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 for honors designation is based on the student's academic performance and recommendation by the faculty of the student's major discipline. To be eligible for the program, students must have a minimum overall grade-point average of 3.0 at UTSA and a minimum grade-point average of 3.0 in their major at UTSA. These minimum averages must be maintained for students to receive the approval of the College Honors Committee and the discipline faculty. Students applying for College Honors are expected to enroll in the appropriate honors research course during their final two semesters. 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 COMPUTER SCIENCE

The division offers a Bachelor of Science degree in Computer Science with a strong technical emphasis on modern computing and systems. The degree program offers students the opportunity to prepare for careers in high-technology companies, business, government, and teaching, and to prepare for advanced graduate study. The division also offers a Minor in Computer Science.

Bachelor of Science Degree in Computer Science

The Bachelor of Science degree in Computer Science requires a minimum of 126 semester credit hours, including the Core Curriculum requirements.

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

All candidates for the Bachelor of Science degree in Computer Science must complete the following:

A. 68 semester credit hours of required courses (MAT 1214, PHY 1904, and PHY 1924 may also be used to satisfy the Core Curriculum requirements for Domain I):

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS 1713, 1711</td>
<td>Introduction to Computer Science and Recitation*</td>
</tr>
<tr>
<td>CS 1723, 1721</td>
<td>Data Structures and Recitation</td>
</tr>
<tr>
<td>CS 2213</td>
<td>Advanced Programming</td>
</tr>
</tbody>
</table>

*The student who has no programming experience or courses should take CS 1063 Introduction to Programming.
CS 2413 Systems Programming
CS 2514 Computer Organization I
CS 2734 Computer Organization II
CS 3233 Discrete Mathematical Structures
CS 3343 Analysis of Algorithms
CS 3723 Programming Languages
CS 3733 Operating Systems
CS 3773 Software Engineering
CS 4753 Computer Architecture
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
PHY 1904 Technical Physics I
PHY 1911 Technical Physics I Laboratory
PHY 1924 Technical Physics II

B. 18 semester credit hours of upper-division computer science courses (not including CS 3133 or 4103)

C. 7 semester credit hours of free electives

**Minor in Computer Science**

All students pursuing the Minor in Computer Science must complete 21 semester credit hours.

A. 18 semester credit hours of required courses:

CS 1713, 1711 Introduction to Computer Science and Recitation
CS 1723, 1721 Data Structures and Recitation
CS 2213 Advanced Programming
CS 2413 Systems Programming
CS 2514 Computer Organization I

B. 3 semester credit hours of approved upper-division computer science electives

To declare a Minor in Computer Science, obtain advice, or seek approval of substitutions for course requirements, students should consult the Undergraduate Advisor of Record in the Division of Computer Science.

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*The student who is not prepared to begin MAT 1214 must take MAT 1093 Precalculus.*

UTSA 1999–2000 Undergraduate Catalog
COURSE DESCRIPTIONS
COMPUTER SCIENCE
(CS)

1023 Cultural Implications of the Information Society
(3-0) 3 hours credit.
This course offers an examination of the modern information society and the influences of technological advances on society and culture. The emphasis is on information and its management from ethical, social, and legal perspectives. Students will make extensive use of the World Wide Web. [TCCN: COSC 1301.]

1033 Microcomputer Applications
(3-0) 3 hours credit.
Study of the uses of the computer and the organization and visualization of data. Topics will be selected from library searching, networking, e-mail, spreadsheets, databases, authoring packages, multimedia and hypertext applications, presentation graphics, and legal/ethical issues. May not be applied toward a major in computer science. (Formerly CS 2083. Credit cannot be earned for both CS 2083 and CS 1033.)

1063 Introduction to Computer Programming
(3-0) 3 hours credit. Prerequisite: MAT 1023 or the equivalent.
A course in computer programming for those who have never programmed a computer before, developing elementary programming skills using a modern computer language such as Java.

1073 Introductory Computer Programming for Scientific Applications
(3-0) 3 hours credit. Prerequisite: MAT 1023.
Introductory programming. Sorting and ranking, plotting, numerical taxonomy, solution of nonlinear equations, linear regression, and solution of linear systems. May not be applied toward a major in computer science.

1711 Introduction to Computer Science Recitation
(1-0) 1 hour credit. Prerequisite: MAT 1093. Concurrent enrollment in CS 1713 is required.
Recitation to accompany CS 1713.

1713 Introduction to Computer Science
(3-0) 3 hours credit. Prerequisite: MAT 1093 and either CS 1063 or previous programming experience, or concurrent enrollment in CS 1063. Concurrent enrollment in CS 1711 is required.
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. (Formerly CS 1714. Credit cannot be earned for both CS 1714 and CS 1713.)

1721 Data Structures Recitation
(1-0) 1 hour credit. Prerequisites: CS 1713 and MAT 1214. Concurrent enrollment in CS 1723 is required.
Recitation to accompany CS 1723.
1723 **Data Structures**  
(3-0) 3 hours credit. Prerequisites: CS 1713 and MAT 1214. Concurrent enrollment in CS 1721 is required. Abstract data structures (stacks, queues, lists, trees). Dynamic memory allocation, pointers, and recursion, sorting, and searching. (Formerly CS 1724. Credit cannot be earned for both CS 1724 and CS 1723.)

2073 **Computer Programming with Engineering Applications**  
(3-0) 3 hours credit. Prerequisites: MAT 1214 and completion of or concurrent enrollment in 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 toward a major in computer science.

2213 **Advanced Programming**  
(3-0) 3 hours credit. Prerequisite: CS 1723. Advanced programming techniques in a specific programming language.

2413 **Systems Programming**  
(3-0) 3 hours credit. Prerequisite: CS 2213. A study of systems-level programming in a specific system (at present, Unix).

2514 **Computer Organization I**  
(3-2) 4 hours credit. Prerequisite: CS 1713. Introduction to theoretical concepts of digital logic design.

2734 **Computer Organization II**  
(3-2) 4 hours credit. Prerequisite: CS 1723 and CS 2514. Assembly language programming and computer organization. (Formerly CS 2733. Credit cannot be earned for both CS 2734 and CS 2733.)

3133 **Computers and Society**  
(3-0) 3 hours credit. Prerequisite: Consent of instructor or one of the following courses: CS 1033, 1063, 1073, 1713, or 2073. 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 1223. Survey and development of theoretical tools suitable for describing algorithmic applications. Propositional and predicate calculus, induction, proofs, set theory, and finite state automata.

3323 **Topics in Programming Languages**  
(3-0) 3 hours credit. Prerequisite: CS 2413. Study of two or three languages important to the computer science curriculum. (Formerly CS 3321. Credit cannot be earned for both CS 3323 and CS 3321.)
3343 Analysis of Algorithms
(3-0) 3 hours credit. Prerequisites: CS 2413, 3233, and MAT 2213.
Analysis of the performance of algorithms; discussion of programming
techniques and data structures used in the writing of effective algorithms.
(Formerly CS 4323. Credit cannot be earned for both CS 3343 and CS 4323.)

3413 Data Communications
(3-0) 3 hours credit. Prerequisite: CS 2734 or consent of 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 2213 and 3233.
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 2734, 2413, and 3233.
An introduction to the functions and major techniques of a modern
multiprogramming 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 2413 and 3233.
Study of systems for management of large amounts of related data. Basic
concepts, implementation approaches, user data models, and commercially
available systems.

3773 Software Engineering
(3-0) 3 hours credit. Prerequisite: CS 3343.
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. Prerequisite: CS 3343.
Discussion of theorem-proving by machine; includes 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 databases, networks,
artificial intelligence, and computer security. Legal issues are also covered.
4313 Automata, Computability, and Formal Languages
(3-0) 3 hours credit. Prerequisite: CS 3343.
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.

4383 Computer Graphics
(3-0) 3 hours credit. Prerequisites: CS 3343 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.

4393 Topics in User Interfaces
(3-0) 3 hours credit. Prerequisite: CS 3323.
Study of advanced user interface issues. Topics will be selected from user
interface design, human factors, window systems and toolkits, GUI
programming models, and input devices, psychological aspects of human-
computer interaction, and the psychology of computer users.

4633 Simulation
(3-0) 3 hours credit. Prerequisites: CS 3233, STA 3513, and STA 3523.
Design, execution and analysis of simulation models, discrete event
simulation techniques, input and output analysis, random numbers, and
simulation tools and languages.

4713 Compiler Writing
(3-0) 3 hours credit. Prerequisites: CS 2734 and 3343.
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. Prerequisites: CS 2734 and CS 3733.
Instruction set architecture, datapath and control unit design, advanced
computer arithmetic, pipelining, memory hierarchy and I/O subsystem,
performance issues.

4763 Multimedia Systems
(3-0) 3 hours credit. Prerequisite: CS 3733.
Multimedia hardware capabilities. Sound and video generation and editing.
Multimedia applications development and toolkits. Analysis of operational
characteristics of multimedia systems.

4773 Object-Oriented Systems
(3-0) 3 hours credit. Prerequisite: CS 3773.
Study of object-oriented concepts and techniques, encapsulation, inheritance
mechanisms, polymorphism, and programming in one or more object-
oriented languages.
4793 **Introduction to Artificial Neural Networks**
(3-0) 3 hours credit. Prerequisite: CS 3793.
Analysis of biological nervous systems, supervised and unsupervised training algorithms, Perceptrons and threshold logic-based systems, associative memories, nonlinear regression, and backpropagation learning methods.

4823 **Introduction to Parallel Programming**
(3-0) 3 hours credit. Prerequisites: CS 3343 and CS 3733.
Parallel programming concepts (partitioning, synchronization and communication, programming models—shared memory based and message based), programming tools and languages, performance issues.

4873 **Computer Networks**
(3-0) 3 hours credit. Prerequisites: CS 3733 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 in computer science program or consent of instructor.
Scheduled and impromptu presentations on subjects of interest given by division faculty and visiting lecturers. May be repeated for credit, but no more than 3 semester credit hours will apply toward the major in computer science.

4913 **Independent Study**
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. For students desiring specialized work. May be repeated for credit, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree.

4953 **Special Studies in Computer Science**
(3-0) 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 may be repeated for credit when topics vary, but not more than 6 semester credit 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 their last two semesters; approval by the College Honors Committee.
Supervised research and preparation of an honors thesis. May be repeated one time with approval.
The degree programs offered by the Division of Earth and Physical Sciences 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 basic science curriculum allows students to apply for entry into one of several highly specialized areas in chemistry, geology, or physics. Students who have majored in any of these degree programs are eligible to apply for positions in industry and government as well as for entry into professional and graduate schools. The degree in multidisciplinary science gives students broad training in the sciences and is suitable as a preparation to teach science at the secondary school level. The division also offers Minors in Chemistry, Geology, and Physics.

**Bachelor of Science Degree in Multidisciplinary Science**

The Bachelor of Science degree in Multidisciplinary Science is primarily for students preparing to teach science at the secondary school level.

The minimum number of semester credit hours required for this degree, including the Core Curriculum requirements, is 132.

A. **45 or 47 semester credit hours of required science courses:**

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<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>AST 1013, 1031</td>
<td></td>
<td>Introduction to Astronomy and Laboratory**</td>
</tr>
<tr>
<td>BIO 1203, 1212</td>
<td></td>
<td>Biology I and Laboratory Investigations in Biology**</td>
</tr>
<tr>
<td>BIO 2123</td>
<td></td>
<td>Comparative Anatomy of Vertebrates</td>
</tr>
<tr>
<td>CHE 1103, 1122</td>
<td></td>
<td>General Chemistry and Laboratory Workshop**</td>
</tr>
<tr>
<td>CHE 1303</td>
<td></td>
<td>Chemical Principles**</td>
</tr>
<tr>
<td>CHE 1312</td>
<td></td>
<td>Inorganic Qualitative and Quantitative Analysis</td>
</tr>
<tr>
<td>GEO 1103, 1111</td>
<td></td>
<td>Introduction to Earth Systems and Laboratory**</td>
</tr>
<tr>
<td>GEO 1123, 1131</td>
<td></td>
<td>Earth History and Laboratory**</td>
</tr>
<tr>
<td>GEO 4113, 4121</td>
<td></td>
<td>Geomorphology and Laboratory</td>
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<tr>
<td>GRG 3713</td>
<td></td>
<td>Weather and Climate</td>
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</tbody>
</table>

**Either**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHY 1603, 1611</td>
<td></td>
<td>General Physics I and Laboratory**</td>
</tr>
<tr>
<td>PHY 1623, 1631</td>
<td></td>
<td>General Physics II and Laboratory**</td>
</tr>
<tr>
<td>or PHY 1904, 1911</td>
<td></td>
<td>Technical Physics I and Laboratory**</td>
</tr>
<tr>
<td>PHY 1924, 1931</td>
<td></td>
<td>Technical Physics II and Laboratory**</td>
</tr>
</tbody>
</table>

B. **29 semester credit hours of approved electives in biology, chemistry, physics, geology, and/or mathematics; 15 of these hours must be at the upper-division level**

C. **6 semester credit hours in computer science and mathematics:**

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*Students seeking teacher certification should contact the Office of Teacher Advising, Certification, and Placement early in their studies for information about certificate requirements and admission procedures. Undergraduates seeking elementary teacher certification must complete the interdisciplinary studies degree.** May be used to satisfy the Core Curriculum requirement in Domain IB.
MAT 1093 Precalculus (or above)*

CS 1073 Introductory Computer Programming for Scientific Applications
or

CS 1033 Microcomputer Applications

D. 19 to 24 semester credit hours of electives, as set forth below:

1. For students seeking the degree only (without teacher certification), at least 19 semester credit hours of electives are required, including a sufficient number of upper-division hours to meet UTSA's minimum of 39 upper-division hours

2. For students seeking the degree with teacher certification, these electives must include

   IDS 3003 Science and Humanity
   21 semester credit hours of professional education courses

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, and medical technology, and for graduate study in chemistry or other related fields.

The minimum number of semester credit hours required for this degree, including the Core Curriculum requirements, is 124. All major and support work courses must be completed with a grade of "C" or better.

A. 53 semester credit hours of required courses in chemistry:

   CHE 1103 General 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 3264 Descriptive Inorganic Chemistry
   CHE 4103 Instrumental Analysis
   CHE 4243 Organic Chemistry III
   CHE 4253 Physical Chemistry III
   CHE 4263 Inorganic Chemistry

*May be used to satisfy the Core Curriculum requirement in Domain IA.
**May be used to satisfy the Core Curriculum requirement in Domain IB.
B. 6 additional semester credit hours of approved upper-division chemistry electives, 3 hours of which must be an organized course in chemistry, at the senior level or above; no more than 3 semester credit hours may be from CHE 4913 Independent Study or CHE 4923 Special Project in Chemistry

C. 23 semester credit hours of support work in science and mathematics:

1. 20 or 21 semester credit hours of required courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>MAT 1214</td>
<td>Calculus I*</td>
</tr>
<tr>
<td>MAT 1223</td>
<td>Calculus II</td>
</tr>
<tr>
<td>MAT 2213</td>
<td>Calculus III</td>
</tr>
<tr>
<td>CS 1723, 1721</td>
<td>Data Structures and Recitation</td>
</tr>
<tr>
<td>PHY 1904, 1911</td>
<td>Technical Physics I and Laboratory**</td>
</tr>
<tr>
<td>PHY 1924, 1931</td>
<td>Technical Physics II and Laboratory**</td>
</tr>
</tbody>
</table>

2. 3 additional semester credit hours of elective work from the College of Sciences and Engineering, as approved by the advisor

D. 3 semester credit hours in computer science:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS 1033</td>
<td>Microcomputer Applications</td>
</tr>
</tbody>
</table>

E. 6 semester credit hours of electives

**Bachelor of Arts Degree in Chemistry**

The Bachelor of Arts degree in Chemistry is a less comprehensive degree than the Bachelor of Science degree in Chemistry. It provides opportunities for preparation for careers in industry, government agencies, environmental studies, and preprofessional programs. It is not recommended for students planning to pursue graduate studies in chemistry or related fields. It does not meet the criteria for an American Chemical Society-approved degree in chemistry.

The minimum number of semester credit hours required for this degree, including the Core Curriculum requirements, is 121. All major and support work courses must be completed with a grade of "C" or better.

All candidates for the degree must complete the following:

A. 37 semester credit hours of required courses in chemistry:

*May be used to satisfy the Core Curriculum requirement in Domain IA.
**May be used to satisfy the Core Curriculum requirement in Domain IB.

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CHE 1103 General 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 3124 Basic Physical Chemistry
CHE 3212 Physical Chemistry Laboratory
CHE 3264 Descriptive Inorganic Chemistry
CHE 4103 Instrumental Analysis
CHE 4971 Proseminar

B. 12 additional semester credit hours of approved upper-division chemistry electives; no more than 6 semester credit hours may be from CHE 4913 Independent Study or CHE 4923 Special Project in Chemistry

C. 27 to 29 semester credit hours of support work in science and mathematics:

1. 18 to 20 semester credit hours of required courses:
   
   MAT 1214 Calculus I**
   MAT 1223 Calculus II

   Either
   PHY 1603, 1611 General Physics I and Laboratory*
   PHY 1623, 1631 General Physics II and Laboratory*
   or
   PHY 1904, 1911 Technical Physics I and Laboratory*
   PHY 1924, 1931 Technical Physics II and Laboratory*

   CS 1033 Microcomputer Applications

2. 9 additional semester credit hours of approved electives from the College of Sciences and Engineering; up to 6 semester credit hours may be outside the college (9 hours for students seeking teacher certification) with approval of the advisor

D. 12 semester credit hours of electives

**Minor in Chemistry**

The purpose of this program is to permit students majoring in other areas to obtain a solid, broad-based knowledge of chemistry. The program is applicable to those students in other areas of science and in preprofessional programs. All coursework for the Minor in Chemistry must be completed with a grade of "C" or better.

22 semester credit hours are required for this minor:

*May be used to satisfy the Core Curriculum requirement in Domain IB.
**May be used to satisfy the Core Curriculum requirement in Domain IA.

UTSA 1999–2000 Undergraduate Catalog
CHE 1303 Chemical Principles
CHE 1312 Inorganic Qualitative and Quantitative Analysis
CHE 2203 Organic Chemistry I
CHE 2242 Organic Chemistry I Laboratory
CHE 2303 Organic Chemistry II
CHE 2342 Organic Chemistry II Laboratory
CHE 3103 Analytical Chemistry
CHE 3264 Descriptive Inorganic Chemistry

To declare a Minor in Chemistry, obtain advice, or seek approval of substitutions for course requirements, students should consult the Undergraduate Advisor of Record in the Division of Earth and Physical Sciences.

COURSE DESCRIPTIONS
CHEMISTRY
(CHE)

1003 Chemistry for Allied Health Sciences
(3-0) 3 hours credit.
Introduction to atomic structure, chemical bonding, stoichiometry, states of matter, inorganic chemical reactions, and acids and bases. For majors in occupational therapy, prenursing, and dental hygiene. May not be applied to a major in chemistry, biology, or clinical laboratory sciences. Concurrent enrollment in CHE 1011 is recommended. [TCCN: CREM 1305.]

1011 Chemistry Laboratory for Allied Health Sciences
(1-4) 1 hour credit. Prerequisite: Completion of or concurrent enrollment in CHE 1003.
Introduction to chemical laboratory techniques. For majors in occupational therapy, prenursing, and dental hygiene. May not be applied to a major in chemistry, biology, or clinical laboratory sciences. [TCCN: CHEM 1105.]

1053 Chemistry of Ordinary Things
(3-0) 3 hours credit.
An introduction to the fundamental concepts of chemistry and the study of the chemistry of life and the everyday world. For nonscience majors. May not be applied to a major in the natural sciences, engineering, or allied health sciences.

1073 Basic Chemistry
(3-0) 3 hours credit.
A one-semester preparatory course covering some basic concepts of inorganic chemistry, atomic-molecular structure, and related mathematics. May not be applied to a B.S. or B.A. in Chemistry. May apply toward the Level I Core Curriculum requirement in science. May not be applied to a B.S. or B.A. in Chemistry.
1103 General Chemistry
(3-0) 3 hours credit. Prerequisites: Passing grade on Chemistry Placement Exam or grade of "C" or better in CHE 1073, and completion of or concurrent enrollment in MAT 1023.
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. Concurrent enrollment in CHE 1122 is recommended. May apply toward the Level II Core Curriculum requirement in science. [TCCN: CREM 1311.]

1122 General Chemistry Laboratory Workshop
(1-5) 2 hours credit. Prerequisite: Completion of or concurrent enrollment in 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.
A survey of the structures and reactions of some important functional groups of organic chemistry, and the relationship of these functional groups to the chemistry of lipids, carbohydrates, nucleic acids, and proteins. May not be applied to a major in chemistry. Concurrent enrollment in CHE 1211 is recommended. (Formerly CHE 2103. Credit cannot be earned for both CHE 1203 and CHE 2103.) [TCCN: CREM 1307.]

1211 Organic and Biochemistry Laboratory
(1-4) 1 hour credit. Prerequisite: Completion of or concurrent enrollment in CHE 1203.
Laboratory examination of the properties of some simple organic and biological chemicals; topics include solubility, crystallization, organic reactions, titration, enzyme action, sugars, and vitamins. May not be applied to a major in chemistry. [TCCN: CHEM 1107.]

1303 Chemical Principles
(3-0) 3 hours credit. Prerequisite: At least a "C" in CHE 1103 or an equivalent.
A continuation of CHE 1103. Elementary inorganic and physical chemistry; topics include solutions, electrolytes, oxidation-reduction reactions, reaction trends, coordination chemistry, basic thermodynamics, chemical kinetics, and electrochemistry. Primarily for science majors. May apply toward Level II Core Curriculum requirement in science. [TCCN: CHEM 1312.]

1312 Inorganic Qualitative and Quantitative Analysis
(1-5) 2 hours credit. Prerequisite: Completion of or concurrent enrollment in CHE 1303.
Techniques of qualitative and quantitative chemical analysis, illustrated primarily via inorganic chemical systems and their reactions. Laboratory to accompany CHE 1303. [TCCN: CHEM 1112.]
2203 Organic Chemistry I
(3-0) 3 hours credit. Prerequisites: CHE 1303 and 1312.
An elementary study of structure, stereochemistry, reactions, and reaction
mechanisms associated with organic compounds. Primarily for chemistry,
premed, and science majors. Concurrent enrollment in CHE 2242 and 2251
is recommended. [TCCN: CHEM 2323.]

2242 Organic Chemistry I Laboratory
(1-5) 2 hours credit. Prerequisite: Completion of or concurrent enrollment
in CHE 2203.
The first of two semesters of organic chemistry laboratory. 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. [TCCN: CHEM
2223.]

2251 Organic Chemistry I Recitation
(0-2) 1 hour credit. Prerequisite: Concurrent enrollment in 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. Prerequisites: CHE 2203 and completion of or concurrent
enrollment in CHE 2242.
Continuing study of fundamentals of structure, reactions, and reaction
mechanisms of phosphorus and sulphur; polyfunctional organic compounds.
A continuation of CHE 2203. (Formerly CHE 3003. Credit cannot be earned
for both CHE 2303 and CHE 3003.) [TCCN: CHEM 2325.]

2342 Organic Chemistry II Laboratory
(1-5) 2 hours credit. Prerequisites: CHE 2242 and completion of or concurrent
enrollment in CHE 2303.
Quantitative and continuing qualitative study of organic reactions and
molecular structure through functional group interactions and spectroscopic
techniques. Simple and multistep syntheses of organic compounds. A
continuation of CHE 2242. (Formerly CHE 3022. Credit cannot be earned
for both CHE 2342 and CHE 3022.) [TCCN: CHEM 2225.]

2351 Organic Chemistry II Recitation
(0-2) 1 hour credit. Prerequisite: Concurrent enrollment in 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, CHE 1312, and CS 1063.
A detailed study of wet chemical and basic instrumental analysis, including
gravimetric, volumetric, and spectrophotometric determinations.
3124  **Basic Physical Chemistry**  
(3-2) 4 hours credit. Prerequisites: CHE 1303, CHE 1312, MAT 1214, and either PHY 1623 and 1611 or 1924 and 1911.  
A one-semester course covering some basic concepts of thermodynamics, chemical equilibria, kinetics, spectroscopy, and related topics. May not be applied to a B.S. in Chemistry.

3204  **Physical Chemistry I**  
(4-0) 4 hours credit. Prerequisites: CHE 1303, CHE 1312, MAT 1223, and PHY 1924 and 1931; completion of two semesters of organic chemistry is strongly recommended.  
States of matter, gas laws, equations of state, and intermolecular 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: CHE 3124 or 3224.  
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 photochemistry. A continuation of CHE 3204.

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.

4103  **Instrumental Analysis**  
(1-6) 3 hours credit. Prerequisites: CHE 2342, CHE 3103, and completion of or concurrent enrollment in CHE 3124 or 3224.  
Electrochemical methods; use of modern spectrometric and chromatographic instrumentation in separation, purification, and/or quantitative characterization of chemical systems. (Formerly CHE 3243. Credit cannot be earned for both CHE 4103 and CHE 3243.)

4203  **Introduction to Polymer Chemistry**  
(3-0) 3 hours credit. Prerequisite: CHE 2303, 3224, or consent of instructor.  
Fundamental concepts of polymer chemistry, including mechanisms for synthesis, kinetics, and copolymerization; molecular weight, stereoisomerism, morphology, solubility, and thermal transitions; visco- and rubber elasticity; and the molecular basis for physical properties.
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 and organic molecular orbital theory and its application to pericyclic reactions.

4253  Physical Chemistry III  
(3-0) 3 hours credit. Prerequisites: CHE 2303 and 3224 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.

4363  NMR Spectroscopy  
(3-0) 3 hours credit. Prerequisite: PHY 1924, completion of or concurrent enrollment in CHE 3224, or consent of instructor. 
A lecture course with demonstrations dealing with the basic theory and applications of one- and two-dimensional nuclear magnetic resonance spectroscopy, including the interpretation of spectra. The parameters and pulse sequences for various types of NMR experiments and explanations of how molecular structural information can be obtained will be presented.

4373  Organic Spectral Studies  
(3-0) 3 hours credit. Prerequisite: 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.

4383  Introduction to Mass Spectrometry  
(3-0) 3 hours credit. Prerequisite: CHE 3224, 4373, or consent of instructor. 
The basic principles of interpreting mass spectra and how they are produced. The effect the method of ion production has on the observed mass spectra, and the theory and operation of various types of mass spectrometers will be covered. The basic theory of ion-molecule reactions and other advanced topics will be presented.

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- and six-membered ring systems with one or more heteroatoms. Applications in the field of synthetic drugs.
4603 Synthesis and Biosynthesis of Natural Products
(3-0) 3 hours credit. Prerequisites: CHE 4373 and 4243, 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 to 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 this course is offered.
Independent reading, research, discussion, and/or writing under the direction of a faculty member. For students desiring specialized work. May be repeated for credit, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree.

4923 Special Project in Chemistry
3 hours credit. Prerequisite: Consent of Division Director (form available in division office).
A special laboratory research or library readings project under the direction of a faculty member that results in a report. Limited to science majors in their final year of undergraduate study.

4953 Special Studies in Chemistry
(3-0) 3 hours credit. Prerequisites: 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 may be repeated for credit when the topics vary, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree.

4971 Proseminar
(0-3) 1 hour credit. Prerequisites: CHE 2303 and either 3204 or 3124.
Oral reports on current publications in chemistry and chemical technology using important chemical reference materials and periodicals. May be repeated for credit, but only 2 semester credit hours may be applied toward the degree.

4993 Honors Research
3 hours credit. Prerequisites: 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 only once with approval.

Bachelor of Science Degree in Geology

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

The minimum number of semester credit hours required for this degree, including the Core Curriculum requirements, is 123.

All candidates for the degree must complete the following:

A. 52 semester credit hours in geology completed with a grade of "C" or better:

1. 39 semester credit hours of required courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEO 1103, 1111</td>
<td>Introduction to Earth Systems and Laboratory*</td>
</tr>
<tr>
<td>GEO 1123, 1131</td>
<td>Earth History and Laboratory*</td>
</tr>
<tr>
<td>GEO 2003, 2011</td>
<td>Mineralogy and Laboratory</td>
</tr>
<tr>
<td>GEO 2023, 2031</td>
<td>Optical Mineralogy and Laboratory</td>
</tr>
<tr>
<td>GEO 3043, 3052</td>
<td>Petrology and Laboratory</td>
</tr>
<tr>
<td>GEO 3063, 3071</td>
<td>Paleontology and Laboratory</td>
</tr>
<tr>
<td>GEO 3103, 3111</td>
<td>Structural Geology and Laboratory</td>
</tr>
<tr>
<td>GEO 3123, 3131</td>
<td>Sedimentary Geology and Laboratory</td>
</tr>
<tr>
<td>GEO 4946</td>
<td>Field Geology</td>
</tr>
</tbody>
</table>

2. 13 additional semester credit hours selected from the following (a maximum of 3 hours of GEO 4911-3 or 4951-3 may apply to this requirement):

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEO 3083, 3091</td>
<td>Stratigraphy and Laboratory</td>
</tr>
<tr>
<td>GEO 3113</td>
<td>Geologic Field Investigations</td>
</tr>
<tr>
<td>GEO 3143, 3151</td>
<td>Economic Geology and Laboratory</td>
</tr>
<tr>
<td>GEO 3163</td>
<td>Oceanography</td>
</tr>
<tr>
<td>GEO 3374</td>
<td>Geochemistry</td>
</tr>
<tr>
<td>GEO 3383</td>
<td>General Geophysics</td>
</tr>
<tr>
<td>GEO 4023</td>
<td>Engineering Geology</td>
</tr>
<tr>
<td>GEO 4063</td>
<td>Principles of Environmental Geology</td>
</tr>
<tr>
<td>GEO 4113, 4121</td>
<td>Geomorphology and Laboratory</td>
</tr>
<tr>
<td>GEO 4623</td>
<td>Ground-Water Hydrology</td>
</tr>
<tr>
<td>GEO 4803</td>
<td>X-Ray Crystallography</td>
</tr>
<tr>
<td>GEO 4911-3</td>
<td>Independent Study</td>
</tr>
<tr>
<td>GEO 4951-3</td>
<td>Special Studies in Geology</td>
</tr>
<tr>
<td>GEO 4993</td>
<td>Honors Research</td>
</tr>
</tbody>
</table>

B. 26 to 29 required semester credit hours in the College of Sciences and Engineering:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE 1103</td>
<td>General Chemistry*</td>
</tr>
<tr>
<td>CHE 1303</td>
<td>Chemical Principles*</td>
</tr>
<tr>
<td>CHE 1312</td>
<td>Inorganic Qualitative and Quantitative Analysis</td>
</tr>
</tbody>
</table>
   | CS 1073     | Introductory Computer Programming for Scientific Applications or
   | CS 1713, 1711 | Introduction to Computer Science and Recitation |
   | MAT 1214    | Calculus I**                               |
   | MAT 1223    | Calculus II**                              |

*May be used to satisfy the Core Curriculum requirement in Domain IB.
**May be used to satisfy the Core Curriculum requirement in Domain IA.
Either
PHY 1904, 1911 Technical Physics I and Laboratory
PHY 1924, 1931 Technical Physics II and Laboratory
or
PHY 1603, 1611 General Physics I and Laboratory
PHY 1623, 1631 General Physics II and Laboratory

C. 12 semester credit hours of electives

Bachelor of Arts Degree in Geology

The Bachelor of Arts degree in Geology provides opportunities to prepare for careers in fields such as law, insurance, financial services, and environmental management. It is not recommended for students planning to pursue graduate studies in geology or related fields.

The minimum number of semester credit hours required for this degree, including the Core Curriculum requirements, is 120.

All candidates for the degree must complete the following:

A. 40 semester credit hours of geology:

1. 32 semester credit hours of required courses:

   GEO 1103, 1111 Introduction to Earth Systems and Laboratory
   GEO 1123, 1131 Earth History and Laboratory
   GEO 2003, 2011 Mineralogy and Laboratory
   GEO 2023, 2031 Optical Mineralogy and Laboratory
   GEO 3043, 3052 Petrology and Laboratory
   GEO 3063, 3071 Paleontology and Laboratory
   GEO 3113 Geologic Field Investigations
   GEO 4113, 4121 Geomorphology and Laboratory

2. 8 additional semester credit hours selected from the following (a maximum of 3 hours from either GEO 4911-3 or 4953 may apply to this requirement):

   GEO 3083, 3091 Stratigraphy and Laboratory
   GEO 3103, 3111 Structural Geology and Laboratory
   GEO 3123, 3131 Sedimentary Geology and Laboratory
   GEO 3143, 3151 Economic Geology and Laboratory
   GEO 3163 Oceanography
   GEO 3374 Geochemistry
   GEO 3383 General Geophysics
   GEO 4023 Engineering Geology
   GEO 4063 Principles of Environmental Geology
   GEO 4623 Ground-Water Hydrology
   GEO 4803 X-Ray Crystallography
   GEO 4911-3 Independent Study
   GEO 4951-3 Special Studies in Geology
   GEO 4993 Honors Research

*May be used to satisfy the Core Curriculum requirement in Domain IB.

UTSA 1999–2000 Undergraduate Catalog
B. 23 to 24 semester credit hours in the College of Sciences and Engineering:

- **CHE 1103** General Chemistry*
- **CHE 1303** Chemical Principles*
- **CHE 1312** Inorganic Qualitative and Quantitative Analysis
- **CS 1073** Introductory Computer Programming for Scientific Applications
- **CS 1713, 1711** Introduction to Computer Science and Recitation
- **MAT 1214** Calculus I**
- **PHY 1603, 1611** General Physics I and Laboratory*
- **PHY 1623, 1631** General Physics II and Laboratory*

C. 24 semester credit hours of electives

**Minor in Geology**

All students pursuing the Minor in Geology must complete 22 semester credit hours.

A. 16 semester credit hours of required courses:

- **GEO 1103, 1111** Introduction to Earth Systems and Laboratory
- **GEO 1123, 1131** Earth History and Laboratory
- **GEO 3203, 3211** Introduction to Rocks and Minerals
- **GEO 3303, 3311** Introduction to Paleontology and Laboratory

B. 6 semester credit hours of approved upper-division geology electives

To declare a Minor in Geology, obtain advice, or seek approval of substitutions for course requirements, students should consult the Undergraduate Advisor of Record in the Division of Earth and Physical Sciences.

**COURSE DESCRIPTIONS**

**GEOLOGY**

(GEO)

**1013 The Third Planet**

(3-0) 3 hours credit.
Evolution of ideas concerning the earth's origin, structure, and age; social impact of recognizing the antiquity of the planet and humankind's brief presence; examination of how the distribution of planetary resources influenced the rise and clash of civilizations. May not be applied to a major in geology. May apply toward the Level I Core Curriculum requirement in science. [TCCN: GEOL 1301.]

**1103 Introduction to Earth Systems**

(3-0) 3 hours credit. Prerequisite: Successful completion the following Core Curriculum requirement: MAT 1023 or above.

*May be used to satisfy the Core Curriculum requirement in Domain IB.
**May be used to satisfy the Core Curriculum requirement in Domain IA.
The earth as a dynamic planet; relation of the earth’s present processes to its resources, structure, and internal composition. Nature of minerals and rocks, the hydrosphere, tectonics, earthquakes, volcanism, and surface features of the earth. Concurrent enrollment in GEO 1111 recommended. May apply toward the Level II Core Curriculum requirement in science. (Formerly GEO 1003. Credit cannot be earned for both GEO 1103 and GEO 1003.) [TCCN: GEOL 1303.]

1111 **Introduction to Earth Systems Laboratory**

(0-3) 1 hour credit. Prerequisite: Completion of or concurrent enrollment in GEO 1103.

Relation of the earth’s present processes to its resources, structure, and internal composition. Field trips and laboratory study of minerals, rocks, maps, and aerial and satellite photos. (Formerly GEO 1011. Credit cannot be earned for both GEO 1111 and GEO 1011.) [TCCN: GEOL 1103.]

1123 **Earth History**

(3-0) 3 hours credit. Prerequisite: Successful completion the following Core Curriculum requirement: MAT 1023 or above.

Formation and evolution of the earth, its life forms, and the major features of its surface. Concurrent enrollment in GEO 1131 recommended. May apply toward the Level II Core Curriculum requirement in science. (Formerly GEO 1023. Credit cannot be earned for both GEO 1123 and GEO 1023.) [TCCN: GEOL 1304.]

1131 **Earth History Laboratory**

(0-3) 1 hour credit. Prerequisite: Completion of or concurrent enrollment in GEO 1123.

Laboratory study of fossils and rock sequences; interpretation of earth history. (Formerly GEO 1031. Credit cannot be earned for both GEO 1131 and GEO 1031.) [TCCN: GEOL 1104.]

2003 **Mineralogy**

(3-0) 3 hours credit. Prerequisites: CHE 1103, GEO 1103, GEO 1111, MAT 1093, or consent of instructor; concurrent enrollment in GEO 2011.

Crystallography, chemistry, physical properties, and origins of minerals. Field trips required.

2011 **Mineralogy Laboratory**

(0-3) 1 hour credit. Prerequisite: Concurrent enrollment in GEO 2003.

Laboratory study of crystal models, crystals, and minerals. Field trips required.

2023 **Optical Mineralogy**

(3-0) 3 hours credit. Prerequisites: GEO 2003, 2011, and concurrent enrollment in GEO 2031.

Principles and methods of optical mineralogy. Optical properties of minerals and microscopic determination of opaque and nonopaque minerals.

2031 **Optical Mineralogy Laboratory**

(0-3) 1 hour credit. Prerequisites: GEO 2003, 2011, and concurrent enrollment in GEO 2023.

Use of the petrographic microscope for the identification of minerals.
3043 Petrology
(3-0) 3 hours credit. Prerequisites: GEO 2023, 2031, and concurrent enrollment in 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, 2031, and concurrent enrollment in GEO 3043.
Laboratory study of rocks in hand specimen and thin section. Field trips required.

3063 Paleontology
(3-0) 3 hours credit. Prerequisites: GEO 1103, 1111, 1123, 1131, or consent of instructor; concurrent enrollment in 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 1103, 1111, 1123, 1131, and concurrent enrollment in GEO 3063.
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, 3071, 3123, and 3131, or consent of instructor; concurrent enrollment in GEO 3091.
Application of stratigraphic principles to the interpretation of rocks formed at or near the surface of the earth. Field trips required.

3091 Stratigraphy Laboratory
(0-3) 1 hour credit. Prerequisite: Concurrent enrollment in GEO 3083.
Laboratory study of stratigraphic methods using maps, measured sections, geologic and stratigraphic cross-sections, air photos, seismic data, modeling techniques, systems analysis, and various aspects of sequence stratigraphic analysis. Field trips required.

3103 Structural Geology
(3-0) 3 hours credit. Prerequisites: GEO 3043, 3052, and concurrent enrollment in 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. Prerequisite: Concurrent enrollment in GEO 3103.
Laboratory study of geologic structures using maps, cross-sections, photographs, and descriptive geometric and stereographic methods. Field trips required.
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 semester credit hours may be applied to a B.A. or B.S. in Geology. Concurrent enrollment in GEO 4946 is not permitted. Field trips required.

3123 **Sedimentary Geology**
(3-0) 3 hours credit. Prerequisite: Completion of or concurrent enrollment in GEO 3043 and 3052; concurrent enrollment in GEO 3131.
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: Completion of or concurrent enrollment in GEO 3043, 3052, and 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, GEO 2011, and 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. Prerequisite: 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. Field trips required.

3163 **Oceanography**
(3-0) 3 hours credit. Prerequisite: Consent of instructor.
General oceanography, with emphasis on marine geology and especially the continental margins. Field trips required.

3203 **Introduction to Rocks and Minerals**
(3-0) 3 hours credit. Prerequisite: GEO 1103, GEO 1111, CHE 1103, MAT 1023, or consent of instructor.
Description, classification, and origin of common rocks and minerals as well as gemstones and ores. Field trips required. May not be applied toward a B.S. in Geology.

3211 **Introduction to Rocks and Minerals Laboratory**
(0-3) 1 hour credit. Prerequisite: Concurrent enrollment in GEO 3203.
Laboratory study in hand specimens of common rocks, minerals, gemstones, and ores. May not be applied toward a B.S. in Geology. Field trips required.
3303 **Introduction to Paleontology**  
(3-0) 3 hours credit. Prerequisite: GEO 1103, GEO 1111, CHE 1103, MAT 1023, or consent of instructor.  
Description, taxonomy, paleoecology, and correlation techniques of special interests to geoscientists will be introduced. May not be applied toward a B.S. in Geology. Field trips required.

3311 **Introduction to Paleontology Laboratory**  
(0-3) 1 hour credit. Prerequisite: Concurrent enrollment in GEO 3303.  
Laboratory study in specimen characteristics, species analysis, collecting, and preservation techniques. May not be applied toward a B.S. in Geology. Field trips required.

3323 **Global Tectonism and Geologic Processes**  
(3-0) 3 hours credit. Prerequisites: GEO 1103, GEO 1111, and MAT 1023 or above.  
Global tectonism provides a framework for understanding the planet. The distribution of lithologies, mountains, volcanoes, earthquake, and resources is controlled by tectonism. The transfer of heat from the interior of the planet toward the surface provides the driving force for tectonism. Students may explore the evolution of our current global tectonic paradigm from continental drift to pale tectonics. May not be applied toward a B.S. in Geology.

3331 **Global Tectonism and Geologic Processes Laboratory**  
(0-3) 1 hour credit. Prerequisite: Concurrent enrollment in GEO 3323.  
Students will study the concepts that underlie global tectonism through the medium of hands-on activities specifically designed for adaptation and use in school classrooms. May not be applied toward a B.S. in Geology.

3374 **Geochemistry**  
(2-4) 4 hours credit. Prerequisite: CHE 1303 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.

4023 **Engineering Geology**  
(3-0) 3 hours credit. Prerequisite: PHY 1904, PHY 1603, 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 1103 and 1111.  
Geologic factors important to city and regional planning. Land capability studies; geologic hazards. Field trips required.
4113 **Geomorphology**  
(3-0) 3 hours credit. Prerequisites: GEO 1103, 1111, and concurrent enrollment in GEO 4121.  
Analysis of Cenozoic landform evolution. Field trips required.

4121 **Geomorphology Laboratory**  
(0-3) 1 hour credit. Prerequisites: GEO 1103, 1111, and concurrent enrollment in GEO 4113.  
Interpretation of maps and aerial photographs. Field trips required.

4623 **Ground-Water Hydrology**  
(3-0) 3 hours credit. Prerequisites: GEO 1103, GEO 1111, 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.

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 to 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. For students desiring specialized work. May be repeated for credit, but not more than 3 semester credit hours will apply to a bachelor’s degree in geology.

4946 **Field Geology**  
(6-12) 6 hours credit. Prerequisites: GEO 3103, 3111, and consent of instructor.  
Field mapping and measurements during a seven-week period in summer. (Formerly GEO 4947. Credit cannot be earned for both GEO 4946 and GEO 4947.)

4951-3 **Special Studies in Geology**  
(1,2,3-0) 1 to 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 may be repeated for credit when the topics vary, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor’s degree.

4993 **Honors Research**  
3 hours credit. Prerequisites: 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 only once with approval.
Bachelor of Science Degree in Physics

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

The minimum number of semester credit hours required for this degree, including the Core Curriculum requirements, is 121.

All candidates for the degree must complete the following:

A. 49 semester credit hours:

1. 40 semester credit hours of required courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
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<tbody>
<tr>
<td>PHY 1904</td>
<td>Technical Physics I and Laboratory</td>
</tr>
<tr>
<td>PHY 1911</td>
<td>Technical Physics II and Laboratory</td>
</tr>
<tr>
<td>PHY 1924</td>
<td>Modern Physics</td>
</tr>
<tr>
<td>PHY 1931</td>
<td>Computer Visualization of Physics</td>
</tr>
<tr>
<td>PHY 3203</td>
<td>Classical Mechanics I</td>
</tr>
<tr>
<td>PHY 3293</td>
<td>Statistical Thermodynamics</td>
</tr>
<tr>
<td>PHY 3343</td>
<td>Advanced Physics Laboratory I</td>
</tr>
<tr>
<td>PHY 3353</td>
<td>Advanced Physics Laboratory II</td>
</tr>
<tr>
<td>PHY 3423</td>
<td>Electricity and Magnetism</td>
</tr>
<tr>
<td>PHY 3443</td>
<td>Optics</td>
</tr>
<tr>
<td>PHY 3823</td>
<td>Mathematical Physics</td>
</tr>
<tr>
<td>PHY 4263</td>
<td>Quantum Mechanics I</td>
</tr>
</tbody>
</table>

2. 9 additional approved semester credit hours selected from the following (a maximum of 3 hours from either PHY 4911-3 or 4953 may apply to this requirement):

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
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<tbody>
<tr>
<td>PHY 3163</td>
<td>Theoretical Physics</td>
</tr>
<tr>
<td>PHY 3233</td>
<td>Environmental Physics</td>
</tr>
<tr>
<td>PHY 3313</td>
<td>Solid State Physics</td>
</tr>
<tr>
<td>PHY 3433</td>
<td>Introduction to the Theory of Solid State Electronics</td>
</tr>
<tr>
<td>PHY 3453</td>
<td>Lasers: Theory and Applications</td>
</tr>
<tr>
<td>PHY 4133</td>
<td>Numerical Methods for Physicists</td>
</tr>
<tr>
<td>PHY 4203</td>
<td>Classical Mechanics II</td>
</tr>
<tr>
<td>PHY 4423</td>
<td>Quantum Mechanics II</td>
</tr>
<tr>
<td>PHY 4553</td>
<td>Health Physics</td>
</tr>
<tr>
<td>PHY 4911-3</td>
<td>Independent Study</td>
</tr>
<tr>
<td>PHY 4953</td>
<td>Special Studies in Physics</td>
</tr>
<tr>
<td>PHY 4993</td>
<td>Honors Research</td>
</tr>
</tbody>
</table>

B. 39 semester credit hours required in the College of Sciences and Engineering:

1. 27 semester credit hours of required courses (excluding physics):

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE 1103</td>
<td>General Chemistry*</td>
</tr>
<tr>
<td>CHE 1303</td>
<td>Chemical Principles*</td>
</tr>
<tr>
<td>CHE 1312</td>
<td>Inorganic Qualitative and Quantitative Analysis</td>
</tr>
<tr>
<td>CS 1073</td>
<td>Introductory Computer Programming for Scientific Applications</td>
</tr>
</tbody>
</table>

*May be used to satisfy the Core Curriculum requirement in Domain 1B.
2. 12 additional approved semester credit hours in the College of Sciences and Engineering

B.A. in Physics

The Bachelor of Arts degree in Physics provides opportunities for careers in several professional fields. It is not recommended for students planning to pursue graduate studies in physics or related fields.

The minimum number of semester credit hours required for this degree, including the Core Curriculum requirements, is 121.

All candidates must complete the following:

A. 28 semester credit hours:

1. 25 semester credit hours of required courses:

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHY</td>
<td>1904, 1911 Technical Physics I and Laboratory**</td>
</tr>
<tr>
<td>PHY</td>
<td>1924, 1931 Technical Physics II and Laboratory**</td>
</tr>
<tr>
<td>PHY</td>
<td>3103 Modern Physics</td>
</tr>
<tr>
<td>PHY</td>
<td>3203 Classical Mechanics I</td>
</tr>
<tr>
<td>PHY</td>
<td>3343 Advanced Physics Laboratory I</td>
</tr>
<tr>
<td>PHY</td>
<td>3423 Electricity and Magnetism</td>
</tr>
<tr>
<td>PHY</td>
<td>4133 Numerical Methods for Physicists</td>
</tr>
</tbody>
</table>

2. 3 additional semester credit hours selected from the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHY</td>
<td>3143 Computer Visualization of Physics</td>
</tr>
<tr>
<td>PHY</td>
<td>3163 Theoretical Physics</td>
</tr>
<tr>
<td>PHY</td>
<td>3293 Statistical Thermodynamics</td>
</tr>
<tr>
<td>PHY</td>
<td>3313 Solid State Physics</td>
</tr>
<tr>
<td>PHY</td>
<td>3353 Advanced Physics Laboratory II</td>
</tr>
<tr>
<td>PHY</td>
<td>3443 Optics</td>
</tr>
<tr>
<td>PHY</td>
<td>3823 Mathematical Physics</td>
</tr>
<tr>
<td>PHY</td>
<td>4263 Quantum Mechanics I</td>
</tr>
</tbody>
</table>

B. 60 semester credit hours required in the College of Sciences and Engineering:

1. 27 semester credit hours of required courses (excluding physics):

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE</td>
<td>1103 General Chemistry**</td>
</tr>
<tr>
<td>CHE</td>
<td>1303 Chemical Principles**</td>
</tr>
<tr>
<td>CHE</td>
<td>1312 Inorganic Qualitative and Quantitative Analysis</td>
</tr>
<tr>
<td>CS</td>
<td>1073 Introductory Computer Programming for Scientific Applications</td>
</tr>
</tbody>
</table>

*May be used to satisfy the Core Curriculum requirement in Domain IA.
**May be used to satisfy the Core Curriculum requirement in Domain IB.
MAT 1214  Calculus I*
MAT 1223  Calculus II
MAT 2213  Calculus III
MAT 2233  Linear Algebra
MAT 3613  Differential Equations I

2. 33 additional approved semester credit hours from the College of Sciences and Engineering

Minor in Physics

All students pursuing the Minor in Physics must complete 22 semester credit hours.

A. 19 semester credit hours of required courses:

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

B. 3 semester credit hours selected from the following:

PHY 3143  Computer Visualization of Physics
PHY 3163  Theoretical Physics
PHY 3293  Statistical Thermodynamics
PHY 3313  Solid State Physics
PHY 3443  Optics
PHY 3823  Mathematical Physics
PHY 4133  Numerical Methods for Physicists
PHY 4263  Quantum Mechanics I

To declare a Minor in Physics, obtain advice, or seek approval of substitutions for course requirements, students should consult the Undergraduate Advisor of Record in the Division of Earth and Physical Sciences.

COURSE DESCRIPTIONS

PHYSICS

(PHY)

1003  Topics in Physics
(3-0) 3 hours credit.

An organized course offering the opportunity for specialized study in physics. This course is not often available as part of the regular course offering and provides special opportunities for students to learn about practical methods and/or special topics in physics. Topics include practical problem solving, the nature of things, and energy and the environment. May be repeated for credit when the topics vary, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. May not be counted toward the B.S. in Physics without written approval of the department.

*May be used to satisfy the Core Curriculum requirement in Domain IA.

UTSA 1999–2000 Undergraduate Catalog
1013 **Universes**  
(3-0) 3 hours credit. Prerequisites: MAT 1023, AST 1013, or consent of instructor.  
This course emphasizes how the major ideas of physics have influenced and reshaped our general concept of the universe. Selected topics include the historical development of the scientific method, ancient cosmological ideas beginning with the geocentric model, and the classical cosmological models emphasizing Newtonian cosmology. Modern cosmological ideas including Einstein's and Hawking's universe will be compared. Topics will include the large-scale structure, origin, and fate of the universe. Modern evidence supporting these theories will be presented. May not be applied toward the B.S. in Physics without prior written approval of the division. May apply toward the Level II Core Curriculum requirement in science. (Formerly AST 1003. Credit cannot be earned for both PHY 1013 and AST 1003.) [TCCN: PHYS 1310.]

1014 **Conceptual Physics and Civilization**  
(3-1) 4 hours credit. Prerequisite: MAT 1023.  
Major scientific discoveries since the Renaissance and their impact on the development of culture. May not be applied toward a B.S. or B.A. in Physics.

1603 **General Physics I**  
(3-0) 3 hours credit. Prerequisite: MAT 1023 completed with a grade of "C" or better.  
Motion, forces, conservation of energy and momentum, fluids, wave motion, and heat. Concurrent enrollment in PHY 1611 recommended. May apply toward the Level II Core Curriculum requirement in science. [TCCN: PHYS 1301.]

1611 **General Physics I Laboratory**  
(1-3) 1 hour credit. Prerequisites: Completion of or concurrent enrollment in PHY 1603; proficiency in DOS, spreadsheets, and word processing.  
Laboratory accompanies PHY 1603; uses modern data acquisition and analysis tools to study the classic physics experiments that underlie the concepts discussed in PHY 1603. [TCCN: PHYS 1101.]

1623 **General Physics II**  
(3-0) 3 hours credit. Prerequisites: PHY 1603 completed with a grade of "C" or better.  
Electrostatics, electromagnetism, light, sound, and atomic and nuclear physics. Concurrent enrollment in PHY 1631 recommended. May apply toward the Level II Core Curriculum requirement in science. [TCCN: PHYS 1302.]

1631 **General Physics II Laboratory**  
(1-3) 1 hour credit. Prerequisites: PHY 1611 completed with a grade of "C" or better and completion of or concurrent enrollment in PHY 1623; proficiency in DOS, spreadsheets, and word processing.  
Laboratory accompanies PHY 1623; uses modern data acquisition and analysis tools to study the classic physics experiments that underlie the concepts discussed in PHY 1623. [TCCN: PHYS 1102.]

UTSA 1999–2000 Undergraduate Catalog
1904  **Technical Physics I**  
(4-0) 4 hours credit. Prerequisite: MAT 1214 and completion of or concurrent enrollment in MAT 1223 completed with a grade of "C" or better. The basic concepts and methods of physics. Mechanics, heat, and fluids. Concurrent enrollment in PHY 1911 and MAT 1223 recommended. May apply toward the Level II Core Curriculum requirement in science. [TCCN: PHYS 2425.]

1911  **Technical Physics I Laboratory**  
(1-3) 1 hour credit. Prerequisites: Completion of with a grade of "C" or better or concurrent enrollment in PHY 1904; proficiency in DOS, spreadsheets, and word processing. Laboratory to accompany PHY 1904: uses modern data acquisition and analysis tools to study the classic physics experiments that underlie the concepts discussed in PHY 1904. [TCCN: PHYS 2125.]

1924  **Technical Physics II**  
(4-0) 4 hours credit. Prerequisites: PHY 1904 and MAT 1223 completed with a grade of "C" or better. Electricity and magnetism, wave phenomena, and elements of modern physics. Concurrent enrollment in PHY 1931 is recommended. May apply toward the Level II Core Curriculum requirement in science. [TCCN: PHYS 2426.]

1931  **Technical Physics II Laboratory**  
(1-3) 1 hour credit. Prerequisites: PHY 1911 completed with a grade of "C" or better and completion of or concurrent enrollment in PHY 1924; proficiency in DOS, spreadsheets, and word processing. Laboratory to accompany PHY 1924. [TCCN: PHYS 2126.]

2004  **Understanding Physics**  
(3-3) 4 hours credit. Prerequisites: Completion of Core Curriculum requirements in science. Study of major concepts, principles, and theories in the fields of physics and ways of scientific thinking that contribute to empirical and theoretical inquiries. Study of the fundamental laws that govern the universe, including the worlds of mechanics, thermodynamics, electromagnetism, and quantum theory, and how they relate to physics. Topics include but are not limited to fundamental forces; energy and how it is conserved and transformed; optics; matter; atomic structure; and molecular interactions. Includes a laboratory. May not be applied to a major in physics. May apply toward the Level I Core Curriculum requirement in science. [TCCN: PHYS 1410.]

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, spectra, the atomic nucleus, nuclear reactions, and an introduction to elementary particles.
3133 **Computers in the Physics Laboratory**  
(3-0) 3 hours credit. Prerequisites: PHY 1924, 1931, and 3103.  
Topics covered include i80x86 assembly language programming, the FORTH programming environment, construction of customized computer interfaces to equipment, writing DOS/Windows device drivers for scientific instrumentation, and computer-controlled data acquisition and analysis.

3143 **Computer Visualization of Physics**  
(3-0) 3 hours credit. Prerequisite: PHY 3103.  
Simulations of physical processes from classical and quantum mechanics, electrodynamics, and solid state physics. May be applied toward a B.S. in Physics with approval of the physics advisor.

3163 **Theoretical Physics**  
(3-0) 3 hours credit. Prerequisites: PHY 1924 and MAT 2213.  
Methods of theoretical physics applied to problems in electromagnetism and quantum and statistical physics, with an emphasis on physical formulation and interpretation.

3203 **Classical Mechanics I**  
(3-0) 3 hours credit. Prerequisites: PHY 1924 and completion of or concurrent enrollment in PHY 3103 and MAT 2213.  
Kinematics and dynamics of systems of particles; rigid body motion. Lagrangian formalizing pathway to quantum physics. Applications are emphasized.

3233 **Environmental Physics**  
(3-0) 3 hours credit. Prerequisite: PHY 1623 or PHY 1924.  
The essentials of environmental physics: global climate, energy for human use, pollutants, noise, environmental spectroscopy, and LiDAR.

3293 **Statistical Thermodynamics**  
(3-0) 3 hours credit. Prerequisites: PHY 1924, PHY 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, semiconductor crystals, and devices.

3343 **Advanced Physics Laboratory I**  
(0-6) 3 hours credit. Prerequisites: PHY 1924 and 1931.  
Laboratory experience in the areas of optics, modern physics, and solid state and surface physics. (Formerly PHY 3346. Credit cannot be earned for both PHY 3343 and PHY 3346.)
3353 **Advanced Physics Laboratory II**  
(0-6) 3 hours credit. Prerequisite: PHY 3343.  
A continuation of PHY 3343. (Formerly PHY 3356. Credit cannot be earned for both PHY 3353 and PHY 3356.)

3423 **Electricity and Magnetism**  
(3-0) 3 hours credit. Prerequisites: PHY 1924 and completion of or concurrent enrollment in MAT 2213.  
Vector calculus, electrostatics, electromagnetic waves, magnetostatics, Faraday's Law, Maxwell’s equations, and solution to Laplace’s equation.

3433 **Introduction to the Theory of Solid State Electronics**  
(3-0) 3 hours credit. Prerequisites: PHY 3103 and 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, nonlinear properties, and Fourier optics.

3453 **Lasers: Theory and Applications**  
(3-0) 3 hours credit. Prerequisite: PHY 3103.  
Basic principles and designs of lasers: Einstein A and B coefficients; semiclassical laser theory; the phase-coherent nature of the stimulated emission process; and laser efficiency. Various applications of lasers, such as laser-induced fluorescence, light wave communications, holography, surgery, and laser fusion.

3823 **Mathematical Physics**  
(3-0) 3 hours credit. Prerequisite: MAT 2233.  
Tensor analysis, complex variable theory, partial differential equations of physics, special functions, and approximation techniques.

4003 **Introduction to Astrophysics**  
(3-0) 3 hours credit. Prerequisites: MAT 1223 and PHY 1924, or consent of instructor.  
A survey of the fundamentals of modern astrophysics and gravitation including observed properties of stars (normal, multiple, variable, and peculiar). Stellar and nonstellar radiation laws, stellar and planetary atmospheres and interiors, high-energy astrophysics, collapsed objects (neutron stars and black holes), structure and inventory of normal (Milky Way) and active galaxies, quasars, and an introduction to cosmology.

4133 **Numerical Methods for Physicists**  
(3-0) 3 hours credit. Prerequisites: PHY 1924 and MAT 3613.  
Topics covered include numerical integration of functions, solution of linear algebraic equations, matrices, Monte Carlo methods, root finding, minimization and maximization of functions, fast Fourier and discrete wavelet transform methods, and solution of differential equations. Knowledge of Mathematica is helpful.
4203 Classical Mechanics II  
(3-0) 3 hours credit. Prerequisite: PHY 3203.  
Advanced methods in mechanics; Lagrangian and Hamiltonian formulations.  
Nonlinear dynamics, chaos, strange attractors, and fractals.

4263 Quantum Mechanics I  
(3-0) 3 hours credit. Prerequisites: PHY 3203 and 3423.  
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.

4453 Physics Demonstrations  
(3-0) 3 hours Prerequisites: PHY 1603 and 1623, or PHY 1904 and 1924.  
Introduction to teaching materials and laboratory demonstrations illustrating principles of classical and modern physics, with emphasis on inexpensive techniques and direct experience. May not be counted toward a B.S. or B.A. in Physics.

4463 Physics and the Entrepreneurial Process  
(3-0) 3 hours credit. Prerequisites: PHY 1603 and 1623, PHY 1904 and 1924, or consent of instructor.  
The entrepreneurial process usually is coupled to innovation, and in today’s technological business world, innovation usually involves some form of applied physics. This course begins with the invention process itself and the physics behind some of the most famous inventions. It proceeds to look at the research and developmental physics that typically follows a new product concept. The course then examines the challenges that face the entrepreneur in the technical marketing of the new product, in which the physics must be conveyed to the consumer.

4553 Health Physics  
(3-0) 3 hours credit. Prerequisite: PHY 1924 or the equivalent.  

4911-3 Independent Study  
1 to 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. For students desiring specialized work. May be repeated for credit, but not more than 3 semester credit hours will apply to a bachelor’s degree in physics.
4933.6 Internship in Physics
3 to 6 hours credit. Prerequisites: Senior standing and consent of internship coordinator.
This course offers supervised work experience relevant to physics within selected organizations and agencies. Internships should be relevant to previous coursework. A maximum of 6 semester credit hours may be earned through Internship in Physics.

4953 Special Studies in Physics
(3-0) 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 may be repeated for credit when the topics vary, but not more than 6 semester credit 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 their last two semesters; approval by the College Honors Committee.
Supervised research and preparation of an honors thesis. May be repeated once with approval.

COURSE DESCRIPTIONS
ASTRONOMY

(1013) Introduction to Astronomy
(3-0) 3 hours credit. Prerequisite: MAT 1023.
A descriptive course including the development of astronomy, its methods, and the motions, laws, and evolution of the solar system. Topics include 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. May apply toward the Level I Core Curriculum requirement in science. [TCCN: PHYS BU.]

(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, including simple observations, measurement, and photography. [TCCN: PHYS 1111.]

(1033) Exploration of the Solar System
(3-0) 3 hours credit. Prerequisite: MAT 1023.
A descriptive course of modern studies of the solar system, including a survey of the properties of the planets and smaller bodies (asteroids and comets) and current theories of the origin of planetary systems. Topics include results from the latest satellite, robotic, and human exploration of space, origin of life in the solar system, existence of other planetary systems, possibilities of space colonization, and the search for extraterrestrial life (techniques and possibilities of communication with other intelligences). May apply toward the Level II Core Curriculum requirement in science. [TCCN: PHYS 1312.]
COURSE DESCRIPTIONS
ENVIRONMENTAL SCIENCES
(ES)

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 on understanding system dynamics and their relation to public policy formulation and natural resource use. May apply toward the Level I Core Curriculum requirement in science. (Formerly ENV 2013. Credit cannot be earned for both ES 2013 and ENV 2013.) [TCCN: BIOL 2306.]

3023 Man and His Natural Resources
(3-0) 3 hours credit.
An in-depth analysis of humankind’s dependency on 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. (Formerly ENV 3023. Credit cannot be earned for both ES 3023 and ENV 3023.)

4043 Introduction to Geographic Information Systems (GIS)
(2-2) 3 hours credit. Prerequisites: Experience using a computer and consent of instructor.
Use of geographic information systems (GIS) to analyze and solve spatially related problems commonly encountered by professionals in many disciplines. The course uses ArcView as the base program and emphasizes the fundamental concepts and principles of GIS. Overviews for other commonly used GIS programs are included.

4053 Advanced Geographic Information Systems
(2-2) 3 hours credit. Prerequisite: ES 4043.
Geographic information systems provide excellent tools for modeling environmental systems and managing or processing environmental data. This course will use ArcView, ArcView Spacial Analyzer, ERDAS, and PC ArcInfo to assist students in solving and modeling real-world problems in a variety of discipline, including environmental science, geology, engineering, biology, and social sciences. Global Positioning Systems will be used to map geographic features in field studies. Additional topics covered include topology correction, geographic projections, and registering of raster images and aerial photographs.
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 active participants in many traditional, new, and emerging areas of high technology.

The division has excellent laboratory facilities where students receive hands-on instruction by faculty. Computer-aided design (CAD) facilities, including state-of-the-art workstations, are routinely used in all programs. Some classes are taught by adjunct faculty from local industries, giving students the opportunity to interact with engineering professionals engaged in relevant engineering practice.

This quality engineering education is complemented by the Core Curriculum. Graduates from the Division of Engineering should have excellent opportunities for employment and pursuit of graduate degrees.

Cooperative Education in Engineering Program

The Cooperative Education in Engineering Program formally integrates students’ University studies with institutionally supervised work experiences at cooperating organizations. Students participating in this program alternate periods of study at the University with periods of employment in industry. This combination of experiences enhances the student’s knowledge, personal development, and preparation for a professional career. Participants register at the University each semester. During the work periods, students register for the 1-semester-credit-hour Engineering Co-op course. At the end of each work period, students submit reports covering the period. These reports are the basis of the students’ grades in the course. The cooperative education work periods also provide students with a source of income to help pay for their college expenses.

Students may petition to apply 3 semester credit hours of Engineering Co-op as a technical elective toward their degree in engineering. They are encouraged to petition prior to co-op activities.

To qualify for the Cooperative Education in Engineering Program, a student must have declared a major in the Division of Engineering; have completed at least 36 semester credit hours of major and support work, including 10 hours of college-level calculus and 10 hours of college-level physics; and have a minimum cumulative grade-point average of 2.50 and a minimum grade-point average of 2.50 in their College of Sciences and Engineering courses. Students are advised that many co-op employers require cumulative grade-point averages higher than 2.50, and some require a minimum cumulative grade-point average of 3.0. Transfer students may participate in the program after completing at least one semester at the University.

For more information and to apply to the Cooperative Education in Engineering Program, students should contact Career Services.
DEGREE REQUIREMENTS
COMMON TO ALL PROGRAMS

Entering students should enroll in a specific engineering program by selecting civil, electrical, or mechanical engineering as a major. Undecided engineering students should select a major closest to their area of interest (refer to the following program descriptions). Students may obtain additional information about each program from the division office or a faculty advisor in the appropriate discipline.

Prerequisites for civil engineering (CE), electrical engineering (EE), mechanical engineering (ME), and engineering (EGR) courses must be completed with a grade of "C" or better. Students must satisfy the University's Core Curriculum and ABET accreditation requirements. Recommended degree plans and current ABET requirements may be obtained from the Division of Engineering.

Requirements common to all engineering degree programs follow.

I. Core Curriculum requirements:

Students seeking the Bachelor of Science degree in any engineering field must fulfill University Core Curriculum requirements in the same manner as other students (see chapter 6, Bachelor’s Degree Regulations).

MAT 1214, CHE 1103, and PHY 1904 may be used to satisfy the Core Curriculum requirements for Domain I: Mathematics and Science.

II. General Engineering requirements:

All degree-seeking candidates in engineering must complete the following 29 semester credit hours:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE 1103</td>
<td>General Chemistry</td>
</tr>
<tr>
<td>CS 2073</td>
<td>Computer Programming with Engineering Applications</td>
</tr>
<tr>
<td>EGR 3713</td>
<td>Engineering Economic Analysis</td>
</tr>
<tr>
<td>MAT 1214</td>
<td>Calculus I</td>
</tr>
<tr>
<td>MAT 1223</td>
<td>Calculus II</td>
</tr>
<tr>
<td>MAT 2213</td>
<td>Calculus III</td>
</tr>
<tr>
<td>PHY 1904, 1911</td>
<td>Technical Physics I and Laboratory</td>
</tr>
<tr>
<td>PHY 1924, 1931</td>
<td>Technical Physics II and Laboratory</td>
</tr>
</tbody>
</table>

COURSE DESCRIPTIONS
ENGINEERING (EGR)

1402 Engineering Graphical Communications
(1-3) 2 hours credit. Prerequisite: Completion of or concurrent enrollment in MAT 1214.
Technical communication, engineering graphics, and an introduction to computer-aided graphics. Introduction to engineering analysis, design, synthesis, and production methods.
2213   Engineering Mechanics  
(3-0) 3 hours credit. Prerequisites: MAT 1223 and PHY 1904.  
Force systems, moments, equilibrium, kinematics, and kinetics of particles 
and plane rigid bodies. Not open to students majoring in civil or mechanical 
engineering. May not be substituted for CE 2203 or ME 2213.  

3301   Engineering Co-op  
1 hour credit. Prerequisite: Acceptance into the Cooperative Education in 
Engineering Program.  
Designed for students participating in Cooperative Education in Engineering 
Program. Problems related to students' work assignments during their work 
for co-op employers. May be repeated for credit, but no more than 3 semester 
credit hours may apply to a bachelor's degree. The grade report for the 
course is either CR (satisfactory performance) or NC (unsatisfactory performance).  

3713   Engineering Economic Analysis  
(3-0) 3 hours credit. Prerequisite: Junior or senior standing in the Division 
of Engineering.  
Fundamentals of economics and economic policies. Techniques of investment 
analysis for engineering decisions. Discussion of professional practice-ethics, 
project management, proposal preparation, and communication. (Formerly 
EGR 4713. Credit cannot be earned for both EGR 3713 and EGR 4713.)  

4113   Engineering Fracture Mechanics  
(3-0) 3 hours credit. Prerequisite: ME 3813 or equivalent, or consent of 
instructor.  
Introduction to the theory of fracture mechanics through the Griffith energy 
balance, Irwin's stress intensity and strain energy release rate, and Rice's 
conservation integral. Fracture mechanics will be applied to several modern 
engineering problems.  

4183   Propulsion  
(3-0) 3 hours credit. Prerequisites: ME 3293 or ME 3283, and ME 3663 or 
EE 3413.  
Introduction to analysis, design, control of air-breathing engines, including 
performance and cycle analysis, heat transfer, material considerations, and 
shocks; design and analysis of inlets, compressors, combustors, turbines, 
and nozzles. Applications to aeronautical and ground transportation.  

4213   Introduction to the Theory of Finite Elements  
(2-3) 3 hours credit. Prerequisite: ME 3423.  
Introduction to the theory of finite element analysis through the method of 
weighted residuals. The method will be applied to find the solution of 
boundary-valued and time-dependent problems of solid/fluid mechanics and 
heat transfer.  

4953   Special Studies in Engineering  
(3-0) 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 may be
repeated for credit when topics vary, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree.

4993 Honors Research
3 hours credit. Prerequisites: 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.

Bachelor of Science Degree in Civil Engineering

The Bachelor of Science degree in Civil Engineering is a broad-based program designed to prepare students for careers in areas traditionally associated with civil engineering and several modern areas of high technology. Students are required to take courses in subjects related to environmental and water resource 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 transportation systems, structures made with advanced composite materials, construction, and other areas. Upon graduation from the civil engineering program, successful students should be qualified to seek employment in local or national companies and government agencies associated with aerospace, automotive and transportation, environmental, structural, geotechnical, and other industries.

All candidates for the degree must complete the following:

A. 64 semester credit hours of required courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 1301</td>
<td>Introduction to Civil Engineering</td>
</tr>
<tr>
<td>CE 2103</td>
<td>Civil Engineering Measurements</td>
</tr>
<tr>
<td>CE 2203</td>
<td>Statics</td>
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<tr>
<td>CE 2503</td>
<td>Dynamics</td>
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<tr>
<td>CE 2633</td>
<td>Environmental Engineering</td>
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<tr>
<td>CE 3103</td>
<td>Mechanics of Solids</td>
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<tr>
<td>CE 3113</td>
<td>Structural Analysis</td>
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<td>CE 3213</td>
<td>Reinforced Concrete Design</td>
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<td>CE 3233</td>
<td>Steel Design</td>
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<tr>
<td>CE 3243</td>
<td>Properties and Behavior of Engineering Materials</td>
</tr>
<tr>
<td>CE 3413</td>
<td>Geotechnical Engineering</td>
</tr>
<tr>
<td>CE 3603</td>
<td>Hydraulic Engineering</td>
</tr>
<tr>
<td>CE 3713</td>
<td>Civil Engineering Systems Analysis</td>
</tr>
<tr>
<td>CE 4603</td>
<td>Water Resources Engineering</td>
</tr>
<tr>
<td>CE 4813</td>
<td>Civil Engineering Design</td>
</tr>
<tr>
<td>EE 2214</td>
<td>Electric Circuits and Electronics</td>
</tr>
<tr>
<td>EGR 1402</td>
<td>Engineering Graphical Communications</td>
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<tr>
<td>ENG 2413</td>
<td>Technical Writing</td>
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<td>CHE 1303</td>
<td>Chemical Principles</td>
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<tr>
<td>GEO 4023</td>
<td>Engineering Geology</td>
</tr>
<tr>
<td>MAT 3253</td>
<td>Engineering Analysis</td>
</tr>
<tr>
<td>ME 3283</td>
<td>Fundamentals of Thermal Sciences</td>
</tr>
</tbody>
</table>
B. 9 semester credit hours of civil engineering electives, 6 of which must be selected from the following list:

- CE 3633 Water and Wastewater Treatment
- CE 3723 Hydrology
- CE 4113 Transportation Systems
- CE 4223 Earth Structures
- CE 4333 Solid Waste Engineering
- CE 4413 Foundation Engineering
- CE 4523 Advanced Reinforced Concrete Design
- CE 4543 Construction Planning
- CE 4643 Air Quality Engineering
- CE 4653 Design of Pollution Control Systems
- CE 4723 Hydraulic Systems Design

COURSE DESCRIPTIONS
CIVIL ENGINEERING (CE)

1301 Introduction to Civil Engineering
(1-0) 1 hour credit.
Engineering as a career, engineering ethics, and approaches to engineering problem formulation and solution using principles of design and decision making. (Formerly EGR 1301. Credit cannot be earned for both CE 1301 and EGR 1301.)

2103 Civil Engineering Measurements
(2-3) 3 hours credit. Prerequisite: MAT 1214.
Principles of measurement and error analysis. Application of equipment to acquire, analyze, and control data in civil engineering systems. Introduction to plane surveying. (Formerly CE 2113. Credit cannot be earned for both CE 2103 and CE 2113.)

2203 Statics
(3-0) 3 hours credit. Prerequisites: CE 1301, MAT 1223, and PHY 1904.
Vector algebra, force systems, and free body diagrams. Engineering applications of equilibrium, centroids, and moments of inertia. [TCCN: ENGR 2301.] (Formerly EGR 2203. Credit cannot be earned for both CE 2203 and EGR 2203.)

2503 Dynamics
(3-0) 3 hours credit. Prerequisites: EGR 2203 and completion of or concurrent enrollment in MAT 2213.
Kinematics and kinetics of particles and plane rigid bodies, work and energy, impulse and momentum, and engineering applications. [TCCN: 2302.] (Formerly EGR 2503. Credit cannot be earned for both CE 2503 and EGR 2503.)
2633 Environmental Engineering  
(3-0) 3 hours credit. Prerequisites: CHE 1103 and PHY 1904. Principles, analysis, and design related to environmental monitoring, protection, and remediation systems. Topics include environmental quality and legislation, modeling, water treatment, wastewater treatment, solid and hazardous waste management, air and noise pollution, and radioactive waste management. (Formerly CE 2133. Credit cannot be earned for both CE 2633 and CE 2133.)

3103 Mechanics of Solids  
(3-0) 3 hours credit. Prerequisite: CE 2203. Internal forces and deformations in solids; stress, strain, and their relations; stresses and deflections in beams column theory and analysis; and engineering applications. (Formerly EGR 3213. Credit cannot be earned for both CE 3103 and EGR 3213.)

3113 Structural Analysis  
(3-0) 3 hours credit. Prerequisite: CE 3103. Forces and deflections in structural systems; considers stationary and moving loads and exact and approximate methods.

3213 Reinforced Concrete Design  
(2-3) 3 hours credit. Prerequisite: Completion of or concurrent enrollment in CE 3113. Ultimate strength theory and design for reinforced concrete members.

3233 Steel Design  
(2-3) 3 hours credit. Prerequisite: Completion of or concurrent 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: CE 3103 and ENG 2413. Structure, properties, and behavior of engineering materials; measurement and analysis of material properties and behavior. Laboratory exercises illustrate typical material behavior and selected principles of mechanics.

3413 Geotechnical Engineering  
(2-3) 3 hours credit. Prerequisite: CE 3103. 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 geotechnical materials. (Formerly CE 4213. Credit cannot be earned for both CE 3413 and CE 4213.)

3603 Hydraulic Engineering  
(2-3) 3 hours credit. Prerequisite: CE 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. Prerequisites: CE 2633 and completion of or concurrent enrollment in CE 3603.  
The application of chemical, biochemical, and physical processes to water treatment, wastewater treatment, and pollution control. (Formerly CE 4633. Credit cannot be earned for both CE 3633 and CE 4633.)

3713 **Civil Engineering Systems Analysis**  
(3-0) 3 hours credit. Prerequisite: 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 3713 and CE 4713.)

3723 **Hydrology**  
(3-0) 3 hours credit. Prerequisite: CE 3603.  
Hydrologic cycle, precipitation, hydrologic abstractions, surface runoff; unit hydrographs; synthetic hydrographs; peak discharge relationships; flood frequency analysis; flood and reservoir routing; and groundwater hydrology.

4113 **Transportation Systems**  
(3-0) 3 hours credit. Prerequisite: Completion of or concurrent 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, and pavement. Economic analysis.

4223 **Earth Structures**  
(3-0) 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.

4333 **Solid Waste Engineering**  
(3-0) 3 hours credit. Prerequisite: CE 2633.  
Analysis and design of municipal solid waste systems. Topics covered include waste generation and sources, quality, legislation, collection and transport, treatment trends, disposal, reduction, recovery, and recycling. Introduction to hazardous waste engineering.
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**  
(3-0) 3 hours credit. Prerequisite: CE 3213.  
Design of reinforced concrete buildings by ultimate strength methods; prestressed concrete design.

4543 **Construction Planning**  
(3-0) 3 hours credit. Prerequisite: Completion of or concurrent 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**  
(3-0) 3 hours credit. Prerequisites: CE 2633 and 3603.  
Analysis and design of surface and subsurface water resource systems; dam and reservoir design for recharge, flood control, and water supply; and design of water supply, wastewater collection, and stormwater systems.

4643 **Air Quality Engineering**  
(3-0) 3 hours credit. Prerequisites: CE 2633 and senior standing in civil engineering.  
Discussion of the sources, quantities, effects of sampling, and control of airborne pollutants in ambient air and in urban and industrial environments.

4653 **Design of 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, wastewater, and hazardous wastes.

4723 **Hydraulic Systems Design**  
(3-0) 3 hours credit. Prerequisites: CE 3603, MAT 3253, and senior standing in civil engineering.  
Hydraulic structure design, culverts, transitions, and energy dissipators; stable channel design.

4813 **Civil Engineering Design**  
(2-3) 3 hours credit. Prerequisites: CE 3213, 3233, 3413, 3713, and 4603.  
Opportunity to apply design skills to execution of an open-ended integrated civil engineering design project, including field and laboratory investigations, numerical and scale modeling, design, and formal oral and written
presentation of results. Considers safety, reliability, environmental, economic, and other constraints, and ethical and social impacts.

4911-3 Independent Study
1 to 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 semester credit hours of independent study, regardless of discipline, will apply to a bachelor’s degree.

4953 Special Studies in Civil Engineering
(3-0) 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 may be repeated for credit when topics vary, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor’s degree.

Bachelor of Science Degree in Electrical Engineering

The Bachelor of Science degree in Electrical Engineering offers students the opportunity to prepare for careers in areas associated with electronics, digital systems, computer architecture and design, communications, controls and robotics, computer-aided design (CAD), instrumentation, bioengineering, 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 that may lead to employment with electronic companies, high-technology industries, and government agencies.

All candidates for the degree must complete the following:

A. 64 semester credit hours of required courses:

1. 55 semester credit hours of electrical engineering:

   EE 1303 Introduction to Electrical Engineering
   EE 2323 Applied Engineering Analysis
   EE 2423 Network Theory
   EE 2513 Logic Design
   EE 3113 Electrical Engineering Laboratory I
   EE 3213 Electromagnetic Engineering
   EE 3313 Electronic Circuits I
   EE 3413 Analysis and Design of Control Systems
   EE 3423 Signals and Systems I
   EE 3463 Microcomputer Systems I
   EE 3513 Electromechanical Systems
   EE 3523 Signals and Systems II
   EE 3563 Digital Systems Design I
   EE 4113 Electrical Engineering Laboratory II
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EE 4313  Electronic Circuits II
EE 4613  Communication Systems
EE 4643  Digital Signal Processing
EE 4811  Electrical Engineering Design I
EE 4813  Electrical Engineering Design II

2. 9 semester credit hours of supporting courses:

EGR 2213  Engineering Mechanics
ME 3283  Fundamentals of Thermal Sciences
STA 3533  Probability and Random Processes
EE 3533  Random Signals and Noise

B. 12 semester credit hours of electrical engineering electives selected from the following:

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 4553  VLSI Testing
EE 4573  Engineering Workstations
EE 4583  Microcomputer Systems II
EE 4623  Digital Filtering
EE 4653  Digital Communications
EE 4723  Intelligent Robotics

Students may petition the electrical engineering faculty for approval of other appropriate engineering or advanced science electives, such as EGR 4183 and EE 4953.

COURSE DESCRIPTIONS
ELECTRICAL ENGINEERING
(EE)

1303  Introduction to Electrical Engineering
(3-0) 3 hours credit. Prerequisite: Completion of or concurrent enrollment in MAT 1214.
Techniques for problem solving and design in electrical engineering.

2214  Electric Circuits and Electronics
(3-3) 4 hours credit. Prerequisites: PHY 1924 and 1931; corequisite: MAT 3253 or EE 2323.

UTSA 1999–2000 Undergraduate Catalog
Electric, magnetic, and electronic circuits; transient analysis, transforms, and phasors; transformers; solid state devices; analog and digital circuits. Laboratory component includes basic experiments with electrical networks and electronic circuits. Not open to electrical engineering majors. (Formerly EE 2213. Credit cannot be earned for both EE 2214 and EE 2213.)

2323 Applied Engineering Analysis
(3-0) 3 hours credit. Prerequisite: MAT 1223.
Linear algebra and differential equations with applications in electrical engineering.

2423 Network Theory
(3-0) 3 hours credit. Prerequisites: MAT 2213 and completion of or concurrent enrollment in PHY 1924 and MAT 3253, or EE 2323.
Basic network principles; steady state responses to DC and AC signals; transient responses; nodal and loop analysis; Laplace transforms; and 2-port analysis. Use of SPICE to solve network problems. (Formerly EE 2424. Credit cannot be earned for both EE 2423 and EE 2424.)

2513 Logic Design
(3-0) 3 hours credit. Prerequisite: Major in computer science, or completion of or concurrent enrollment in CS 2073.
Number systems, Boolean algebra, combinational and sequential circuit design. Minimization and implementation. Introduction to computer-aided design (CAD) tools. (Formerly EE 2514. Credit cannot be earned for both EE 2513 and EE 2514.)

3113 Electrical Engineering Laboratory I
(1-6) 3 hours credit. Prerequisites: EE 2423, 2513, and completion of or concurrent enrollment in EE 3313.
Introduction to basic measurement equipment and techniques. Use of analog and digital simulation tools; 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.
Review of vector calculus, Maxwell's equations, electromagnetic waves, dielectrics, and boundary conditions. Selected other topics include wave guides, 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, EE 2423, and completion of or concurrent enrollment in EE 3423 or ME 3323.
Electrical properties of semiconductors; P-N junctions; diode circuits; BJTs and FETs; and application to digital and analog circuits. Use of SPICE to solve simple circuits.

3413 Analysis and Design of Control Systems
(3-0) 3 hours credit. Prerequisites: EE 2323 or MAT 3253; EE 3423 for electrical engineering majors; ME 3323 for mechanical engineering majors.
Modeling, analysis, and design of linear automatic control systems. Time and frequency domain techniques; stability analysis, state variable techniques, and other topics. Control systems analysis and design software will be used. (Formerly EE 4413. Credit cannot be earned for both EE 3413 and EE 4413.)

3423 Signals and Systems I
(3-0) 3 hours credit. Prerequisites: EE 2323 and EE 2423.
Frequency response and complex variables, Fourier series, Fourier transforms, Dirac Delta function, convolution, mathematical modeling of systems, and the Z-transform.

3463 Microcomputer Systems I
(3-0) 3 hours credit. Prerequisites: EE 2513, CS 2073, and completion of or concurrent enrollment in EE 3563.
Introduction to assembly- and C-language programming. Architecture, peripherals, operating system interfacing principles, and development tools. Software documentation techniques. (Formerly EE 4563. Credit cannot be earned for both EE 3463 and EE 4563.)

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; and power devices.

3523 Signals and Systems II
(3-0) 3 hours credit. Prerequisites: EE 3423.
Time and frequency characteristics of signals and systems, sampling, and application of Laplace transforms and Z transforms to linear time invariant systems and linear feedback systems.

3533 Random Signals and Noise
(3-0) 3 hours credit. Prerequisite: MAT 1223.
Probability, statistics, random variables, and random processes, with applications in electrical engineering.

3563 Digital Systems Design I
(2-3) 3 hours credit. Prerequisite: EE 2513.
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 dealing, and mixed-mode simulation.

4113 Electrical Engineering Laboratory II
(1-6) 3 hours credit. Prerequisites: EE 3113, 3413, 3463, and 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 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 4243 and EE 3583.)

4313 Electronic Circuits II
(3-0) 3 hours credit. Prerequisites: EE 3313, 3523, 3563, and 3563.
Multiple transistor circuits; feedback and frequency response analysis; operational amplifier analysis and design; power semiconductors; and 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: Completion of or concurrent enrollment in EE 4113 and consent of instructor.
Laboratory experience in one of the following: controls, optics, digital systems, communications, or instrumentation.

4333 Instrumentation Systems
(2-3) 3 hours credit. Prerequisites: EE 3463, 3413, and completion of or concurrent 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, and 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 may include Fourier optics, coherence theory, holography, lasers, Gaussian beams, acousto-optics, electro-optics, and fiber-optic communications.

4443 Discrete-Time and Computer-Controlled Systems
(2-3) 3 hours credit. Prerequisites: EE 3413 and completion of or concurrent 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, 3413, and completion of or concurrent 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.

UTSA 1999–2000 Undergraduate Catalog
4513 LSI and VLSI Design  
(2-3) 3 hours credit. Prerequisites: EE 3213, 4313, and completion of or concurrent enrollment in EE 4243 or 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 4313. 
Analysis and design of analog and digital integrated circuits. Integrated circuit technologies, computer-aided analysis, design, and other tools. Fabrication and testing.

4553 VLSI Testing  
(2-3) 3 hours credit. Prerequisite: EE 4513. 
Faults modeling and simulation; stuck at faults, bridging faults, and functional testing; self-testing concepts; standard and test patterns; device and system testing; and design for testability.

4573 Engineering Workstations  
(2-3) 3 hours credit. Prerequisites: EE 3463 and 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. Prerequisites: EE 3463, 3313, and completion of or concurrent enrollment in EE 4313. 
Advanced microprocessor-based system design. High-speed bus interfacing, coprocessors, and other specialized input/output devices. High-level languages and software performance analysis.

4613 Communication Systems  
(3-0) 3 hours credit. Prerequisites: STA 3533 or EE 3533. 
Fundamentals of communication systems engineering using analog and digital techniques. Signal analysis, signal-to-noise ratio, and circuit implementations.

4623 Digital Filtering  
(3-0) 3 hours credit. Prerequisites: EE 4643 and completion of or concurrent enrollment in EE 3463. 
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: Concurrent enrollment or completion of EE 3523, and STA 3533 or EE 3533. 
4653 Digital Communications  
(3-0) 3 hours credit. Prerequisite: EE 4613.  
Elements of information theory and modulation and coding for efficient signaling and error correction. Hardware and software implementation of encoders and decoders.

4723 Intelligent Robotics  
(3-0) 3 hours credit. Prerequisites: EE 2214 or 2423, and completion of or concurrent enrollment in ME 4523 or EE 3413.  
Theory and industrial application of robots; sensing and artificial intelligence. (Formerly EGR 4723 and ME 4713. Credit cannot be earned for both EE 4723 and EGR 4723 or ME 4713.)

4811 Electrical Engineering Design I  
(1-0) 1 hour credit. Prerequisite: Concurrent enrollment or completion of EE 4113.  
Selection of a design project and development of a detailed design proposal.

4813 Electrical Engineering Design II  
(1-6) 3 hours credit. Prerequisites: EE 4113, 4811, 4643, and EGR 3713.  
Complex system design. Advanced ATE. Project management, proposals, status reporting, formal oral and written technical reports, and business plans. Open-ended design project considering safety, reliability, environmental, economic, and other constraints, and ethical and social impacts.

4911-3 Independent Study  
1 to 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 semester credit hours of independent study, regardless of discipline, will apply to a bachelor's degree.

4953 Special Studies in Electrical Engineering  
(3-0) 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 may be repeated for credit when topics vary, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree.

Bachelor of Science Degree in Mechanical Engineering

The Bachelor of Science degree in Mechanical Engineering offers students the opportunity to prepare for careers in traditional and emerging high-technology areas of mechanical engineering associated with machinery and mechanism design, thermal and fluid sciences, solid mechanics, robotics, bioengineering and materials, the finite element method (FEM), fatigue and fracture, vibration, and control. Through the proper selection of elective courses to augment required courses, successful students...
may develop a specialization pertinent to many of these areas that may lead to employment with companies or government agencies associated with aerospace, automotive, heating and air conditioning, manufacturing, and other industries.

All candidates for the degree must complete the following:

A. 8 semester credit hours of required courses:

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<td>Chemical Principles</td>
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<td>EGR 1402</td>
<td>Engineering Graphical Communications</td>
</tr>
<tr>
<td>MAT 3253</td>
<td>Engineering Analysis</td>
</tr>
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</table>

B. 20 semester credit hours of required introductory mechanical and electrical engineering courses:

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<tbody>
<tr>
<td>EE   2214</td>
<td>Electric Circuits and Electronics</td>
</tr>
<tr>
<td>ME   2103</td>
<td>Introduction to Mechanical Engineering Problem Solving</td>
</tr>
<tr>
<td>ME   2213</td>
<td>Statics of Deformable Bodies</td>
</tr>
<tr>
<td>ME   2241</td>
<td>Materials Engineering Laboratory</td>
</tr>
<tr>
<td>ME   2243</td>
<td>Materials Engineering</td>
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<tr>
<td>ME   3103</td>
<td>Dynamics of Rigid Bodies</td>
</tr>
<tr>
<td>ME   3293</td>
<td>Thermodynamics I</td>
</tr>
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</table>

C. 39 semester credit hours of required mechanical engineering courses:

1. 29 semester credit hours of required mechanical engineering sciences courses:

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<th>Code</th>
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<tr>
<td>ME   3313</td>
<td>Measurements and Instrumentation</td>
</tr>
<tr>
<td>ME   3323</td>
<td>Dynamics of Mechanical Systems</td>
</tr>
<tr>
<td>ME   3423</td>
<td>Applied Engineering Analysis</td>
</tr>
<tr>
<td>ME   3663</td>
<td>Fluid Mechanics</td>
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<td>ME   3713</td>
<td>Numerical Methods in Mechanical Engineering</td>
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<td>ME   3813</td>
<td>Solid Mechanics</td>
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<td>ME   4293</td>
<td>Thermodynamics II</td>
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<td>ME   4313</td>
<td>Heat Transfer and Rate Processes</td>
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<td>ME   4523</td>
<td>Dynamic Systems and Control</td>
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<tr>
<td>ME   4802</td>
<td>Mechanical Engineering Laboratory</td>
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2. 10 semester credit hours of mechanical engineering design courses:

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<td>ME   4423</td>
<td>Machine Element Design</td>
</tr>
<tr>
<td>ME   4811</td>
<td>Mechanical Engineering Design Project Planning Laboratory</td>
</tr>
<tr>
<td>ME   4813</td>
<td>Mechanical Engineering Design Project</td>
</tr>
</tbody>
</table>

D. 9 semester credit hours of mechanical engineering elective courses:

1. 3 semester credit hours of mechanical engineering design electives selected from the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME   4323</td>
<td>Thermal Systems Design</td>
</tr>
<tr>
<td>ME   4343</td>
<td>Heating, Air Conditioning, and Refrigeration Design</td>
</tr>
</tbody>
</table>

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2. 6 semester credit hours of upper-division mechanical engineering (ME) electives or engineering (EGR) science electives.

If upper-division engineering science (EGR) electives are selected they must be from the following:

EGR 4113  Engineering Fracture Mechanics
EGR 4183  Propulsion
EGR 4213  Introduction to the Theory of Finite Elements

COURSE DESCRIPTIONS
MECHANICAL ENGINEERING
(ME)

2103  Introduction to Mechanical Engineering Problem Solving
(2-3) 3 hours credit. Prerequisites: EGR 1402 and MAT 1214; corequisite: MAT 1223.
Approaches to mechanical engineering problem formulation and solution; conceptual design of mechanical components and systems; introduction to solid mechanics; thermodynamic properties, work, energy, modes of heat transfer, and fluid statics.

2213  Statics of Deformable Bodies
(3-0) 3 hours credit. Prerequisites: MAT 1223 and PHY 1904.
Vector algebra, force systems, statically determinant and indeterminant systems, rods, beams, and an introduction to elasticity.

2241  Materials Engineering Laboratory
(0-3) 1 hour credit. Corequisite: ME 2243.
Investigation of the properties of engineering materials, with emphasis on metals, sample preparation, metallography, and foundry processes. (Formerly ME 3241. Credit cannot be earned for both ME 2241 and ME 3241.)

2243  Materials Engineering
(3-0) 3 hours credit. Prerequisite: CHE 1303.
Fundamental aspects of the structure, properties, and behavior of engineering materials. (Formerly ME 3243. Credit cannot be earned for both ME 2243 and ME 3243.)

3103  Dynamics of Rigid Bodies
(3-0) 3 hours credit. Prerequisites: ME 2213 and MAT 2213.
Kinematics and kinetics of plane rigid bodies, equations of motion, work and energy, impulse and momentum, and engineering applications.
3263 Materials Processing
(2-3) 3 hours credit. Prerequisites: ME 2243 and 3103.
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. Prerequisite: PHY 1904; corequisite: MAT 3253 or EE 2323.
Introduction to classical thermodynamics, fluid mechanics, and heat transfer; thermodynamics systems, first and second laws, thermodynamic cycles; fluid statics and dynamics; applications of conduction, convections, and radiation heat transfer. Not open to students majoring in mechanical engineering. May not be substituted for ME 3293, 3663, or 4313.

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, and introduction to basic thermodynamic cycles.

3313 Measurements and Instrumentation
(2-3) 3 hours credit. Prerequisites: ME 2213 and EE 2214; corequisite: MAT 3253.
Fundamentals of measurement systems; standards and treatment of data; transducers and signal conditioning; strain, force, acceleration, pressure, temperature, pressure, and fluid flow.

3323 Dynamics of Mechanical Systems
(3-0) 3 hours credit. Prerequisites: ME 3103 and 3713.
Mechanical system dynamics, linear systems, modeling techniques, analytical dynamics, and vibrations.

3423 Applied Engineering Analysis
(3-0) 3 hours credit. Prerequisites: CS 2073 and MAT 3253.
Application of mathematical principles to the analysis of engineering problems using traditional and modern techniques; Fourier series, partial differential equations, vector calculus, and complex number analysis.

3503 Alternative Energy Sources
(3-0) 3 hours credit. Prerequisite: ME 3293.

3513 Mechanism Design
(3-0) 3 hours credit. Prerequisites: CS 2073 and ME 3103.
Introduction to kinematics and mechanisms; graphical and linear analytical methods for kinematic synthesis; displacement, velocity, and acceleration analyses of mechanisms; and cam design.
Introduction to Mechanical Design
(3-0) 3 hours credit. Prerequisite: ME 2213.
Design process, design of machine elements for static and fatigue strength, and design of welded and bolted connections; simple mechanical design project and graphical communication of design.

Fluid Mechanics
(3-0) 3 hours credit. Prerequisites: CS 2073, MAT 3253, and ME 3103.
Fluid properties; fluid statics and dynamics; concepts and equations of fluid flow; similitude; viscous effects; lift and drag; and compressible fluid flow.

Numerical Methods in Mechanical Engineering
(3-0) 3 hours credit. Prerequisites: MAT 3253, ME 2103, and CS 2073.
Introduction to computational methods. Topics include finding roots of equations, interpolation, curve fitting, integration and differentiation, and methods to solve initial value problems. Applications will show how these methods can be applied to engineering problems.

Solid Mechanics
(3-0) 3 hours credit. Prerequisites: MAT 2213 and ME 2213.
Energy methods for rods, beams, plates, and finite elements. Classical and modern fatigue and failure criteria.

Intermediate Materials Engineering
(3-0) 3 hours credit. Prerequisites: ME 2241, 2243, and 3523.
Selected topics in ceramics and polymers; introduction to composites; fracture mechanics and corrosion; engineering design applications in material selection for control of fracture, deflection, wear, and corrosion.

Nondestructive Evaluation
(2-3) 3 hours credit. Prerequisites: ME 2243 and 3313.
Defect detection. Materials and defect characterization using nondestructive evaluation methods such as ultrasonic, eddy current, magnetic and electromagnetic methods, radiography, and thermography.

Thermodynamics II
(3-0) 3 hours credit. Prerequisite: ME 3293.
Nonreactive and reactive mixtures, vapor and gas power cycles, refrigeration, and thermodynamic relations.

Heat Transfer and Rate Processes
(3-0) 3 hours credit. Prerequisites: ME 3293, 3423, and 3713; corequisite: ME 3663.
Generalized potential distribution and gradients; transient and steady mass and heat transfer including conduction, forced and free convection, and radiation.

Thermal Systems Design
(2-3) 3 hours credit. Corequisite: ME 4313.
Application of basic thermodynamics, fluid mechanics, heat transfer, and computer methods to the design of heat exchangers, coils, fans, pumps, and thermal energy systems.

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4343 Heating, Air Conditioning, and Refrigeration Design  
(2-3) 3 hours credit. Corequisites: ME 4293 and 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 3663 and 3713.  Application of mass, energy, and force balance to compressible fluids; treatment of one-dimensional steady and transient flows, isentropic flow, adiabatic flow, and 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, radiative transfer, natural convection, boiling, condensation, mass diffusion, heat exchangers, and thermal storage systems.

4413 Intermediate Mechanism Design  
(3-0) 3 hours credit. Prerequisite: ME 3513.  Linear and nonlinear analytical methods for kinematic synthesis; statics, kinetostatics, and dynamics of mechanisms; design of cam and cam-link mechanisms; case studies; and computer-aided design.

4423 Machine Element Design  
(3-0) 3 hours credit. Prerequisite: ME 3513 and 3813.  Design of spur, helical, bevel, and worm gearings; design of couplings, clutches, and brakes; design of journal and rolling bearings, shafts, and springs; and computer-aided design.

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; and computer-assisted methods.

4513 Mechanical Vibrations and Dynamics of Machinery  
(3-0) 3 hours credit. Prerequisites: ME 3323 and 3423.  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.

4523 Dynamic Systems and Control  
(2-3) 3 hours credit. Prerequisites: ME 3313 and 3323.  Introduction to modeling and control of dynamic physical systems; analysis and design of control systems for mechanical, electrical, fluid, and thermal systems. (Formerly ME 4522. Credit cannot be earned for both ME 4523 and ME 4522.)
4533 Mechanical Engineering Design Methodology  
(3-0) 3 hours credit. Prerequisites: ME 3323 and 4423.  
Mechanical systems component design methodology; creative design,  
analysis, synthesis, selection, and design of components and systems;  
computer-aided design; and several short design projects.

4603 Finite Element Applications in Mechanical Design  
(2-3) 3 hours credit. Prerequisite: ME 4423.  
Design case studies and finite element applications in mechanical design.  
Finite element method fundamentals; finite element modeling methodology;  
design case studies using finite element programs; commercial and/or  
government codes will be utilized during scheduled laboratory.

4613 Power Systems Design  
(3-0) 3 hours credit. Prerequisites: ME 3663 and 4293.  
Application of basic fluid mechanics to the design of turbomachinery,  
turbines, pumps, compressors, and internal combustion engines.

4663 Intermediate Fluid Mechanics  
(3-0) 3 hours credit. Prerequisites: ME 3663 and 3713.  
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.

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 Laboratory  
(0-6) 2 hours credit. Prerequisite: ME 3313; corequisites: ME 3323 and  
4313.  
An experimental laboratory concerned with fluid statics, fluid flow, heat  
transfer, internal combustion engines, rotating machinery, and design of  
experiments.

4811 Mechanical Engineering Project Planning Laboratory  
(0-3) 1 hour credit. Prerequisites: ME 3323, 4423, and 4293; corequisite:  
ME 4313.  
Development, presentation, and approval of design project proposals,  
computer-aided synthesis, analysis, and modeling of an open-ended problem.  
Industrial cooperation is encouraged.

4813 Mechanical Engineering Design Project  
(2-3) 3 hours credit. Prerequisites: ME 4811 and EGR 3713.  
Completion of significant group design project. Development of design(s)  
using computer-aided synthesis, analysis, modeling, and optimization  
methods. Considerations of safety, reliability, environmental, and economic  
constraints, and ethical and social impacts. Formal presentations of progress  
and final reports.
4911-3 Independent Study
1 to 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 semester credit hours of independent study, regardless of discipline, will apply to a bachelor's degree.

4953 Special Studies in Mechanical Engineering
(3-0) 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 may be repeated for credit when topics vary, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree.
DIVISION OF LIFE SCIENCES

The Division of Life Sciences offers a Bachelor of Science degree in Biology with emphases in molecular cell biology and neurobiology. The degree is structured around a comprehensive core curriculum and related offerings in chemistry, physics, and mathematics that 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.

DIVISION HONORS

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

Selection of students for admission to the honors program is based on the student’s academic performance and recommendation by the faculty. To be eligible for the program, students must have a minimum overall grade-point average of 3.0 and a minimum grade-point average of 3.5 in their major. The minimum grade-point averages must be maintained for students to receive the approval of the Division Honors Committee and faculty. Students admitted to the honors program are expected to enroll in Honors Thesis (BIO 4993) during their final two semesters. The completed thesis must be approved by the supervising faculty sponsor and another divisional faculty member. Students interested in this program should contact their faculty advisors for additional information. Division Honors can be attained independent of or in addition to University Honors.

Bachelor of Science Degree in Biology

The minimum number of semester credit hours required for the Bachelor of Science degree in Biology, including the Core Curriculum requirements, is 126. Thirty-nine of the total semester credit hours required for the degree must be at the upper-division level. All major and support work courses must be completed with a grade of “C” or better.

All candidates for the degree must complete the following:

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

1. 23 semester credit hours in biology are required:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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<tbody>
<tr>
<td>BIO 1203</td>
<td>Biology I*</td>
</tr>
<tr>
<td>BIO 1212</td>
<td>Laboratory Investigations in Biology</td>
</tr>
<tr>
<td>BIO 1223</td>
<td>Biology II**</td>
</tr>
<tr>
<td>BIO 2313, 2322</td>
<td>Genetics and Laboratory</td>
</tr>
</tbody>
</table>

*Students seeking teacher certification should consult the Certification Program through the Office of Teacher Advising, Certification, and Placement in the Division of Education for information. Undergraduates seeking elementary teacher certification must complete the interdisciplinary studies degree.

**May be used to satisfy the Core Curriculum requirement in Domain IB.
BIO 3413, 3422  General Physiology and Laboratory
BIO 3513, 3522  Biochemistry and Laboratory

2. 10 semester credit hours of upper-division biology electives; two of the following must be completed:

BIO 3283, 3292  Principles of Ecology and Laboratory
BIO 3713, 3722  Microbiology and Laboratory
BIO 3813, 3822  Cellular Biology and Laboratory
BIO 4143, 4152  Developmental Biology and Laboratory
BIO 4433, 4442  Neurobiology and Laboratory

3. 15 additional semester credit hours of biology electives, 12 of which must be at the upper-division level

B. 24 to 25 semester credit hours of support work:

1. 13 semester credit hours are required in chemistry:

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

2. A minimum of 3 semester credit hours of mathematics selected from the following:

MAT 1214  Calculus II**
STA 1993  Statistical Methods for the Life and Social Sciences

3. 8 semester credit hours of physics:

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

C. 21 semester credit hours of free electives

COURSE DESCRIPTIONS
BIOLOGY
(BIO)

1023 Human Sex and Reproduction
(3-0) 3 hours credit.
An in-depth look at human reproductive anatomy, physiology, and behavior. Topics to be considered include sexual selection, mating, endocrine function, fertilization, birth control, and sexually transmitted diseases. (Formerly BIO 2003. Credit cannot be earned for both BIO 1023 and BIO 2003.)

*May be used to satisfy the Core Curriculum requirement in Domain IB.
**May be used to satisfy the Core Curriculum requirement in Domain IA.

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1033 **Drugs and Society**  
(3-0) 3 hours credit.  
An examination of licit and illicit drugs and their biosocial effects. Topics include pharmacology of alcohol, stimulants, hallucinogens, addiction, and abuse. May apply toward the Level I Core Curriculum requirement in interdisciplinary studies. (Formerly BIO 3023. Credit cannot be earned for both BIO 1033 and BIO 3023.) [TCCN: PHED 1346.]

1203 **Biology I**  
(3-0) 3 hours credit.  
An introduction to the science of biology, emphasizing a comparative study of the diversity of life forms. Topics include cell biology, energetics, metabolism, sexual reproduction, development, physiology, and animal behavior. May apply toward the Level I Core Curriculum requirement in science. (Credit cannot be earned for both BIO 1203 and BIO 1103.) [TCCN: BIOL 1306.]

1212 **Laboratory Investigations in Biology**  
(0-6) 2 hours credit.  
Introduction to the tools, techniques, and topics of modern experimental biology. (Formerly BIO 1112. Credit cannot be earned for both BIO 1212 and BIO 1112.) [TCCN: BIOL 1106.]

1223 **Biology II**  
(3-0) 3 hours credit. Prerequisites: BIO 1203 and MAT 1023 or an equivalent.  
An introduction to the science of biology, emphasizing a comparative study of the diversity of life forms. Topics include the decomposers, the producers, the consumers, genetics, ecology, and evolution. May apply toward the Level II Core Curriculum requirement in science. [TCCN: BIOL 1307.]

2123 **Comparative Anatomy of Vertebrates**  
(3-0) 3 hours credit. Prerequisites: BIO 1203 and 1212.  
A detailed study of anatomical differences and similarities of vertebrates with reference to evolutionary changes. Concurrent enrollment in BIO 2132 is recommended.

2132 **Comparative Anatomy of Vertebrates Laboratory**  
(0-6) 2 hours credit.  
Concurrent enrollment in BIO 2123 is recommended.

2313 **Genetics**  
(3-0) 3 hours credit. Prerequisites: BIO 1203, 1223, and 1212, and CHE 1103 or an equivalent.  
Principles governing transmission of hereditary factors in plants and animals, with emphasis on molecular biochemical and population genetics. Concurrent enrollment in BIO 2322 is recommended. [TCCN: BIOL 2316.]

2322 **Genetics Laboratory**  
(0-6) 2 hours credit. Optional for nonmajors.  
Concurrent enrollment in BIO 2313 is recommended.
3003 Introduction to Oceanography
(3-0) 3 hours credit. Prerequisites: BIO 1203, 1223, and 1212.
General oceanography with an emphasis on biological aspects and living marine resources.

3013 Introductory Pathology
(3-0) 3 hours credit. Prerequisites: BIO 1203, 1223, and 1212, or AHS 2103.
Concepts of disease and diagnosis of pathological conditions.

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 1203, 1223, and 1212.
A comprehensive study of the invertebrate animals, with emphasis on their taxonomy, morphology, ecology, and evolution.

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. Prerequisites: BIO 1203, 1223, and 1212.
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.

3163 Histology and Cytology
(3-0) 3 hours credit. Prerequisites: BIO 1203, 1223, and 1212.
The cytological and histological aspects of cellular organization. Concurrent enrollment in BIO 3172 is recommended.

3172 Histological and Cytological Laboratory
(0-6) 2 hours credit.
Concurrent enrollment in BIO 3163 is recommended.

3213 Animal Behavior
(3-0) 3 hours credit. Prerequisites: BIO 1203, 1223, and 1212.
A detailed study of animal behaviors and their biological determinants.

3263 The Woody Plants
(2-3) 3 hours credit. Prerequisite: Consent of instructor.
A study of the woody plants emphasizing the characteristics of family, genus, species. Includes identification of the common woody plants. Leaf, stem, and flower morphology, anatomy, and collecting techniques. Lecture, laboratory, and fieldwork will be included as part of the course.
3273 Biology of Flowering Plants
(2-3) 3 hours credit.
A study of the wildflowers of Texas emphasizing identification of the more common wildflowers, as well as family characteristics, flower anatomy, and plant morphology. Plant-collecting techniques and wildflower photography will be included. Lecture, laboratory, and fieldwork are also part of the course.

3283 Principles of Ecology
(3-0) 3 hours credit. Prerequisites: BIO 1203, 1223, 1212, or consent of instructor; completion of the Core Curriculum requirement in mathematics. A study of the interaction of organisms with their environment, with focus on ecological principles, adaptations of organisms, environmental pollution, and principles of conservation. Concurrent enrollment in BIO 3292 is recommended for biology majors. May apply toward the Level II Core Curriculum requirement in science.

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. Concurrent enrollment in BIO 3283 is recommended.

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 1203, 1223, and 1212.
A study of the life histories and phylogenetic relationships of vascular and nonvascular plants. Concurrent enrollment in BIO 3351 is recommended.

3351 Plant Sciences Laboratory
(0-3) 1 hour credit.
Concurrent enrollment in BIO 3343 is recommended.

3413 General Physiology
(3-0) 3 hours credit. Prerequisites: BIO 1203, 1223, 1212, and CHE 1303.
Fundamental properties and processes in living systems. Concurrent enrollment in BIO 3422 is recommended. (Credit cannot be earned for both AHS 2103 and BIO 3413.)

3422 General Physiology Laboratory
(0-6) 2 hours credit.
Concurrent enrollment in BIO 3413 is recommended. (Credit cannot be earned for both AHS 2111 and BIO 3422.)
3513 Biochemistry
(3-0) 3 hours credit. Prerequisites: CHE 2203 and 2242; BIO 2313 is also recommended.
Introduction to biochemistry: amino acids, protein structure, enzymes, lipids, metabolism, nucleic acid structure, bioenergetics, and carbohydrates. Concurrent enrollment in BIO 3522 is recommended.

3522 Biochemistry Laboratory
(0-6) 2 hours credit.
Basic biochemical laboratory techniques: titration, protein purification, enzyme kinetics, chromatography, electrophoresis, and centrifugation. Concurrent enrollment in BIO 3513 is recommended.

3613 The Biology of Aging
(3-0) 3 hours credit. Prerequisites: BIO 1203 and 1223.
The biological principles of human life and health; the changes that occur with aging and their implications for the lives of students and their families.

3633 Human Environmental Physiology
(3-0) 3 hours credit. Prerequisite: 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. Concurrent enrollment in BIO 3722 is recommended. (Credit cannot be earned for both AHS 1053 and BIO 3713.)

3722 Microbiology Laboratory
(0-6) 2 hours credit.
Concurrent enrollment in BIO 3713 is recommended. (Credit cannot be earned for both AHS 1061 and BIO 3722.)

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 the molecular level. Concurrent enrollment in BIO 3822 is recommended.

3822 Cellular Biology Laboratory
(0-6) 2 hours credit.
Concurrent enrollment in BIO 3813 is recommended.
3913 Molecular Biology
(3-0) 3 hours credit. Prerequisite: BIO 3513.
A study of nucleotides, DNA, replication, recombination, RNA, transcription, genetic code, translation, and chromosomes.

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, as well as examinations of desert climatic patterns, geology, and natural history. Lecture, laboratory, and fieldwork will be included.

4073 Law, Ethics, and the Life Sciences
(3-0) 3 hours credit. Prerequisites: BIO 1203, 1223, and 1212, 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 The Biotechnology of Malting and Brewing
(3-0) 3 hours credit. Prerequisites: BIO 3513, 3522, 3713, and 3722.
A study of the scientific principles underlying brewing and other fermentation technology.

4143 Developmental Biology
(3-0) 3 hours credit. Prerequisites: BIO 1203, 1223, 3513, and 3813.
Sequential analysis of development in vertebrates and the factors which affect fertilization, organogenesis, and implantation. Concurrent enrollment in BIO 4152 is recommended. (Formerly BIO 3143. Credit cannot be earned for both BIO 3143 and 4143.)

4152 Developmental Biology Laboratory
(0-6) 2 hours credit.
Concurrent enrollment in BIO 4143 is recommended. (Formerly BIO 3152. Credit cannot be earned for both BIO 3152 and 4152.)

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. Concurrent enrollment in BIO 4221 is recommended.
4221  **Plant Ecology Laboratory**  
(0-3) 1 hour credit.  
Provides the opportunity for field-oriented study to examine qualitative and quantitative methods and evaluate plant communities. Concurrent enrollment in BIO 4203 is recommended.

4233  **Field Biology**  
(3-0) 3 hours credit. Prerequisites: BIO 1203, 1223, and 1212, 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. Concurrent enrollment in BIO 4241 is recommended.

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. Concurrent enrollment in BIO 4233 is recommended.

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 and 2322.  
Application of recombinant DNA techniques to the study of animals and plants in industry, medicine, and research. Concurrent enrollment in BIO 4352 is recommended.

4352  **Molecular Genetics Laboratory**  
(0-6) 2 hours credit. Prerequisites: BIO 2313 and 2322.  
A laboratory course emphasizing techniques for cloning, sequencing, and analyzing recombinant DNA molecules. Concurrent enrollment in BIO 4343 is recommended.

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. Concurrent enrollment in BIO 4442 is recommended.

4442  **Neurobiology Laboratory**  
(0-6) 2 hours credit.  
A laboratory course emphasizing principles presented in BIO 4433. Concurrent enrollment in BIO 4433 is recommended.
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, with a study of the gross and microscopic morphology of  
the glands of internal secretion. Concurrent enrollment in BIO 4462 is  
recommended.

4462 Endocrinology Laboratory  
(0-6) 2 hours credit.  
A laboratory course emphasizing principles presented in BIO 4453.  
Concurrent enrollment in BIO 4453 is recommended.

4523 Intermediary Metabolism  
(3-0) 3 hours credit. Prerequisites: BIO 3513 and 3522.  
A detailed consideration of metabolic pathways and energy metabolism and  
their regulation.

4592 Advanced Neurobiology Laboratory  
(0-6) 2 hours credit.  
Instruction and hands-on training in techniques of in-vitro electrophysiology,  
nearal modeling, cell culture, and molecular neurobiology. Concurrent  
enrollment in BIO 4593 is recommended.

4593 Advanced Neurobiology  
(3-0) 3 hours credit. Prerequisites: BIO 4433 and 4442.  
A lecture-seminar course with an emphasis on current topics in  
neurophysiological, neurocomputational, cellular and molecular biological  
research. Concurrent enrollment in BIO 4592 is recommended.

4603 Plant Physiology  
(3-0) 3 hours credit. Prerequisites: BIO 3343 and 3351, and CHE 2203 and  
2242.  
Principles of organization of cellular activity and molecular structure of  
protoplasm; includes nutrition, translocation, mineral metabolism,  
respiration, and photosynthesis. Concurrent enrollment in BIO 4611 is  
recommended.

4611 Plant Physiology Laboratory  
(0-3) 1 hour credit.  
Qualitative and quantitative experiments in the study of plant physiology.  
Concurrent enrollment in BIO 4603 is recommended.

4723 Virology  
(3-0) 3 hours credit. Prerequisite: BIO 3713.  
A study of the diversity of viruses and biochemical mechanisms for their  
replication. Concurrent enrollment in BIO 4732 is recommended.

4732 Virology Laboratory  
(0-6) 2 hours credit.  
Concurrent enrollment in BIO 4723 is recommended. A laboratory course  
emphasizing the principles of virus replication, genetics, and structure.  
Introduction to modern laboratory techniques for virus propagation, detection,
quantitation, and for genetic-phenotypic analysis. (Formerly BIO 4731. Credit cannot be earned for both BIO 4731 and 4732.)

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 and current concepts of humoral and cell-mediated immunity and the cells involved. Concurrent enrollment in BIO 4752 is recommended.

4752 Immunology Laboratory
(0-6) 2 hours credit. Concurrent enrollment in BIO 4743 is recommended.

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. Concurrent enrollment in BIO 4772 is recommended.

4772 Parasitology Laboratory
(0-6) 2 hours credit. Concurrent enrollment in BIO 4763 is recommended.

4813 Brain and Behavior
(3-0) 3 hours credit. Prerequisite: BIO 1203, 1223, and 1212, or consent of instructor. Basic physiological functions of the brain and how they relate to behavior.

4911-3 Independent Study
1 to 3 hours credit. (Hours arranged.) Prerequisite: Permission in writing (form available) from 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 semester credit hours, regardless of discipline, will apply to a bachelor’s degree.

4951-3 Special Studies in Biology
(1,2,3-0) 1 to 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 may be repeated for credit when the topics vary, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor’s degree.

4963 Seminar in Biology
(3-0) 3 hours credit. Prerequisite: Minimum of 20 semester credit hours in biological sciences. An undergraduate seminar surveying selected biological topics through presentation and discussion of relevant contemporary research and literature. May not be repeated for credit. Limited to biology majors in their junior or senior year.
4972 **MBRS-MARC Symposium**

(2-0) 2 hours credit. Prerequisites: BIO 1203, 1223, and 1212; 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, but not more than 6 semester credit hours may be applied to a bachelor’s degree.

4993 **Honors Research**

3 hours credit. (Hours arranged.) Prerequisite: Enrollment limited to candidates for honors in biology during their last two semesters and approval by the Division Honors Committee and faculty.

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

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**JOINT ALLIED HEALTH SCIENCE PROGRAMS**

A joint degree program with The University of Texas Health Science Center at San Antonio (UTHSCSA) leading to the Bachelor of Science is available in Clinical Laboratory Sciences. A degree in this allied health program is awarded jointly. Completion of joint program prerequisites does not guarantee or imply preferential admittance to the professional phase of the program.

The preclinical curriculum for clinical laboratory sciences (CLS) includes Core Curriculum requirements, basic science lecture and laboratory courses, and CLS courses. Clinical laboratory science concepts are introduced throughout the curriculum, ending in a senior-year clinical practicum at UTHSCSA. Upon completion of all requirements, the student is eligible to take one of the clinical laboratory sciences national certification examinations.

**Preprofessional Curriculum**

Also available are preprofessional courses offering students the opportunity to prepare for admission to nursing, medical, dental, and other professional schools.

UTSA offers courses that fulfill the nursing preprofessional curriculum requirements for The University of Texas Health Science Center at San Antonio. All coursework listed will transfer to UTHSCSA without any loss of credit. Specific premedical and predental programs are not offered at UTSA. Admission requirements for these professional schools are outlined in a separate section 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 Subcommittee of UTSA.

**Professional Liability (Malpractice) Insurance Requirement**

Allied health students are required by policies of the Board of Regents of The University of Texas System to show evidence of professional liability (malpractice) insurance coverage prior to official registration for courses that involve a clinical situation. Additional information on the requirement for obtaining such coverage is available from the director of the Division of Life Sciences.
UTSA/UTHSCSA Joint Bachelor of Science Degree in Clinical Laboratory Sciences (CLS)

Certain specific physical skills and abilities are required to successfully participate in the clinical laboratory sciences 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 sciences 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. Students complete clinical laboratory sciences courses during their sophomore and junior years and enroll in classes on both the UTSA and UTHSCSA campuses. To enroll in UTHSCSA courses, students must complete a course card obtainable from both the UTHSCSA Office of Admissions and the Department of Clinical Laboratory Sciences. All CLSC courses are taught at UTHSCSA and are listed separately.

For consideration for admission into the joint degree program, students must complete a separate application form. This form 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 1 for fall admission and November 1 for spring admission. Students must be admitted to UTHSCSA before they enroll in CLSC courses. Minimum requirements for admission to UTHSCSA include 24 semester credit hours of college work, an overall grade-point average of 2.0, and no grade lower than a “C” in any basic science course.

Admission to and successful continuation in the program will provide the student with a clinical practicum position at one of the UTHSCSA teaching affiliates. A list of these affiliates may be obtained from the Department of Clinical Laboratory Sciences at UTHSCSA.

The clinical laboratory sciences 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, students are eligible to take one of the national certification examinations. All students are encouraged to be counseled each semester by either the CLS department chair or a member of the CLS faculty to ensure enrollment in appropriate coursework.

The minimum number of semester credit hours required for this degree, including the Core Curriculum requirements, is 149.

All candidates for the degree must complete the following:

A. 57 semester credit hours in preprofessional support work:

1. 27 semester credit hours in the biological sciences:
   AHS 1883 Introduction to Clinical Laboratory Sciences
   BIO 1203 Biology I*

*Any two of these courses may be used to satisfy the Core Curriculum requirements in Domain IB.
BIO 1212  Laboratory Investigations in Biology
BIO 2313  Genetics
AHS 2103  Human Biology: Physiology
or
BIO 3413  General Physiology
or
AHS 3463  Human Physiology
BIO 3513, 3522  Biochemistry and Laboratory
BIO 3713, 3722  Microbiology and Laboratory
BIO 4743  Immunology

2. 13 semester credit hours in chemistry:

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

3. 8 semester credit hours in physics:

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

4. 6 semester credit hours in mathematics:

MAT 1093  Precalculus**
STA 1053  Basic Statistics

5. 3 semester credit hours in computer science

B. 59 semester credit hours in clinical laboratory sciences, all of which must be completed at UTHSCSA:

1. These courses are taken prior to clinical training and are integrated with support work taken at UTSA:

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

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

   a. Senior Fall
   CLSC 40333  Advanced Medical Microbiology
   CLSC 40353  Advanced Hematology
   CLSC 40587  Chemistry Practicum
   CLSC 40567  Immunohematology Practicum
   CLSC 40192  Management I

*Any two of these courses may be used to satisfy the Core Curriculum requirements in Domain IB.
**May be used to satisfy the Core Curriculum requirement in Domain IA.
The postbaccalaureate certificate option in Clinical Laboratory Sciences is designed for students who hold a bachelor’s degree in science from an accredited institution. The curriculum includes 59 semester credit hours of professional coursework. Prerequisite science requirements not completed as a part of the bachelor’s degree may be taken as a part of the certificate curriculum. The certificate option course of study is 18 months long.

In addition, the program offers a categorical certificate designed for individuals with a bachelor’s degree in science who are interested in a particular subdiscipline of the clinical laboratory. These certificates are available in Microbiology, Clinical Chemistry, Immunohematology, and Hematology. Students can complete the categorized requirements in 12 to 18 months, based on part-time enrollment. Successful completion of the certificate curriculum qualifies students to take the national certification examinations as generalists or categorical scientists.

Interested persons should contact the Department of Clinical Laboratory Sciences at UTHSCSA for further details.

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 semester credit hours (two years) of prenursing course requirements available at UTSA. Phase I coursework at UTSA is approved by the Division of Life Sciences Health Related Professions Advisory Subcommittee. Phase II requires students to complete 60 semester credit hours of courses in the nursing major through either the Generic Process or Flexible Process track at the UTHSCSA School of Nursing. The minimum number of semester credit hours required for this degree is 120.

Admission into Phase I must be made through UTSA. Admission into Phase II must be made through UTHSCSA. Students who have completed 40 to 45 semester credit hours of Phase I courses may request an application for admission from the Office of 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
The University of Texas Health Science Center
at San Antonio
7703 Floyd Curl Drive
San Antonio, Texas 78284-7702
(210) 567-2670

UTHSCSA B.S. in Nursing / 357
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 grade-point average of 2.0 and a grade-point average of 2.3 in prenursing course requirements in order to be considered for admission. *Students with higher grade-point averages will be more competitive.*

Applicants must have passed all sections of the Texas Academic Skills Program (TASP) test and must meet minimum standards before they may enroll in upper-division (Phase II) coursework. Students may not enroll in the upper-division nursing courses until they have completed the 60 semester credit hours of prerequisite courses and have been formally accepted by UTHSCSA.

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

**Phase I:** 59 semester credit hours at UTSA. All courses are subject to approval by the School of Nursing when the student applies for Phase II.

A. 20 semester credit hours of natural and physical sciences:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHS 2083, 2091</td>
<td>Human Biology: Anatomy and Laboratory*</td>
</tr>
<tr>
<td>AHS 2103, 2111</td>
<td>Human Biology: Physiology and Laboratory*</td>
</tr>
<tr>
<td>AHS 1053, 1061</td>
<td>Introductory Microbiology (Laboratory strongly recommended)*</td>
</tr>
<tr>
<td>CHE 1003, 1011</td>
<td>General Chemistry for Allied Health Sciences (Laboratory strongly recommended)</td>
</tr>
<tr>
<td>CHE 1203, 1211</td>
<td>Elementary Organic and Biochemistry (Laboratory strongly recommended)</td>
</tr>
</tbody>
</table>

B. 15 semester credit hours in the behavioral sciences:

1. PSY 1013 Introduction to Psychology**  
   PSY 2503 Developmental Psychology  
   SOC 1013 Introduction to the Study of Society**

2. 6 semester credit hours of electives

C. 24 semester credit hours in other basic requirements:

1. 6 required semester credit hours:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHS 2043</td>
<td>Nutrition</td>
</tr>
<tr>
<td>STA 1053</td>
<td>Basic Statistics (or 1063 or 1073)</td>
</tr>
</tbody>
</table>

2. 18 semester credit hours of UTSA Core Curriculum requirements (for a listing of the courses that fulfill these requirements, see chapter 6, Bachelor’s Degree Regulations, of this catalog):

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*BIO 1203 Biology I and BIO 1212 Laboratory Investigations in Biology are prerequisites to the above allied health services courses.

**May be used to satisfy the Core Curriculum requirement in Domain IIC.
Phase II: One of the following plans, completed at UTHSCSA:

A. Generic Plan

The following lists the courses in 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.

**FIRST SEMESTER, JUNIOR YEAR**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>NURS 3209</td>
<td>Introduction to Professional Nursing</td>
<td>2</td>
</tr>
<tr>
<td>NURS 3310</td>
<td>Nursing and Drug Therapy</td>
<td>3</td>
</tr>
<tr>
<td>NURS 3811</td>
<td>Nursing of Individuals with Deviations in Health Status</td>
<td>8</td>
</tr>
</tbody>
</table>

**SECOND SEMESTER, JUNIOR YEAR**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>NURS 3522</td>
<td>Nursing the Client with Mental Illness</td>
<td>5</td>
</tr>
<tr>
<td>NURS 3912</td>
<td>Nursing of Families: Childbirth, Parenting, Illness</td>
<td>9</td>
</tr>
</tbody>
</table>

**THIRD SEMESTER, SENIOR YEAR**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>NURS 4203</td>
<td>The Nurse as a Professional</td>
<td>2</td>
</tr>
<tr>
<td>NURS 4513</td>
<td>Community Health Nursing</td>
<td>5</td>
</tr>
<tr>
<td>NURS 4523</td>
<td>Nursing of Clients with Chronic Health Problems</td>
<td>5</td>
</tr>
</tbody>
</table>

**FOURTH SEMESTER, SENIOR YEAR**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>NURS 4504</td>
<td>The Nurse as Manager and Leader</td>
<td>5</td>
</tr>
<tr>
<td>NURS 4704</td>
<td>Nursing the Client with Major Health Problems</td>
<td>7</td>
</tr>
</tbody>
</table>

Upper-Division Electives: 3 hours of electives must be in nursing 9 hours

B. Flexible Plan

Only students with previous nursing experience are eligible for this 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. Some courses are offered by examination only. Credit for much of the program can be completed by examination also. For a complete list of these courses, contact the UTHSCSA Center School of Nursing.
FIRST SEMESTER (courses offered by examination only)

NURS 3327 Nursing of Clients with Alteration in Mental Health 3 hours
NURS 3624 Nursing Practice: Clinical Skills 6 hours
NURS 3925 Nursing of Adults with Health Problems 9 hours
NURS 3926 Nursing of Children and Childbearing Women 9 hours

SECOND SEMESTER

NURS 4212 Professional Nursing: Health Assessment 2 hours
NURS 4504 The Nurse as a Manager and Leader 5 hours
NURS 4512 Professional Nursing: Health Promotion 5 hours

THIRD SEMESTER

NURS 4114 Professional Nursing: Research 1 hour
NURS 4213 Professional Nursing: Issues and Ethics 2 hours
NURS 4413 Professional Nursing: Family Focus 4 hours
NURS 4513 Community Health Nursing 5 hours
Upper-Division Electives 3 semester hours of electives must be in nursing 9 hours

COURSE DESCRIPTIONS

ALLIED HEALTH SCIENCES (AHS)

1053 Introductory Microbiology
(3-0) 3 hours credit. Prerequisites: BIO 1203 and 1212, or consent of instructor.
A general study of microorganisms, their characteristics, isolation, growth, and importance in nature, industry, public health, and human disease. (Credit cannot be earned for both AHS 1053 and BIO 3713.) [TCCN: BIOL 2320.]

1061 Introductory Microbiology Laboratory
(0-3) 1 hour credit.
Credit cannot be earned for both AHS 1061 and BIO 3722. [TCCN: BIOL 2120.]

1883 Introduction to Clinical Laboratory Sciences
(3-0) 3 hours credit. Prerequisite: CHE 1103 is recommended.
Overview of the profession of clinical laboratory sciences, 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 1203 and 1212, or AHS 2103.
An examination of human nutritional needs from infancy to adulthood. [TCCN: BIOL 1322.]
2083 **Human Biology: Anatomy**
(3-0) 3 hours credit. Prerequisites: BIO 1203 and 1212.
Systemic anatomy of the human organism. Includes cell biology, histology, and gross anatomy of major organ systems. May not be applied to a B.S. in Biology. [TCCN: BIOL 2301.]

2091 **Human Biology: Anatomy Laboratory**
(3-0) 1 hour credit.
May not be applied to a B.S. in Biology. [TCCN: BIOL 2101.]

2103 **Human Biology: Physiology**
(3-0) 3 hours credit. Prerequisites: BIO 1203 and 1212.
Physiological processes in human systems. May not be applied to a B.S. in Biology. [TCCN: BIOL 2302.]

2111 **Human Biology: Physiology Laboratory**
(3-0) 1 hour credit.
May not be applied to a B.S. in Biology. [TCCN: BIOL 2102.]

3463 **Human Physiology**
(3-0) 3 hours credit. Prerequisites: BIO 1203 and 1212, CHE 1203 or 2203, or consent of instructor.
Physiological processes in human systems.
DIVISION OF MATHEMATICS AND STATISTICS

The Division of Mathematics and Statistics offers a Bachelor of Science degree in Mathematics. The degree is offered in three concentrations: mathematics, statistics, and general mathematical studies. The Mathematics and Statistics Concentrations offer students the opportunity to prepare to provide technical support and do research for high-technology industries, government, and private companies; to teach mathematics at the secondary level; and to pursue advanced graduate study. The General Mathematical Studies Concentration is designed primarily for those students wishing to teach mathematics at the secondary level. The division also offers Minors in Mathematics and Statistics.

Bachelor of Science Degree in Mathematics

The Bachelor of Science degree in Mathematics is offered with three concentrations: mathematics, statistics, and general mathematical studies.

The minimum number of semester credit hours required for this degree, including the Core Curriculum requirements, is 126. Thirty-nine of the total semester credit hours required for the degree must be at the upper-division level.

Students choosing the General Mathematical Studies Concentration must satisfy Core Curriculum requirements and Texas Teacher Certification Program requirements.

All required and elective mathematics and statistics courses must be completed with a grade of "C" or better.

All candidates for the Bachelor of Science degree in Mathematics, regardless of concentration, must complete the following 28 to 29 semester credit hours of required courses (this includes the 3 hours of the Core Curriculum requirement in mathematics):

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS 1073</td>
<td>Introductory Computer Programming for Scientific Applications</td>
</tr>
<tr>
<td>CS 1713, 1711</td>
<td>Introduction to Computer Science and Recitation</td>
</tr>
<tr>
<td>CS 2073</td>
<td>Computer Programming with Engineering Applications</td>
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<tr>
<td>MAT 1214</td>
<td>Calculus I*</td>
</tr>
<tr>
<td>MAT 1223</td>
<td>Calculus II</td>
</tr>
<tr>
<td>MAT 2213</td>
<td>Calculus III</td>
</tr>
<tr>
<td>MAT 2233</td>
<td>Linear Algebra</td>
</tr>
<tr>
<td>MAT 3213</td>
<td>Foundations of Analysis</td>
</tr>
<tr>
<td>MAT 4213</td>
<td>Real Analysis I</td>
</tr>
<tr>
<td>STA 3513</td>
<td>Probability and Statistics</td>
</tr>
<tr>
<td>STA 3523</td>
<td>Statistical Methods</td>
</tr>
</tbody>
</table>

*The student who is not prepared to begin MAT 1214 must take MAT 1093 Precalculus, which may also satisfy the Core Curriculum requirement in Domain IA.

UTSA 1999–2000 Undergraduate Catalog
In addition, a candidate for the Bachelor of Science degree in Mathematics must complete the course requirements for the concentration declared by the candidate.

Mathematics Concentration

A. 15 semester credit hours of required courses:

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

B. 6 additional semester credit hours of upper-division courses in mathematics or statistics approved by the student's advisor

C. 37 to 38 semester credit hours of electives

Statistics Concentration

A. 18 semester credit hours of required courses:

MAT 3633 Numerical Analysis
STA 3013 Multivariate Analysis for the Life and Social Sciences
STA 3433 Applied Nonparametric Statistics
STA 4643 Introduction to Stochastic Processes
STA 4713 Applied Regression Analysis
STA 4723 Design and Analysis of Experiments

B. 9 additional semester credit hours of approved courses in the division, of which at least 6 hours must be upper-division; 3 hours may be at the 2000 level

C. 31 to 32 semester credit hours of electives

General Mathematical Studies Concentration

A. 15 semester credit hours of mathematics and/or statistics:

1. 9 semester credit hours of mathematics:

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

2. 6 approved upper-division semester credit hours in mathematics or statistics

B. 6 semester credit hours of required academic foundations:

   COM 1043 Introduction to Communication
   3 semester credit hours of English literature*

*May be used to satisfy the Core Curriculum requirement in Domain IIIA. If so, an additional 3 semester credit hours must be taken to meet the 126-semester-credit-hour minimum for the degree.

UTSA 1999–2000 Undergraduate Catalog
Students seeking teacher certification should use 21 of these hours for the required certification courses. Other students should take an additional 6 semester credit hours of upper-division mathematics or statistics courses approved by the Undergraduate Advisor of Record.

Certification requirements for students pursuing the General Mathematical Studies Concentration are different from degree requirements. In addition to specific course requirements, teacher certification in Texas also requires passing scores on 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 Advising, Certification, and Placement at UTSA.

**Minor in Mathematics**

All students pursuing the Minor in Mathematics must complete 22 semester credit hours.

A. 16 semester credit hours of required courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td>MAT 1214</td>
<td>Calculus I</td>
</tr>
<tr>
<td>MAT 1223</td>
<td>Calculus II</td>
</tr>
<tr>
<td>MAT 2213</td>
<td>Calculus III</td>
</tr>
<tr>
<td>MAT 2233</td>
<td>Linear Algebra</td>
</tr>
<tr>
<td>MAT 3613</td>
<td>Differential Equations</td>
</tr>
</tbody>
</table>

B. 6 semester credit hours of approved upper-division mathematics electives

To declare a Minor in Mathematics, obtain advice, or seek approval of substitutions for course requirements, students should consult the Undergraduate Advisor of Record in the Division of Mathematics and Statistics.

**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 toward any degree at UTSA.
0113 **Elemental Algebra**  
(3-0) 3 hours credit.  
Introductory algebra course that includes the Texas Academic Skills Program (TASP) Algebra and Problem Solving objectives. Operations with algebraic expressions; solving one- and two-variable equations; solving word problems involving one and two variables; graphing numbers and number relationships; solving problems involving quadratic equations. Course does not count toward any degree at UTSA.

1023 **College Algebra**  
(3-0) 3 hours credit. Prerequisite: Placement.  
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, and polynomials. Other topics may include sequences, series, binomial expansion, mathematical induction, permutations, and combinations. (Formerly MAT 1063. Credit cannot be earned for both MAT 1023 and MAT 1063.) [TCCN: MATH 1314.]

1033 **Algebra with Calculus for Business**  
(3-0) 3 hours credit. Prerequisite: Placement.  
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; matrices; and differentiation and integration. [TCCN: MATH 1325.]

1093 **Precalculus**  
(3-0) 3 hours credit. Prerequisite: MAT 1023 or an equivalent course or placement.  
Exponential functions, logarithmic functions, trigonometric functions, complex numbers, DeMoivre's theorem, and polar coordinates. [TCCN: MATH 2312.]

1143 **Essential Elements in Mathematics**  
(3-0) 3 hours credit. Prerequisite: MAT 1023.  
Numeration systems; properties of the systems of whole numbers, integers, rational numbers, and real numbers; problem solving, geometry, and measurement; probability and statistics; logic. May not be applied toward a major in mathematics. [TCCN: MATH 1335.]

1214 **Calculus I**  
(4-0) 4 hours credit. Prerequisite: MAT 1093 or an equivalent course or placement.  
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. [TCCN: MATH 2413.]

1223 **Calculus II**  
(3-0) 3 hours credit. Prerequisite: MAT 1214.  
Methods of integration, inverse trigonometric functions, and applications of the integral. [TCCN: MATH 2314.]
2213  **Calculus III**  
(3-0) 3 hours credit. Prerequisite: MAT 1223.  
Special areas of differential and integral calculus; includes Taylor series,  
power series, convergence tests, vectors, functions of several variables, partial  
derivatives, and multiple integrals. [TCCN: MATH 2315.]

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. [TCCN: MATH 2318.]

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 1214.  
A survey of geometric concepts, including axiomatic developments of  
advanced Euclidean geometry, coordinate geometry, non-Euclidean geometry,  
three-dimensional geometry, and topology. May not be applied toward a  
major in mathematics other than the General Mathematical Studies  
Concentration of the B.S. in Mathematics.

3213  **Foundations of Analysis**  
(3-0) 3 hours credit. Prerequisite: MAT 1214 (MAT 2243 is recommended).  
Axiomatic definition of real numbers, including order properties and  
completeness; infinite sequences and their convergence; basic notions related  
to series and their convergence; functions and function limits. Introduction  
to topology of the real line. Emphasis on theorem proving.

3223  **Complex Variables**  
(3-0) 3 hours credit. Prerequisites: MAT 2213 and either 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 1214 (MAT 2243 is recommended).  
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, and Divergence theorem.
3253 **Engineering Analysis**  
(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 mathematics.

3273 **Applied Mathematics for Sciences and Engineering**  
(3-0) 3 hours credit. Prerequisite: MAT 3253 or 3613.  
Complex analysis, Fourier series, Fourier transforms, harmonic analysis,  
and partial differential equations. (Formerly MAT 3263. Credit cannot be  
earned for both MAT 3273 and MAT 3263.)

3613 **Differential Equations I**  
(3-0) 3 hours credit. Prerequisite: Completion of 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,  
and 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, MAT 3213, and either CS  
1073 or CS 1713.  
Solution of linear and nonlinear equations, curve-fitting, and eigenvalue  
problems.

4113 **Computer Mathematical Topics**  
(3-0) 3 hours credit. Prerequisites: MAT 3233 and either 3123 or 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 BASIC programming language.  
May not be applied toward a major in mathematics other than the General  
Mathematical Studies Concentration of the B.S. in Mathematics.

4123 **History of Mathematics**  
(3-0) 3 hours credit. Prerequisites: MAT 3233 and either 3123 or 4263.  
Selected subjects in mathematics developed through historical perspectives  
and biographies. May not be applied toward a major in mathematics other  
than the General Mathematical Studies Concentration of the B.S. in  
Mathematics.

4213 **Real Analysis I**  
(3-0) 3 hours credit. Prerequisite: MAT 3213.  
Continuous functions, uniform continuity; theory of differentiation;  
applications of the derivatives to properties of functions; antiderivatives;  
Riemann integral; connection between differentiation and integration.
4223  **Real Analysis II**  
(3-0) 3 hours credit. Prerequisite: MAT 4213. 
Lebesque integral on the real line; $n$-dimensional spaces; vectors; calculus of functions of several variables; multidimensional integration.

4233  **Modern Abstract Algebra I**  
(3-0) 3 hours credit. Prerequisite: MAT 3213. 
An in-depth study of groups and rings.

4253  **Number Theory**  
(3-0) 3 hours credit. Prerequisite: MAT 3213. 
The theory of primes, congruences, and related subjects.

4263  **Geometry**  
(3-0) 3 hours credit. Prerequisite: MAT 3213. 
Projective, affine, and non-Euclidean geometry.

4273  **Topology**  
(3-0) 3 hours credit. Prerequisite: MAT 3213. 
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 semester credit hours, regardless of discipline, will apply to a bachelor's degree.

4953  **Special Studies in Mathematics**  
(3-0) 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. May be repeated for credit when the topics vary, but not more than 6 semester credit 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 their last two semesters; approval by the College Honors Committee. 
Supervised research and preparation of an honors thesis.

**Minor in Statistics**

All students pursuing the Minor in Statistics must complete 22 semester credit hours.

A. 19 semester credit hours of required courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAT 1214</td>
<td>Calculus I</td>
</tr>
<tr>
<td>MAT 1223</td>
<td>Calculus II</td>
</tr>
</tbody>
</table>

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MAT 2213  Calculus III
MAT 2233  Linear Algebra
STA 3513  Probability and Statistics
or
STA 3533  Probability and Random Processes
STA 3523  Statistical Methods

B. 3 semester credit hours of approved upper-division statistics electives

To declare a Minor in Statistics, obtain advice, or seek approval of substitutions for course requirements, students should consult the Undergraduate Adviser of Record in the Division of Mathematics and Statistics.

COURSE DESCRIPTIONS
STATISTICS
(STA)

1053  Basic Statistics
(3-0) 3 hours credit. Prerequisite: Placement.
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; and applications of the chi-square distribution. [TCCN: MATH 1342.]

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. (Formerly STA 1064. Credit cannot be earned for both STA 1063 and 1064.)

1073  Statistics for Psychology
(3-0) 3 hours credit. Prerequisites: MAT 1023 or MAT 1033 and one psychology course.
The use of statistics in psychological research. Includes elementary probability theory; descriptive statistics, including histograms, graphing, and measures of central tendency and dispersion; correlational techniques; binomial and normal distributions; and 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, and 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, and
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, and nonsampling errors.

3433 Applied Nonparametric Statistics
(3-0) 3 hours credit. Prerequisite: STA 1993 or 3523.
Tests of location, goodness-of-fit tests, rank tests, tests based on nominal
and ordinal data for both related and independent samples, and measures of
association.

3513 Probability and Statistics
(3-0) 3 hours credit. Prerequisite: Completion of or concurrent enrollment
in MAT 2213.
Axioms of probability, random variables, probability functions, density
functions, functions of random variables, sampling distributions, important
discrete and continuous random variables, and Central Limit Theorem.

3523 Statistical Methods
(3-0) 3 hours credit. Prerequisite: STA 3513 or 3533.
Estimation and hypothesis testing, 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, and
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, and Probit and Logit analysis.

4613 Operations Research I
(3-0) 3 hours credit. Prerequisite: MAT 2233.
Introduction to analytical methods and models of operations research, with
emphasis on optimization. Linear, integer, and nonlinear programming,
network analysis including PERT and CPM, and introduction to dynamic
programming.
4623 Operations Research II  
(3-0) 3 hours credit. Prerequisite: STA 3513 or an equivalent.  
Introduction to probabilistic analysis and models in operations research.  
Decision analysis, Markov chains, and 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, and 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, and nonlinear  
regression.

4723 Design and Analysis of Experiments  
(3-0) 3 hours credit. Prerequisite: STA 1993 or 3523.  
General concepts in the design and analysis of experiments. Emphasis will  
be placed on both the experimental designs and analysis and tests of the  
validity of assumptions. Topics covered include 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 that  
arise in manufacturing and their application to control of manufacturing  
processes. Includes acceptance sampling in terms of standard sampling plans:  
MIL-STD 105, MIL-STD 414, Dodge-Romig plans, continuous plans, and  
others.

4903 Survival Analysis  
(3-0) 3 hours credit. Prerequisite: STA 3523 or an equivalent.  
Measures of survival, hazard function, means residual life function, common  
failure distributions and a procedure for selecting an appropriate model,  
reliability of complex series and parallel systems, and the probabilistic  
approach to biomedical applications.

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 semester  
credit hours, regardless of discipline, will apply to a bachelor’s degree.
4953 Special Studies in Statistics
(3-0) 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 may be repeated for credit when the topics vary, but not more than 6
semester credit hours, regardless of discipline, will apply to a bachelor’s
degree.

4993 Honors Research
3 hours credit. Prerequisites: 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.