

COLLEGE OF SCIENCES AND MATHEMATICS

DIVISION OF ALLIED HEALTH AND LIFE SCIENCES

The Division offers a Bachelor of Science Degree in Biology as well as Allied Health programs leading to Bachelor of Science Degrees in Medical Technology, Occupational Therapy, and Physical Therapy. Also available are preprofessional courses to offer students the opportunity to prepare for admission to medical, dental, and nursing school.⁵¹

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

There are two programs at UT San Antonio that lead to a B.S. Degree in Medical Technology. One program consists of three years of academic work and twelve months of clinical laboratory training in a hospital school of medical technology approved by the Council of Education of the American Medical Association. The second program is a four-year integrated program in which clinical training is introduced at the beginning of the program and in which there is a concentrated clinical hospital experience in the latter part of the program. The integrated program is offered in cooperation with The University of Texas Health Science Center at San Antonio. Graduates of both the three-plus-one and the integrated programs may obtain certification by passing the examination of the Board of Registry of the American Society of Clinical Pathologists.

The Bachelor of Science Degree in Occupational Therapy offers the opportunity for the student to gain strong background in the life sciences, behavioral sciences, humanities, and special skill areas. Specific application of occupational therapy skills in laboratory and clinical settings occurs in the last two years of a student's program and includes a minimum of six months approved field work experience. Upon completion of the degree program the student is eligible to take the national examination for registration with the American Occupational Therapy Association.

The Bachelor of Science Degree program in Physical Therapy emphasizes the biological and physical sciences essential for understanding the functioning of the human body, as well as the importance of the humanities and social sciences in addition to the specific skill areas. Preclinical and clinical experience is taken in the last two years of a student's program. Upon completion of the degree program the student is eligible to take licensure examinations.

Special Admission Requirements for Upper-Division Allied Health Sciences Courses. Acceptance into The University to major in Medical Technology, Occupational Therapy, and Physical Therapy does not indicate acceptance into the upper-division Allied Health Sciences courses. Admission requirements for those courses are:

- 1) completion of pre-professional requirements with a minimum grade of "C" in each course;
- 2) a minimum cumulative GPA of 2.8 in all pre-professional courses;

⁵¹Specific premedical, predental, and prenursing programs are not offered at UT San Antonio. Admission requirements for these professional schools are outlined in the Appendix of this catalog. Additional information can be obtained from the Office of the Division of Allied Health and Life Sciences and through the Chairman of the Health Related Professions Advisory Committee of The University of Texas at San Antonio.

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- 3) a report from the student's personal physician regarding the applicant's physical and mental health; and
- 4) a personal interview for selected applicants.

Acceptance into the Three-Plus-One Medical Technology program does not guarantee the student a position in the final year of clinical training. UT San Antonio students compete with students from other universities for the available internships at hospital schools of medical technology. Securing the fourth year clinical training is the student's responsibility. The Director of the Medical Technology Program assists the students in this regard, but the final decisions upon acceptance are made by individual hospitals.

Acceptance into the junior year of the Integrated Medical Technology program guarantees a student a continued position in the upper-division Allied Health Science courses, as long as he or she maintains at least a 2.5 cumulative grade-point average.

BACHELOR OF SCIENCE DEGREE IN BIOLOGY

The minimum number of semester hours required for the Bachelor of Science Degree in Biology, including the 42 hours of General Education Requirements, is 126.⁵²

All candidates for the degree must complete:

- A. 45 semester hours in the *major*, 22 of which must be at the upper-division level.
 1. 25 semester hours in the Biology Core Curriculum are required:

BIO	1103, 1112	Principles of Biology and Laboratory
BIO	1213, 1222	Principles of Environmental Biology and Laboratory
BIO	2313, 2322	Genetics and Laboratory
BIO	3413, 3422	General Physiology and Laboratory
BIO	3513, 3522	Biochemistry and Laboratory
 2. 20 additional semester hours of Biology electives are required, 12 of which must be at the upper-division level in consultation with the student's Advisor. The Biology electives may be selected from any of the Biology courses, except those for non-majors, and from certain Allied Health Sciences courses.
- B. 24 semester hours minimum of *support work*.
 1. 13 semester hours are required in Chemistry:

CHE	1103	Introductory Chemistry
CHE	2003	Chemical Principles
CHE	2012	Inorganic Qualitative and Quantitative Analysis
CHE	2203	Organic Chemistry I
CHE	2212	Organic Qualitative Analysis
 2. 3 semester hours minimum in addition to the 3 semester hours required under the General Education Requirements are required in Mathematics:

MAT	1214	Calculus I
		or
STA	1993	Statistical Methods for the Life and Social Sciences
 3. 8 semester hours are required in Physics:

PHY	1803, 1811	Physics for Life Sciences I and Laboratory
PHY	1823, 1831	Physics for Life Sciences II and Laboratory
- C. 15 semester hours of *electives*.

⁵²Thirty-nine of the total semester hours required for the degree must be at the upper-division level.

Students seeking teacher certification should consult the Undergraduate Certification Programs in Education brochure for information.

BACHELOR OF SCIENCE DEGREE IN MEDICAL TECHNOLOGY

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

The minimum number of semester hours required for this degree, including the 42 hours of General Education Requirements, is 138.

THREE-PLUS-ONE PROGRAM

A. 72 semester hours are required in the *major*.

1. 26 semester hours in the biological sciences:

BIO 1103, 1112	Principles of Biology and Laboratory
BIO 2313	Genetics
BIO 3513, 3522	Biochemistry and Laboratory
BIO 3713, 3722	Microbiology and Laboratory
BIO 4743, 4751	Immunology and Laboratory
BIO 4763, 4771	Parasitology and Laboratory

2. 12 semester hours are required in Allied Health Sciences: (These courses are taken at UTSA prior to the hospital clinical rotation.)

AHS 1871	Allied Health Sciences
AHS 1883	Introduction to Medical Technology
AHS 3463	Human Physiology
AHS 4783, 4792	Pathogenic Microorganisms and Laboratory
AHS 4942-9	Clinical Field Work Experience — Level II (to be repeated during the 12 month hospital training for a total of 36 hours: 12 hours in each of Fall, Spring and Summer semesters).

3. 34 additional semester hours are required in Allied Health Sciences: (These courses are the hospital clinical rotation.)

AHS 2413, 2422	Hematology & Laboratory
AHS 2533, 2542	Parasitology & Urinalysis & Laboratory
AHS 3773, 3782	Clinical Chemistry & Laboratory
AHS 3863, 3872	Immunohematology & Serology and Laboratory
AHS 4843	Advanced Clinical Microbiology
AHS 4854	Advanced Clinical Chemistry
AHS 4863	Advanced Clinical Hematology
AHS 4884	Advanced Immunohematology & Serology

B. 24 hours of *support work*.

1. 13 semester hours are required in Chemistry:

CHE 1103	Introductory Chemistry
CHE 2003	Chemical Principles
CHE 2012	Inorganic Qualitative and Quantitative Analysis
CHE 2203	Organic Chemistry I
CHE 2212	Organic Qualitative Analysis

2. 8 semester hours are required in Physics:

PHY 1803, 1811	Physics for Life Sciences I and Laboratory
PHY 1823, 1831	Physics for Life Sciences II and Laboratory

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

STA 1053 Basic Statistics

INTEGRATED PROGRAM

A. 72 semester hours in the *major*.

1. 22 semester hours are required in the biological sciences:

BIO 1103, 1112	Principles of Biology and Laboratory
BIO 2313	Genetics
BIO 3513, 3522	Biochemistry and Laboratory
BIO 3713, 3722	Microbiology and Laboratory
BIO 4743, 4751	Immunology and Laboratory

A. 2. 32 semester hours are required in Allied Health Sciences:

AHS 1871	Allied Health Sciences
AHS 1883	Introduction to Medical Technology
AHS 2413, 2422	Hematology and Laboratory
AHS 2533, 2542	Parasitology and Urinalysis and Laboratory
AHS 3463	Human Physiology
AHS 3773, 3782	Clinical Chemistry and Laboratory
AHS 3863, 3872	Immunohematology and Serology and Laboratory
AHS 4783, 4792	Pathogenic Microorganisms and Laboratory

3. 18 additional semester hours are required in Allied Health Sciences:
(These courses are the hospital clinical experience.)

AHS 4843	Advanced Clinical Microbiology
AHS 4854	Advanced Clinical Chemistry
AHS 4863	Advanced Clinical Hematology
AHS 4884	Advanced Immunohematology and Serology
AHS 4942-9	Clinical Field Work Experience — Level II (to be repeated during the two-semester hospital clinical rotation for a total of 4 hours)

B. 24 semester hours of *support work*.

1. 13 semester hours are required in Chemistry:

CHE 1103	Introductory Chemistry
CHE 2003	Chemical Principles
CHE 2012	Inorganic Qualitative and Quantitative Analysis
CHE 2203	Organic Chemistry I
CHE 2212	Organic Qualitative Analysis

2. 8 semester hours are required in Physics:

PHY 1803, 1811	Physics for Life Sciences I and Laboratory
PHY 1823, 1831	Physics for Life Sciences II and Laboratory

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

STA 1053 Basic Statistics

BACHELOR OF SCIENCE DEGREE IN OCCUPATIONAL THERAPY

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

The minimum number of semester hours required for this degree, including the 42 hours of General Education Requirements, is 151.

All candidates for the degree must complete:

- A. 99 semester hours in the *major*, 88 of which must be at the upper-division level.

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

BIO	1103, 1112	Principles of Biology and Laboratory
BIO	2123, 2131	Comparative Anatomy of Vertebrates and Laboratory
		<i>or</i>

AHS	2083, 2091	Human Biology: Anatomy and Laboratory
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2. 90 semester hours are required in Allied Health Sciences:

AHS	1871	Allied Health Sciences
AHS	1891	Survey of Physical Medicine and Rehabilitation
AHS	3002	Principles of Practice
AHS	3012	Introductory Pathology
AHS	3164, 3174	Human Gross Anatomy for Occupational and Physical therapy and Laboratory
AHS	3213	Occupational Therapy Media I
AHS	3232	Occupational Therapy Media II
AHS	3463, 3471	Human Physiology and Laboratory
AHS	3754	Dynamics of Motion I
AHS	3793	Occupational Therapy Theory I
AHS	3802	Clinical Medicine I
AHS	3812	Clinical Seminar
AHS	3902	Occupational Therapy Skills Laboratory I
AHS	3924	Clinical Field Work Experience Level I
AHS	4003	Clinical Medicine II
AHS	4013	Clinical Medicine III
AHS	4023	Occupational Therapy Skills Laboratory II
AHS	4033	Occupational Therapy Skills Laboratory III
AHS	4043	Occupational Therapy Media III
AHS	4053	Occupational Therapy Theory II
AHS	4463, 4471	Human Neurosciences and Laboratory
AHS	4501	Seminar in Rehabilitation
AHS	4803	Occupational Therapy Theory III
AHS	4823	Allied Health Management and Consultation
AHS	4923	Special Project
AHS	4942-9	Clinical Field Work Experience — Level II (repeated for a total of 18 hours credit)

- B. 10 semester hours of *support work*.

1. 4 semester hours are required in Chemistry:

CHE	1003, 1111	General Chemistry for Allied Health Sciences and Laboratory
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- or
- CHE 1103, 1122 Introductory Chemistry and Laboratory Workshop
2. 6 semester hours are required in Psychology:
- PSY 2513 Abnormal Psychology
PSY 2523 Personality
- C. All students are required to complete:
SOC 1013, Introduction to the Study of Society, PSY 2013, Fundamentals of Psychology and PSY 2503, Developmental Psychology as a part of their preprofessional training. Students following tract 2 of the General Education Requirements may elect 6 semester hours of this sequence as part of their General Education Requirement.

BACHELOR OF SCIENCE DEGREE IN PHYSICAL THERAPY

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

The minimum number of semester hours required for this degree, including the 42 hours of General Education Requirements, is 145.

All candidates for the degree must complete:

- A. 90 semester hours in the *major*, 79 of which must be at the upper-division level.
1. 14 semester hours are required in Biology:
- BIO 1103, 1112 Principles of Biology and Laboratory
BIO 2123, 2131 Comparative Anatomy of Vertebrates and Laboratory
BIO 3413, 3422 General Physiology and Laboratory
2. 73 semester hours are required in Allied Health Sciences courses:
- AHS 1871 Allied Health Sciences
AHS 1891 Survey of Physical Medicine and Rehabilitation
AHS 3012 Introductory Pathology
AHS 3164, 3174 Human Gross Anatomy for Occupational and Physical therapy and Laboratory
AHS 3201 Physical Therapy: History and Philosophy
AHS 3302, 3311 Physical Therapy Procedures and Laboratory
AHS 3754 Dynamics of Motion I
AHS 3881, 3892 Therapeutic Concepts and Procedures in Physical Therapy and Laboratory
AHS 3922-6 Clinical Field Work Experience — Level I
AHS 4003 Clinical Medicine II
AHS 4013 Clinical Medicine III
AHS 4104 Normal and Abnormal Aspects of Human Development
AHS 4222, 4231 Advanced Concepts and Procedures in Physical Therapy and Laboratory
AHS 4301 Clinical Education (repeated for a total of 4 credit hours)
AHS 4313 Therapeutic Exercise I
AHS 4323 Therapeutic Exercise II

AHS 4413, 4421	Mammalian Physiology and Laboratory
AHS 4463, 4471	Human Neurosciences and Laboratory
AHS 4501	Seminar in Rehabilitation
AHS 4823	Allied Health Management and Consultation
AHS 4923	Special Project
AHS 4942-9	Clinical Field Work Experience — Level II

B. 16 semester hours of *support work*.

1. 8 semester hours are required in Chemistry:

CHE 1103	Introductory Chemistry
CHE 2003	Chemical Principles
CHE 2012	Inorganic Qualitative and Quantitative Analysis

2. 8 semester hours are required in Physics:

PHY 1803, 1811	Physics for Life Sciences I and Laboratory
PHY 1823, 1831	Physics for Life Sciences II and Laboratory

C. All students are required to complete:

SOC 1013, Introduction to the Study of Society, PSY 2013, Fundamentals of Psychology and PSY 2503, Developmental Psychology as a part of their pre-professional training. Students following tract 2 of the General Education Requirements may elect 6 semester hours of this sequence as part of their General Education Requirement.

COURSE DESCRIPTIONS

BIOLOGY (BIO)

1013 Introduction to Life Sciences

(3-0) 3 hours credit. Concurrent enrollment in BIO 1021 recommended. May not be applied to a major in this Division.

An introduction to the life sciences emphasizing general principles, diversity of life forms, reproduction and interrelationships between living things. Credit cannot be earned for both BIO 1013 and BIO 1103.

1021 Introduction to Life Sciences Laboratory

(0-3) 1 hour credit. Concurrent enrollment: BIO 1013. May not be applied to a major in this Division.

Laboratory exercises, films and demonstrations in biology. Credit cannot be earned for both BIO 1021 and BIO 1112.

1103 Principles of Biology

(3-0) 3 hours credit. Concurrent enrollment: BIO 1112.

An introduction to living organisms emphasizing fundamentals of organization, reproduction, growth and interrelationships between various forms of life. Required for students majoring in Biology. Credit cannot be earned for both BIO 1013 and BIO 1103.

1112 Principles of Biology Laboratory

(0-6) 2 hours credit. Concurrent enrollment: BIO 1103.

1213 Principles of Ecology

(3-0) 3 hours credit. Prerequisites: BIO 1103 and BIO 1112. Concurrent enrollment: BIO 1222.

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

1222 Principles of Ecology Laboratory

(0-6) 2 hours credit. Concurrent enrollment: BIO 1213.

Emphasis will be placed on modern ecological techniques, including examinations of plant, animal and bacterial populations, and measurement of selected chemical and

physical parameters. One overnight field trip and several other off-campus trips will be required.

2003 Human Sex and Reproduction

(3-0) 3 hours credit. Prerequisites: BIO 1013 or 1103 or consent of instructor. May not be applied to a major in this Division.

Human reproductive anatomy and physiology, fertility control, reproductive disease, and parameters influencing fertility patterns.

2063 Invertebrate Biology

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

A comprehensive treatment of the invertebrate animals with emphasis on their taxonomy, morphology, ecology, and evolution.

2071 Invertebrate Biology Laboratory

(0-3) 1 hour credit. Concurrent enrollment: BIO 2063.

2123 Comparative Anatomy of Vertebrates

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

A detailed study of anatomical differences and similarities of vertebrates with reference to evolutionary changes.

2131 Comparative Anatomy of Vertebrates Laboratory

(0-3) 1 hour credit. Concurrent enrollment: BIO 2123.

2313 Genetics

(3-0) 3 hours credit. Prerequisites: BIO 1103, 1112, CHE 1103, 2003, and MAT 1183 or equivalent.

Principles governing transmission of hereditary factors in plants and animals with emphasis on molecular, biochemical and population genetics.

2322 Genetics Laboratory

(0-6) 2 hours credit. Concurrent enrollment: BIO 2313. Optional for non-majors.

3003 Introduction to Oceanography

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

General oceanography with emphasis on biological aspects and living marine resources.

3012 Introductory Pathology

(2-0) 2 hours credit. Prerequisites: BIO 1103, 1112 or AHS 2103.

Concepts of disease and diagnosis of pathological conditions.

3023 Drugs and Society

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

An examination of drugs and their role in society.

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.

3143 Comparative Vertebrate Embryology

(3-0) 3 hours credit. Prerequisites: BIO 3413 and 3422.

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

3151 Comparative Vertebrate Embryology Laboratory

(0-3) 1 hour credit. Concurrent enrollment: BIO 3143.

3162 Histology and Cytology

(2-0) 2 hours credit. Prerequisites: BIO 1103 and 1112. Concurrent enrollment: BIO 3172.

The cytological and histological aspects of cellular organization.

3172 Histological and Cytological Laboratory

(0-6) 2 hours credit. Concurrent enrollment: BIO 3162.

3203 Plant Ecology

(3-0) 3 hours credit. Prerequisite: BIO 1213, 1222, or consent of instructor.

The major biomes of North America and Texas will be studied, including the chemical, physical and biological factors that influence the development of these biomes.

3211 Plant Ecology Laboratory

(0-3) 1 hour credit. Concurrent enrollment: BIO 3203.

Laboratory will include four weekend field trips to major biomes of Texas. Qualitative and quantitative methods used to evaluate plant communities will be examined.

3213 Animal Ecology

(3-0) 3 hours credit. Prerequisites: BIO 1213 and 1222.

A detailed study of populations, interrelationships, behavior patterns and physiological responses of animals to their environment.

3221 Animal Ecology Laboratory

(0-3) 1 hour credit. Concurrent enrollment: BIO 3213.

3243 Field Biology and Ecology

(3-0) 3 hours credit. Prerequisite: BIO 1103, 1112, or consent of instructor. Concurrent enrollment: BIO 3251.

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.

3251 Field Biology and Ecology Laboratory

(0-3) 1 hour credit. Concurrent enrollment: BIO 3243.

Practical experience observing, collecting and identifying Texas plants and animals. Several field trips will be required.

3263 Ornithology

(2-3) 3 hours credit. Prerequisites: BIO 1213 and 1222.

A detailed examination of the class Aves, stressing the taxonomy, anatomy, physiology, ecology and behavior of birds. Field and laboratory work will be included as part of the course.

3273 Spring Flowers

(2-3) 3 hours credit.

A study of the wild flowers that occur in central Texas. Identification of the more common wild flowers will be stressed, as well as family characteristics, flower anatomy, and plant morphology. Off-campus field trips will be required. Plant collecting techniques and wild flower photography will be included.

3323 Evolution

(3-0) 3 hours credit. Prerequisite: BIO 2313.

A discussion of theories and possibly mechanisms for evolutionary changes at various levels of organization.

3343 Plant Sciences

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

The life histories and phylogenetic relationships of vascular and non-vascular plants.

3351 Plant Sciences Laboratory

(0-3) 1 hour credit. Concurrent enrollment: BIO 3343.

3413 General Physiology

(3-0) 3 hours credit. Prerequisites: BIO 1103, CHE 2003 and PHY 1823; recommended: MAT 1093.

Fundamental properties and processes in living systems.

3422 General Physiology Laboratory

(0-6) 2 hours credit. Concurrent enrollment: BIO 3413.

3513 Biochemistry

(3-0) 3 hours credit. Prerequisites: CHE 2203, 2212; BIO 2313 recommended.

Introduction to biochemistry: amino acids; protein structures; enzyme action; lipids and saccharides; metabolism; nucleic acids and molecular biology.

3522 Biochemistry Laboratory

(0-6) 2 hours credit. Concurrent enrollment: BIO 3513.

Basic biochemical laboratory techniques: titration, protein purification, enzyme kinetics, chromatography, electrophoresis, centrifugation.

3533 Radiation Biology

(3-0) 3 hours credit. Prerequisites: BIO 3513 and 3522.
Interactions of ionizing ultraviolet and visible radiations with matter; biological effects; cellular repair of radiation damage; biological photo-receptors.

3541 Radiation Biology Laboratory

(0-3) 1 hour credit. Concurrent enrollment: BIO 3533.

3713 Microbiology

(3-0) 3 hours credit. Prerequisites: BIO 2313 and CHE 2203. Concurrent enrollment: BIO 3722.

A comprehensive study of microorganisms including their composition, morphology, growth, metabolism, classification, ecology and significance in disease.

3722 Microbiology Laboratory

(0-6) 2 hours credit. Concurrent enrollment: BIO 3713.

3733 Industrial Microbiology

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

A study of fermentations of industrial importance, food processing, and quality control.

3741 Industrial Microbiology Laboratory

(0-3) 1 hour credit. Concurrent enrollment: BIO 3733.

3813 Cellular Biology

(3-0) 3 hours credit. Prerequisites: BIO 3413 and 3513.

The composition, function and interaction of cellular constituents and substructures at the ultra-structural level.

3821 Cellular Biology Laboratory

(0-3) 1 hour credit. Concurrent enrollment: BIO 3813.

3831 Tissue and Organ Culture

(1-0) 1 hour credit. Prerequisites: BIO 3513 and 3522. Concurrent enrollment: BIO 3842.
Theoretical and practical aspects of maintaining and growing cells, tissues and organs from various sources.

3842 Tissue and Organ Culture Laboratory

(0-6) 2 hours credit. Concurrent enrollment: BIO 3831.

4003 Principles of Marine Biology

(3-0) 3 hours credit. Prerequisite: BIO 1213.

The fauna and flora of marine ecosystems with special emphasis on the Northwestern Gulf Coast.

4011 Principles of Marine Biology Laboratory

(0-3) 1 hour credit. Concurrent enrollment: BIO 4003.

Shallow and deep water collection, identification and observation. Some weekend field trips required.

4022 Limnology

(2-0) 2 hours credit. Prerequisites: BIO 1213.

Ecology of inland waters with emphasis on functional aspects of lake ecosystems, productivity and nutrient relations of plankton, pollution and eutrophication.

4032 Limnology Laboratory

(0-6) 2 hours credit. Concurrent enrollment: BIO 4022.

Comparative limnology of Texas lakes and streams supported by laboratory analysis of biological material collected in water samples.

4043 Desert Ecology

(2-3) 3 hours credit. Prerequisites: BIO 1213 and 1222.

A study of the deserts of the world with an emphasis on U. S. Deserts. Adaptations of plants and animals and their responses to desert conditions will be included, as well as examinations of desert climatic patterns, geology, and natural history. Off-campus field trips to several desert regions will be required.

4073 Law, Ethics and the Life Sciences

(3-0) 3 hours credit. Prerequisites: BIO 1013, 1103, 1112, or consent of instructor.

An examination of the ethical, philosophical and social implications of studies in those

areas of the life sciences which affect public policy or action, e.g., incentives to slow population growth; psychology of consciousness and definitions of life and death.

4243 Physiological Ecology

(3-0) 3 hours credit. Prerequisites: BIO 3213, 3221, 3243 and 3251.

An integration of physiological and biochemical solutions and mechanisms to environmental problems at the organismic level.

4251 Physiological Ecology Laboratory

(0-3) 1 hour credit. Concurrent enrollment: BIO 4243.

4333 Population Genetics

(3-0) 3 hours credit. Prerequisites: BIO 2313 and 2322.

A quantitative approach to the study of genetics systems in populations, including mutations, selection, polymorphism and mating systems.

4343 Molecular Genetics

(3-0) 3 hours credit. Prerequisites: BIO 2313, 2322, 3513 and 3522.

Molecular approach to structure, replication, mutation and phenotypic expression of genetic material.

4353 Comparative Physiology

(3-0) 3 hours credit. Prerequisites: BIO 3413 and 3422.

A phylogenetic study of physiologic adaptation in animals.

4361 Comparative Physiology Laboratory

(0-3) 1 hour credit. Concurrent enrollment: BIO 4353.

A laboratory course illustrating the principles presented in BIO 4353.

4433 Neurobiology

(3-0) 3 hours credit. Prerequisites: BIO 3413 and 3422.

Anatomy and physiology of nervous systems, the mechanisms of neuronal functions.

4443 Endocrinology

(3-0) 3 hours credit. Prerequisites: BIO 3413, 3422, 3513 and 3522.

A consideration of the physiological effects of hormones on the organism in health and disease, together with a study of the gross and microscopic morphology of the glands of internal secretion.

4451 Endocrinology Laboratory

(0-3) 1 hour credit. Concurrent enrollment: BIO 4443.

4523 Intermediary Metabolism

(3-0) 3 hours credit. Prerequisites: BIO 3513 and 3522.

A detailed consideration of metabolic pathways, energy metabolism and their regulation.

4603 Plant Physiology

(3-0) 3 hours credit. Prerequisites: BIO 3343, 3351, CHE 2203 and 2212.

Principles of organization of cellular activity and molecular structure of protoplasm; nutrition, translocation, mineral metabolism, respiration and photosynthesis.

4611 Plant Physiology Laboratory

(0-3) 1 hour credit. Concurrent enrollment: BIO 4603.

Qualitative and quantitative experiments in the study of plant physiology.

4622 Biological Literature

(2-0) 2 hours credit. Prerequisite: senior standing.

Survey of selected biological references with emphasis on utilization of journals and scientific writing.

4723 Virology

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

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

4731 Virology Laboratory

(0-3) 1 hour credit. Concurrent enrollment: BIO 4723.

4743 Immunology

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

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

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4751 Immunology Laboratory

(0-3) 1 hour credit. Concurrent enrollment: BIO 4743.

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.

4771 Parasitology Laboratory

(0-3) 1 hour credit. Concurrent enrollment: BIO 4763.

4911-3 Independent Study

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

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

4923 Special Project

3 hours credit. Prerequisite: Consent of Division Director.

An intensive supervised student project.

4951-3 Special Studies in Biology

1-3 hours credit. Prerequisite: Consent of instructor.

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

4973 Proseminar

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

Presentation and discussion of current scientific literature.

ALLIED HEALTH SCIENCES (AHS)

1053 Introductory Microbiology

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

May not be applied to a major in this Division.

A general study of microorganisms, their characteristics, isolation, growth, and importance in nature, industry, public health and human disease.

1061 Introductory Microbiology Laboratory

(0-3) 1 hour credit.

May not be applied to a major in this Division. Concurrent enrollment: AHS 1053.

1871 Allied Health Sciences

(1-0) 1 hour credit.

Nature of the various allied health science programs and their interrelation. On-site hospital visits to the various programs. This course is taught on a credit/no credit basis only. Students completing this course will receive a grade of CR or NC.

1883 Introduction to Medical Technology

(3-0) 3 hours credit. Prerequisite: AHS 1871.

Clinical laboratory safety, specimen collection and preservation, quality controls, medical laboratory calculations, reagent preparation and medical technical terminology.

1891 Survey of Physical Medicine and Rehabilitation

(1-0) 1 hour credit. Prerequisite: AHS 1871.

The role of each therapeutic discipline working within the process of rehabilitation. Topics include medical terminology, ethics, and effects of illness on the patient.

2043 Nutrition

(3-0) 3 hours credit. Prerequisites: BIO 1103, 1112, or AHS 2103.

An examination of human nutritional needs from infancy to adulthood.

- 2083 Human Biology: Anatomy**
(3-0) 3 hours credit. Prerequisite: BIO 1103 or consent of instructor.
The structure of human muscular, skeletal, nervous and organ systems.
- 2091 Human Biology: Anatomy Laboratory**
(0-3) 1 hour credit.
Concurrent enrollment: AHS 2083.
- 2103 Human Biology: Physiology**
(3-0) 3 hours credit. Prerequisite: BIO 1013, 1103, or consent of instructor.
Physiological processes in human systems.
- 2111 Human Biology: Physiology Laboratory**
(0-3) 1 hour credit.
Concurrent enrollment: AHS 2103.
- 2413 Hematology**
(3-0) 3 hours credit. Prerequisite: AHS 1883 or consent of instructor. Concurrent enrollment: AHS 2422.
Normal and abnormal blood pictures and cell maturations with related clinical analyses, hemoglobinopathies, bone marrows, blood coagulation and all factors.
- 2422 Hematology Laboratory**
(0-6) 2 hours credit.
Concurrent enrollment: AHS 2413. Clinical hematological laboratory.
- 2533 Parasitology and Urinalysis**
(3-0) 3 hours credit. Prerequisite: AHS 1883.
Study of human parasitology, urinalysis with correlation to physiological condition.
- 2542 Parasitology and Urinalysis Laboratory**
(0-6) 2 hours credit.
Concurrent enrollment: AHS 2533. Clinical human parasitology and urinalysis.
- 3002 Principles of Practice**
(2-0) 2 hours credit. Prerequisite: Approval of Occupational Therapy Program Director.
Overview of occupational therapy theory and clinical application.
- 3012 Introductory Pathology**
(2-0) 2 hours credit. Prerequisites: BIO 1103, 1112, or AHS 2103.
Concepts of disease and diagnosis of pathological conditions.
- 3113 Kinesiology**
(3-0) 3 hours credit. Prerequisite: AHS 2083 and 2103. Primarily designed for students majoring in physical education.
A study of the principles of human motion.
- 3164 Human Gross Anatomy for Occupational Therapy and Physical Therapy**
(4-0) 4 hours credit. Prerequisite: Approval of the appropriate Allied Health Program Director.
Lectures and demonstrations on the structure of the human body.
- 3174 Human Gross Anatomy Laboratory**
(0-12) 4 hours credit.
Concurrent enrollment: AHS 3164.
Includes prosections, demonstrations and dissections of human material.
- 3201 Physical Therapy: History and Philosophy**
(1-0) 1 hour credit.
The history and philosophy of Physical Therapy. Includes presentations on various aspects of the profession.
- 3213 Occupational Therapy Media I**
(0-9) 3 hours credit. Prerequisite: Consent of instructor.
Use of tools in Handcrafts.
- 3232 Occupational Therapy Media II**
(0-6) 2 hours credit. Prerequisite: AHS 3213 and consent of instructor. Use of machinery in crafts and occupational therapy.

3302 Physical Therapy Procedures

(2-0) 2 hours credit. Prerequisite: Consent of the instructor.
Fundamental concepts for basic patient care and management.

3311 Physical Therapy Procedures Laboratory

(0-3) 1 hour credit. Concurrent enrollment: AHS 3302.

3463 Human Physiology

(3-0) 3 hours credit. Prerequisites: BIO 1103, 1112, CHE 2103 or 2203 or consent of instructor.
Physiological processes in human systems.

3471 Human Physiology Laboratory

(0-3) 1 hour credit.
Concurrent enrollment: AHS 3463.

3754 Dynamics of Motion I

(4-0) 4 hours credit. Prerequisites: AHS 3164 and approval of the appropriate Allied Health Program Director.
Study of the application of biomechanical, kinesiological and neurological principles to the control of individual and combined joint movements, including the analysis of normal human movement patterns.

3773 Clinical Chemistry

(3-0) 3 hours credit. Prerequisite: BIO 3513.
Physiological systems in normal and diseased processes and their correlation with clinical chemistry laboratory.

3782 Clinical Chemistry Laboratory

(0-6) 2 hours credit.
Concurrent enrollment: AHS 3773.
Analytical clinical chemistry techniques and automated clinical instrumentation with quality controls and blood analyses.

3793 Occupational Therapy Theory I

(3-0) 3 hours credit. Prerequisite: Approval of Occupational Therapy Program Director.
Study of psycho-social problems and treatment methods as related to Occupational Therapy.

3802 Clinical Medicine I

(2-0) 2 hours credit. Prerequisite: Approval of appropriate Allied Health Program Director.
Analysis of psychiatric theory and clinical application.

3812 Clinical Seminar

(2-0) 2 hours credit.
Analysis of treatment modalities related to clinical treatment.

3863 Immunohematology and Serology

(3-0) 3 hours credit. Prerequisites: AHS 2413 and BIO 4743.
Discussion of bloodbanking antigens and antibodies, cross-matching, and clinical serological assays in regard to normal and diseased states.

3872 Immunohematology and Serology Laboratory

(0-6) 2 hours credit.
Concurrent enrollment: AHS 3863.
Bloodbanking techniques and serological assays including radio immune assay procedures.

3881 Therapeutic Concepts and Procedures in Physical Therapy

(1-0) 1 hour credit. Prerequisite: Approval of Physical Therapy Program Director.
Theory and application of the use of physical agents in patient treatment.

3892 Therapeutic Concepts Laboratory

(0-6) 2 hours credit.
Concurrent enrollment: AHS 3881.

3902 Occupational Therapy Skills Laboratory I

(0-6) 2 hours credit. Prerequisites: AHS 3793 and approval of Occupational Therapy Program Director.
Applied therapeutic techniques in psycho-social dysfunction.

3922-6 Clinical Field Work Experience — Level I

Variable hours credit. Prerequisite: Approval of appropriate Allied Health Program Director.

Observation and Level I participation in the delivery of health care services. This course is taught on a credit/no credit basis only. Students completing this course will receive a grade of CR or NC.

4003 Clinical Medicine II

(3-0) 3 hours credit. Prerequisites: AHS 3012 and approval of the appropriate Allied Health Program Director.

The study of medical and surgical conditions treated by Physical and Occupational Therapy.

4013 Clinical Medicine III

(3-0) 3 hours credit. Prerequisites: AHS 4003 and approval of the appropriate Allied Health Program Director.

The study of medical and surgical conditions treated by Physical and Occupational Therapy. A continuation of AHS 4003.

4023 Occupational Therapy Skills Laboratory II

(0-9) 3 hours credit. Prerequisite: Approval of the Occupational Therapy Program Director. Concurrent enrollment: AHS 4053.

The application of theory to physical disabilities.

4033 Occupational Therapy Skills Laboratory III

(0-9) 3 hours credit. Prerequisite: Approval of the Occupational Therapy Program Director.

The use and analysis of developmental assessment techniques as related to Occupational Therapy.

4043 Occupational Therapy Media III

(0-9) 3 hours credit. Prerequisite: AHS 3232 and Approval of the Occupational Therapy Program Director.

Crafts used in the Occupational Therapy Clinical Programs.

4053 Occupational Therapy Theory II

(3-0) 3 hours credit. Prerequisite: Approval of the Occupational Therapy Program Director. Concurrent enrollment: AHS 4023.

The study of physical disabilities as related to treatment modalities.

4104 Normal and Abnormal Aspects of Human Development

(4-0) 4 hours credit. Prerequisites: AHS 3164, 4471, and approval of appropriate Allied Health Program Director.

Physical and behavioral maturation of the human organism from fetal life to geriatrics. Emphasizes normal and abnormal motor development in infancy and childhood and the relationship to cognitive, emotional, and social development.

4222 Advanced Concepts and Procedures in Physical Therapy

(2-0) 2 hours credit. Prerequisite: Approval of Physical Therapy Program Director.

Offers the opportunity to gain advanced training in developing rehabilitation treatment plans for comprehensive patient care.

4231 Advanced Concepts and Procedures in Physical Therapy Laboratory

(0-3) 1 hour credit.

Must be taken concurrently with AHS 4222.

4301 Clinical Education

(0-1) 1 hour credit. Prerequisite: Approval of appropriate Allied Health Program Director.

Offers the opportunity for supervised training in a clinical setting. May be repeated for a total of 4 hours credit. This course is taught on a credit/no credit basis only. Students completing this course will receive a grade of CR or NC.

4313 Therapeutic Exercise I

(2-6) 3 hours credit. Prerequisites: AHS 4104, 4463 and approval of Physical Therapy Program Director.

Emphasis on exercise techniques that are based on neurosciences and human development patterns.

4323 Therapeutic Exercise II

(2-6) 3 hours credit. Prerequisites: AHS 4313 and approval of Physical Therapy Program Director.

Emphasis on exercise techniques that are based on neurosciences and human development patterns. A continuation of AHS 4313.

4413 Mammalian Physiology

(3-0) 3 hours credit. Prerequisites: BIO 3413, 3422, and consent of instructor.

Physiology of mammalian organs and organ systems.

4421 Mammalian Physiology Laboratory

(0-3) 1 hour credit.

Concurrent enrollment: AHS 4413.

4463 Human Neurosciences

(3-0) 3 hours credit. Prerequisite: BIO 3413 or AHS 3463.

Structure and function of the human nervous system.

4471 Human Neurosciences Laboratory

(0-3) 1 hour credit.

Concurrent enrollment: AHS 4463.

4501 Seminar in Rehabilitation

(1-0) 1 hour credit. Prerequisite: Approval of appropriate program director.

Presentation and discussion of current scientific literature and/or issues.

4783 Pathogenic Microorganisms

(3-0) 3 hours credit. Prerequisites: BIO 3713 and 3722. Concurrent enrollment: AHS 4792.

A consideration of medically important microorganisms and their interaction with animal and human hosts.

4792 Pathogenic Microorganisms Laboratory

(0-6) 2 hours credit.

Concurrent enrollment: AHS 4783.

4803 Occupational Therapy Theory III

(3-0) 3 hours credit. Prerequisite: Approval of Occupational Therapy Program Director.

Overview of life tasks and adaptive skills of the developing human; treatment planning procedures with field observations.

4823 Allied Health Management and Consultation

(3-0) 3 hours credit. Prerequisite: Approval of appropriate Allied Health Program Director.

Planning, organizing, supervising, and implementing occupational therapy services as a line function and as a consultant; legal and ethical considerations.

4843 Advanced Clinical Microbiology

(2-6) 3 hours credit. Prerequisite: Approval of Medical Technology Program Director.

An integrated lecture and laboratory with emphasis on abnormal microbial flora found in diseased humans.

4854 Advanced Clinical Chemistry

(2-9) 4 hours credit. Prerequisite: Approval of Medical Technology Program Director.

An integrated lecture and laboratory with emphasis on special clinical chemistries, toxicology, and clinical chemistry of abnormal or diseased states.

4863 Advanced Clinical Hematology

(2-6) 3 hours credit. Prerequisite: Approval of Medical Technology Program Director.

An integrated lecture and laboratory with emphasis on blood pictures, bone marrows and hematological findings of diseased states.

4884 Advanced Immunohematology and Seriology

(2-9) 4 hours credit. Prerequisite: Approval of Medical Technology Program Director.

An integral lecture and laboratory with emphasis on unusual antibodies and incompatibilities.

4911-3 Independent Study

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

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

4923 Special Project

(2-9) 3 hours credit. Prerequisite: Consent of Program Director.

Offers the opportunity to accomplish an intensive supervised student research project.

4942-9 Clinical Field Work Experience — Level II

Variable hours credit. Prerequisites: Approval of appropriate Allied Health Program Director.

In depth experience in and responsibility for the delivery of health care. May be repeated for the required hours of the specific Allied Health degree. When necessary, may be elected for up to 12 hours in a single semester. This course is taught on a credit/no credit basis only. Students completing this course will receive a grade of CR or NC.

DIVISION OF EARTH AND PHYSICAL SCIENCES

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

BACHELOR OF SCIENCE DEGREE IN APPLIED SCIENCE

The Bachelor of Science in Applied Science has three major goals: (1) to provide the student with the opportunity to prepare for employment in one of the option areas (Applied Geology, Applied Physics, Environmental Science, Polymer Science), (2) to offer the student the opportunity to take the fundamental courses and apply for to transfer to The University of Texas at Austin to complete a degree program in Civil Engineering, Environmental Engineering, Chemical Engineering, Electrical Engineering, Engineering Science, or Mechanical Engineering, and (3) to offer the student the opportunity to gain the background necessary for graduate study in a variety of science and engineering specialty areas.

The minimum number of semester hours required for this degree, including the 42 hours of General Education Requirements, is dependent upon the option elected: Applied Geology, 129 semester hours; Applied Physics, 130 semester hours; Environmental Science, 136 semester hours; and Polymer Science, 129 semester hours.⁵³

All candidates for the degree must complete the following core of 26 semester hours (minimum) in the sciences and mathematics:

CHE	1103	Introductory Chemistry
CHE	2003	Chemical Principles
CHE	2012	Inorganic Qualitative and Quantitative Analysis
CS	1073	Introductory Computer Programming for Scientific Applications, or
CS	1714	Introduction to Computer Science
MAT	1214	Calculus I
MAT	1223	Calculus II
PHY	1903	Technical Physics I
PHY	1911	Technical Physics I Laboratory
PHY	1923	Technical Physics II
PHY	1931	Technical Physics II Laboratory

In addition, students must complete a minimum of 61 semester hours selected with approval of the student's Advisor from one of the following Applied Science options.

⁵³Thirty-nine of the total semester hours required for the degree must be at the upper-division level.

Students seeking teacher certification should consult the Undergraduate certification Programs in Education brochure for information.

Applied Geology

A. 55 semester hours in Applied Geology, 24 of which must be at the upper-division level.

1. 43 semester hours of required courses are:

- GEO 1003 Introduction to Geology
- GEO 1011 Introduction to Geology Laboratory
- GEO 1023 Earth History
- GEO 1031 Earth History Laboratory
- GEO 2002 Earth Materials I
- GEO 2012 Earth Materials I Laboratory
- GEO 2022 Earth Materials II
- GEO 2031 Earth Materials II Laboratory
- GEO 2063 Introduction to Paleontology
- GEO 2071 Introduction to Paleontology Laboratory
- GEO 3042 Earth Materials III
- GEO 3052 Earth Materials III Laboratory
- GEO 3083 Stratigraphy
- GEO 3103 Structural Geology: Map and Photo Analysis
- GEO 3111 Structural Geology: Map and Photo Analysis Laboratory
- GEO 3123 Surface Processes and Sedimentary Geology
- GEO 3131 Surface Processes and Sedimentary Geology Laboratory
- GEO 3943 Field Methods in Geology
- GEO 4946 Field Geology

2. 12 additional semester hours of approved *elective* courses in Applied Geology and Applied Science at the upper-division level are required from the following:

- AS 4603 Fundamentals of Hydraulic Engineering
- AS 4911-3 Independent Study
- AS 4923 Special Project
- AS 4931-3 Practicum in Applied Science
- AS 4953 Special Studies in Applied Science
- GEO 2951-3 Special Interest Topics
- GEO 3143 Economic Geology I: Metals and Industrial Minerals
- GEO 3163 Oceanography
- GEO 3182 Economic Geology II: Fuels
- GEO 3191 Economic Geology II: Fuels — Laboratory
- GEO 4023 Engineering Geology
- GEO 4063 Principles of Environmental Geology
- GEO 4113 Geomorphology
- GEO 4121 Geomorphology Laboratory
- GEO 4623 Hydrogeology

B. 6 semester hours of *support work* at the upper-division level with the consent of the advisor.

Applied Physics

A. 56 semester hours in the option.

1. 29 semester hours of required courses are:

- AS 3293 Thermodynamics
- AS 4923 Special Project
- AS 4933 Practicum in Applied Science
- PHY 2002 Workshop in Applied Physics

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- PHY 2403 Electronics
- PHY 2412 Electronics Laboratory
- PHY 3203 Dynamics
- PHY 3263 Microphysics
- PHY 3313 Materials Physics
- PHY 3321 Materials Physics Laboratory
- PHY 4403 Electricity and Magnetism II

2. 27 additional semester hours of approved *elective* courses in Applied Science⁵⁴ at the upper-division level are required to be chosen from either Applied Physics, Applied Geology or Applied Science courses with the consent of the Advisor.
- B. 3 semester hours of required *support work* in Applied Geology (GEO 1003 Introduction to Geology).
- C. 3 semester hours of electives.

Environmental Science

- A. 48 semester hours in the option. Required courses are:
 - AS 2203 Statics
 - AS 3503 Alternative Energy Sources
 - AS 3663 Fluid Mechanics
 - AS 3673 Municipal and Rural Sanitation
 - AS 4603 Fundamentals of Hydraulic Engineering
 - AS 4633 Water and Wastewater Treatment
 - AS 4643 Air Pollution and Industrial Hygiene
 - AS 4933 Practicum in Applied Science
 - BIO 1103 Principles of Biology
 - BIO 1112 Principles of Biology Laboratory
 - BIO 1213 Principles of Ecology
 - ENV 3023 Man and His Natural Resources
 - ENV 4603 Environmental Quality Analysis and Monitoring
 - GEO 1003 Introduction to Geology
 - GEO 1011 Introduction to Geology Laboratory
 - GEO 4063 Principles of Environmental Geology
 - GEO 4623 Hydrogeology
- B. 11 semester hours of *support work*. Required courses are:
 - AHS 1053 Introductory Microbiology
 - AHS 1061 Introductory Microbiology
 - CHE 2103 Elementary Organic and Biochemistry
 - CHE 2111 Organic and Biochemistry Laboratory
 - CHE 3103 Analytical Chemistry
- C. 6 semester hours of approved *elective* courses at the upper-division level.
- D. 3 semester hours of electives.

Polymer Science

- A. 34 semester hours in the option, all of which must be at the upper-division level.

⁵⁴With the consent of the student's Advisor, up to 9 hours may be in upper-division Mathematics, Computer Science, Systems Design, Chemistry, or Biology courses.

1. 20 semester hours of required courses are:
 - AS 4923 Special Project
 - AS 4933 Practicum in Applied Science
 - PS 3603 Polymer Science I
 - PS 3612 Polymer Science I Laboratory
 - PS 3623 Polymer Science II
 - PS 3632 Polymer Science II Laboratory
 - PS 4653 Polymer Technology
 - PS 4661 Polymer Technology Laboratory
2. 14 additional semester hours of approved *elective* courses in Applied Science and Polymer Science at the upper-division level to be chosen from the following:
 - AS 2203 Statics
 - AS 3213 Mechanics of Solids
 - AS 3241 Materials Laboratory
 - PS 3643 Natural and Synthetic Organic Polymers
 - PS 3651 Natural and Synthetic Organic Polymers Laboratory
 - PS 4623 Coatings Technology
 - PS 4643 Polymer Processing
 - PS 4703 Organic Chemistry of Coatings
 - PS 4743 Industrial and Commercial Applications of Polymers
- B. 24 semester hours of *support work*.
 1. 18 semester hours of required courses are:
 - CHE 2203 Organic Chemistry I
 - CHE 2212 Organic Qualitative Analysis
 - CHE 3003 Organic Chemistry II
 - CHE 3012 Organic Quantitative Analysis
 - CHE 3203 Physical Chemistry I
 - CHE 3212 Physical Chemistry Laboratory
 - CHE 3223 Physical Chemistry II
 2. 6 additional semester hours of upper-division coursework are required in an area of applied science, biology and/or chemistry, with the consent of the advisor.
- C. 3 semester hours of electives.

COURSE DESCRIPTIONS

APPLIED GEOLOGY (GEO)

1003 Introduction to Geology

(3-0) 3 hours credit. Concurrent enrollment in GEO 1011 recommended.

The Earth as a dynamic planet; relation of Earth's present day processes to its materials, structure and internal constitution. Nature of minerals and rocks, the hydrosphere, tectonics, and surface features of Earth.

1011 Introduction to Geology Laboratory

(0-3) 1 hour credit. Prerequisite or concurrent enrollment: GEO 1003.

Relation of Earth's present day processes to its materials, structure and internal constitution. Field trips and laboratory study of minerals, rocks, maps and air and satellite photos.

1023 Earth History

(3-0) 3 hours credit. Concurrent enrollment in GEO 1031 recommended.

Formation and evolution of the Earth, its life forms, and the major features of its surface.

1031 Earth History Laboratory

(0-3) 1 hour credit. Prerequisite or concurrent enrollment: GEO 1023.
Laboratory study of fossils and rock sequences; interpretation of Earth history.

2002 Earth Materials I

(2-0) 2 hours credit. Prerequisites: GEO 1003 and 1011. Concurrent enrollment: GEO 2012.

Crystallography, chemistry, physical properties and origin of minerals.

2012 Earth Materials I Laboratory

(0-4) 2 hours credit. Concurrent enrollment: GEO 2002.
Laboratory study of crystal models, crystals and minerals.

2022 Earth Materials II

(2-0) 2 hours credit. Prerequisites: GEO 2002 and 2012. Concurrent enrollment: GEO 2031. Principles and methods of optical crystallography.

2031 Earth Materials II Laboratory

(0-3) 1 hour credit. Prerequisites: GEO 2002 and 2012. Concurrent enrollment: GEO 2022.
Use of the petrographic microscope for the identification of minerals in immersion liquids and in thin sections.

2063 Introduction to Paleontology

(3-0) 3 hours credit. Prerequisites: GEO 1003, 1011, 1023 and 1031. Concurrent enrollment: GEO 2071.

Study of fossil animals and plants. Emphasis on invertebrate animals. Systematics, biostratigraphy, paleoecology, and evolution of fossil organisms.

2071 Introduction to Paleontology Laboratory

(0-3) 1 hour credit. Prerequisites: GEO 1003, 1011, 1023 and 1031. Concurrent enrollment: GEO 2063.

Study of fossil specimens, collection and preparation techniques.

2951-3 Special Interest Topics

1-3 hours credit.

Special interest geology courses including topics such as geology of Texas, volcanoes and their activity, crystals and gems, geology of Mexico and Central America, and geological investigation of the moon and planets. May be repeated for credit when the topics vary to a maximum of six hours.

3042 Earth Materials III

(2-0) 2 hours credit. Prerequisites: GEO 2022 and 2031. Concurrent enrollment: GEO 3052.

Description, occurrence, and origin of igneous, metamorphic, and sedimentary rocks.

3052 Earth Materials III Laboratory

(0-4) 2 hours credit. Prerequisites: GEO 2022 and 2031. Concurrent enrollment: GEO 3042.

Laboratory study of rocks in hand specimen and thin section.

3083 Stratigraphy

(3-0) 3 hours credit. Prerequisites: GEO 2063 and 2071.

Application of geologic principles to the interpretation of rocks formed at or near the surface of the earth.

3103 Structural Geology: Map and Photo Analysis

(3-0) 3 hours credit. Prerequisites: GEO 1003 and 1011. Concurrent enrollment: GEO 3111.

Response of earth materials to natural stresses. Description and origin of rock structures.

3111 Structural Geology: Map and Photo Analysis Laboratory

(0-2) 1 hour credit. Prerequisites: GEO 1003 and 1011. Concurrent enrollment: GEO 3103.

Laboratory study of structural interpretation using maps, cross-sections, air photos, and descriptive geometric and stereographic methods.

3123 Surface Processes and Sedimentary Geology

(3-0) 3 hours credit. Prerequisites: GEO 3022 and 3031. Concurrent enrollment: GEO 3131.

Processes of erosion, transportation and deposition that transform the surface of the continents and form bodies of sedimentary rock and their primary structures.

3131 Surface Processes and Sedimentary Geology Laboratory

(0-3) 1 hour credit. Prerequisites: GEO 3022 and 3031. Concurrent enrollment: GEO 3123.

Field trips and laboratory studies of sedimentary processes and their products.

3143 Economic Geology I: Metals and Industrial Minerals

(3-0) 3 hours credit. Prerequisites: GEO 1003 and 1011.

Ore and industrial mineral genesis. Description and distribution of the major mineral deposits.

3163 Oceanography

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

General oceanography, with emphasis on marine geology and especially the continental margins.

3182 Economic Geology II: Fuels

(2-0) 2 hours credit. Prerequisites: GEO 1003, 1011, 1023, and 1031. Concurrent enrollment: GEO 3191.

Geology of petroleum, natural gas, coal, uranium; geothermal energy sources.

3191 Economic Geology II: Fuels Laboratory

(0-3) 1 hour credit. Prerequisites: GEO 1003, 1011, 1023, and 1031. Concurrent enrollment: GEO 3182.

Laboratory studies of samples, maps and logs. Preparation of sample logs and subsurface maps.

3943 Field Methods in Geology

(1-6) 3 hours credit. Prerequisites: GEO 1003, 1011, and consent of instructor.

Use of surveying methods and topographic and air photo bases for geologic mapping. Description, recording, and interpretation of field relationships.

4023 Engineering Geology

(3-0) 3 hours credit. Prerequisites: GEO 1003 and 1011.

Geologic factors in the construction of large structures and excavations. Physical properties of natural minerals. Case studies.

4063 Principles of Environmental Geology

(3-0) 3 hours credit. Prerequisites: GEO 1003 and 1011.

Geologic factors important to city and regional planning. Land capability studies; geologic hazards.

4113 Geomorphology

(3-0) 3 hours credit. Prerequisites: GEO 3083, 3103, and 3111. Concurrent enrollment: GEO 4121.

Interpretation of landforms using geologic techniques.

4121 Geomorphology Laboratory

(0-3) 1 hour credit. Prerequisites: GEO 3083, 3103, and 3111. Concurrent enrollment: GEO 4113.

Interpretation of maps and aerial photographs.

4623 Hydrogeology

(3-0) 3 hours credit. Prerequisites: GEO 1003, 1011, and PHY 1923.

Hydrologic cycle and the theory of underground water. Recharge and discharge of aquifers; water quality; exploration and development of ground water supplies.

4946 Field Geology

(0-17) 6 hours credit. Prerequisite: Consent of instructor.

Field mapping and measurements during a six-week period in summer. Field trips required.

COURSE DESCRIPTIONS

APPLIED PHYSICS (PHY)

1703 Energy and the Environment

(3-0) 3 hours credit.

The topics considered, and some of their inter-relations, are: the automobile and mass transportation, common sources of energy, electrical power generation, nuclear, solar and geothermal energy, communications, air, water and noise pollution. Use of mathematics is limited.

1803 Physics for Life Sciences I

(3-0) 3 hours credit. Prerequisite: Working knowledge of high school algebra. Concurrent enrollment in PHY 1811 recommended.

The principles of physics with applications and problem solving useful to biology and pre-medical students. Mechanics and wave phenomena.

1811 Physics for Life Sciences I Laboratory

(0-3) 1 hour credit. Prerequisite or concurrent enrollment: PHY 1803. Laboratory to accompany PHY 1803.

1823 Physics for Life Sciences II

(3-0) 3 hours credit. Prerequisite: PHY 1803. Concurrent enrollment in PHY 1831 recommended.

The principles of physics with applications and problem solving useful to biology and pre-medical students. Electricity and magnetism, optics and modern physics.

1831 Physics for Life Sciences II Laboratory

(0-3) 1 hour credit. Prerequisite or concurrent enrollment: PHY 1823. Laboratory to accompany PHY 1823.

1903 Technical Physics I

(3-0) 3 hours credit. Prerequisite or concurrent enrollment: MAT 1214. Concurrent enrollment: PHY 1911.

The basic concepts and methods of physics. Mechanics, wave phenomena, and heat.

1911 Technical Physics I Laboratory

(0-3) 1 hour credit. Prerequisite or concurrent enrollment: PHY 1903. Laboratory to accompany PHY 1903.

1923 Technical Physics II

(3-0) 3 hours credit. Prerequisite: PHY 1903. Prerequisite or concurrent enrollment: MAT 1223.

A continuation of PHY 1903. Electricity and magnetism, optics, and an introduction to modern physics.

1931 Technical Physics II Laboratory

(0-3) 1 hour credit. Prerequisite or concurrent enrollment: PHY 1923. Laboratory to accompany PHY 1923.

1941 Problems in Technical Physics I

(1-0) 1 hour credit. Concurrent enrollment: PHY 1903.

Advanced applications to problems in mechanics, wave phenomena and heat. Intended primarily for physics and engineering students.

1951 Problems in Technical Physics II

(1-0) 1 hour credit. Concurrent enrollment: PHY 1923.

Advanced applications to problems in electricity and magnetism, optics, and modern physics. Intended primarily for physics majors and engineering students.

2002 Workshop in Applied Physics

(1-3) 2 hours credit. Prerequisite: PHY 1923.

The opportunity to develop of skills in Applied Physics. Problem solving methods. Fundamentals of experimental techniques.

2223 Musical Acoustics

(3-0) 3 hours credit. 1 year Music Theory desirable.

Sound vibration and transmission, interference, resonance, combinatorial tones, string and wind instruments and architectural acoustics.

2403 Electronics

(3-0) 3 hours credit. Prerequisite: PHY 1923. Concurrent enrollment in PHY 2412 recommended.

Introduction to DC and AC circuits, electric components and their uses in basic circuits for instrumentation.

2412 Electronics Laboratory

(0-6) 2 hour credit. Prerequisite or concurrent enrollment: PHY 2403.

Laboratory to accompany PHY 2403. Construction and testing of electronic circuits and devices.

2424 Network Theory

(3-3) 4 hours credit. Prerequisites: PHY 1923, 1931, and MAT 3613.

Basic network principles; steady state response to DC and AC signals; simple transient response; nodal and loop analysis.

2433 Introduction to Solid State Electronics

(3-0) 3 hours credit. Prerequisite: PHY 2403 or consent of instructor.

Principles of solid state materials and solid state devices; elementary applications of solid state devices to electronic systems.

3203 Dynamics

(3-0) 3 hours credit. Prerequisite: PHY 1923. Prerequisite or concurrent enrollment: MAT 2213.

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

3263 Microphysics

(3-0) 3 hours credit. Prerequisite: PHY 1923. Prerequisite or concurrent enrollment: MAT 2213.

Atomic and molecular physics; elementary principles of quantum mechanics; Bohr model; theory of the hydrogen atom; atomic, diatomic, and molecular spectra.

3273 Modern Physics

(3-0) 3 hours credit. Prerequisite: PHY 3263.

Nuclear radiation and particle physics; theories of interactions between fundamental units; application of theory to materials.

3293 Statistical Mechanics

(3-0) 3 hours credit. Prerequisites: PHY 1923 and AS 3293.

Statistical methods. Molecular models of macro systems. Distributions; Fermi, Bose and Boltzmann statistics; application of theory to materials.

3313 Materials Physics

(3-0) 3 hours credit. Prerequisite or concurrent enrollment: PHY 3263.

Mechanical, electrical, thermal and optical properties of solid state materials, crystalline structures, lattice vibrations, electron theory.

3321 Materials Physics Laboratory

(0-3) 1 hour credit. Concurrent enrollment: PHY 3313.

Determination and methods of evaluating the electrical, thermal, and optical properties of crystalline materials.

3363 Biophysics

(3-0) 3 hours credit. Prerequisites: BIO 1103, CHE 2003, PHY 1823 or PHY 1923, and MAT 1223.

Study of biological systems from the physicist's point of view; introduction to atomic structure, molecular bonds, concepts of molecular biophysics, macro-molecules, survey of physical experimental techniques in molecular biophysics.

3373 Biomaterials

(3-0) 3 hours credit. Prerequisite: PHY 3363.

Study of biological systems from a physicist's point of view; molecular transformations and methods of regulation, macroscopic biostructures and their physical properties, thermodynamics of living systems, interaction of radiation with biological materials.

3383 General Geophysics

(3-0) 3 hours credit. Prerequisites: GEO 1003, 1011, PHY 1923 and consent of instructor.

Geomagnetism, gravity, seismology, and heat flow. Interior of the earth and tectonics.

3423 Electricity and Magnetism I

(3-0) 3 hours credit. Prerequisite: PHY 1923.

Electrostatics, magnetostatics, Ampere's and Faraday's laws.

3443 Optics

(3-0) 3 hours credit. Prerequisite: PHY 3423. Concurrent enrollment in PHY 3452 recommended.

Wave motion and its applications primarily in physical optics. Optical correlation techniques, lasers, holography, fiber optics, magneto- and electro-optical phenomena and their applications.

3452 Optics Laboratory

(0-6) 2 hours credit. Prerequisite or concurrent enrollment: PHY 3443.

Measurement of physical optical phenomena, laser techniques, scattering and diffraction.

3953 Electronics for Scientists

(2-3) 3 hours credit. Prerequisite: one year of college Physics.

Application of various basic electronic instruments, devices, and components widely used in biology, chemistry, geology, engineering, and physics. Emphasis on the functional use of these devices.

4203 Advanced Dynamics

(3-0) 3 hours credit. Prerequisite: PHY 3203.

Advanced methods in mechanics, Lagrangian and Hamiltonian formulations, special relativity, oscillations; applications to materials physics.

4223 Acoustics

(3-0) 3 hours credit. Prerequisites: PHY 1923 and MAT 2213. Concurrent enrollment in PHY 4231 recommended.

Applications of infrasound and ultrasound, including sonar and biomedical applications. Noise suppression methods.

4231 Acoustics Laboratory

(0-3) 1 hour credit. Prerequisite or concurrent enrollment: PHY 4223.

Generation and measurement of acoustical signals.

4263 Introduction to Quantum Mechanics

(3-0) 3 hours credit. Prerequisites: PHY 3203 and MAT 3613, or consent of instructor.

Schrodinger equation, matrix methods, interactions of atoms with radiation, Dirac equation, applications to materials.

4303 Advanced Materials Physics

(3-0) 3 hours credit. Prerequisite: PHY 3313.

Advanced studies in the bulk and surface properties of materials. Special aspects of crystalline and amorphous solids.

4382 Exploration Geophysics

(2-0) 2 hours credit. Prerequisite: PHY 3383. Concurrent enrollment: PHY 4391.

Principles of geophysical prospecting. Magnetic, gravity and seismic methods.

4391 Exploration Geophysics — Laboratory

(0-3) 1 hour credit. Concurrent enrollment: PHY 4382.

Planning and execution of exploration programs and interpretation of the results of magnetic, gravity and seismic surveying.

4403 Electricity and Magnetism II

(3-0) 3 hours credit. Prerequisite: PHY 3423.

Theory and applications of electromagnetic fields; Maxwell's equations; plasmas.

4503 Topics in Astrophysics

(3-0) 3 hours credit. Prerequisite: PHY 1923.

Significant astrophysical topics will be presented. Topics include: General Astrophysics, Astronomical Dynamics, Quantum Processes, Structure of the Universe. May be repeated for credit when topics vary.

COURSE DESCRIPTIONS

APPLIED SCIENCE (AS)

1103 Introduction to Engineering

(3-0) 3 hours credit.

Engineering as a career. Case studies which illustrate the scope and nature of the professional activities of engineers. Alternative approaches to engineering problem solving and design through use of engineering principles.

1802 Engineering Graphics

(1-3) 2 hours credit.

Freehand and instrument drawing; shape and size description; pictorial methods; freehand lettering; charts and graphs.

2203 Statics

(3-0) 3 hours credit. Prerequisites: PHY 1903 and MAT 1223.

Vector algebra, force systems, free body diagrams. Engineering applications of equilibrium, centroids, moments of inertia.

3213 Mechanics of Solids

(3-0) 3 hours credit. Prerequisites: AS 2203 and CHE 2003.

Internal forces and deformations in solids; stress; strain in elastic and plastic solids; application to simple engineering problems.

3241 Materials Laboratory

(0-3) 1 hour credit. Prerequisite or concurrent enrollment: AS 3213.

Laboratory study of principles of mechanics including stress and strain in elastic and plastic solids.

3293 Thermodynamics

(3-0) 3 hours credit. Prerequisites: PHY 1923, CHE 2003, and MAT 2213.

Heat, kinetic theory of gases, laws of thermodynamics and their practical applications to thermodynamic devices including engines.

3503 Alternative Energy Sources

(3-0) 3 hours credit. Prerequisites: PHY 1923 and CHE 2003.

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

3663 Fluid Mechanics

(3-0) 3 hours credit. Prerequisites: AS 2203 and MAT 1223.

Fluid properties; fluid statics, concepts and equations of fluid flow; similitude; viscous effects; compressible fluid flow.

3673 Municipal and Rural Sanitation

(3-0) 3 hours credit. Prerequisites: BIO 1213, CHE 2003, and upper-division standing.

An examination of sanitation practices in rural and urban environments including insect and rodent control, swimming pool sanitation, rural water supply, food sanitation, and disease transmission. Formerly BIO 3233. Credit cannot be earned for both AS 3673 and BIO 3233.

4603 Fundamentals of Hydraulic Engineering

(3-0) 3 hours credit. Prerequisite: AS 3663 or consent of instructor.

Examination of various components of the hydrologic cycle in the atmosphere and outer crust of the earth. Emphasis on surface waters through analysis of hydrologic data relating to rainfall, runoff, infiltration, and evaporation.

4612 Hydraulic Engineering Laboratory

(0-6) 2 hours credit. Prerequisite or concurrent enrollment: AS 4603 or consent of instructor.

Laboratory studies in static and dynamic fluid properties and phenomena.

4633 Water and Wastewater Treatment

(3-0) 3 hours credit. Prerequisites: CHE 2003 and AS 3663 or consent of the instructor.

The application of chemical, biochemical, physical and mathematical processes to water treatment, wastewater treatment and pollution control.

4643 Air Pollution and Industrial Hygiene

(3-0) 3 hours credit. Prerequisites: BIO 1213, CHE 2003 and upper-division standing. Discussion of the sources, quantities, effects of sampling and control of airborne pollutants in ambient air, and in urban and industrial environments. Formerly BIO 4493. Credit cannot be earned for both AS 4643 and BIO 4493.

4911-3 Independent Study

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

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

4923 Special Project

3 hours credit. Prerequisite: Consent of Division Director.

A special studies laboratory research or readings project resulting in a report. Limited to students in their final year of undergraduate study.

4931-3 Practicum in Applied Science

1-3 hours credit. Prerequisite: Consent of Division Director.

A program of research and/or supervised applications of theory in a research, industrial or government environment. This course is taught on a credit/no credit basis only. Students completing this course will receive a grade of CR or NC.

4951-3 Special Studies in Applied Science

1-3 hours credit. Prerequisite: Consent of instructor.

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

COURSE DESCRIPTIONS

POLYMER SCIENCE (PS)

3603 Polymer Science I

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

Basic principles of polymer science; kinetics and mechanisms of polymerization and copolymerizations; methods of polymerization; molecular weight determinations and characterization of polymers; solution properties, polymer reactions, cross-linking, graft and block copolymerizations; polymer degradation and stabilization.

3612 Polymer Science I Laboratory

(0-6) 2 hours credit. Prerequisite or concurrent enrollment: PS 3603.

Laboratory projects illustrating and extending the concepts discussed in PS 3603.

3623 Polymer Science II

(3-0) 3 hours credit. Prerequisite: CHE 3003 or consent of instructor.

Structural and physical aspects of polymers; molecular basis for polymer properties and behavior; the rubbery, glassy and crystalline states; viscoelasticity and rubber elasticity; glass transition; structure, morphology, mechanical, optical and electrical properties.

3632 Polymer Science II Laboratory

(0-6) 2 hours credit. Prerequisite or concurrent enrollment: PS 3623.

Laboratory projects illustrating and extending the concepts discussed in PS 3623.

3643 Natural and Synthetic Organic Polymers

(3-0) 3 hours credit. Prerequisites: PS 3603 and CHE 3003.

Preparation, structure and properties of addition and condensation polymers; polymerization by ring opening; block and graft polymers. Structure and properties of cellulose, proteins, rubber and their derivatives.

3651 Natural and Synthetic Organic Polymers Laboratory

(0-3) 1 hour credit. Prerequisite or concurrent enrollment: PS 3643.

Laboratory projects illustrating and extending the concepts discussed in PS 3643.

4623 Coatings Technology

(3-0) 3 hours credit. Prerequisite: PS 3623.

Convertible and nonconvertible coatings; solvents, plasticizers, lacquers, varnishes, formulation, pigmentation; film properties, chemical resistance, adhesion, hardness, flexibility, abrasion resistance, strength, color, opacity gloss; electrocoating; radiation and photo-curing. Pigmented coatings; extender pigments; decorative paints and industrial finishes; corrosion and chemical resistant paint systems.

4643 Polymer Processes

(3-0) 3 hours credit. Prerequisite: PS 3623.

Fundamentals of extrusion, injection, compression and blow molding, fiber spinning, calendaring and film formation; mixing processes; heat and mass transfer; elastic phenomena; simple flow models and stability of flow; process development and design.

4653 Polymer Technology

(3-0) 3 hours credit. Prerequisites: PS 3643 and 3651.

Finishing of polymers; thermosets; molding powders, laminates; polymer foams; coatings, drying oils, alkyds, epoxy resins, urethanes, natural and synthetic rubber processing; vulcanization and oxidation of polyolefins and polydienes; polymer latices. Film and fiber formation; melt, wet and dry spinning, orientation; adhesion; adhesive systems, polymer-plasticizer interaction, polymer-fiber interactions, reinforced systems, packaging materials.

4661 Polymer Technology Laboratory

(0-3) 1 hour credit. Prerequisite or concurrent enrollment: PS 4653.

Laboratory projects illustrating and extending the concepts discussed in PS 4653.

4703 Organic Chemistry of Coatings

(3-0) 3 hours credit. Prerequisites: PS 3623 and CHE 3003.

Chemistry of autoxidation, glyceride oils; varnishes; and resins, including alkyd, epoxy, amino and phenol formaldehyde, rubber and silicone resins; acrylic and vinyl coatings; polyurethanes and copolymers. Radiation curing, electrodeposition, photo-curable coatings.

4743 Industrial and Commercial Applications of Polymers

(3-0) 3 hours credit. Prerequisite: PS 3623.

Mechanical, electrical and thermal properties of engineering plastics; applications as materials of construction; polymers in biology and biomedical engineering; space technology; specialty polymers for high temperature applications, environmental effects on polymers; rain erosion, weathering, corrosive environment, biological environment; radiation effects.

ENGINEERING

The University of Texas at San Antonio does not offer a degree in engineering. However, the Applied Science Curriculum offers an opportunity for students to obtain a major part of their engineering education at The University of Texas at San Antonio. For example, with a minimal amount of additional work the program enables UT San Antonio graduates in Applied Science to earn a second bachelor's degree at The University of Texas at Austin in Petroleum, Environmental and Civil Engineering (Applied Geology), Electrical Engineering, Engineering Science, or Mechanical Engineering (Applied Physics) or Chemical Engineering (Polymer Science).

For those students who plan to transfer to an engineering curriculum prior to completing the Bachelor of Science in Applied Science degree, a sequence of courses, tailored to the engineering program of interest, will be recommended by the Engineering Advisor.

BACHELOR OF SCIENCE DEGREE IN CHEMISTRY

The minimum number of semester hours required for this degree, including the 42 semester hours of General Education Requirements, is 128⁵⁵. All candidates for the degree must complete:

A. 38 semester hours of required courses in Chemistry.

- CHE 1103 Introductory Chemistry
- CHE 2003 Chemical Principles
- CHE 2012 Inorganic Qualitative and Quantitative Analysis
- CHE 2203 Organic Chemistry I
- CHE 2212 Organic Qualitative Analysis
- CHE 3003 Organic Chemistry II
- CHE 3012 Organic Quantitative Analysis
- CHE 3103 Analytical Chemistry
- CHE 3203 Physical Chemistry I
- CHE 3212 Physical Chemistry Laboratory
- CHE 3223 Physical Chemistry II
- CHE 3232 Instrumental Analysis
- CHE 4263 Inorganic Chemistry I
- CHE 4923 Special Project in Chemistry or CHE 4913 Independent Study
- CHE 4971 Proseminar

B. 15 additional semester hours of approved elective courses.

1. 6 semester hours to be selected from:

- BIO 3513 Biochemistry
- CHE 4243 Organic Chemistry III
- PS 3603 Polymer Science I or PS 3623 Polymer Science II

2. 9 additional semester hours of approved *elective* Chemistry at the upper-division level are required.

C. A minimum of 27 semester hours of *support work* in Science and Mathematics.

Required courses are:

- CS 1073 Introductory Computer Programming for Scientific Applications or
- CS 1714 Introduction to Computer Science
- MAT 1214 Calculus I
- MAT 1223 Calculus II
- MAT 2213 Calculus III or CS 1723 Data Structures I
- PHY 1903 Technical Physics I
- PHY 1911 Technical Physics I Laboratory
- PHY 1923 Technical Physics II
- PHY 1931 Technical Physics II Laboratory

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

D. 6 semester hours of *electives*.

⁵⁵Thirty-nine of the total semester hours required for the degree must be at the upper-division level.

Students seeking teacher certification should consult the Undergraduate Certification Programs in Education brochure for information.

COURSE DESCRIPTIONS

CHEMISTRY (CHE)

1003 General Chemistry for Allied Health Sciences

(3-0) 3 hours credit.

Introduction to atomic structure, chemical bonding, stoichiometry, states of matter, inorganic chemical reactions, acids and bases. For majors in occupational therapy, pre-nursing, and dental hygiene. May not be applied to a major in chemistry, biology, or medical technology.

1103 Introductory Chemistry

(3-0) 3 hours credit.

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.

1111 General Chemistry Laboratory for Allied Health Sciences

(0-3) 1 hour credit. Prerequisite or concurrent enrollment: CHE 1003.

Introduction to chemical laboratory techniques. For majors in occupational therapy, pre-nursing, and dental hygiene. May not be applied to a major in chemistry, biology, or medical technology.

1122 Introductory Chemistry Laboratory Workshop

(1-3) 2 hours credit. Prerequisite or concurrent enrollment: CHE 1103.

An introduction to chemical problem solving and the basic operations of the chemical laboratory; and a survey of inorganic chemical reactions. This course consists of problem sessions, lecture-demonstrations, and/or laboratory experience.

2003 Chemical Principles

(3-0) 3 hours credit. Prerequisite: CHE 1103. CHE 1122 is recommended. Primarily for science majors.

Elementary inorganic and physical chemistry: a continuation of descriptive inorganic chemistry, coordination chemistry, solutions and electrolytes, redox processes, elementary thermodynamics, chemical kinetics, and elementary electrochemistry and nuclear chemistry; introduction to organic chemistry.

2012 Inorganic Qualitative and Quantitative Analysis

(0-6) 2 hours credit. Prerequisite or concurrent enrollment: CHE 2003.

Techniques of qualitative and quantitative chemical analysis, illustrated primarily via inorganic chemical systems and their reactions.

2103 Elementary Organic and Biochemistry

(3-0) 3 hours credit. Prerequisites: CHE 1003 and 1111. May not be applied to a major in chemistry.

A survey of the structures and reactions of some important functional groups of organic chemistry. The relationship of these functional groups to the chemistry of lipids, carbohydrates, nucleic acids and proteins.

2111 Organic and Biochemistry Laboratory

(0-3) 1 hour credit. Prerequisite or concurrent enrollment: CHE 2103. May not be applied to a major in chemistry.

Laboratory examination of the properties of some simple organic and biological chemicals; solubility, crystallization, organic reactions, titration, enzyme action, sugars, vitamins.

2203 Organic Chemistry I

(3-0) 3 hours credit. Prerequisites: CHE 2003 and 2012. Primarily for science majors.

An elementary study of structure, reactions, and reaction mechanisms associated with organic compounds, e.g., aliphatic and aromatic hydrocarbons, alcohols, ethers, organic halogen compounds, aldehydes, and ketones.

2212 Organic Qualitative Analysis

(0-6) 2 hours credit. Prerequisite or concurrent enrollment: CHE 2203. Primarily for science majors.

Determination of physical constants of organic compounds; separation methods: vacuum distillation, crystallization, column chromatography, and gas chromatography; organic elemental analysis, functional group study and qualitative analysis.

3003 Organic Chemistry II

(3-0) 3 hours credit. Prerequisite: CHE 2203; Prerequisite or concurrent enrollment: CHE 2212.

Continuing study of fundamentals of structure, stereo-chemistry, reactions and reaction mechanisms of carbonyl compounds and their derivatives; organic compounds containing nitrogen, phosphorus and sulphur; poly-functional organic compounds; including an introduction to biochemistry. A continuation of CHE 2203.

3012 Organic Quantitative Analysis

(0-6) 2 hours credit. Prerequisite: CHE 2212. Prerequisite or concurrent enrollment: CHE 3003 or consent of instructor.

Continuing laboratory study of quantitative analysis of organic reactions and molecular structure; qualitative and quantitative use of infrared, ultra-violet, and proton nuclear magnetic resonance spectrometry; introduction to mass spectrometry.

3103 Analytical Chemistry

(1-6) 3 hours credit. Prerequisites: CHE 2003 and 2012.

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

3153 Chemistry and Cosmetics

(3-0) 3 hours credit. Prerequisite: upper-division standing. May not be applied to a major in chemistry.

A survey of the chemical components of cosmetics and toiletries. Correlation between these chemical compounds and their physiological properties.

3173 Alchemy and the Sources of Modern Science

(3-0) 3 hours credit. Prerequisite: upper-division standing. May not be applied to a major in chemistry.

Scientific content of magic, witchcraft, alchemy, and iatrochemistry. Origins and development of ideas concerning composition and transformation of matter. Evolution of modern scientific method. Readings will include primary materials selected from Renaissance and modern literary and scientific sources.

3193 Physical Chemistry for Life Sciences

(3-0) 3 hours credit. Prerequisites: CHE 2203, BIO 3413, 3422, and MAT 1214.

May not be applied to a major in chemistry.

Selected topics from physical chemistry with special emphasis on biological systems and applications, including thermodynamics, energetics, kinetics, spectroscopy, nuclear chemistry and macromolecules.

3203 Physical Chemistry I

(3-0) 3 hours credit. Prerequisites: CHE 2003, 2012, MAT 1223, PHY 1923, and 1931; at least one semester of organic chemistry is also recommended.

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

3212 Physical Chemistry Laboratory

(0-6) 2 hours credit. Prerequisite: CHE 3203.

Experimental study of thermodynamics and electrochemistry, spectroscopy, and reaction kinetics.

3223 Physical Chemistry II

(3-0) 3 hours credit. Prerequisite: CHE 3203.

Chemical kinetics, electrolytes and electrochemistry, elements of quantum mechanics, chemical bonds, spectroscopy, and photo-chemistry. A continuation of CHE 3203.

3232 Instrumental Analysis

(0-6) 2 hours credit. Prerequisites or concurrent enrollment: CHE 3012, 3212, and 3223. Electrochemical methods; use of modern spectrometric and chromatographic instrumentation in separation, purification, and/or quantitative characterization of chemical systems.

3252 Chemistry in Industry

(2-0) 2 hours credit. Prerequisites or concurrent enrollment: CHE 3003, 3203, or consent of instructor.

The roles and problems of chemistry and chemists in the chemical industry: laboratory and operations management; basic research and product development; production, quality control, pollution and waste materials control, and safety; advertising, sales, and patents; the governmental/industrial interface; economic considerations, employment practices, and professional societies will also be explored.

3301 Physical Chemistry Problem Solving I

(1-0) 1 hour credit. Concurrent enrollment: CHE 3203.

Development of problem solving skills in physical chemistry.

3311 Physical Chemistry Problem Solving II

(1-0) 1 hour credit. Concurrent enrollment: CHE 3223.

A continuation of CHE 3301.

3373 Geochemistry

(3-0) 3 hours credit. Prerequisites: CHE 2003 or consent of instructor.

A survey of geochemical processes and the distribution of elements in the earth. Application of chemical methods and data to the solution of geologic problems.

4223 Advanced Biochemistry

(3-0) 3 hours credit. Prerequisites: BIO 3513, 3521 and CHE 3003, 3012.

Chemical aspects of regulation and control mechanisms; membrane-related phenomena; oxidative phosphorylation and photosynthesis; transport mechanisms; contractility of muscle.

4231 Advanced Biochemistry Laboratory

(0-3) 1 hour credit. Prerequisite or concurrent enrollment: CHE 4223.

Applications of UV-visible and NMR spectroscopy, electrophoresis, gas chromatography, mass spectrometry and other physical techniques to biochemistry.

4243 Organic Chemistry III

(3-0) 3 hours credit. Prerequisites: CHE 3003 and 3012; CHE 3203 or consent of instructor.

Advanced mechanistic and synthetic aspects of organic reactions. Molecular rearrangements, organic molecular orbital theory and its application to pericyclic reactions. A continuation of CHE 3003.

4253 Physical Chemistry III

(3-0) 3 hours credit. Prerequisites: CHE 3003, 3223 and 3232; 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. Prerequisite: CHE 3203.

A study of the elements and their periodic properties; acid-base theory, crystalline state, coordination chemistry, non-aqueous solvents and other advanced topics.

4272 Advanced Organic Laboratory

(0-6) 2 hours credit. Prerequisites: CHE 3223, 3232, and concurrent enrollment in CHE 4243 or consent of the instructor.

Functional group analysis of organic compounds, structure analysis and proof, multi-step synthesis involving functional group modifications, and separation and identification of complex organic mixtures.

4293 Nuclear Chemistry and Physics

(3-0) 3 hours credit. Prerequisites: CHE 3203 and 3223.

A study of nuclear reactions, radiation detection and measurement, and chemical applications.

4301 Nuclear Chemistry and Physics Laboratory

(0-3) 1 hour credit. Prerequisite or concurrent enrollment: CHE 4293 and consent of instructor.

A laboratory study of nuclear reactions, radiation detection and measurement, and chemical applications.

4373 Spectral Studies

(3-0) 3 hours credit. Prerequisite: CHE 3012.

Identification of functional groups and the determination of the structure of compounds by spectral techniques including IR, NMP, mass spectroscopy and Uv-Vis absorption spectroscopy; basic theory of spectral measurements with emphasis on practical applications.

4403 Chemistry of Heterocyclic Compounds

(3-0) 3 hours credit. Prerequisite: CHE 3003 or consent of instructor.

The chemistry of nitrogen, oxygen, and sulfur heterocycles. Five-membered and six-membered ring systems with one and more than one heteroatom. Applications in the field of synthetic drugs.

4603 Synthesis and Biosynthesis of Natural Products

(3-0) 3 hours credit. Prerequisite: CHE 3012. 4243, 4273, and/or BIO 3513 are recommended.

Comparison of chemical and biochemical formations and transformations for several classes of naturally occurring compounds such as steroids, terpenoids, alkaloids, and other natural products of chemical or biological importance.

4911-3 Independent Study

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

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

4923 Special Project in Chemistry

3 hours credit. Prerequisite: Consent of Division Director.

A special laboratory research or library readings project resulting in a report, limited to students in their final year of undergraduate study.

4931-3 Internship in Applied Chemical Operations

1-3 hours credit. Prerequisites: CHE 3232, 3252, and consent of Division Director.

Practical introduction to industrial and/or similar applied chemistry operations, via supervised extracollegiate internship, resulting in a report. This course is taught on a credit/no credit basis only. Students completing this course will receive a grade of CR or NC.

4951-3 Special Studies in Chemistry

1-3 hours credit. Prerequisite: Consent of instructor.

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

4971 Proseminar

(0-3) 1 hour credit. Prerequisites: CHE 3003 and CHE 3203.

Oral reports and current publications in chemistry and chemical technology and the utilization of important chemical reference materials and periodicals. May be repeated for credit when topics vary, with consent of the Division Director.

COURSE DESCRIPTIONS

ASTRONOMY (AST)

1013 Introduction to Astronomy I

(3-0) 3 hours credit.

A descriptive course including the development of astronomy, and its methods, the motions, laws and evolution of the solar system. Occasional evening viewing sessions are held

1023 Introduction to Astronomy II

(3-0) 3 hours credit. Prerequisite: AST 1013 or consent of instructor.

The general properties and types of stars, unusual stellar objects such as quasars and black holes, galaxies, evolution and cosmology. Occasional evening viewing sessions are held.

1031 Introduction to Astronomy Laboratory

(0-2) 1 hour credit. Prerequisite: AST 1013 or consent of instructor. Concurrent enrollment in AST 1023 is recommended.

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

DIVISION OF MATHEMATICS, COMPUTER SCIENCE, AND SYSTEMS DESIGN

The division offers a Bachelor of Science Degree in Mathematics, Computer Science, and Systems Design in which the student may select one of six emphases: Actuarial Science, Computer Science, Mathematics, Statistics, Systems Design, or Distributed. It also offers a Bachelor of Science Degree in Mathematics designed for students interested in obtaining a secondary teaching certificate.

BACHELOR OF SCIENCE DEGREE IN MATHEMATICS, COMPUTER SCIENCE, AND SYSTEMS DESIGN

The minimum number of semester hours required for this degree, including the 42 hours of General Education Requirements, is 126.⁵⁶

All candidates for the Bachelor of Science degree in Mathematics, Computer Science, and Systems Design, regardless of emphasis, must complete the following 26 semester hours of required courses (which includes the 3 hours of General Education Requirements in Mathematics, Computer Science, and Systems Design):

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

MAT 1214	Calculus I
MAT 1223	Calculus II
MAT 2213	Calculus III
MAT 2233	Matrix Algebra
STA 3513	Probability and Statistics
STA 3523	Statistical Methods
CS 1714	Introduction to Computer Science
CS 1723	Data Structures I

In addition, a candidate for the Bachelor of Science in Mathematics, Computer Science, and Systems Design degree must complete the course requirements for the emphasis declared by the candidate.

ACTUARIAL SCIENCE EMPHASIS

Additional Bachelor of Science in Mathematics, Computer Science, and Systems Design Degree Requirements for the actuarial science emphasis are:

A. The following 27 semester hours:

MAT 2913	Problems in Actuarial Science I
MAT 3613	Differential Equations I
MAT 3633	Numerical Analysis I
MAT 3923	Financial Mathematics
MAT 3933	Mathematics of Life Insurance
MAT 3953	Problems of Actuarial Science II
MAT 3963	Problems in Actuarial Science III
SD 4613	Operations Research I
SD 4623	Operations Research II

B. An additional 9 semester hours chosen from among the following courses:

⁵⁶Thirty-nine of the total semester hours required for the degree must be at the upper-division level.

Students seeking teacher certification should consult the Undergraduate Certification Programs in Education brochure for information.

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COMPUTER SCIENCE, AND SYSTEMS DESIGN**

- CS 2733 Introduction to Computer Organization
- CS 2743 Data Structures II
- CS 3733 Systems Programming
- CS 3743 Data Base Management
- CS 4753 Operating Systems and Computer Architecture I
- C. An additional 9 semester hours chosen from among the following courses:
 - STA 3313 Introduction to Sample Survey Theory and Methods
 - STA 3543 Applied Non-Parametric Statistics
 - STA 4643 Introduction to Stochastic Processes
 - STA 4713 Applied Regression Analysis
 - STA 4723 Design and Analysis of Experiments
 - STA 4733 Statistical Design and Model Building
- D. 16 semester hours of electives

COMPUTER SCIENCE EMPHASIS

Additional Bachelor of Science in Mathematics, Computer Science, and Systems Design Degree Requirements for the computer science emphasis are:

- A. The following 26 semester hours:
 - CS 2733 Introduction to Computer Organization
 - CS 2743 Data Structures II
 - CS 3233 Discrete Mathematical Structures
 - CS 3723 Introduction to Programming Languages
 - CS 3733 Systems Programming
 - CS 3773 Programming Methodology
 - CS 4753 Operating Systems and Architecture I
 - SD 2815 Digital Systems I
- B. Any 12 additional semester hours of approved elective courses in the Division of Mathematics, Computer Science, and Systems Design with a course number of 2000 or above.
- C. 23 semester hours of electives.

MATHEMATICS EMPHASIS

Additional Bachelor of Science in Mathematics, Computer Science, and Systems Design Degree Requirements for the mathematics emphasis are:

- A. MAT 3213 Foundations of Analysis
 - CS 3233 Discrete Mathematical Structures
 - B. 18 semester credit hours chosen from the following courses:

Students should follow one of these three suggested guidelines.

 - i) Students desiring a broad background in mathematics should take at least 12 hours from Group I and 6 hours from Group II.
 - ii) Students desiring a concentration which emphasizes pure mathematics should take at least 6 hours from Group I and 12 hours from Group II.
 - iii) Students desiring a concentration which emphasizes applied mathematics should take all 18 hours from Group I.
- Group I
- MAT 3223 Complex Variables
 - MAT 3243 Calculus for Applications
 - MAT 3613 Differential Equations I

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COMPUTER SCIENCE, AND SYSTEMS DESIGN

MAT	3623	Differential Equations II
MAT	3633	Numerical Analysis I
MAT	3643	Numerical Analysis II
STA	4723	Design and Analysis of Experiments
SD	4613	Operations Research I
SD	4623	Operations Research II

Group II

MAT	4213	Real Analysis I
MAT	4223	Real Analysis II
MAT	4233	Modern Abstract Algebra I
MAT	4243	Modern Abstract Algebra II
MAT	4253	Number Theory
MAT	4263	Geometry
MAT	4273	Topology

- C. Any 7 additional semester hours of approved elective courses in the Division of Mathematics, Computer Science, and Systems Design with a course number of 2000 or above.
- D. 30 semester hours of electives

STATISTICS EMPHASIS

Additional Bachelor of Science in Mathematics, Computer Science, and Systems Design Degree Requirements for the statistics emphasis are:

- A. An additional 12 semester hours chosen from the following courses:

STA	3013	Multivariate Methods for the Life and Social Sciences
STA	3313	Introduction to Sample Survey Theory and Methods
STA	3433	Applied Nonparametric Statistics
STA	4643	Introduction to Stochastic Processes
STA	4713	Applied Regression Analysis
STA	4723	Design and Analysis of Experiments
STA	4733	Statistical Design and Model Building
STA	3813	Discrete Data Analysis and Bioassay

- B. An additional 6 semester hours chosen from the following courses:

MAT	3213	Foundations of Analysis
MAT	3223	Complex Variables
MAT	3613	Differential Equations I
MAT	3923	Finance Mathematics
MAT	3933	Mathematics of Life Insurance
SD	4613	Operations Research I
SD	4623	Operations Research II
SD	4633	Simulation

- C. Any 13 additional semester hours of approved elective courses in the Division of Mathematics, Computer Science, and Systems Design with a course number of 2000 or above.
- D. 30 semester hours of electives.

SYSTEMS DESIGN EMPHASIS

Additional Bachelor of Science in Mathematics, Computer Science, and Systems Design Degree Requirements for the systems design emphasis are:

- A. The following 22 semester hours:

**BACHELOR OF SCIENCE DEGREE IN MATHEMATICS, / 249
COMPUTER SCIENCE, AND SYSTEMS DESIGN**

SD	2815	Digital Circuits Design I
SD	2835	Digital Circuits Design II
SD	3823	Data Acquisition and Distribution
SD	3833	Real-Time Digital Control
SD	3843	Minicomputer Systems Architecture
SD	4803	Microprocessor Laboratory I

B. An additional 9 semester hours chosen from the following courses:

CS	3723	Programming Languages
CS	3743	Data Base Management
CS	3773	Programming Methodology
CSD	4911-3	Independent Study
CSD	4953	Special Studies
SD	3853	Instrumentation Circuits Design
SD	3863	Real-Time Operating Systems for Minicomputers
SD	3873	Analog Simulation
SD	4813	Microprocessor Laboratory II
SD	4823	System Analysis
SD	4833	Optimal Control
SD	4853	Computer Interfaces
MAT	3633	Numerical Analysis I
MAT	3643	Numerical Analysis II

C. Any 3 upper division hours of approved elective courses in the Division of Mathematics, Computer Science, and Systems Design.

D. 27 semester hours of electives.

DISTRIBUTED EMPHASIS

Additional Bachelor of Science in Mathematics, Computer Science, and Systems Design Degree Requirements for the distributed emphasis are:

A. The following 32 semester hours:

CS	2733	Introduction to Computer Organization
CS	2743	Data Structures II
CS	3233	Discrete Mathematical Structures
CS	3723	Programming Languages
MAT	3243	Calculus for Applications
MAT	3613	Differential Equations I
MAT	3633	Numerical Analysis I
SD	2815	Digital Circuits Design I
SD	3823	Data Acquisition and Distribution
SD	4613	Operations Research I

B. Any 9 additional upper-division hours of approved elective courses in the Division of Mathematics, Computer Science, and Systems Design.

C. 20 semester hours of electives.

BACHELOR OF SCIENCE DEGREE IN MATHEMATICS

The minimum number of semester hours required for this degree, including the 42 hours of General Education Requirements, is 126.⁹⁷ The student who is not prepared to begin MAT 1214 must take MAT 1093, Precalculus.

⁹⁷Thirty-nine of the total semester hours required for the degree must be at the upper-division level.

Students seeking teacher certification should consult the Undergraduate Certification Programs in Education brochure for information.

250 / COMPUTER SCIENCE

All candidates for the degree must complete:

A. 32 required semester hours listed below:

CS	1714	Introduction to Computer Science
CS	1723	Information Structures I
CS	3233	Discrete Mathematical Structures
MAT	1214	Calculus I
MAT	1223	Calculus II
MAT	2213	Calculus III
MAT	3213	Foundations of Analysis
MAT	4263	Geometry
STA	3513	Probability and Statistics
STA	3523	Statistical Methods

B. In addition to the required courses, students must take 9 credits of approved math electives, at least 6 of which must be at the upper-division level. It is recommended that students select either MAT 4233 and MAT 4243 Modern Abstract Algebra I and II or MAT 4213 and MAT 4223 Real Analysis I and II as the 6 upper-division credits.

C. 43 semester hours of electives chosen to satisfy the Teacher Certification Requirements.

COURSE DESCRIPTIONS COMPUTER SCIENCE (CS)

1043 Computer Programming for Business Applications

(3-0) 3 hours credit. Concurrent enrollment: STA 1064.

Program development and testing; computer applications; plotting, solution of equations, probability distributions, random variate generation, matrix operations, numeric integration and differentiation and computing statistics. Students majoring in the Division of Mathematics, Computer Science, and Systems Design receiving credit for CS 1043 may not also receive credit for CS 1063 nor for CS 1073.

1063 Introduction to Problem-Solving and Programming

(3-0) 3 hours credit.

A problem-solving approach to computer programming. Stress is on problem definition, problem-solving techniques and algorithm development. Students majoring in the Division of Mathematics, Computer Science, and Systems Design receiving credit for CS 1063 may not also receive credit for CS 1043 nor for CS 1073.

1073 Introductory Computer Programming for Scientific Applications

(3-0) 3 hours credit. Prerequisite: MAT 1183.

Introductory programming. Sorting and ranking; plotting; numerical taxonomy. Solution of non-linear equations; linear regression. Solution of linear systems. Students majoring in the Division of Mathematics, Computer Science, and Systems Design receiving credit for CS 1073 may not also receive credit for CS 1063 nor for CS 1043.

1133 Computer Literacy I

(3-0) 3 hours credit.

An introduction to computers and information processing for those with no previous background; a study of the computer, its uses and social impact; introduction to computer programming. May not be applied to a major in Mathematics, Computer Science, and Systems Design.

1714 Introduction to Computer Science

(4-0) 4 hours credit. Prerequisite: MAT 1183.

Introduction to basic concepts of computer science. Functional components of computers, data representation, problem solving methods, algorithm development, and programming using a high-level programming language.

1723 Data Structures I

(3-0) 3 hours credit. Prerequisite: CS 1714.

Common data structures, operations, applications and alternate methods of data representation. Pointers, linear structures (lists, queues, stacks, strings), arrays and array address calculations, trees, and graphs.

2133 Computer Literacy II

(3-0) 3 hours credit. Prerequisite: CS 1133.

Advanced programming topics in BASIC; special emphasis on microcomputers in home and business applications. May not be applied to a major in Mathematics, Computer Science and Systems Design.

2733 Introduction to Computer Organization

(3-0) 3 hours credit. Prerequisite: CS 1723. Concurrent enrollment: SD 2815.

The characteristics of, and relationships between I/O devices, control units, and storage devices; the organization of modules into a system; the relationship between computer organization and software.

2743 Data Structures II

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

An introduction to data file management. Storage device characteristics, files (access, file types), searching and sorting (hash coding, tables, directories), and analysis of algorithms.

3133 Computers and Society

(3-0) 3 hours credit. Prerequisite: CS 1063, 1043, 1073, 1133, or CS 1714, or consent of instructor.

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

3233 Discrete Mathematical Structures

(3-0) 3 hours credit. Prerequisite: CS 1723 and MAT 2213.

Survey and development of theoretical tools suitable for describing algorithmic applications. Propositional logic and proofs, set theory, algebraic structures, groups, graphs, lattices, Boolean algebra, finite fields, and computability.

3321 Topics in Problem Solving Using High Level Languages

(1-0) 1 hour credit. Prerequisite: CS 1714.

Problem solving techniques using a high-level language. Languages will vary and include COBOL, FORTRAN, BASIC, PL/I, LISP, and SNOBOL. May be repeated for credit when topics vary but not more than 3 hours will apply to the major.

3723 Programming Languages

(3-0) 3 hours credit. Prerequisite: CS 2743.

An introduction to the philosophy and features of high-level programming languages; elementary aspects of computer and run-time considerations, problem solving ability, syntax, semantics, and examples.

3733 Systems Programming

(3-0) 3 hours credit. Prerequisite: CS 2733.

An introduction to system software. Internal representation of data and programs, addressing techniques, I/O, macros, and utilities; introduction to operating systems.

3743 Data Base Management

(3-0) 3 hours credit. Prerequisite: CS 2743.

Study of systems for management of large amounts of related data. Basic concepts, implementation approaches, user data models, commercially available systems.

3773 Programming Methodology

(3-0) 3 hours credit. Prerequisite: CS 2743.

Discussion of modular (structured) programming methods, programming style and program verification techniques.

3793 Introduction to Artificial Intelligence

(3-0) 3 hours credit. Prerequisite: CS 2743 and 3233.

Discussion of theorem proving by machine, computational linguistics, psychological modeling and computer games.

4133 Survey of Computer System Concepts

(3-0) 3 hours credit. Prerequisite: Programming experience or familiarity with the basics of computing.

A survey of some essential concepts of information structures and file systems, operating systems, programming languages, and architecture from a user's point of view. May not be applied to a major in Mathematics, Computer Science and Systems Design.

4313 Automata, Computability and Formal Languages

(3-0) 3 hours credit. Prerequisite: CS 1714 and 3233.

Discussion of abstract machines (finite state automata, pushdown automata and turing machines), formal grammars (regular, context-free and type 0) and the relationships between them.

4323 Analysis of Algorithms

(3-0) 3 hours credit. Prerequisite: CS 2743 and CS 3233.

Analysis of the performance of algorithms and discussion of programming techniques and data structures used in the writing of effective algorithms.

4383 Computer Graphics

(3-0) 3 hours credit. Prerequisite: CS 3773 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.

4713 Compiler Writing Laboratory

(3-0) 3 hours credit. Prerequisite: CS 3723.

An introduction to implementation of translators. Topics include formal grammars, scanners, parsing techniques, symbol table management, code generation, and code optimization.

4753 Operating Systems and Computer Architecture I

(3-0) 3 hours credit. Prerequisite: CS 3733.

A study of the relationship between operating systems and computer architecture. Instruction sets, memory organization and management, process management, multiprogramming systems, protection, and file systems.

COURSE DESCRIPTIONS MATHEMATICS (MAT)

1023 Calculus for the Social Sciences

(3-0) 3 hours credit. Prerequisite: MAT 1183 or the equivalent.

A general introduction to differential and integral calculus for non-science majors: graphing and analyzing polynomial, logarithmic and exponential functions.

1033 Algebra with Calculus for Business

(3-0) 3 hours credit. Prerequisite: MAT 1183 or the equivalent.

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

1093 Precalculus

(3-0) 3 hours credit. Prerequisite: MAT 1183 or the equivalent.

Polynomial and rational functions, exponential functions, logarithmic functions, trigonometric functions. Formerly MAT 1092. Credit cannot be earned for both 1092 and 1093.

1103 Consumer Mathematics

(3-0) 3 hours credit.

A course designed to offer the student the opportunity to gain the necessary mathematical tools for coping with modern technological society. Linear equations and inequalities, ratios, proportion and variation, mathematics of finance.

- 1113 Mathematics for Elementary Teachers I**
(3-0) 3 hours credit. Open only to declared majors in Elementary Education.
Areas of study from arithmetic and geometry; number systems.
- 1123 Mathematics for Elementary Teachers II**
(3-0) 3 hours credit. Prerequisite: MAT 1113 or equivalent. Open only to declared majors in Elementary Education.
Areas of study include geometry and algebra.
- 1183 Intermediate Algebra**
(3-0) 3 hours credit.
Exponents, arithmetic and factorization of polynomials; rational expressions; negative and rational exponents; scientific notation; radicals solving linear and quadratic equations; complex numbers; linear inequalities; absolute values; Cartesian coordinates, distance formula, linear equations; relations; functions, graphing functions.
- 1214 Calculus I**
(4-0) 4 hours credit. Prerequisite: MAT 1093 or the equivalent.
An introduction to the concepts of limit, continuity and derivative, mean value theorem, and applications of derivatives such as velocity, acceleration maximization and curve sketching; introduction to the Riemann integral and the fundamental theorem of calculus.
- 1223 Calculus II**
(3-0) 3 hours credit. Prerequisite: MAT 1214.
Methods of integration, inverse trigonometric functions, applications of the integral, multiple integrals.
- 2213 Calculus III**
(3-0) 3 hours credit. Prerequisite: MAT 1223.
Special areas of differential and integral calculus. Taylor series, power series, convergence tests, vectors, functions of several variables, partial derivatives.
- 2233 Matrix 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.
- 2913 Problems in Actuarial Science I**
(3-0) 3 hours credit. Prerequisite: MAT 2213. Prerequisite or concurrent enrollment: MAT 2233.
Problem solving in problems from advanced calculus and linear algebra which apply to actuarial science.
- 3113 Algebra for Elementary Teachers**
(3-0) 3 hours credit. Prerequisite: MAT 1123. Open only to declared Elementary Education majors.
Areas of study from college algebra including linear and quadratic equations and inequalities, systems of equations, graphical methods.
- 3123 Geometry for Elementary Teachers**
(3-0) 3 hours credit. Prerequisite: MAT 1123. Open only to declared Elementary Education majors.
Geometrical concepts with emphasis on an axiomatic, deductive approach to plane geometry; 3-dimensional and topological aspects.
- 3213 Foundations of Analysis**
(3-0) 3 hours credit. Prerequisite: MAT 2213.
An opportunity for rigorous development of the foundations of real analysis; basic point set topology; limits; continuity. Emphasis on theorem proving and mathematical rigor.
- 3223 Complex Variables**
(3-0) 3 hours credit. Prerequisite: MAT 2213.
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 2213.
An introduction to the concepts of modern algebra by way of the integers. Emphasis on theorem proving and mathematical rigor.

3243 Calculus for Applications

(3-0) 3 hours credit. Prerequisite: MAT 2213.

Line integrals, Green's theorem, Stokes' theorem, Fourier series, Laplace transforms.

3613 Differential Equations I

(3-0) 3 hours credit. Prerequisite or concurrent enrollment in MAT 2233.

Basic notions of differential equations, solution of first order equations and linear equations with constant coefficients, n th order initial value problems, power series solutions of differential equations.**3623 Differential Equations II**

(3-0) 3 hours credit. Prerequisite: MAT 3613.

Continuation of MAT 3613. Stability, partial differential equations and boundary value problems.

3633 Numerical Analysis I

(3-0) 3 hours credit. Prerequisites: MAT 2233 and either CS 1714 or 1073.

Solution of linear and non-linear equations, curve-fitting, eigenvalue problems.

3643 Numerical Analysis II

(3-0) 3 hours credit. Prerequisite: MAT 3633.

Numerical solution of ordinary and partial differential equations.

3923 Finance Mathematics

(3-0) 3 hours credit. Prerequisite: MAT 1023 or 1183.

Analysis of the time value of money; preparation for parts of the actuarial examinations; determining the evaluation of flows of money, mortgage payments, bond amortization schedules, annuities, and related areas.

3933 Mathematics of Life Insurance

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

Probability theory applied to problems of life insurance. Measurement of mortality; annuity and insurance benefits; reserve liabilities; expenses; gross premiums, asset shares, modified reserves, cash values; nonforfeiture options; distribution of surplus.

3953 Problems in Actuarial Science II

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

Problem solving in probability and statistics applied to actuarial science.

3963 Problems in Actuarial Science III

(3-0) 3 hours credit. Prerequisite: MAT 3923 and 3633 or concurrent enrollment.

Problem solving in the theory of interest and in basic numerical analysis applied to actuarial science.

3973 Problems in Actuarial Science IV

(3-0) 3 hours credit. Prerequisite: MAT 3933 or concurrent enrollment.

Problem solving in life contingencies.

4113 Mathematical Subjects for Elementary Teachers

(3-0) 3 hours credit. Open only to declared Elementary Education majors.

Selected mathematical subjects of an advanced nature relevant to the modern elementary mathematics curriculum.

4123 History of Mathematics for Teachers

(3-0) 3 hours credit. Prerequisite: MAT 3113. Open only to preservice and inservice teachers.

Selected subjects in mathematics developed through historical perspectives and biographies.

4213 Real Analysis I

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

An in-depth study of the calculus of functions of several variables. The Bernstein Polynomial Theorem, Stone-Weierstrass Theorem and the derivative in \mathbb{R} .**4223 Real Analysis II**

(3-0) 3 hours credit. Prerequisite: MAT 4213.

The Riemann-Stieltjes integral and related subjects including the bounded convergence theorem, the Riesz representation theorem and the main theorems of integral calculus in \mathbb{R} and \mathbb{R}^p .

4233 Modern Abstract Algebra I

(3-0) 3 hours credit. Prerequisite: MAT 2213. CS 3233 recommended.
An in-depth study of groups and rings.

4243 Modern Abstract Algebra II

(3-0) 3 hours credg. Prerequisite: MAT 4233.
Topics in field theory and vector spaces.

4253 Number Theory

(3-0) 3 hours credit. Prerequisites: MAT 2213.
The theory of primes, congruences and related subjects.

4263 Geometry

(3-0) 3 hours credit. Prerequisite: MAT 2213.
Projective, affine and non-Euclidean geometry.

4273 Topology

(3-0) 3 hours credit. Prerequisite: MAT 2213.
Set theory including cardinal and ordinal numbers. Topological properties of the real line and metric spaces.

4911-3 Independent Study

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

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

4951-3 Special Studies in Mathematics

1-3 hours credit. Prerequisite: Consent of instructor.

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

COURSE DESCRIPTIONS

STATISTICS

(STA)

1053 Basic Statistics

(3-0) 3 hours credit. Prerequisite: MAT 1033 or 1183.

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

1064 Basic Statistics for Business and Economics

(4-0) 4 hours credit. Prerequisite: MAT 1033.

Fundamental concepts and procedures of statistics and probability with business applications: descriptive and inferential statistics, regression and correlation, time series, index numbers. Use of computer library programs.

1993 Statistical Methods for the Life and Social Sciences

(3-0) 3 hours credit. Prerequisite: STA 1053 or 1064.

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

3013 Multivariate Analysis for the Life and Social Sciences

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

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

3313 Introduction to Sample Survey Theory and Methods

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

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

3433 Applied Non-Parametric Statistics

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

Tests of location. Goodness of fit tests. Rank tests. Tests based on nominal and ordinal data for both related and independent samples. Measures of association.

3513 Probability and Statistics

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

Axioms of probability, probability functions and density functions, random variables, functions of random variables and their sampling distributions.

3523 Statistical Methods

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

Principles and methodology of estimation and testing hypotheses. Chi-square tests. Linear regression. Nonparametric tests. Analysis of variance.

3813 Discrete Data Analysis and Bioassay

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

Methods especially useful for problems arising in the life sciences. Analysis of count data. Contingency tables. Probit analysis.

4643 Introduction to Stochastic Processes

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

Finite Markov chains including transition probabilities, classification of states, limit theorems; queuing theory, birth and death processes.

4713 Applied Regression Analysis

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

An introduction to regression analysis with emphasis on practical aspects, fitting a straight line, examination of residuals, matrix treatment of regression analysis, fitting and evaluation of general linear models, non-linear regression.

4723 Design and Analysis of Experiments

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

General concepts in the design and analysis of experiments; response variable, factors to be varied, quantitative and qualitative factors, fixed and random factors and how the factors are to be combined. The method of randomization to be used in the design, the order of experimentation, the mathematical model used to describe the experiment, computation of the test statistics and the interpretation of the results.

4733 Statistical Design and Model Building

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

Elements of model building. Fitting linear models to data. Factorial designs. Response surface methodology.

COURSE DESCRIPTIONS SYSTEMS DESIGN (SD)

2815 Digital Circuits Design I

(3-4) 5 hours credit. Prerequisites: CS 1723 and MAT 1214.

An introduction to modern integrated digital computer circuits. Basics of DTL, TTL, and MOS technologies. Hardware realizations of logical equations. Implementation of digital arithmetic.

2835 Digital Circuits Design II

(3-4) 5 hours credit. Prerequisite: SD 2815.

Design of synchronous sequential circuits. State minimization techniques. Design of small synchronous processor.

3823 Data Acquisition and Distribution

(2-2) 3 hours credit. Prerequisite: CS 1714.

Fundamentals of assembly language for a minicomputer. Programming techniques used to interface a minicomputer to scientific laboratory instrumentation. Analog and digital data formats and characteristics.

3833 Real-Time Digital Control

(2-2) 3 hours credit. Prerequisite: SD 3823.

Principles of real-time minicomputer operating systems. Programming techniques for on-line interactive data acquisition and control. Efficient and reliable system designs.

3843 Minicomputer Systems Architecture

(3-0) 3 hours credit. Prerequisite: SD 2835.

A presentation of the hardware organization and systems architecture of state-of-the-art minicomputer systems. Instruction decoding and central processor organization, memory organization, floating-point processor organization, input-output functions and direct memory access, writable control store organization and micro-programming.

3853 Instrumentation Circuits Design

(3-0) 3 hours credit. Prerequisites: SD 2815, 3823 and PHY 1923.

Functional characteristics of state-of-the-art integrated operational amplifiers, regulated power supplies, digital-to-analog and analog-to-digital converters, isolation amplifiers, serial transmitters, design of hardware configurations to interface scientific and industrial instrumentation to a minicomputer.

3863 Real-Time Operating Systems for Minicomputers

(3-0) 3 hours credit. Prerequisites: SD 3823 or CS 3733.

A study in the design of real-time operating systems for minicomputers. Memory management. Task scheduling in a multitask environment, input/output scheduling, and spooling.

3873 Analog Simulation

(2-2) 3 hours credit. Prerequisite: MAT 1223.

Operational amplifier principles, summers, integrators, multipliers, magnitude and time scaling, the inverse function principle for operational amplifiers. Techniques for simulation of mechanical, electrical, and biological systems.

4613 Operations Research I

(3-0) 3 hours credit. Prerequisites: MAT 2213 and MAT 2233.

Introduction to analytical methods and models of operations research, with emphasis on optimization. Linear, integer and non-linear programming. Network analysis, including PERT and CPM. Introduction to dynamic programming.

4623 Operations Research II

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

Introduction to probabilistic analysis and models in operations research. Decision analysis, Markov chains, queuing models.

4633 Simulation

(3-0) 3 hours credit. Prerequisite or concurrent enrollment: SD 4623.

Construction and use of simulation models on a digital computer. Monte Carlo techniques and associated statistical methods.

4803 Microprocessor Laboratory I

(0-6) 3 hours credit. Prerequisite: SD 3843.

Principles of large-scale integration. Organization and systems architecture of state-of-the-art microprocessors. Large scale integration of random access memory and programmable read-only memory. Assemblers, compilers, and operating systems for microprocessors.

4813 Microprocessor Laboratory II

(0-6) 3 hours credit. Prerequisite: SD 4803.

Students execute projects dealing with the design and implementation of microprocessor software for selected applications in the area of process control.

4823 System Analysis

(3-0) 3 hours credit. Prerequisite: MAT 2213.

Mathematical concepts relevant to the formulation of models for physical systems. Initial

value problems. Laplace transforms and the concept of transfer function. Detailed analysis of simple control systems for position and velocity tracking. Stability. The course deals mainly with linear systems.

4833 Optimal Control

(3-0) 3 hours credit. Prerequisite: SD 4823.

Stability and Liapunov's method. Formulation of state equations for continuous and discrete systems. Formulation of the optimal control problem. Pontryagin's maximum principle. Dynamic programming; adaptive control systems.

4853 Computer Interfaces

(3-0) 3 hours credit. Prerequisite: SD 4803.

Basic characteristics and design considerations of printer, tape, disk controllers, multiplexers and other devices for computer communications and teleprocessing.

COURSE DESCRIPTIONS
COMPUTER SCIENCE/SYSTEMS DESIGN
(CSD)

4901 Seminar in Computer Sciences and Systems Design

(1-0) 1 hour credit. Prerequisite: Upper-division classification.

Scheduled and impromptu presentations on subjects of interest presented by division faculty and visiting lecturers. May be repeated for credit but no more than 3 hours will apply toward the major.

4911-3 Independent Study

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

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

4951-3 Special Studies in Computer Science or Systems Design

1-3 hours credit. Prerequisite: Consent of instructor.

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