regression and correlation.

1073 Statistics for Psychology

(3-0) 3 hours credit. Prerequisites: MAT 1013 and one PSY course.

The use of statistics in psychological research. Elementary probability theory. Descriptive statistics including histograms, graphing, and measures of central tendency and dispersion. Correlational techniques. Binomial and normal distributions. Inferential statistics including hypothesis testing, interval estimation, and analysis of variance.

1993 Statistical Methods for the Life and Social Sciences

(3-0) 3 hours credit. Prerequisite: STA 1053, 1063 or 1073.

Point estimator properties, inference about the means and variances of two or more populations, categorical data analysis, linear regression, analysis of variance, nonparametric tests. Open to students of all disciplines.

3013 Multivariate Analysis for the Life and Social Sciences

(3-0) 3 hours credit. Prerequisite: STA 1993 or 3523.

Linear algebra preliminaries, the multivariate normal distribution, tests on means, discriminant analysis, cluster analysis, principal components, factor analysis. Use of computer library programs. Open to students of all disciplines.

3313 Introduction to Sample Survey Theory and Methods

(3-0) 3 hours credit. Prerequisite: STA 1993 or 3513.

Simple random sampling, stratified random sampling, ratio and regression estimates, systematic sampling, cluster sampling, unequal probability sampling, two-stage and multistage sampling, non-sampling errors.

- 3433 Applied Non-Parametric Statistics**
(3-0) 3 hours credit. Prerequisite: STA 1993 or STA 3523.
Tests of location. Goodness of fit tests. Rank tests. Tests based on nominal and ordinal data for both related and independent samples. Measures of association.
- 3513 Probability and Statistics**
(3-0) 3 hours credit. Prerequisite or concurrent enrollment: MAT 2213.
Axioms of probability, probability functions, density functions, random variables, functions of random variables and their sampling distributions. Important discrete and continuous random variables.
- 3523 Statistical Methods**
(3-0) 3 hours credit. Prerequisite: STA 3513.
Estimation and testing hypotheses, chi-square tests, linear regression, analysis of variance, and other topics which may include nonparametric methods, quality control, and reliability.
- 3533 Probability and Random Processes**
(3-0) 3 hours credit. Prerequisites: EE 3423 and MAT 3253.
Probability, random variables, distribution and density functions, limit theorems, random processes, correlation functions, power spectra, response of linear systems to random inputs.
- 3813 Discrete Data Analysis and Bioassay**
(3-0) 3 hours credit. Prerequisite: STA 1993 or 3523.
Methods especially useful for problems arising in the life sciences, analysis of count data. Contingency tables. Probit and Logit analysis.
- 4613 Operations Research I**
(3-0) 3 hours credit. Prerequisite: MAT 2213 and MAT 2233.
Introduction to analytical methods and models of operations research, with emphasis on optimization. Linear integer and non-linear programming. Network analysis, including PERT and CPM. Introduction to dynamic programming.
- 4623 Operations Research II**
(3-0) 3 hours credit. Prerequisite STA 3513 or equivalent.
Introduction to probabilistic analysis and models in operations research. Decision analysis, Markov chains, queuing models.
- 4643 Introduction to Stochastic Processes**
(3-0) 3 hours credit. Prerequisite; STA 3513.
Finite Markov chains including transition probabilities, classification of states, limit theorems, queuing theory, birth and death processes.
- 4713 Applied Regression Analysis**
(3-0) 3 hours credit. Prerequisite: STA 1993 or 3513.
An introduction to regression analysis with emphasis on practical aspects, fitting a straight line, examination of residuals, matrix treatment of regression analysis, fitting and evaluation of general linear models, non-linear regression.

4723 Design and Analysis of Experiments

(3-0) 3 hours credit. Prerequisite: STA 1993; or STA 3523.

General concepts in the design and analysis of experiments. Emphasis will be placed on both the design and analysis of the experiment and tests of the validity of assumptions. Topics covered are completely randomized designs, randomized block designs, complete factorials, fractional factorials, and covariance analysis. The use of computer software packages will be stressed.

4803 Statistical Quality Control

(3-0) 3 hours credit. Prerequisite: STA 3513.

Statistics and simple probability are introduced in terms of problems which arise in manufacturing and their application to control of manufacturing processes. Acceptance sampling in terms of standard sampling plans: MIL-STD 105, MIL-STD 414, Dodge-Romig plans, continuous plans, etc.

4903 Survival Analysis

(3-0) 3 hours credit. Prerequisite: STA 3523 or equivalent.

Measures of survival, hazard function, mean residual life function. Common failure distributions and a procedure for selecting an appropriate model. Reliability of complex series and parallel systems. Probabilistic approach to biomedical applications.

4953 Special Studies in Statistics

3 hours credit. Prerequisite: Consent of instructor.

An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies courses may be repeated for credit when the topics vary, but not more than 6 hours, regardless of discipline will apply to a bachelor's degree.