TAYLOR UNIVERSITY | School of Natural and Applied Sciences

MATTHEW RENFROW, PHD, DEAN

BIOLOGY, ENVIRONMENTAL SCIENCE, AND SUSTAINABLE DEVELOPMENT

CHEMISTRY AND BIOCHEMISTRY

COMPUTER SCIENCE AND ENGINEERING

KINESIOLOGY

MATHEMATICS

PHYSICS AND ENGINEERING

Biology, Environmental Science, and Sustainable Development

Co-Chairs, Professor M. Guebert, Associate Professor B. Dewar
Professor J. Reber
Associate Professor P. Grabowski
Assistant Professors A. Bergen, E. Hasenmyer, R. Reber, L. Woodward
Visiting Professor D. Sas
Visiting Assistant Professor R. Miles

The Department of Biology, Environmental Science, and Sustainable Development equips and mentors students with practical scientific knowledge, ethical grounding, and professional skills to effectively minister to a world in need. The department offers majors in Biology Health Science, Biology Investigations and Applications, Biology Science Education, Environmental Science, Medical Laboratory Science, and Sustainable Development and minors in Biology, Environmental Science, and Sustainability, all of which involve a deep concern for God's human and non-human creation.

Our programs include a deep understanding of the Christian foundation beneath a faith-based pursuit of knowledge and application in our courses. This approach, both inside and outside the classroom, is fundamental to our offering of foundational core courses for students completing other majors in the liberal arts as well as to students majoring in our department. Students pursuing one of the Biology majors are trained to model Christ to His created world as they engage in biology investigation and practice. Students majoring in Environmental Science and Sustainable Development are trained to live out their faith through integrating environmental stewardship, social justice, and sustainable living. All majors are required to complete a senior comprehensive requirement; Biology majors meet this requirement by passing the Biology Major Field Test during the Fall semester of their senior year.

Biology

The Biology program is a dynamic community of learning, leadership, and service. We equip and mentor students through faith-integrated scholarship and research in the exploration of diversity and processes of life. Students are prepared to model Christ to His created world as they engage in biology investigation and practice, healthcare, and science education professions. Biology graduates are prepared to enter diverse careers, such as biology research, healthcare (e.g., physicians, dentists, nurses, physical therapists, physician assistants), and science teaching. All majors are required to complete a senior comprehensive requirement; Biology majors meet this requirement by passing the biology Major Field Test taken during their senior year.

Biology Health Science (BA or BS)

The Biology Health Science major requires 83-90 hours in the major. A Bachelor of Arts degree requires two years of one foreign language. *All major courses must be completed with a grade of C- or better and are included in the major GPA.*

Foundational Requirements

BIO 201	4	Biology I: Foundations of Cell Biology and Genetics
BIO 202	4	Biology II: Organisms and Diversity
BIO 203	4	Principles of Genetics
BIO 493	4	Biology Senior Capstone
ENS 204	4	Principles of Ecology

Major Requirements

BIO 185	1	Biology Major Orientation
BIO 285	1	Biology Colloquium I
BIO 310	4	Human Anatomy and Physiology I
BIO 311	4	Human Anatomy and Physiology II
BIO 385	1	Biology Colloquium II
BIO 485	1	Biology Colloquium III
KIN 221	3	Exercise as Medicine

Concentrations *– Students must select <u>one</u> of the following concentrations:*

Pre-Allied Health Careers

BIO 210	3	Medical Terminology
BIO 471	4	Microbiology and Immunology
CHE 211	4	College Chemistry I
CHE 212	4	College Chemistry II
CHE 311	4	Organic Chemistry I
MAT 210	4	Introductory Statistics

Select <u>one</u> course from the following:

PSY 100	3	Introductory Psychology
PSY 250	3	Life Span Development

Select <u>one</u> course from the following:

SOC 100	3	Introduction to Sociology
SOC 210	3	Contemporary Social Issues
SOC 220	3	Ethnic and Minority Issues

Select at least <u>6</u> hours from the following:

BIO 306	3	Introduction to Bioinformatics
BIO 312	4	Cellular and Molecular Biology
BIO 393	2-4	Practicum
BIO 432	4	Developmental Biology
BIO 450	2-4	Directed Research
BIO 462	4	Molecular Genetics
BIO 472	4	Histology

Select at least an additional <u>6</u> hours from the following:

BIO 306	3	Introduction to Bioinformatics
BIO 312	4	Cellular and Molecular Biology
BIO 345	3	Evolution and the Nature of Science
BIO 393	2-4	Practicum
BIO 432	4	Developmental Biology
BIO 450	2-4	Directed Research
BIO 462	4	Molecular Genetics
BIO 472	4	Histology
EXS 306	3	Physiology of Exercise
EXS 316	3	Applied Nutrition
EXS 381	3	Kinesiology
HPH 310	3	Cardiorespiratory Physiology and Chronic Disease
HPH 315	3	Pathophysiology of Immunological and Metabolic Chronic Diseases
HPH 320	3	Neuromuscular Physiology and Chronic Disease
PBH 100	3	Introduction to Public Health
PBH 335	4	Environmental Health
PHI 311	3	Medical Ethics
SUS 315	4	Sustainable Food Systems and Health

Select an additional <u>8</u> hours from the following:

CHE 312	4	Organic Chemistry II
CHE 411	3	Biochemistry I
NAS 230	2	Health Education for Behavior Change
NAS _70	1	Special Topics *(advisor approval)*
PHY 203	4	General Physics I
PHY 204	4	General Physics II

Biology Health Science requirements continued on next page

Biology Health Science requirements continued from previous page

Pre-Dental

CHE 211	4	College Chemistry I
CHE 212	4	College Chemistry II
CHE 311	4	Organic Chemistry I
CHE 312	4	Organic Chemistry II
CHE 411	3	Biochemistry I
MAT 210	4	Introductory Statistics
PHY 203	4	General Physics I
PHY 204	4	General Physics II

Select <u>one</u> course from the following:

PSY 100	3	Introductory Psychology
PSY 250	3	Life Span Development

Select <u>one</u> course from the following:

SOC 100	3	Introduction to Sociology
SOC 210	3	Contemporary Social Issues
SOC 220	3	Ethnic and Minority Issues

Select <u>three</u> courses from the following:

BIO 306	3	Introduction to Bioinformatics
BIO 312	4	Cellular and Molecular Biology
BIO 432	4	Developmental Biology
BIO 462	4	Molecular Genetics
BIO 471	4	Microbiology and Immunology
BIO 472	4	Histology

Select at least an additional <u>6</u> hours from the following:

BIO 306	3	Introduction to Bioinformatics
BIO 312	4	Cellular and Molecular Biology
BIO 345	3	Evolution and the Nature of Science
BIO 393	2-4	Practicum
BIO 432	4	Developmental Biology
BIO 450	2-4	Directed Research
BIO 462	4	Molecular Genetics
BIO 471	4	Microbiology and Immunology
BIO 472	4	Histology
EXS 306	3	Physiology of Exercise
EXS 316	3	Applied Nutrition
EXS 381	3	Kinesiology
HPH 310	3	Cardiorespiratory Physiology and Chronic Disease
HPH 315	3	Pathophysiology of Immunological and Metabolic Chronic Diseases
HPH 320	3	Neuromuscular Physiology and Chronic Disease
PBH 100	3	Introduction to Public Health
PBH 335	4	Environmental Health
PHI 311	3	Medical Ethics
SUS 315	4	Sustainable Food Systems and Health

Recommended Courses

BIO 210	3	Medical Terminology
NAS 230	2	Health Education for Behavior Change
NAS _70	1	Special Topics *(advisor approval)*

Pre-Medicine

CHE 211	4	College Chemistry I
CHE 212	4	College Chemistry II
CHE 311	4	Organic Chemistry I
CHE 312	4	Organic Chemistry II
CHE 411	3	Biochemistry I
MAT 210	4	Introductory Statistics
PHY 203	4	General Physics I
PHY 204	4	General Physics II

Select <u>one</u> course from the following:

PSY 100	3	Introductory Psychology
PSY 250	3	Life Span Development

Select <u>one</u> course from the following:

SOC 100	3	Introduction to Sociology
SOC 210	3	Contemporary Social Issues
SOC 220	3	Ethnic and Minority Issues

Select <u>three</u> courses from the following:

BIO 306	3	Introduction to Bioinformatics
BIO 312	4	Cellular and Molecular Biology
BIO 432	4	Developmental Biology
BIO 462	4	Molecular Genetics
BIO 471	4	Microbiology and Immunology
BIO 472	4	Histology

Select at least an additional <u>6</u> hours from the following:

BIO 306	3	Introduction to Bioinformatics
BIO 312	4	Cellular and Molecular Biology
BIO 345	3	Evolution and the Nature of Science
BIO 393	2-4	Practicum
BIO 432	4	Developmental Biology
BIO 450	2-4	Directed Research
BIO 462	4	Molecular Genetics
BIO 471	4	Microbiology and Immunology
BIO 472	4	Histology
EXS 306	3	Physiology of Exercise
EXS 316	3	Applied Nutrition
EXS 381	3	Kinesiology
HPH 310	3	Cardiorespiratory Physiology and Chronic Disease
HPH 315	3	Pathophysiology of Immunological and Metabolic Chronic Diseases
HPH 320	3	Neuromuscular Physiology and Chronic Disease
PBH 100	3	Introduction to Public Health
PBH 335	4	Environmental Health
PHI 311	3	Medical Ethics
SUS 315	4	Sustainable Food Systems and Health

Recommended Courses

BIO 210	3	Medical Terminology
NAS 230	2	Health Education for Behavior Change
NAS _70	1	Special Topics *(advisor approval)*

Pre-Optometry

BIO 210	3	Medical Terminology
BIO 471	4	Microbiology and Immunology
CHE 211	4	College Chemistry I
CHE 212	4	College Chemistry II
CHE 311	4	Organic Chemistry I
CHE 411	3	Biochemistry I
MAT 210	4	Introductory Statistics
PHY 203	4	General Physics I
PHY 204	4	General Physics II
PSY 100	3	Introductory Psychology

Select <u>one</u> course from the following:

SOC 100	3	Introduction to Sociology
SOC 210	3	Contemporary Social Issues
SOC 220	3	Ethnic and Minority Issues

Select at least <u>6</u> hours from the following:

BIO 306	3	Introduction to Bioinformatics
BIO 312	4	Cellular and Molecular Biology
BIO 393	2-4	Practicum
BIO 432	4	Developmental Biology
BIO 450	2-4	Directed Research
BIO 462	4	Molecular Genetics
BIO 472	4	Histology

Select at least an additional <u>6</u> hours from the following:

BIO 306	3	Introduction to Bioinformatics
BIO 312	4	Cellular and Molecular Biology
BIO 345	3	Evolution and the Nature of Science
BIO 393	2-4	Practicum
BIO 432	4	Developmental Biology
BIO 450	2-4	Directed Research
BIO 462	4	Molecular Genetics
BIO 472	4	Histology
EXS 306	3	Physiology of Exercise
EXS 316	3	Applied Nutrition
EXS 381	3	Kinesiology
HPH 310	3	Cardiorespiratory Physiology and Chronic Disease
HPH 315	3	Pathophysiology of Immunological and Metabolic Chronic Diseases
HPH 320	3	Neuromuscular Physiology and Chronic Disease
PBH 100	3	Introduction to Public Health
PBH 335	4	Environmental Health
PHI 311	3	Medical Ethics
SUS 315	4	Sustainable Food Systems and Health

Recommended Courses

CHE 312	4	Organic Chemistry II
NAS 230	2	Health Education for Behavior Change
NAS _70	1	Special Topics *(advisor approval)*

Biology Health Science requirements continued on next page

Biology Health Science requirements continued from previous page

Pre-Physician Assistant

BIO 210	3	Medical Terminology
BIO 471	4	Microbiology and Immunology
CHE 211	4	College Chemistry I
CHE 212	4	College Chemistry II
CHE 311	4	Organic Chemistry I
CHE 312	4	Organic Chemistry II
CHE 411	3	Biochemistry I
MAT 210	4	Introductory Statistics
PSY 250	3	Life Span Development

Select one course from the following:

SOC 100	3	Introduction to Sociology
SOC 210	3	Contemporary Social Issues
SOC 220	3	Ethnic and Minority Issues

Select at least 6 hours from the following:

BIO 306	3	Introduction to Bioinformatics
BIO 312	4	Cellular and Molecular Biology
BIO 393	2-4	Practicum
BIO 432	4	Developmental Biology
BIO 450	2-4	Directed Research
BIO 462	4	Molecular Genetics
BIO 472	4	Histology

Select at least an additional 6 hours from the following:

BIO 306	3	Introduction to Bioinformatics
BIO 312	4	Cellular and Molecular Biology
BIO 345	3	Evolution and the Nature of Science
BIO 393	2-4	Practicum
BIO 432	4	Developmental Biology
BIO 450	2-4	Directed Research
BIO 462	4	Molecular Genetics
BIO 472	4	Histology
EXS 306	3	Physiology of Exercise
EXS 316	3	Applied Nutrition
EXS 381	3	Kinesiology
HPH 310	3	Cardiorespiratory Physiology and Chronic Disease
HPH 315	3	Pathophysiology of Immunological and Metabolic Chronic Diseases
HPH 320	3	Neuromuscular Physiology and Chronic Disease
PBH 100	3	Introduction to Public Health
PBH 335	4	Environmental Health
PHI 311	3	Medical Ethics
SUS 315	4	Sustainable Food Systems and Health

Recommended Courses

NAS 230	2	Health Education for Behavior Change
NAS _70	1	Special Topics *(advisor approval)*
PHY 203	4	General Physics I

Biology Investigations and Applications (BA or BS)

The Biology Investigations and Applications major requires 70 hours in the major. A Bachelor of Arts degree requires two years of one foreign language. *All major courses must be completed with a grade of C- or better and are included in the major GPA.*

Foundational Requirements

BIO 201	4	Biology I: Foundations of Cell Biology and Genetics
BIO 202	4	Biology II: Organisms and Diversity
BIO 203	4	Principles of Genetics
BIO 493	4	Biology Senior Capstone
ENS 204	4	Principles of Ecology

Major Requirements

BIO 185	1	Biology Major Orientation
BIO 285	1	Biology Colloquium I
BIO 381	3	Research Methods
BIO 385	1	Biology Colloquium II
BIO 440	1	Research Proposal
BIO 450	5	Directed Research
BIO 460	1	Research Communication
BIO 485	1	Biology Colloquium III

Additional Major Requirements

CHE 211	4	College Chemistry I
CHE 212	4	College Chemistry II
MAT 210	4	Introductory Statistics

Select 8 credits† from the following:

CHE 311	4	Organic Chemistry I
CHE 312	4	Organic Chemistry II
COS 120	4	Introduction to Computational Problem Solving
COS 121	4	Foundations of Computer Science
ENS 383	4	Environmental Ethics
MAT 311	3	Introduction to Data Science
MAT 382	3	Advanced Statistical Methods
NAS 370	1	Selected Topics*
NAS 480	1	Seminar
PHI 311	3	Medical Ethics
PHY 203	4	General Physics I
PHY 204	4	General Physics II
SUS 231	4	Environmental Science, Society, and Sustainability

†Any additional course under the General Biology concentration not otherwise counting toward the major or concentration may count toward the 8 credits.

**Must be a course in Perspectives in Scientific Reasoning.*

***Concentrations** – Students must select one of the following concentrations:*

Anatomy and Physiology

BIO 310	4	Human Anatomy and Physiology I
BIO 311	4	Human Anatomy and Physiology II

Select 8 credits from the following:

BIO 312	4	Cellular and Molecular Biology
BIO 331	4	Comparative Anatomy
BIO 360	1-4	Independent Study (approved by advisor)
BIO 370	1-4	Selected Topics *(approved by advisor)*
BIO 452	4	Animal Physiology
BIO 472	4	Histology
EXS 316	3	Applied Nutrition
EXS 381	3	Kinesiology

Cellular and Molecular Biology

Select 12 credits from the following:

BIO 312	4	Cellular and Molecular Biology
BIO 360	1-4	Independent Study *(approved by advisor)*
BIO 370	1-4	Selected Topics *(approved by advisor)*
BIO 432	4	Developmental Biology
BIO 462	4	Molecular Genetics
BIO 471	4	Microbiology and Immunology
CHE 410L	2	Biochemistry Lab
CHE 411	3	Biochemistry I
CHE 412	3	Biochemistry II

Select 4 additional credits from any additional upper-division Biology course not otherwise counting toward major or concentration.

General Biology

Select 16 credits from the following:

BIO 301	4	Taxonomy of Vascular Plants
BIO 304	4	Field Natural History of the Black Hills
BIO 307	4	Vertebrate Natural History
BIO 310‡	4	Human Anatomy and Physiology I
BIO 311‡	4	Human Anatomy and Physiology II
BIO 312	4	Cellular and Molecular Biology
BIO 331‡	4	Comparative Anatomy
BIO 345	3	Evolution and the Nature of Science
BIO 360	1-4	Independent Study *(approved by advisor)*
BIO 370	1-4	Selected Topics *(approved by advisor)*
BIO 432	4	Developmental Biology
BIO 452‡	4	Animal Physiology
BIO 462	4	Molecular Genetics
BIO 471	4	Microbiology and Immunology
BIO 472	4	Histology
CHE 410L	2	Biochemistry Lab
CHE 411	3	Biochemistry I
CHE 412	3	Biochemistry II
ENS 375	4	Systems Ecology

‡A maximum of two courses may be taken from BIO 310, 311, 331, 452.

Biology Investigations and Applications requirements continued on next page

Biology Investigations and Applications requirements continued from previous page

Organisms and Systems Biology/Pre-Veterinary Medicine

Select 12 credits from the following:

BIO 301	4	Taxonomy of Vascular Plants
BIO 304	4	Field Natural History of the Black Hills
BIO 307	4	Vertebrate Natural History
BIO 331	4	Comparative Anatomy
BIO 345	3	Evolution and the Nature of Science
BIO 360	1-4	Independent Study *(approved by advisor)*
BIO 370	1-4	Selected Topics *(approved by advisor)*
BIO 452	4	Animal Physiology
ENS 375	4	Systems Ecology

Select 4 additional credits from any additional upper-division Biology course not otherwise counting toward major or concentration.

Biology Science Education (BA/BS)

The Biology Science Education major requires 61-65 hours plus education courses. Optional concentrations are available in SpEd Mild-Moderate P-12 Licensure, SpEd Intense P-12 Licensure, and TESOL P-12 Licensure. The Bachelor of Arts degree requires two years of one foreign language. *All major courses, including education curriculum courses, must be completed with a grade of C- or better and are included in the major GPA.*

Professional Education

EDU 150	3	Education in America
EDU 222	2	Literacy in the Content Area for Secondary Teachers
EDU 260	3	Educational Psychology
EDU 307	2	Discipline and Classroom Management for Secondary Teachers
EDU 309	1	Methods of Instruction and Assessment in Secondary Education
EDU 332	2	The Junior High/Middle School
EDU 344	1	Educational Technology in Secondary Education
EDU 384	1	Perspectives on Diversity
EDU 431	17	Supervised Internship in Secondary Schools
NAS 309	2	Science Education Methods
SED 220	3	Exceptional Children

Additional Education Requirements

ENG 110	3	College Composition
PSY 340	3	Adolescent Psychology

Select one course from the following:

CAC 160	3	Integrative Communication
COM 210	3	Public Speaking

Foundational Requirements

BIO 185	1	Biology Major Orientation
BIO 201	4	Biology I: Foundations of Cell Biology and Genetics
BIO 202	4	Biology II: Organisms and Diversity
BIO 203	4	Principles of Genetics
BIO 345	3	Evolution and the Nature of Science
BIO 493	4	Biology Senior Capstone
ENS 204	4	Principles of Ecology

Science Core Courses

Select one of the following chemistry course combinations:

CHE 201	4	General, Organic, and Biochemistry I
CHE 202	4	General, Organic, and Biochemistry II
or		
CHE 211	4	College Chemistry I
CHE 212	4	College Chemistry II

Select one course from the following:

PHY 203	4	General Physics I
PHY 211	4	University Physics I

Select one course from the following:

ENS 240	3	Introduction to Geology
ENS 241	4	Physical Geology
ENS 242	3	Geology of Indiana
PHY 204	4	General Physics II
PHY 212	5	University Physics II

Biology Electives

Select 4 hours in the summer field studies program‡ from:

BIO 304	4	Field Natural History of the Black Hills
BIO 370	4	Selected Topics *(approved by advisor)*

‡Additional courses from Au Sable Institute may count toward this requirement with departmental approval. Courses from other institutions may count with departmental approval. See www.ausable.org or Dr. Regier for details.

Select one cell and molecular course from the following:

BIO 312	4	Cellular and Molecular Biology
BIO 432	4	Developmental Biology
BIO 462	4	Molecular Genetics
BIO 471	4	Microbiology and Immunology

Select two organismal biology courses from the following:

BIO 307	4	Vertebrate Natural History
BIO 310	4	Human Anatomy and Physiology I
BIO 311	4	Human Anatomy and Physiology II
BIO 331	4	Comparative Anatomy
BIO 452	4	Animal Physiology

Select one biology experience course from the following:

BIO 381	3	Research Methods
BIO 450	2-4	Directed Research

*Select an additional 4 credits from a 300/400-level biology course**

**BIO 370, 393, and 450 may not meet this requirement.*

Biology Minor

A minor in Biology requires 26 hours. *All minor courses must be completed with a grade of C- or better and are included in the minor GPA.*

Minor Requirements

BIO 201	4	Biology I: Foundations of Cell Biology and Genetics

Select an additional 14 credits of 200-, 300-, and 400-level biology courses. A minimum of 6 credits must be upper-division (300/400).

Additional Minor Requirements

Select one course from the following:

MAT 151	4	Calculus I
MAT 210	4	Introductory Statistics
MAT 230	4	Calculus II

Select one course from the following:

CHE 201	4	General, Organic, and Biochemistry I
CHE 211	4	College Chemistry I

Medical Laboratory Science (BS)

The Bachelor of Science degree with a major in Medical Laboratory Science requires 79 hours. *All major courses must be completed with a grade of C- or better and are included in the major GPA.*

Foundational Requirements

BIO 201	4	Biology I: Foundations of Cell Biology & Genetics
BIO 203	4	Principles of Genetics

Major Requirements

BIO 185	1	Biology Major Orientation
BIO 285	1	Biology Colloquium I
BIO 385	1	Biology Colloquium II

Additional Major Requirements

BIO 312	4	Cellular and Molecular Biology
BIO 471	4	Microbiology and Immunology
CHE 211	4	College Chemistry I
CHE 212	4	College Chemistry II
CHE 311	4	Organic Chemistry I
MAT 210	4	Introductory Statistics

Select <u>one</u> of the following:

BIO 244	4	Fundamentals of Anatomy and Physiology I
BIO 310	4	Human Anatomy and Physiology I

Select <u>one</u> of the following:

BIO 245	4	Fundamentals of Anatomy and Physiology II
BIO 311	4	Human Anatomy and Physiology II

Select <u>4</u> credits from the following:

CHE 312	4	Organic Chemistry II
CHE 411	3	Biochemistry I
CHE 411L	1	Biochemistry I Lab

Medical Laboratory Science Requirements*

MLS 301	2	Medical Chemistry I
MLS 302	2	Medical Chemistry II
MLS 303	2	Medical Chemistry III
MLS 304	2	Medical Chemistry IV
MLS 310	2	Blood Bank I
MLS 311	2	Blood Bank II
MLS 312	2	Serology/Virology
MLS 321	2	Hematology I
MLS 322	2	Hematology II
MLS 323	2	Phlebotomy/Phlebotomy Rotation
MLS 411	2	Medical Microbiology I
MLS 412	2	Medical Microbiology II
MLS 413	2	Mycology and Parasitology
MLS 421	2	Hemostasis
MLS 422	2	Urinalysis
MLS 431	2	Clinical Rotations

**Courses taken through IU Health Medical Laboratory Science program. Taylor University cannot guarantee acceptance into the program.*

Environmental Science

In this major, students gain knowledge in natural sciences, principles of environmental ethics, law, and stewardship, and practical skills in problem-solving. With concentrations in Biology and Geology, students may focus on deep conceptual knowledge in the natural sciences which prepares them for a variety of environmental careers in government agencies, private consulting, non-profit organizations, and education institutions.

A mid-level, field-intensive course, Field Natural History of the Black Hills (in South Dakota) is required usually in Sophomore summer and is a favorite among students. To build professional skills and experience, a practicum is required, usually in the summer following the Sophomore or Junior year. Faculty-mentored student research is encouraged to build capacity for graduate school. As a result of this powerful combination of relevant theory and field experience, nearly 100% of our graduates find placement in either graduate programs or the workplace.

Environmental Science (BS)

The Bachelor of Science degree with a major in Environmental Science requires 77 hours. *Students may not double major with Sustainable Development. All major courses, including those in the concentration, must be completed with a grade of C- or better and are included in the major GPA.*

Core Requirements

BIO 304	4	Field Natural History of the Black Hills
ENS 302	4	Environmental Law and Policy
ENS 383	4	Environmental Ethics
ENS 393	2	Practicum
ENS 493	2	Environmental Science Capstone
MAT 210	4	Introductory Statistics
SUS 120	1	Environmental Stewardship and Sustainable Living
SUS 231	4	Environmental Science, Society, and Sustainability

Biology Requirements

BIO 202	4	Biology II: Organisms and Diversity
ENS 204	4	Principles of Ecology

Select <u>two</u> of the following courses:

BIO 301	4	Taxonomy of Vascular Plants
BIO 307	4	Vertebrate Natural History
ENS 375	4	Systems Ecology

Chemistry Requirements

CHE 201	4	General, Organic, and Biochemistry I
CHE 202	4	General, Organic, and Biochemistry II
CHE 320	4	Environmental Pollution and Toxicology

Geology Requirements

ENS 241	4	Physical Geology
ENS 355	4	Geospatial Analysis

Select <u>two</u> of the following courses:

ENS 319	4	Principles of Soil Science
ENS 361	4	Geomorphology
ENS 362	4	Hydrogeology

Concentrations

Select <u>one</u> of the following concentrations:

Biology

Select <u>two</u> courses not previously used from the following:

BIO 301	4	Taxonomy of Vascular Plants
BIO 307	4	Vertebrate Natural History
BIO 331	4	Comparative Anatomy
BIO 471	4	Microbiology and Immunology
ENS 375	4	Systems Ecology
SUS 315	4	Sustainable Food Systems and Health
SUS 325	4	Sustainable Development in Practice

Geology

Select <u>two</u> courses not previously used from the following:

ENS 319	4	Principles of Soil Science
ENS 341	4	Earth Materials
ENS 361	4	Geomorphology
ENS 362	4	Hydrogeology
ENS 364	4	Water Resources and Appropriate Technology

Environmental Science Minor

The minor in Environmental Science requires 18-20 hours. *Minor not open to Environmental Science, Sustainable Development, or Integrated majors. All major courses must be completed with a grade of C- or better and are included in the major GPA.*

Minor Requirements

ENS 383	4	Environmental Ethics
Select <u>one</u> course from the following:		
SUS 200	3	Environment and Society
SUS 231	4	Environmental Science, Society, and Sustainability
Select <u>one</u> course from the following:		
ENS 240	3	Introduction to Geology
ENS 241	4	Physical Geology
Select <u>one</u> course from the following:		
ENS 302	4	Environmental Law and Policy
SUS 315	4	Sustainable Food Systems and Health
Select <u>one</u> course from the following:		
ENS 204	4	Principles of Ecology
ENS 319	4	Principles of Soil Science
ENS 341	4	Earth Materials
ENS 355	4	Geospatial Analysis
ENS 361	4	Geomorphology
ENS 362	4	Hydrogeology
ENS 364	4	Water Resources and Appropriate Technology
ENS 375	4	Systems Ecology
SUS 325	4	Sustainable Development in Practice

Sustainable Development

Sustainable Development, established in 2015, provides interdisciplinary training for solving global sustainability problems in U.S. and international settings. Students build a broad foundational understanding of the interactions of the three spheres of sustainability—environment, economics, and society. By studying at the nexus of these subjects, students develop a holistic understanding of key issues facing humanity and the environment.

In this program, students take core courses in sustainability, environmental science, sociology, public health, and economics and gain depth in a specific area by choosing elective courses that connect their passion for studies with their desire to help people. An international, field-based course during January interterm enables students to experience and apply what they have been learning. Near the end of the curriculum each student participates in a field-based development project through a required practicum and a senior capstone experience involving a research project on a local, real-world issue.

Sustainable Development (BS)

The Bachelor of Science degree with a major in Sustainable Development requires 66 hours. *Students may not double major with Environmental Science. All major courses must be completed with a grade of C- or better and are included in the major GPA.*

Core Requirements

ANT 200	3	Cultural Anthropology
ECO 201	3	Principle of Microeconomics
ENS 204	4	Principles of Ecology
ENS 241	4	Physical Geology
ENS 302	4	Environmental Law and Policy
ENS 355	4	Geospatial Analysis
ENS 383	4	Environmental Ethics
OVC 329	3	Monitoring, Evaluation, and Research Methods
PBH 110	3	Global Health
PBH 330	3	Assessment for Program Planning
PBH 330L	1	Service Learning in Community Assessment
SUS 120	1	Environmental Stewardship and Sustainable Living
SUS 231	4	Environmental Science, Society, and Sustainability
SUS 310	3	Poverty and Sustainable Development
SUS 310L	1	Poverty and Sustainable Development Lab
SUS 325	4	Sustainable Development in Practice
SUS 393	2	Practicum
SUS 493	2	Sustainable Development Capstone
Select <u>one</u> of the following:		
SOC 100	3	Introduction to Sociology
SOC 110	3	Introduction to Global Societies *(recommended)*

Electives

Select <u>10</u> additional credits from the following:

<u>Public and Environmental Health</u>		
PBH 320	4	Epidemiology
PBH 335	4	Environmental Health
PBH 350	3	Determinants of Health and Health Equity
<u>Sustainable Agriculture</u>		
BIO 301	4	Taxonomy of Vascular Plants
ENS 319	4	Principles of Soil Science
SUS 211	4	Crops and Society
SUS 315	4	Sustainable Food Systems and Health
<u>Urban Sustainability</u>		
PBH 335	4	Environmental Health
SOC 220	3	Ethnic and Minority Issues
SOC 410	3	Community and Urban Affairs
<u>Water Resources</u>		
ENS 362	4	Hydrogeology
ENS 364	4	Water Resources and Appropriate Technology
<u>Additional Electives</u>		
CAC 340	3	Intercultural Communication
ENT 381	3	Global Entrepreneurship and Business as Missions
IAS 310	3	Philanthropy and Grant-Writing
ITB 375	3	International Business
POS 327	3	International Law and Justice
REL 311	3	Foundations of Christian World Mission
REL 391	3	Preparation and Strategy for Christian World Mission

Sustainability Minor

The minor in Sustainability requires 20-23 hours. *Minor not open to Environmental Science majors. All major courses must be completed with a grade of C- or better and are included in the major GPA.*

Minor Requirements

SUS 120	1	Environmental Stewardship and Sustainable Living
SUS 310	3	Poverty and Sustainable Development
SUS 310L	1	Poverty and Sustainable Development Lab
Select <u>one</u> of the following:		
SUS 200	3	Environment and Society
SUS 231	4	Environmental Science, Society, and Sustainability
Select <u>one</u> of the following:		
ENS 302	4	Environmental Law and Policy
ENS 383	4	Environmental Ethics
PBH 335	4	Environmental Health
PBH 345	3	International Humanitarian Response
SUS 315	4	Sustainable Food Systems and Health
Select <u>one</u> of the following:		
ENS 355	4	Geospatial Analysis
OVC 329	3	Monitoring, Evaluation, and Research Methods
PBH 320	4	Epidemiology
PBH 330	3	Assessment for Program Planning
PBH 340	4	Community Health Development in Practice
SUS 325	4	Sustainable Development in Practice

Sustainability requirements continued on next page

Sustainability requirements continued from previous page

Electives
Select an additional two courses from two areas.

Business and Economics

ECO _____	3	*Any 200/300/400-level elective*
ENT _____	3	*Any 200/300/400-level elective*
FIN _____	3	*Any 200/300/400-level elective*
MGT _____	3	*Any 200/300/400-level elective*
MKT _____	3	*Any 200/300/400-level elective*

Public Health

PBH _____	3	*Any 100-level elective*

Social Sciences

GBS _____	3	*Any 200/300/400-level elective*
OVC _____	3	*Any 200/300/400-level elective*
POS _____	3	*Any 200/300/400-level elective*
SOC _____	3	*Any 200/300/400-level elective*
SWK _____	3	*Any 200/300/400-level elective*

Biology Courses

BIO 100 **4 hours**
General Biology
Concepts and principles are studied to provide basic knowledge that assists students to meet the obligations of an informed citizen. The Spring semester of General Biology is intended for elementary education majors as a content course that emphasizes instructional methodologies in science education. *Three hours of lecture and two hours of laboratory per week. Meets foundational core life science requirement; not available to biology majors.*

BIO 102 **4 hours**
Biology for Educators
Introductory principles of biology taught with materials appropriate for future teachers. Topics include cell biology, inheritance, diversity, evolution, and ecology. *Three hours of lecture and two hours of laboratory per week. Meets foundational core life science requirement; not available to biology majors.*

BIO 104 **3 hours**
Animal Biology
A foundational core course designed to provide a broad look at life science through the study of the Kingdom Animalia. Includes a consideration of tissues, anatomy, ecology, natural history, and human interaction with representative vertebrates and invertebrates. *Two hours lecture and two hours laboratory per week. Meets foundational core life science requirement. Offered Fall semester of odd years.*

BIO 106 **4 hours**
Human Biology
This course is designed as a one semester anatomy and physiology course covering all body organ systems and the interrelatedness of human health and lifestyle, environment, etc. *Three hours lecture and two hours of laboratory per week. Meets foundational core life science requirement. Offered Fall semester. Preference given to Social Work majors.*

BIO 107 **4 hours**
Introduction to Wildlife
This course looks at the wide range of adaptations, behavior, life history, and geographical distribution of vertebrates from fishes to mammals. Labs focus on observation (and sometimes capture) of vertebrates in their natural habitat and involve several outdoor sessions. *Three hours of lecture and two to three hours of lab per week. Meets foundational core life science requirement. Not available to biology majors. Offered Spring semester.*

BIO 112 **3 hours**
Topics in Biology
A study of some areas of biology most relevant to today's students with an emphasis on concepts and principles that will best assist students to meet the obligations of an informed citizen. Topics to be considered include process of science, structure and function of plants and animals, the relationship of organisms to one another and their environment, genetics, microbiology, biotechnology, bioethics, and evolution. *Two hours of lecture and two hours of laboratory per week. Meets foundational core life science requirement.*

BIO 113 **3 hours**
Botany for Beginners
An introductory course designed for the non-science major to provide a basic understanding of the processes through which plants function, the role of plants in the environment, and to equip students with skills that will allow them to continue to enjoy plants long after the course is over. Topics covered will range from subcellular processes to ecological roles. Plant adaptation, diversity, ecological interactions, basic plant identification, plant propagation, and plants of economic importance are included. Two hours of lecture and two hours of laboratory per week. *Meets foundational core life science requirement.*

BIO 170 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

BIO 185 **1 hour**
Biology Major Orientation
This course is required for all new biology majors and will provide students with the opportunity to explore the field of biology and begin to develop their professional portfolio. Information will be shared through guest, faculty and student presentations, discussions, and writing assignments. *Open to biology majors only. Offered second half of Fall semester.*

BIO 201 **4 hours**
Biology I: Foundations of Cell Biology and Genetics
Study of cellular structures and metabolism emphasizing form and function on structure; the cellular pathways of energy and matter transformation; the information flow, exchange, and storage; and the molecular, mitotic, and meiotic mechanism of inheritance. *Three hours of lecture and two hours of laboratory per week. Meets foundational core life science requirement. Open to Biology majors only in the Fall; open to all majors and minors requiring BIO 201 in the Spring.*

BIO 202 **4 hours**
Biology II: Organisms and Diversity
This course is the second of the two-course sequence for freshman biology majors. In this course we will examine the diversity of organisms, including algae, protozoa, fungi, plants, and animals, as they appear through the fossil record from the Paleozoic Era to the present time. *Majors/Minors only. Prerequisite: BIO 201.*

BIO 203 **4 hours**
Principles of Genetics
Fundamental principles of Mendelian inheritance, introduction to molecular genetics, along with quantitative and evolutionary genetics will be examined. *Three hours of lecture and two hours of laboratory per week. Meets foundational core life science requirement. Prerequisite: BIO 201.*

BIO 210 **3 hours**
Medical Terminology
This course is designed to assist students in learning medical terminology, as well as to provide instruction in word-building skills so that words can be identified by their parts. It provides a solid vocabulary foundation for those individuals who anticipate taking the MCAT or plan to enter an area of allied health studies.

BIO 244 **4 hours**
Fundamentals of Anatomy and Physiology I
This course is the first of two courses which provide a foundation in human anatomy and physiology for Nursing students. The core physiology concepts of levels of organization, structure/ function relationship, interdependence, and homeostasis will be emphasized in the context of the study of cells, tissues, and several body systems, including the integumentary, skeletal, muscular, lymphatic, and immune systems. *Three hours of lecture and two hours of lab per week. Restricted to Nursing majors. Offered Fall semester.*

BIO 245 **4 hours**
Fundamental of Anatomy and Physiology II
This course is the second of two courses which provide a foundation in human anatomy and physiology for Nursing students. The core physiology concepts of interdependence and homeostasis will be emphasized in the context of the study of the endocrine, cardiovascular, respiratory, digestive, and urinary systems, as well as the concepts metabolism, fluid and electrolyte balance, and acid-base balance. *Three hours of lecture and two hours of lab per week. Prerequisite: BIO 244. Restricted to Nursing majors. Offered Spring semester.*

BIO 270 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

BIO 285 **1 hour**
Biology Colloquium I
This course is for sophomore biology majors and will provide students with the opportunity to explore the field of biology, to begin developing professional skills, and to add artifacts to their professional portfolio. The course will be delivered via seminar format with guest, faculty and student presentations, class discussions, and writing assignments. *Prerequisite: BIO 185. Offered first half of Fall semester.*

BIO 300 **4 hours**
Human Medical Physiology
Human Medical Physiology is an advanced study of human physiology as it examines the functional processes of the organ systems. The course covers human physiology in a clinical setting as well as laboratory experiences. Class is approached from a pathology problems based curriculum with laboratories in the university hospital. *The course is part of the Global Engagement Centre program.*

BIO 301 **4 hours**
Taxonomy of Vascular Plants
Identification, classification, and systematics of vascular plants are studied. Topics include basic population genetics, the process of speciation, phylogeny reconstruction, and molecular patterns of diversification. Laboratory emphasis is on local flora, plant family characteristics, and modern systematic techniques. *Two hours of lecture and four hours of laboratory per week. Prerequisite: BIO 202; BIO 203 is recommended. Offered Fall semester of odd years.*

BIO 304 **4 hours**
Field Natural History of the Black Hills
Field Course: Introduction to basic field and lab methods used in field natural history. Includes basic nomenclature of spring flora and fauna in terrestrial as well as aquatic systems. Examines the principles of geology/paleontology, ecosystems, communities, and wildlife as exhibited in the Black Hills region of South Dakota, including Mt. Rushmore, Badlands National Park, Custer State Park, Devils Tower National Monument, the Black Hills National Forest, and Yellowstone and Grand Teton National Parks. *Prerequisites: BIO 202 and ENS 204 or permission of instructor. Offered Summer at the Wheaton College Science Station, Black Hills South Dakota.*

BIO 306 **3 hours**
Introduction to Bioinformatics
This course is designed to introduce students to concepts of bioinformatics, as well as basic bioinformatics skills, using the R programming language. The course will explore methods and datasets spanning from the level of DNA (genomics) up to the organismal and ecosystem level. Bioinformatics is an interdisciplinary field combining concepts of biology, computer science, and statistics to analyze and interpret biological datasets and solve complex questions. *Two hours of lecture and one hour of one hour of coding/data analysis in a computer lab per week. Prerequisite: BIO 203 or instructor permission. Offered Fall semester of even years.*

BIO 307 **4 hours**
Vertebrate Natural History
This course looks at the adaptive anatomy, feeding relationships, behavior, life history, and geographical distribution of vertebrates from fishes to mammals. Labs focus on methods currently employed for study and observation of vertebrates in the field and involve several outdoor sessions. *Three hours of lecture and three hours of lab per week. Prerequisite: BIO 202 or permission of the instructor; ENS 204 is recommended. Offered Spring semester.*

BIO 309 **4 hours**
Directed Field Experience
Investigative learning involving closely directed field research or field experience. *Instructor permission required.*

BIO 310 **4 hours**
Human Anatomy and Physiology I
The lecture portion focuses on structure and function of the skeletal, muscular, nervous and endocrine systems, and examines core concept of homeostasis and feedback loops. The lab portion of the course consists of detailed laboratory dissections of the dogfish shark and domestic cat, serving as models of human anatomy, coupled to computer aided examination of human anatomy and some histology. *Three hours lecture and three hours of laboratory per week. Meets foundational core life science requirement. Prerequisites: BIO 201 or CHE 201 or CHE 211. Offered Fall semester.*

BIO 311 **4 hours**
Human Anatomy and Physiology II
A continuation of BIO 310, the lecture focuses on the respiratory, cardiovascular, urinary, and digestive systems, and examines several core concepts demonstrated by these systems. The lab portion of the course focuses on common experimental techniques and physiological measures relevant to respiratory, cardiovascular, and urinary systems. *Three hours of lecture and two hours of lab per week. Prerequisite: BIO 310. Offered Spring semester.*

BIO 312 **4 hours**
Cellular and Molecular Biology
Analysis of the eukaryotic cell with regard to its molecular and biochemical characteristics, including bioenergetics, protein kinesis, cell signaling, cell-division cycle, cell junctions and extracellular matrix, cancer, stem cells and tissue renewal, and the adaptive immune system. *Three hours lecture and three hours of lab per week. Prerequisites: BIO 201; BIO 203; CHE 201 or CHE 211; CHE 202 or CHE 212; and minimum junior status or permission of the instructor.*

BIO 331 **4 hours**
Comparative Anatomy
Classification, characteristics, and comparison of typical chordate animals with emphasis on the vertebrates. Lab contains detailed dissection of representative vertebrates. *Three hours of lecture and three hours laboratory per week. Prerequisite: BIO 202 or permission of instructor. Offered Fall semester of even years and Summer at discretion of faculty.*

BIO 345 **3 hours**
Evolution and the Nature of Science
This course introduces the conceptual and theoretical foundations of evolution and the nature of science. Students will be introduced to the longer-term processes of change. Evaluation of theories of species dynamics will be understood within the framework of the nature of science. *Prerequisite: Junior standing as a biology major or instructor permission. Offered January interterm.*

BIO 360 **1-4 hours**
Independent Study
An individualized, directed study involving a specified topic.

BIO 370 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

BIO 381 **3 hours**
Research Methods
Research Methods will introduce students to essential components of experimental design and the research process in Biology. The goal is to prepare students to critically interpret the research of others and to undertake research projects in course-based labs, through independent or summer research projects, and post-graduation research programs. Class topics will include defining a research question, hypothesis formulation, experimental design (correlation vs. necessity or sufficiency), controls, power and the role of statistics, interpreting results, and presenting and publishing results. The course will also include a series of instructor and student led seminars on articles and techniques relevant to a targeted research field. *Prerequisites: BIO 201; and BIO 202 or BIO 203. Offered January interterm.*

BIO 385 **1 hour**
Biology Colloquium II
This course is for junior biology majors. Students will have the opportunity to prepare for employment and graduate school, to continue developing professional skills, and to add artifacts to their professional portfolio. The course will be delivered via seminar format with guest, faculty and student presentations, class discussions, and writing assignments. *Prerequisite: BIO 285. Offered Spring semester.*

BIO 393 **1-4 hours**
Practicum
Supervised learning involving a first-hand field experience or a project. Generally, one hour of credit is awarded for a minimum of 40 hours of practicum experience. *Offered primarily during Summer.*

BIO 410 **3 hours**
Bioethics
An introduction to bioethics, comprising an overview of ethical theory, uniquely Christian contributions to ethical theory, and a consideration of specific bioethical problems. The interaction of bioethics in the worlds of ideologies, politics, and economics, and the unique contribution a Christian bioethical perspective brings to the public square, will also be foci of the course. Designed for upper level biology students, but open to any upper division student willing and able to acquire the necessary biological competence to knowledgably deal with the biology of the course material.

BIO 432 **4 hours**
Developmental Biology
A study of development at the molecular, cellular, and organismal levels. The class sessions focus on current concepts in developmental biology. The lab utilizes living model organisms (e.g. urchin, fly, chick) to conduct inquiry-based projects. *Three hours of lecture and three hours of laboratory per week. Prerequisites: BIO 201; BIO 203; and BIO 312 or BIO 462 recommended. Offered Fall semester of even years.*

BIO 440 **1 hour**
Research Proposal
Research Proposal prepares students to complete their research project by guiding them through the literature review and research proposal process. Students will work with the course instructor and intended research supervisor to prepare a written research proposal. *Prerequisite: BIO 381.*

BIO 450 **1-4 hours**
Directed Research
Investigative learning involving closely directed research and the use of such facilities as the library or laboratory. *The student must accumulate 42 hours of experience (e.g., research, class/group meetings, assignments) per credit hour earned. Departmental approval required.*

BIO 452 **4 hours**
Animal Physiology
A study of the physiological nature of living organisms with special consideration of the functions of vertebrate organ systems. Practical experience is given in working with live animals and the instrumentation used to examine the functional processes of various systems. *Three hours of lecture and three hours of laboratory per week. Prerequisites: BIO 331; CHE 201 or CHE 211; and CHE 202 or CHE 212. Offered Spring semester of odd years.*

BIO 455 **0 hours**
Supervised Summer Research
This course is a student-initiated alternative to BIO 450 Directed Research, to be completed during the summer months. The research project, approved in advance by the department and supervised by a formal research advisor (eg. a professor on- or off-campus), must include applied, hands-on learning and must involve a minimum of 300 documented hours. *Prerequisite: BIO 381. Prerequisite or Corequisite: BIO 440.*

BIO 460 **1 hour**
Research Communication
Research Communication will be taken following the student's research experience (BIO 450 or BIO 455). Each student will use the semester to write a formal report of his or her research findings and prepare a poster or oral presentation of his or her research. Students will present their research to the class and possibly in an on- or off-campus venue. *Prerequisites: BIO 440; and BIO 450 or BIO 455; or instructor permission.*

BIO 462 **4 hours**
Molecular Genetics
The current understanding of what a gene is, how it functions, and how it is regulated, particularly from a molecular perspective, is the essence of this course. Viral, prokaryotic, and eukaryotic systems are studied. Current scientific literature as well as a published textbook serve as sources. *Three hours lecture and one four-hour laboratory per week. Prerequisites: BIO 201, BIO 203, and two courses in chemistry; BIO 471 is recommended. Offered Fall semester of odd years.*

BIO 471 **4 hours**
Microbiology and Immunology
An introduction to general microbiology and to the human immune response. Included are microbial growth and control, diversity and taxonomy, the ecological role of microorganisms, and medical microbiology. The laboratory provides basic bacterial culture techniques, including the identification of unknowns. *Three hours lecture and three hours of laboratory per week. Prerequisites: BIO 201 and BIO 203. Two courses in chemistry are recommended. Offered Spring semester.*

BIO 472 **4 hours**
Histology
The study of minute structure, composition, and function of tissue. Lectures and laboratories help expose students to both the normal tissue formation found in animal tissues (chiefly mammalian) and many of the abnormal tissue developments associated with pathological dysfunctions. *Prerequisites: Completion of the biology core courses before enrolling or permission of the instructor. Offered Spring semester of even years.*

BIO 480 **1-4 hours**
Seminar
A limited-enrollment course designed especially for upper-class majors with emphasis on directed readings and discussion.

BIO 485 **1 hour**
Biology Colloquium III
This course is for junior biology majors. Students will have the opportunity to prepare for employment and graduate school, to continue developing professional skills, and to add artifacts to their professional portfolio. The course will be delivered via seminar format with guest, faculty and student presentations, class discussions, and writing assignments. *Prerequisite: BIO 385. Offered Spring semester.*

BIO 490 **1-2 hours**
Honors
Individualized study or research of an advanced topic within a student's major. *Open to students with at least a 3.00 GPA in the major field.*

BIO 493 **4 hours**
Biology Senior Capstone
An integrative, senior-level course in which major themes from within the biology major and from the Taylor foundational core program are intentionally revisited at a depth appropriate to college seniors. Such themes include the nature of biology as a natural science, the historical and philosophical foundations of the natural sciences, and the interaction and integration of biology with the Christian faith. Students will also actively engage in the process of doing current biological science, as well as consider several ethical issues that arise from current biology. *Prerequisite: Senior standing as a biology major. Offered January interterm.*

Environmental Science Courses

ENS 170 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

ENS 201 **4 hours**
Introduction to Geology in the Field
Introduction to earth's materials, processes, and history as discovered through field observations of minerals, rocks, fossils, strata, caves, rivers, canyons, and mountains. Emphasis is placed on field experiences and observations, complemented by study of maps, laboratory work, and discussions. *Offered during select Summers at the Black Hills Science Station near Rapid City, South Dakota.*

ENS 204 **4 hours**
Principles of Ecology
An introduction to the relationships existing between organisms and their environment. Lectures focus on the structural and functional aspects of populations, communities, and ecosystems in the context of the major North American biomes. *Three hours lecture and two hours laboratory per week. Meets foundational core life science requirement. Prerequisite: Four hours of BIO or ENS or permission of the instructor.*

ENS 240 **3 hours**
Introduction to Geology
Basic course dealing with the fundamental concepts of physical and historical geology. Three hours of lecture and two hours of lab per week. *Meets foundational core earth science requirement.*

ENS 241 **4 hours**
Physical Geology
A general introduction to the earth's internal and external physical, dynamic systems. Topics include occurrence and formation of minerals and rocks, processes that shape the earth's surface, and the internal structure and dynamics that lead to plate tectonics and crustal deformation. Special emphasis is placed on the environmental aspects of humans' interaction with the earth. *Three hours of lecture and two hours of lab per week. Meets foundational core earth science requirement.*

ENS 242 **3 hours**
Geology of Indiana
An introduction to the concepts of physical and historical geology in the context of Indiana. Topics include rocks, fossils, structure, landforms, and earth and environmental resources of the state. Offered during Summer session and includes a required field trip to several regions of Indiana for field observation and collection of mineral, rock, and fossil specimens. *Meets foundational core earth science requirement.*

ENS 270 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

ENS 302 **4 hours**
Environmental Law and Policy
Lectures introduce the major elements of U.S. environmental law: NEPA, EIS, CAA, CWA, RCRA, CERCLA, TSCA, FIFRA and CRTK. The administrative process, cost/benefit analysis and the role of litigation in enforcement are also discussed. Presentation techniques and debate skills are introduced. *Three hours of lecture and a discussion section per week. Prerequisite: Senior environmental science majors and minors or permission from the instructor.*

ENS 319 **4 hours**
Principles of Soil Science
An introduction to soil science with an emphasis on soil formation and taxonomy in the context of the landscape. Soil physical properties, water relations, and chemistry and biological properties will be the central focus. Special emphasis is placed on human interaction with the soil resource. Agricultural and current environmental issues as they relate to the soil resource are addressed. Lab exercises focus on the analysis of basic soil physical and chemical properties. Soil fertility and conservation are additional lab topics. *Prerequisite: SUS 200 or SUS 231.*

ENS 341 **4 hours**
Earth Materials
Basic principles of mineralogy and petrology, with emphasis placed on description, identification, classification, and interpretation of rock-forming minerals and the igneous, sedimentary, and metamorphic rocks they comprise. Also includes origin and occurrence of earth materials and their uses in economic and environmental contexts. Lab emphasizes observation of hand specimens and some thin-sections. *Three hours of lecture and the equivalent of two hours of lab per week, including field trips to selected locations throughout the state. Prerequisite: ENS 241 or permission from the instructor.*

ENS 355 **4 hours**
Geospatial Analysis
An introduction to methods of collection, management and analysis of geospatial data. Topics include basic map properties, preparation and interpretation of thematic and topographic maps, analysis of aerial photographs, surveying by traditional and global positioning systems (GPS) techniques, and acquisition of remotely-sensed satellite data. Special emphasis is placed on methods and applications of geographic information systems (GIS) in geospatial analysis. *Prerequisite: ENS 241 or SUS 200 or SUS 231.*

ENS 360 **1-4 hours**
Independent Study
An individualized, directed study involving a specified topic.

ENS 361 **4 hours**
Geomorphology
An applied approach to the study of earth surface processes and the landforms they produce. Topics include processes and landforms associated with weathering, mass wasting, rivers, karst, tectonics, glaciers, shorelines, and wind. Emphasis placed on environmental and land-use applications. Field and lab assignments include qualitative descriptions and quantitative measurements from fieldwork, topographic and geologic maps, and aerial photographs. *Three hours of lecture and three hours of lab per week. Prerequisite: ENS 241 or permission from the instructor.*

ENS 362 **4 hours**
Hydrogeology
Basic processes and measurement of the hydrologic cycle, including precipitation, evaporation, surface runoff, stream flow, soil moisture, and groundwater. Emphasis placed on groundwater, including aquifer characteristics, principles of flow, conceptual models of regional flow, geology of occurrence, well hydraulics, chemistry and quality, detection of pollutants, contaminant transport and remediation, and resource development. *Three hours of lecture and three hours of lab per week. Prerequisite: ENS 241 or permission from the instructor.*

ENS 364 **4 hours**
Water Resources and Appropriate Technology
Concepts and practices of water resource development and appropriate technology in the context of environmental resources in a developing country. Students participate in a service-learning project of design and implementation of water resource related appropriate technology (such as well-drilling, water quality protection, hygiene training, and sanitation system design) as part of a holistic ministry toward transformational development. Students develop a perspective on the role of appropriate technology in the responsibility of individuals in cross-cultural service, in issues of cross-cultural communication and interactions, and in God's purposes in missions and the worldwide church. *Prerequisite: IAS 120.*

ENS 370 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

ENS 375 **4 hours**
Systems Ecology
The principles of systems theory are introduced in an integrated study of the development, dynamics, and disruption of natural ecosystems. Theoretical, analytical, and experimental aspects of ecosystems are explored. Students are introduced to the use of microcomputers as a tool in ecosystem modeling. *Prerequisites: ENS 204 and one course in college-level mathematics or computer science.*

ENS 383 **4 hours**
Environmental Ethics
An in-depth discussion of the ethical implications of major environmental problems, such as world population and food supply, inequities in land and resource distribution, animal rights, materialism and personal life styles, and exploitation versus stewardship of the environment. *Three hours of lecture and a discussion section per week. Prerequisite: Junior or senior standing as an environmental science major or permission from the instructor.*

ENS 393 **1-4 hours**
Practicum
Supervised learning involving a first-hand field experience or a project. Generally, one hour of credit is awarded for a minimum of 40 hours of practicum experience. *Offered primarily during Summer.*

ENS 450 **1-4 hours**
Directed Research
Investigative learning involving closely directed research and the use of such facilities as the library or laboratory.

ENS 480 **1-4 hours**
Seminar
A limited-enrollment course designed especially for upper-class majors with emphasis on directed readings and discussion.

ENS 490 **1-2 hours**
Honors
Individualized study or research of an advanced topic within a student's major. *Open to students with at least a 3.00 GPA in the major field.*

ENS 493 **2 hours**
Environmental Science Capstone
An integrative, junior/senior-level course in which major themes from within the environmental science major and from the Taylor foundational core curriculum are intentionally revisited at a depth appropriate to college seniors. *Offered in the Fall semester of every other year. Prerequisite: Junior or senior standing as an environmental science major.*

Medical Laboratory Science Courses

MLS 301 **2 hours**
Medical Chemistry I
Emphasis on metabolic processes that maintain chemical homeostasis in humans, the application of clinical chemistry assay values in evaluating the integrity of these processes, and the correlation of abnormal results with metabolic dysfunction or disease states. Laboratory experience emphasis is on utilization of basic and intermediate methodologies and instrumentation and their application to assaying a variety of body constituents in a clinical chemistry laboratory.

MLS 302 **2 hours**
Medical Chemistry II
See MLS 301.

MLS 303 **2 hours**
Medical Chemistry III
See MLS 301.

MLS 304 **2 hours**
Medical Chemistry IV
See MLS 301.

MLS 310 **2 hours**
Blood Bank I
Emphasis on major blood group antigens and antibodies including their role in transfusion medicine. Current practices in blood donation, apheresis, and quality control are also covered. Review of serologic principles and technical fundamentals of transfusion practice; comprehensive consideration of blood groups and Rh factors, extensive practice with pre-transfusion techniques and safety practices. Other blood types, antigen-antibody relationships with techniques for demonstrating these. Elementary knowledge of genetics is helpful. Transfusion service bloods provide problem cases in isoimmunization and sensitization, Rh titration, etc. Responsibility for blood bank operation and application to special transfusion problems placed before the student.

MLS 311 **2 hours**
Blood Bank II
See MLS 310.

MLS 312 **2 hours**
Serology/Virology
Introduction to serologic and immunologic principles. Laboratory experience in performance of various testing procedures utilized in serologic diagnosis of infectious diseases and various syndromes. Techniques include precipitation, flocculation, various hemagglutination and hemagglutination inhibition techniques, fluorescent antibody testing, and complement fixation.

MLS 321 **2 hours**
Hematology I
Experience in blood cell identification on stained smears; blood cell, platelet, and reticulocyte counting procedures. Techniques of sedimentation rates, hematocrits, corpuscular indices, hemoglobin determination, and smear preparation staining. Introduction to instrumentation and quality control. Special procedures including bone marrow preparations, flow cytometry, and automated differential counters. Study of functions, maturation, and morphology of blood cells in addition to factors regulating production, metabolism, and kinetics of blood cells. The etiologic and morphologic classifications of blood disorders and diseases; correlations with bone marrows and cytochemistries. Study of cellular contents of other body fluids. Laboratory experience in collecting, staining, and counting blood cells; supervised experience with patients. Experience with specimens of spinal fluid, special determinations (platelets, reticulocytes, etc.), and pathologic smears. Also offers additional techniques such as erythrocyte sedimentation rate, hematocrit, and the calculation of indices.

MLS 322 **2 hours**
Hematology II
See MLS 321.

MLS 323 **2 hours**
Phlebotomy/Phlebotomy Rotation

MLS 411 **2 hours**
Medical Microbiology I
An in-depth study of the clinically significant microorganisms with special emphasis on their clinical significance, cultural and biochemical characteristics, and susceptibility testing patterns. Laboratory experience in the performance of skills and procedures needed for the isolation, identification, and susceptibility testing of clinically significant microorganisms. Diagnostic procedures as means to familiarize students with techniques; work on specimens received from hospital patients under supervision; practical experience with all types of human specimens for bacteriologic and mycologic study. Agglutination and precipitin techniques and their special application to agglutination titers and the use of antibiotics. Special assignments to provide experience with organisms infrequently encountered.

MLS 412 **2 hours**
Medical Microbiology II
See MLS 411.

MLS 413 **2 hours**
Mycology and Parasitology
Lecture and laboratory experience covering clinically significant fungi and parasites. Clinical manifestations, collection, procedures for processing of specimens, and identification techniques will be employed.

MLS 421 **2 hours**
Hemostasis
Hemostasis is a course covering the basic principles of the hemostasis mechanism, including an overview of the laboratory techniques used to evaluate disorders of hemostasis. Emphasizes the major components of hemostasis, interaction of these components, and laboratory evaluation of the major hemostatic disorders.

MLS 422 **2 hours**
Urinalysis
Routine urine examination and special tests; laboratory and special lectures.

MLS 431 **2 hours**
Clinical Rotations
Student rotates through various areas of supervised clinical experiences.

Sustainable Development Courses

SUS 120 **1 hour**
Environmental Stewardship and Sustainable Living
Key topics related to stewardship and sustainable living are presented in a weekly seminar. Guest lecturers and discussions are focused on aspects of ecological and social sustainability and its application in daily life and on campus.

SUS 170 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

SUS 200 **3 hours**
Environment and Society
Introduction to ecological principles and human impacts on the environment. Issues studied include population dynamics, natural resources, pollution problems, and environmental ethics. Lab exercises focus on experimental ecology and the basic techniques used to describe and measure environmental quality. *Meets foundational core life science requirement. Environmental science majors should elect SUS 231 rather than SUS 200.*

SUS 211 **4 hours**
Crops and Society
This course will study the contribution of crops to society and society's development. The course will cover cereal crops, legumes, herbs, spice, fibers, medicinal plants, and tropical and temperate fruits and nuts. Soil and water conservation will be covered. Emphasis will be on agriculture in developing nations and development policies that affect agriculture, stewardship, the poor, and malnourished. *Meets foundational core life science requirement.*

SUS 231 **4 hours**
Environmental Science, Society, and Sustainability
An introduction to environmental science, including a discussion of ecological principles and their application, energy systems, pollution problems, environmental policy and decision making, and the scientific and ethical implications of human impacts on the environment. Lab exercises focus on experimental ecology and the basic techniques used to describe and measure environmental quality. This course serves three functions: (1) it is the entry level course for environmental science majors; (2) it may be taken for foundational core lab science credit; and (3) biology majors may count it as a 200-level biology course when calculating course hour requirements in biology. *Three hours of lecture and two hours of lab per week. Meets foundational core life science requirement.*

SUS 270 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

SUS 310 **3 hours**
Poverty and Sustainable Development
An exploration of the key ideas and debates in development theory with an emphasis on evaluating whether and how global poverty can be alleviated without irreparably damaging the environment. Case studies feature interdisciplinary approaches to sustainable and transformational development drawn from agroecology, sociology, public health, holistic missions, and political economy.

SUS 310L **1 hour**
Poverty and Sustainable Development Lab
Labs feature community-based skills and interdisciplinary analytical approaches to sustainable and transformational development applied to service-learning projects to understand poverty in surrounding communities. *Corequisite: SUS 310.*

SUS 315 **4 hours**
Sustainable Food Systems and Health
This course focuses on understanding agriculture and food systems from a sustainability perspective and connecting that with human health. Students learn the principles of agro-ecology and how to apply them to various types of agriculture. They also critically evaluate global and local food systems, becoming familiar with strategies that have been tried to improve the equitable distribution of food and the environmental sustainability of food systems. Students also learn about the connection between food and chronic disease with specific skills in preparing food to help reduce the risk of diabetes and cardiovascular disease.

SUS 325 **4 hours**
Sustainable Development in Practice
This field-based course explores contemporary trends in international development through the lens of sustainable community development. The social, ecological, and economic sustainability of development are assessed through a case-study approach. The course will be offered in partnership with a non-governmental organization doing transformational development in one of the countries where they are working. The course will include a service component and discussions of those experiences will emphasize intercultural competencies. *Offered Interterm of odd calendar years. Prerequisite: SUS 231.*

SUS 330L **1 hour**
Assessment and Planning Lab for Sustainability
Students will participate in a community-based sustainability assessment and mapping project. This will include direct observations, carrying out interviews, and gathering secondary data related to sustainability. *Offered Fall semester of every other year. Prerequisite: SUS 231.*

SUS 360 **1-4 hours**
Independent Study
An individualized, directed study involving a specified topic.

SUS 370 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

SUS 393 **1-4 hours**
Practicum
Supervised learning involving a first-hand field experience or a project. Generally, one hour of credit is awarded for a minimum of 40 hours of practicum experience. *Offered primarily during Summer.*

SUS 435 **4 hours**
Environmental and Sustainability Planning and Assessment
A culminating course involving application of interdisciplinary principles of environmental and sustainability planning, monitoring, and evaluation involving community-based projects and case studies.

SUS 450 **1-4 hours**
Directed Research
Investigative learning involving closely directed research and the use of such facilities as the library or laboratory.

SUS 480 **1-4 hours**
Seminar
A limited-enrollment course designed especially for upper-class majors with emphasis on directed readings and discussion.

SUS 490 **1-2 hours**
Honors
Individualized study or research of an advanced topic within a student's major. *Open to students with at least a 3.00 GPA in the major field.*

SUS 493 **2 hours**
Sustainable Development Capstone
An integrative, junior/senior-level course in which major themes from within the sustainable development major and from the Taylor foundational core curriculum are intentionally revisited at a depth appropriate to college seniors. *Offered Fall semester of every other year. Prerequisite: Junior or senior standing as a sustainable development major.*

Chemistry and Biochemistry

Chair, Associate Professor P. Stan
Professor D. King, V. Sichula
Associate Professor D. Kaluka
Assistant Professors M. Bowman, T. Troyer

The Department of Chemistry and Biochemistry provides high-quality training in chemistry and biochemistry while providing opportunities for meaningful spiritual and interpersonal experiences that will enable students to move successfully into the next phase of their professional training or the career of their choice. Chemistry is an excellent starting point for careers in research within the physical and life sciences, medicine, veterinary medicine, dentistry, pharmacy, environmental science, forensic science, education, industry, food science, and many others.

Biochemistry (BS)

The Bachelor of Science degree with a major in Biochemistry requires 70-72 hours. This program prepares students for a career in biochemistry, medicine, molecular biology, and other related fields. *All major courses must be completed with a grade of C- or better and are included in the major GPA.*

During their sophomore year, students interested in medicine should check out the medical school admissions requirements for the school(s) to which they plan to apply. The Medical School Admission Requirements guide published annually by AAMC is the best resource for this information. It is important to meet the specific entrance requirements of the medical school(s) chosen.

Maintaining at least an A- average and scoring well on the MCAT test (usually taken in the Spring of the junior year) are common prerequisites for acceptance to a medical school. Assistance is available in preparing for the MCAT examinations.

Major Requirements

CHE 211	4	College Chemistry I
CHE 212	4	College Chemistry II
CHE 301	4	Analytical Chemistry I
CHE 302	4	Analytical Chemistry II
CHE 311	4	Organic Chemistry I
CHE 312	4	Organic Chemistry II
CHE 330	4	Advanced Inorganic Chemistry
CHE 411	3	Biochemistry I
CHE 411L	1	Biochemistry I Lab
CHE 412	3	Biochemistry II
CHE 412L	1	Biochemistry II Lab
CHE 420	1	Chemistry Thesis
CHE 431	4	Physical Chemistry I

Select 3 hours of advanced biochemistry or directed research.

Additional Major Requirements

BIO 201	4	Biology I: Foundations of Cell Biology and Genetics
MAT 151	4	Calculus I
MAT 230	4	Calculus II
PHY 211	4-5	University Physics I

Select one of the following:

PHY 204	4	General Physics II
PHY 212	5	University Physics II

Electives

Select two additional upper-division biology courses totaling at least 6 hours. BIO 203 may also count as an elective.

Recommended Biology Courses

BIO 203	4	Principles of Genetics
BIO 462	4	Molecular Genetics
BIO 471	4	Microbiology and Immunology
CHE 320	4	Environmental Pollution and Toxicology

Chemistry (BA)

The Bachelor of Arts degree with a major in Chemistry requires two years of one foreign language and 57-59 hours in the major. This program is suitable for students wishing to enter either graduate school or the chemical industry. *All major courses must be completed with a grade of C- or better and are included in the major GPA.*

Major Requirements

CHE 211	4	College Chemistry I
CHE 212	4	College Chemistry II
CHE 301	4	Analytical Chemistry I
CHE 302	4	Analytical Chemistry II
CHE 311	4	Organic Chemistry I
CHE 312	4	Organic Chemistry II
CHE 330	4	Advanced Inorganic Chemistry
CHE 411	3	Biochemistry I
CHE 411L	1	Biochemistry I Lab
CHE 420	1	Chemistry Thesis
CHE 431	4	Physical Chemistry I
CHE 432	4	Physical Chemistry II

Additional Major Requirements

MAT 151	4	Calculus I
MAT 230	4	Calculus II
PHY 211	4-5	University Physics I

Select one of the following:

PHY 204	4	General Physics II
PHY 212	5	University Physics II

Recommended Courses

CHE 320	4	Environmental Pollution and Toxicology
CHE 412	3	Biochemistry II
CHE 412L	1	Biochemistry II Lab
COS ___	1-4	Any Computer Science course
MAT 240	4	Calculus III
MAT 251	4	Differential Equations
MAT 352	4	Mathematical Statistics

NAS 480 is recommended in the junior or senior year.

Chemistry (BS)

The Bachelor of Science degree with a major in Chemistry requires 67-69 hours in the major. This program is especially attractive to students planning to enter either graduate school or the chemical industry. *All major courses must be completed with a grade of C- or better and are included in the major GPA.*

Major Requirements

CHE 211	4	College Chemistry I
CHE 212	4	College Chemistry II
CHE 301	4	Analytical Chemistry I
CHE 302	4	Analytical Chemistry II
CHE 311	4	Organic Chemistry I
CHE 312	4	Organic Chemistry II
CHE 330	4	Advanced Inorganic Chemistry
CHE 411	3	Biochemistry I
CHE 411L	1	Biochemistry I Lab
CHE 412	3	Biochemistry II
CHE 412L	1	Biochemistry II Lab
CHE 420	1	Chemistry Thesis
CHE 431	4	Physical Chemistry I
CHE 432	4	Physical Chemistry II
CHE 450*	6	Directed Research

**A minimum of 3 credits must be completed on campus*

Additional Requirements

MAT 151	4	Calculus I
MAT 230	4	Calculus II
PHY 211	4-5	University Physics I

Select <u>one</u> of the following:

PHY 204	4	General Physics II
PHY 212	5	University Physics II

Recommended Courses

BIO 201	4	Biology I: Foundations of Cell Biology and Genetics
CHE 320	4	Environmental Pollution and Toxicology
MAT 240	4	Calculus III
MAT 251	4	Differential Equations
MAT 352	4	Mathematical Statistics

Chemistry Education (BA/BS)

The Chemistry Education major requires 44-47 hours in addition to education courses. Optional concentrations are available in SpEd Mild-Moderate P-12 Licensure, SpEd Intense P-12 Licensure, and TESOL P-12 Licensure. The Bachelor of Arts degree requires two years of one foreign language. *All major courses, including education curriculum courses, must be completed with a grade of C- or better and are included in the major GPA.*

Chemistry Courses

CHE 211	4	College Chemistry I
CHE 212	4	College Chemistry II
CHE 301	4	Analytical Chemistry I
CHE 302	4	Analytical Chemistry II
CHE 311	4	Organic Chemistry I
CHE 420	1	Chemistry Thesis
CHE 431	4	Physical Chemistry I

Select at least <u>one</u> course from:

CHE 312	4	Organic Chemistry II
CHE 320	4	Environmental Pollution and Toxicology
CHE 330	4	Advanced Inorganic Chemistry
CHE 411	3	Biochemistry I

Additional Major Requirements

MAT 151	4	Calculus I
MAT 230	4	Calculus II
PHY 211	4-5	University Physics I

Select <u>one</u> of the following:

PHY 204	4	General Physics II
PHY 212	5	University Physics II

Professional Education

EDU 150	3	Education in America
EDU 222	2	Literacy in the Content Area for Secondary Teachers
EDU 260	3	Educational Psychology
EDU 307	2	Discipline and Classroom Management for Secondary Teachers
EDU 309	1	Methods of Instruction and Assessment in Secondary Education
EDU 332	2	The Junior High/Middle School
EDU 344	1	Educational Technology in Secondary Education
EDU 384	1	Perspectives on Diversity
EDU 431	17	Supervised Internship in Secondary Schools
NAS 309	2	Science Education Methods
SED 220	3	Exceptional Children

Additional Education Requirements

ENG 110	3	College Composition
PSY 340	3	Adolescent Psychology

Select <u>one</u> course from the following:

CAC 160	3	Integrative Communication
COM 210	3	Public Speaking

Chemistry–Environmental Science (BS)

This integrated major has a strong emphasis on the physical aspects of environmental studies. It is appropriate for students planning careers in environmental research or industrial or municipal environmental monitoring and control. The Bachelor of Science degree with a major in Chemistry–Environmental Science requires 91 major hours. *All major courses must be completed with a grade of C- or better and are included in the major GPA.*

Chemistry Requirements

CHE 211	4	College Chemistry I
CHE 212	4	College Chemistry II
CHE 301	4	Analytical Chemistry I
CHE 302	4	Analytical Chemistry II
CHE 311	4	Organic Chemistry I
CHE 312	4	Organic Chemistry II
CHE 330	4	Advanced Inorganic Chemistry
CHE 411	3	Biochemistry I
CHE 411L	1	Biochemistry I Lab
CHE 420	1	Chemistry Thesis
CHE 431	4	Physical Chemistry I
CHE 432	4	Physical Chemistry II

Physics Requirements

PHY 211	4-5	University Physics I

Select <u>one</u> of the following:

PHY 204	4	General Physics II
PHY 212	5	University Physics II

Environmental Science Requirements

CHE 320	4	Environmental Pollution and Toxicology
CHE 450	3	Directed Research
ENS 204	4	Principles of Ecology
ENS 302	4	Environmental Law and Policy
ENS 383	4	Environmental Ethics
SUS 231	4	Environmental Science, Society, and Sustainability

Mathematics Requirements

MAT 151	4	Calculus I
MAT 230	4	Calculus II

Electives *(to complete a minimum of 91 major hours)*

CHE 412	3	Biochemistry II
CHE 412L	1	Biochemistry II Lab
ENS 241	4	Physical Geology
MAT 210	4	Introductory Statistics

Chemistry/Pre-Medicine Concentration (BA)

The Bachelor of Arts degree with a major in Chemistry and a pre-professional concentration in Pre-Medicine requires two years, sequential study of one foreign language and 65-67 major hours.

Students interested in the pre-medicine curriculum should check out during their sophomore year the medical school admissions requirements for the school(s) to which they plan to apply. The Medical School Admission Requirements guide published annually by AAMC is the best resource for this information. It is important to meet the specific entrance requirements of the medical school(s) chosen.

Maintaining at least an A- average and scoring well on the MCAT test (usually taken in the Spring of the junior year) are common prerequisites for acceptance to a medical school. Assistance is available in preparing for the MCAT examinations. *All major courses, including those in the concentration, must be completed with a grade of C- or better and are included in the major GPA.*

Major Requirements

CHE 211	4	College Chemistry I
CHE 212	4	College Chemistry II
CHE 301	4	Analytical Chemistry I
CHE 302	4	Analytical Chemistry II
CHE 311	4	Organic Chemistry I
CHE 312	4	Organic Chemistry II
CHE 330	4	Advanced Inorganic Chemistry
CHE 411	3	Biochemistry I
CHE 411L	1	Biochemistry I Lab
CHE 420	1	Chemistry Thesis
CHE 431	4	Physical Chemistry I

Additional Major Requirements

MAT 151	4	Calculus I
MAT 230	4	Calculus II
PHY 211	4-5	University Physics I

Select <u>one</u> of the following:

PHY 204	4	General Physics II
PHY 212	5	University Physics II

Select <u>three</u> biology courses from the following:

BIO 201*	4	Biology I: Foundations of Cell Biology and Genetics
BIO 202	4	Biology II: Organisms and Diversity
BIO 203*	4	Principles of Genetics
BIO 310	4	Human Anatomy and Physiology I
BIO 311	4	Human Anatomy and Physiology II
BIO 312	4	Cellular and Molecular Biology
BIO 331	4	Comparative Anatomy
BIO 432	4	Developmental Biology
BIO 452	4	Animal Physiology
BIO 471	4	Microbiology and Immunology

**BIO 201, 203, 310, and 311 are highly recommended.*

Recommended Courses

CHE 320	4	Environmental Pollution and Toxicology
CHE 412	3	Biochemistry II
CHE 412L	1	Biochemistry II Lab
PSY ___	__	Any Psychology course
SOC ___	__	Any Sociology course

Chemistry Minor

The Chemistry minor requires a minimum of 22-24 hours and includes at least four semesters of core chemistry lab courses. *All minor courses must be completed with a grade of C- or better and are included in the minor GPA.*

Minor Requirements

CHE 211	4	College Chemistry I
CHE 212	4	College Chemistry II
CHE 301	4	Analytical Chemistry I
CHE 311	4	Organic Chemistry I

Electives

Select at least <u>two</u> additional, 3-4 credit hour upper-division (300/400-level) chemistry courses.

Chemistry Courses

CHE 100 **4 hours**
Chemistry for Living
A course designed for students who have little or no background in chemistry. Basic principles of chemistry are applied in a social context. *Three hours of lecture and one two-hour lab per week. Meets foundational core physical science requirement. No prerequisite, although high school algebra is recommended.*

CHE 120 **4 hours**
Forensic Science
This course is a one semester introduction to forensic science which will focus on the application of physical and life sciences to criminal investigation. Topics include the crime scene, physical evidence, fingerprints, forensic toxicology, forensic serology, as well as many others. *There are no prerequisites. Based upon the course section selected, will meet either a life or physical science foundational core requirement.*

CHE 170 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

CHE 201 **4 hours**
General, Organic, and Biochemistry I
This is the first semester of a two-semester sequence designed for students with minimal backgrounds in chemistry yet need a solid foundation in chemistry for their major. These students do not typically take other chemistry courses beyond this sequence. The two semesters are a comprehensive overview of general chemistry, organic chemistry, and biochemistry. The first semester focuses on general chemistry with an introduction to organic chemistry. *Three hours of lecture and three hours of lab per week. Meets foundational core physical science requirement. No college level prerequisites, but high school algebra and chemistry are strongly recommended.*

CHE 202 **4 hours**
General, Organic, and Biochemistry II
This is the continuation of CHE 201 (see CHE 201 description). The second semester continues with the introduction to organic chemistry and includes an overview of biochemistry. *Three hours of lecture and three hours of lab per week. Prerequisite: CHE 201.*

CHE 203 **5 hours**
Chemistry for Nursing
This one semester course is designed to meet the chemistry requirements for pre-nursing students. The lecture portion of the course will provide students with an overview of general, organic, and biochemistry. Laboratory experiments are biochemistry-focused and utilize general and organic chemistry concepts relevant to the nursing field. Throughout the course, both lecture and lab activities will be tailored to help prepare students with the biochemical and mathematical skills necessary for the successful completion of their nursing program and future success in their field. *Four hours of lecture and three hours of lab per week. Meets foundational core physical science requirement. Prerequisite: Math proficiency.*

CHE 211 **4 hours**
College Chemistry I
This is a general chemistry course for those intending to take later coursework in chemistry, such as organic, inorganic, analytical, or environmental chemistries. The course thoroughly explores the basic concepts and theories of chemistry, using quantitative skills to predict and characterize chemical properties and changes. The nature of atomic structure and chemical bonding and the properties of solids, liquids, and gases are all presented and studied using lectures, demonstrations, and computer-assisted teaching and testing methods. Chemical change is studied in terms of reaction classes, energy flows, and kinetic theories. *Three hours of lecture and three hours of lab per week. Meets the foundational core physical science requirement. Prerequisite: Mathematics proficiency. High school algebra and chemistry are strongly recommended.*

CHE 212 **4 hours**
College Chemistry II
The second general chemistry course for those intending to take later coursework in chemistry, such as organic, inorganic, analytical, or environmental chemistries. This course thoroughly explores the basic concepts and theories of chemistry using quantitative skills to predict and characterize chemical properties and changes. The nature of organic chemistry, complexes, equilibria, electrochemistry, and advanced acid-base properties are all presented and studied using lectures, demonstrations, and computer-assisted teaching and testing methods. Chemical change is studied in terms of entropy, free energy, and kinetic theories. *Three hours of lecture and three hours of lab per week. Prerequisite: CHE 211.*

CHE 270 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

CHE 301 **4 hours**
Analytical Chemistry I
Introduction to modern theories and methods used in separations and quantitative determinations. Topics include basic statistics and treatment of data, gravimetry, titrations, and spectroscopy. Topics correlate with the lab. Lab includes gravimetric, titrations, and spectroscopy. Some instrumentation is used including AA and GCMS. *Three hours of lecture and three hours of lab per week. Prerequisite: CHE 212 or permission of instructor.*

CHE 302 **4 hours**
Analytical Chemistry II
A continuation of CHE 301 in which instrumental methods of analysis are emphasized. A survey of instrumental methods used in modern analytical chemistry. Topics include the general principles of basic instrument components and their integration into the wide variety of modern instrumentation. Students will gain hands-on experience with a variety of spectroscopic (UV, VIS, AA), spectrometric (MS), electrochemical, chromatographic (HPLC, GC, IC), and hybrid (GC/MS, LC/MS) analytical instrumentations. *Three hours of lecture and three hours of lab per week. Prerequisite: CHE 301 or permission of instructor.*

CHE 311 **4 hours**
Organic Chemistry I
The study of covalent carbon compounds. Nomenclature, properties, and reactions (including reaction mechanisms) of all classes of hydrocarbons, alcohols, ethers, halides, and organometallic substances are studied. NMR, IR, and MS spectroscopic methods are learned and applied. The lab includes development of advanced lab skills and study of the kinetics and properties of organic substances in reactions. *Three hours of lecture and three hours of lab* per week. *Prerequisite: CHE 212.*

CHE 312 **4 hours**
Organic Chemistry II
Continuation of CHE 311. Focuses on carbonyl and carboxylate compounds and their derivatives, amines, and polyfunctional compounds, including biomolecules. Lab work includes study of the properties of aromatic compounds, qualitative organic analysis, and small group original research projects. *Three hours of lecture and three hours of lab per week. Prerequisite: CHE 311.*

CHE 320 **4 hours**
Environmental Pollution and Toxicology
A course that emphasizes principles and analysis of pollution sources, movement, distribution, and toxic effects in natural and biological environments. The principles of toxicology related to industry and the environment, including dose response, mechanisms of toxicity, hazard evaluation will be explored. The laboratory work will provide experience in sampling and analysis of water, as well as common toxicology techniques. *Three hours of lecture and three hours of lab per week. One year of general chemistry is recommended.*

CHE 330 **4 hours**
Advanced Inorganic Chemistry
Coverage of the bonding and properties of the main group and especially transition metal elements with a focus on their coordination and solid-state chemistry. Molecular symmetry principles, spectroscopy, materials science and catalytic applications of these substances are discussed in lecture and studied in lab. *Three hours of lecture and three hours of lab per week. Prerequisite: CHE 311.*

CHE 360 **1-4 hours**
Independent Study
An individualized, directed study involving a specified topic.

CHE 370 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

CHE 393 **1-4 hours**
Practicum
Supervised learning involving a first-hand field experience or a project. Generally, one hour of credit is awarded for a minimum of 40 hours of practicum experience. *Offered primarily during Summer.*

CHE 411 **3 hours**
Biochemistry I
An introduction to the fundamental principles of biochemistry focusing on the structure and function of biomolecules such as carbohydrates, lipids, proteins, and nucleic acids. The relation between structure and function is explored in such topics as enzyme kinetics, the chemistry of major metabolic pathways, and their regulation. This course is designed for chemistry, biology, and Pre-Med related majors with a background in organic chemistry. *Prerequisite: CHE 311. BIO 201 and CHE 312 are strongly recommended.*

CHE 411L **1 hour**
Biochemistry I Lab
This project-based laboratory class is designed for Biochemistry I (CHE 411) students. The students will utilize science fundamentals to participate in a broad research topic. Students will employ various biochemical investigative tools, including but not limited to molecular modeling, protein expression, chromatography, DNA manipulation, spectroscopy, and enzyme assays, to study structure-function relationships in major biomolecules. *This course is designed for chemistry and biology majors with a background in organic chemistry. Prerequisite: CHE 311. Corequisite: CHE 411. BIO 201 is strongly recommended.*

CHE 412 **3 hours**
Biochemistry II
This course is a continuation of CHE 411 with emphasis on metabolism of major biomolecules (i.e., carbohydrates, lipids, proteins, and nucleic acid). Example topics include synthesis and degradation of glycogen and nitrogen-containing (e.g., amino acids, DNA, and RNA bases) compounds, protein synthesis, and metabolic integration. *Prerequisite: CHE 411. BIO 201 is strongly recommended.*

CHE 412L **1 hour**
Biochemistry II Lab
This project-based laboratory class is designed for Biochemistry II (CHE 412) students. The students will utilize science fundamentals to participate in a broad research topic. Students will employ various biochemical investigative tools, including but not limited to molecular modeling, protein expression, chromatography, DNA manipulation, spectroscopy, and enzyme assays, to study structure-function relationships in major biomolecules. *This course is designed for chemistry and biology majors with a background in organic chemistry. Prerequisite: CHE 411 and CHE 411L. Corequisite: CHE 412. BIO 201 is strongly recommended.*

CHE 420 **1 hour**
Chemistry Thesis
Students write a major paper, receive coaching and feedback, modify their paper if necessary, and give an oral presentation. *Prerequisite: Successful completion of Fall term paper writing workshop. Required of all chemistry seniors.*

CHE 431 **4 hours**
Physical Chemistry I
An introduction to the principles of thermodynamics, kinetic-molecular theory of gases, and chemical kinetics. The lab includes vacuum techniques, calorimetry, electrochemistry, physical characterization of solutions, and optical techniques. *Three hours of lecture and three hours of lab per week. Prerequisites: CHE 211; CHE 212; PHY 211; PHY 204 or PHY 212; MAT 151; and MAT 230.*

CHE 432 **4 hours**
Physical Chemistry II
Emphasis on elementary principles of quantum mechanics, molecular structure, spectroscopy, and photochemistry. The lab focuses on computational chemistry, mathematical modeling, and spectroscopy. *Three hours of lecture and three hours of lab per week. Prerequisites: CHE 211; CHE 212; PHY 211; PHY 204 or PHY 212; MAT 151; and MAT 230.*

CHE 450 **1-4 hours**
Directed Research
Investigative learning involving closely directed research and the use of such facilities as the library or laboratory.

CHE 480 **1-4 hours**
Seminar
A limited-enrollment course designed especially for upper-class majors with emphasis on directed readings and discussion.

CHE 490 **1-2 hours**
Honors
Individualized study or research of an advanced topic within a student's major. *Open to students with at least a 3.00 GPA in the major field.*

Computer Science and Engineering

Chair, Associate Professor J. Denning
Professors S. Brandle, A. White
Associate Professor D. Read
Assistant Professors O. Ayano, B. Messick, J. Mikels

In support of the overall Taylor University mission, the mission of Computer Science and Engineering is to:

- Honor God in all we do
- Pursue excellence
- Help students become
  - Outstanding computer scientists
  - Exceptional systems analysts
  - Committed Christians
  - Highly motivated to serve

Baccalaureate majors are offered by the department:

- **Computer Science (BA)**
  A concentration is required in either Applied or Digital Media.
- **Computer Science (BS)**
  A concentration is required in Cybersecurity, Digital Media Systems, Information Systems and Analysis, or Theory.
- **Computer Engineering (BS)**
  Combination of fundamental engineering, computer science, and electronics curricula. Program is accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012; telephone (410) 347-7700.

Each year the Department of Computer Science and Engineering offers at least ten sanctioned events such as special lectures, workshops, or colloquiums. All majors are required to participate in at least 21 sanctioned events before completing COS 491.

Information Systems and Analytics for Bachelor of Science Degree

The information systems and analytics program is offered by the Computer Science and Engineering Department. *For a description of the program and requirements for majors outside of the department, refer to* ***Academic Programs and Requirements*** *and* ***Academic Departments and Courses*** *sections of this catalog.*

Computer Engineering (BS)

Intimate knowledge of both physics and computer science is the foundation of the design and development of powerful and efficient embedded computer systems. The Computer Engineering major is offered jointly by the Computer Science and Engineering and the Physics and Engineering Departments and focuses on the theoretical and applied operation of computer hardware and software.

The computer engineering program is accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012; telephone (410) 347-7700.

Program Objectives:

1. Prepare our graduates to serve others dependably, most importantly their employer, customers, and community.
2. Prepare our graduates to practice technical competence, producing reliable engineering designs.
3. Prepare our graduates to exercise creativity in their work, fostering innovative solutions.
4. Prepare our graduates to pursue growth in their faith, social understanding, and technical competence so that they can adapt to meet the needs of an ever-changing world.

The Bachelor of Science degree with a major in Computer Engineering requires 98 hours. Majors are required to attend 21 sanctioned events. Majors are also required to complete a comprehensive examination during their senior year. This examination includes a major design and implementation project (COS 493, 494, 495), written and oral presentation of this work, and a written examination over coursework in the major field. *All major courses must be completed with a grade of C- or better and are included in the major GPA.*

Physics and Engineering Requirements

PHY 211	4	University Physics I
PHY 212	5	University Physics II
ENP 104	3	Introduction to Engineering and Software Tools
ENP 231	4	Introduction to Electric Circuits
ENP 253	4	Electrical Circuits II
ENP 261	3	Digital Systems Design
ENP 332	4	Control Systems
ENP 341	4	Microcomputer Interfacing
ENP 392	3	Junior Engineering Project
ENP 405	1	Engineering Ethics
ENP 431	4	Advanced Electronics and Microcircuits

Mathematics Requirements

MAT 151	4	Calculus I
MAT 215	3	Discrete Mathematics for Computer Science
MAT 230	4	Calculus II
MAT 240	4	Calculus III
MAT 251	4	Differential Equations
MAT 352	4	Mathematical Statistics

Computer Science Requirements

COS 103	1	Computer Science and Engineering: New Majors Orientation
COS 121	4	Foundations of Computer Science
COS 130	3	Computational Problem Solving for Engineers
COS 265	4	Data Structures and Algorithms
COS 284	3	Introduction to Computer Systems
COS 331	3	Data Communications
COS 340	3	Software Engineering
COS 381	3	Computer Architecture
COS 393	2	Practicum
COS 421	3	Operating Systems
COS 491	1	Computer Science Senior Capstone
COS 493	2	Engineering Senior Capstone I
COS 494	3	Engineering Senior Capstone II
COS 495	1	Engineering Senior Capstone II

Computer Science (BA)

The Bachelor of Arts degree with a major in Computer Science requires the completion of two years of one foreign language and 62-64 major hours including a concentration in Applied or Digital Media. Majors are required to attend 21 sanctioned events. Majors are also required to complete a comprehensive examination during their senior year. This examination includes an implementation project, written and oral presentation of this work, and a written examination over coursework in the major field. The project and presentation portions of this examination are included in COS 492 Senior Project. Courses may not be used to fulfill more than one requirement: core or concentration. *All major courses must be completed with a grade of C- or better and are included in the major GPA.*

Core Requirements

COS 103	1	Computer Science and Engineering: New Majors Orientation
COS 109	3	Computer and Network Operations
COS 120	4	Introduction to Computational Problem Solving
COS 121	4	Foundations of Computer Science
COS 143	3	Interactive Webpage Development
COS 243	3	Multi-tier Web Application Development
COS 265	4	Data Structures and Algorithms
COS 393	3	Practicum
COS 491	1	Computer Science Senior Capstone
COS 492	3	Senior Project

Select <u>one</u> course from the following:

COS 311	3	Ethics in Computer Science
COS 321H	3	Ethics and Technology

***Concentrations**—Students must select <u>one</u> of the following concentrations:*

Applied

COS 232	3	Computer and Network Security I
COS 284	3	Introduction to Computer Systems
MAT 151	4	Calculus I
MAT 210	4	Introductory Statistics
MAT 215	3	Discrete Mathematics for Computer Science

Select <u>one</u> course from the following:

COS 320	3	Algorithm Design
COS 382	3	Language Structures
COS 435	3	Theory of Computation

Select <u>12</u> credits from the following:

COS ___	1-12	Computer Science Elective
MAT 230	4	Calculus II
MAT 240	4	Calculus III
MAT 251	4	Differential Equations
MAT 310	3	Mathematical Modeling with Numerical Analysis
MAT 345	4	Linear Algebra
MAT 401	3	Operations Research
MGT 403	3	Operations Management
NAS 480	1	Seminar
SYS 214	3	Principles of Human Computer Interaction
SYS 352	3	Knowledge Based Systems
SYS 402	3	Modeling and Simulation
SYS 411	3	Machine Learning

Digital Media

COS 350	3	Computer Graphics
ART 152	3	Visual Communication
ART 154	1	Digital Tools: Illustrator
ART 156	1	Digital Tools: Photoshop
ART 253	3	Foundations of Photography
ART 456	4	Motion Design
FMA 215	3	Audio Production
FMA 220	3	Film and Video Production
SYS 214	3	Principles of Human Computer Interaction

Select <u>one</u> course from the following:

COS 331	3	Data Communications
COS 351	3	Computer Vision
COS 424	3	Surfaces and Modeling
COS 486	3	Game Engine Architecture
SYS 310	3	E-Commerce

Select <u>one</u> course from the following:

ART 151	3	Two-Dimensional Design
ART 251	3	Typography
ART 353	3	Commercial Photography
CAC 345	3	Writing for Interactive Media
FMA 230	3	Scriptwriting

Computer Science (BS)

The Bachelor of Science degree with a major in Computer Science requires the completion of 76-92 major hours including a concentration in Cybersecurity, Digital Media Systems, Information Systems and Analysis, or Theory. Majors are required to attend 21 sanctioned events. Majors are also required to complete a comprehensive examination during their senior year. This examination includes an implementation project, written and oral presentation of this work, and a written examination over coursework in the major field. Courses may not be used to fulfill more than one requirement: core or concentration. *All major courses must be completed with a grade of C- or better and are included in the major GPA.*

Core Requirements

COS 103	1	Computer Science and Engineering: New Majors Orientation
COS 109	3	Computer and Network Operations
COS 120	4	Introduction to Computational Problem Solving
COS 121	4	Foundations of Computer Science
COS 143	3	Interactive Webpage Development
COS 232	3	Computer and Network Security I
COS 243	3	Multi-tier Web Application Development
COS 265	4	Data Structures and Algorithms
COS 491	1	Computer Science Senior Capstone
MAT 151	4	Calculus I
MAT 210	4	Introductory Statistics

Select <u>one</u> course from the following:

COS 311	3	Ethics in Computer Science
COS 321H	3	Ethics and Technology

Computer Science requirements continued on next page

Computer Science requirements continued from previous page

***Concentrations**—Students must select one of the following concentrations:*

Cybersecurity

COS 284	3	Introduction to Computer Systems
COS 323	3	Computer and Network Security II
COS 331	3	Data Communications
COS 343	3	Database Systems
COS 393	3	Practicum
COS 411	3	Digital Forensics
COS 421	3	Operating Systems
COS 432	3	Software Reverse Engineering and Analysis
COS 492	3	Senior Project
MAT 215	3	Discrete Mathematics for Computer Science
POS 350	3	International Security

Select two courses from the following:

COS 280	3	Introduction to Artificial Intelligence
COS 320	3	Algorithm Design
COS 381	3	Computer Architecture
COS 382	3	Language Structures
COS 435	3	Theory of Computation
COS 436	3	Parallel and Distributed Computing
SYS 411	3	Machine Learning

Digital Media Systems

ART 152	3	Visual Communication
ART 154	1	Digital Tools: Illustrator
ART 156	1	Digital Tools: Photoshop
ART 253	3	Foundations of Photography
ART 456	4	Motion Design
COS 326	3	Data Visualization
COS 350	3	Computer Graphics
COS 393	3	Practicum
COS 492	3	Senior Project
FMA 215	3	Audio Production
FMA 220	3	Film and Video Production
MAT 382	3	Advanced Statistical Methods
SYS 214	3	Principles of Human Computer Interaction
SYS 330	3	Human Relations in Organizations
SYS 390	3	Information Systems Analysis
SYS 394	4	Information Systems Design

Select one course from the following:

COS 331	3	Data Communications
COS 351	3	Computer Vision
COS 424	3	Surfaces and Modeling
COS 486	3	Game Engine Architecture
SYS 310	3	E-Commerce

Select one course from the following:

ART 151	3	Two-Dimensional Design
ART 251	3	Typography
ART 353	3	Commercial Photography
CAC 345	3	Writing for Interactive Media
FMA 230	3	Scriptwriting

Select one course from the following:

ENT 422	3	New Venture Planning
MGT 201	3	Introduction to Business
MGT 403	3	Operations Management
SYS 214	3	Principles of Human Computer Interaction
SYS 310	3	E-Commerce
SYS 352	3	Knowledge Based Systems

Information Systems and Analytics

COS 284	3	Introduction to Computer Systems
COS 326	3	Data Visualization
COS 393	3	Practicum
COS 492	3	Senior Project
MAT 215	3	Discrete Mathematics for Computer Science
MAT 382	3	Advanced Statistical Methods
SYS 330	3	Human Relations in Organizations
SYS 390	3	Information Systems Analysis
SYS 394	4	Information Systems Design

Select one course from the following:

COS 320	3	Algorithm Design
COS 382	3	Language Structures
COS 435	3	Theory of Computation

Select 12 credits from the following:

COS ___	1-12	Computer Science Elective
MAT 230	4	Calculus II
MAT 240	4	Calculus III
MAT 251	4	Differential Equations
MAT 310	3	Mathematical Modeling with Numerical Analysis
MAT 345	4	Linear Algebra
MAT 401	3	Operations Research
MGT 403	3	Operations Management
NAS 480	1	Seminar
SYS 214	3	Principles of Human Computer Interaction
SYS 352	3	Knowledge Based Systems
SYS 402	3	Modeling and Simulation
SYS 411	3	Machine Learning

Select one of the following:

MAT 311	3	Introduction to Data Science
MAT 401	3	Operations Research
SYS 402	3	Modeling and Simulation
SYS 411	3	Machine Learning

Theory

COS 284	3	Introduction to Computer Systems
COS 310	1	Current Literature Survey
COS 320	3	Algorithm Design
COS 382	3	Language Structures
COS 435	3	Theory of Computation
COS 452	3	Research I
COS 453	3	Research II
MAT 215	3	Discrete Mathematics for Computer Science

Select two courses from the following:

COS 381	3	Computer Architecture
COS 421	3	Operating Systems
COS 436	3	Parallel and Distributed Computing

Select 15 credits from the following:

COS ___	1-15	Computer Science Elective
MAT 230	4	Calculus II
MAT 240	4	Calculus III
MAT 251	4	Differential Equations
MAT 310	3	Mathematical Modeling with Numerical Analysis
MAT 345	4	Linear Algebra
MAT 401	3	Operations Research
MGT 403	3	Operations Management
NAS 480	1	Seminar
SYS 214	3	Principles of Human Computer Interaction
SYS 352	3	Knowledge Based Systems
SYS 402	3	Modeling and Simulation
SYS 411	3	Machine Learning

Computer Science Minor

A Computer Science minor requires 25 hours. Courses may not meet both a requirement and elective. *All minor courses must be completed with a grade of C- or better and are included in the minor GPA.*

Minor Requirements

COS 109	3	Computer and Network Operations
COS 120	4	Introduction to Computational Problem Solving
COS 121	4	Foundations of Computer Science
COS 143	3	Interactive Webpage Development

Select <u>one</u> course from the following:

COS 311	3	Ethics in Computer Science
COS 321H	3	Ethics and Technology

Electives

Select additional electives to complete the 25-hour requirement from any of the following:

COS 1__	1-16	*Any 100-level COS course*
COS 2__	1-16	*Any 200-level COS course*
COS 3__	1-16	*Any 300-level COS course*
COS 4__	1-16	*Any 400-level COS course*
MAT 215	3	Discrete Mathematics for Computer Science
SYS 214	3	Principles of Human Computer Interaction
SYS 352	3	Knowledge Based Systems
SYS 411	3	Machine Learning

Cybersecurity Minor

A Cybersecurity minor requires 26 hours. *All minor courses must be completed with a grade of C- or better and are included in the minor GPA.*

Minor Requirements

COS 109	3	Computer and Network Operations
COS 121	4	Foundations of Computer Science
COS 232	3	Computer and Network Security I
COS 311	3	Ethics in Computer Science
COS 323	3	Computer and Network Security II
COS 331	3	Data Communications

Select <u>one</u> course from the following:

COS 120	4	Introduction to Computational Problem Solving
SYS 120	4	Introduction to Problem Solving

Select <u>one</u> course from the following:

COS 393	3	Practicum
COS 450	3	Directed Research

Information Systems Minor

An Information Systems minor requires 26-27 hours. *All minor courses must be completed with a grade of C- or better and are included in the minor GPA. Minor is not available to students completing the information systems and analytics curriculum included within a major.*

Minor Requirements

COS 143	3	Interactive Webpage Development
SYS 214	3	Principles of Human Computer Interaction
SYS 390	3	Information Systems Analysis
SYS 394	4	Information Systems Design

Select <u>one</u> course from the following:

COS 109	3	Computer and Network Operations
SYS 101	3	Introduction to Systems

Select <u>one</u> course from the following:

COS 120	4	Introduction to Computational Problem Solving
SYS 120	4	Introduction to Problem Solving

Select <u>one</u> course from the following:

PSY 425	3	Industrial-Organizational Psychology
SYS 330	3	Human Relations in Organizations

Select <u>one</u> course from the following:

___ 393	3-4	Practicum
SYS 393	3-4	Practicum

Computer Science Courses

COS 101 2 hours
Information Technology Concepts
The course focuses on practical understanding and application of computing technology in educational, small business, or organizational environments. Specific topics include an overview of operating systems, application software, computing hardware, telecommunications, networking, and information management systems and analysis. In addition, it heavily emphasizes the impact of technology on modern society and the ethical issues related to use of information and communication systems. *This course is offered through Taylor University Online (TUO) and does not count toward any major, minor, or foundational core curriculum requirement for residential students.*

COS 102 3 hours
Fundamentals of Systems and Computing
An introduction to the basic concepts of "system" and "process" with particular emphasis on computing systems. Major topics include systems thinking, quality, problem solving, and design. Computing-specific topics include algorithms, networks, computer hardware, and basic relational database concepts. The learning experience features field trips and guest lectures. *Offered Fall semester.*

COS 103 1 hour
Computer Science and Engineering: New Majors Orientation
Provides an introduction to the Computer Science and Engineering majors focusing on the habits, mindset, and requirements for success in the major. The course includes an overview of the discipline with an exploration of various career paths in computing (e.g., industry, missions, graduate school). A significant portion of the course involves a weekend retreat with faculty, staff, and graduating seniors. Lastly, students are introduced to integrating faith and computing. *Offered Fall semester.*

COS 104 2 hours
Computing and Culture – Applications and Context
An introduction to the ideas of computational technology including the use of applications, ethical foundations, and the understanding of the context of technology in our world. Analysis from a Christian perspective is emphasized. Topics discussed include algorithmic thinking, artificial intelligence, organization of data, internet and security, hardware, software, and the history of computers. Important skills covered in the course include web design, office productivity applications, information literacy, and an introduction to the process of programming. *Meets foundational core computation requirement.*

COS 105 1 hour
Ethics, Computing, and Society
As computing technology becomes more complex and less visible, we understand less about how the world functions. Our worldview is impacted by technology in ways that are not recognized and, therefore, not critically evaluated, particularly with a Christian understanding. This course is designed to introduce students to the context of computation in their world. Through writing, discussions, and class assignments, students will gain an understanding of computing technology that goes beyond its use and explores the impact of technology on our world view. The context provided includes an introduction to the issues in our society associated with ethics and technology. Main topics addressed include applying major ethical theories, intellectual property, privacy, and putting technology into context with a Christian perspective. *This course is available only to transfer students who have credit in an acceptable computer competency course and will meet the foundational core computation requirement for such students.*

COS 109 3 hours
Computer and Network Operations
A study of the concepts, principles, tools, and constraints related to computer and network operations, including the following topics: shell scripting, information technology system components, systems policy and governance, operating systems management, network devices, and virtual machines. Students will install and configure commodity operating systems, manage users, analyze system logs, write scripts to automate systems administration, review and write information technology policies, and related activities.

COS 120 4 hours
Introduction to Computational Problem Solving
Approaches to computing solutions for problems from a variety of subject areas are examined and provide motivation for the study of the development of algorithms and their implementation. Programming concepts are introduced incrementally in order to solve increasingly complex problems. Good algorithm design and program structure are emphasized. Introductory data structures and software engineering principles are stressed. An introduction to object-oriented programming is included. *Three hours of lecture and two hours of lab per week. Meets foundational core computation requirement.*

COS 121 **4 hours**
Foundations of Computer Science
This course builds on COS 120 by emphasizing object-oriented programming and including concepts of computer science such as computational complexity simulation and recursion. The use and implementation of data structures such as lists, stacks, queues, and trees are introduced as they are needed in developing algorithms for problems studied. Additional topics include the Linux operating system and tools, source code versioning, unit testing, and code refactoring. *Three hours of lecture and two hours of lab per week. Prerequisite: COS 120 or COS 130 or SYS 120.*

COS 130 **3 hours**
Computational Problem Solving for Engineers
This introductory programming course will take a similar approach to solving problems as COS 120. The differences will be an accelerated pace and using computational tools (emphasis on the C language) expected to be used in the various fields of engineering. *Meets foundational core computation requirement. Offered Spring semester.*

COS 143 **3 hours**
Interactive Webpage Development
In this comprehensive webpage development course, students will gain the fundamental skills and knowledge to create engaging and well-designed web pages that respond to user interactions. Through a hands-on approach, students will learn how to utilize the essential technologies, including HTML5, CSS3, and JavaScript, to craft interactive elements, manipulate the Document Object Model (DOM), and retrieve JSON data from remote servers for page updates. *Prerequisite: COS 120 or COS 130 or SYS 120.*

COS 170 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

COS 230 **3 hours**
Missions Technology
A survey and in-depth study of the range of technology applied to Christian missions. Theory and issues in sustainable application are developed. Interaction with mission agencies and a practical project are included.

COS 232 **3 hours**
Computer and Network Security I
A study of the fundamentals of operating systems, network, and application security. Major areas of exploration include fundamental security design principles, application vulnerability analysis, network penetration testing, basic cryptography, and defensive programming techniques. *Prerequisite: COS 121. Offered Fall semester.*

COS 243 **3 hours**
Multi-tier Web Application Development
The course will explore how to develop a complete web application with implementation separating concerns between content delivery, business logic, and data storage. An emphasis on a modern MVC platform will be used to provide the separation of concerns. Additionally, core database knowledge for a functioning application will be explored including data modeling for a relational database, common SQL queries, data normalization foreign key constraints, and aggregate operations. *Prerequisites: COS 121 and COS 143.*

COS 265 **4 hours**
Data Structures and Algorithms
A survey of data structures and algorithms that operate on them, with an emphasis on abstract data types and analysis of computational complexity. *Three hours of lecture and two hours of lab per week. Prerequisite: COS 121.*

COS 270 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

COS 280 **3 hours**
Introduction to Artificial Intelligence
A survey of the field of artificial intelligence. Major areas of exploration include search, logic, learning, knowledge representation, problem solving, natural language processing, computer vision, robotics, expert systems, and neural networks. An introduction to Lisp is included. *Prerequisite: COS 121.*

COS 284 **3 hours**
Introduction to Computer Systems
An integrated introduction to computer hardware architecture, operating systems, and their interaction. Assembly language and operating system programming are emphasized. *Prerequisites: COS 121 and MAT 215. Offered Spring semester.*

COS 306 **3 hours**
Introduction to Bioinformatics
This course is designed to introduce students to concepts of bioinformatics, as well as basic bioinformatics skills, using the R programming language. The course will explore methods and datasets spanning from the level of DNA (genomics) up to the organismal and ecosystem level. Bioinformatics is an interdisciplinary field combining concepts of biology, computer science, and statistics to analyze and interpret biological datasets and solve complex questions. *Two hours of lecture and one hour of one hour of coding/data analysis in a computer lab per week. Prerequisites: BIO 203 or instructor permission. Offered Fall semester of even years.*

COS 310 **1 hour**
Current Literature Survey
A survey of computer science literature. Students lead discussions over papers and topics of interest and produce a literature survey that could serve as a basis for an undergraduate research.

COS 311 **3 hours**
Ethics in Computer Science
A study of the ethical implications of computers in society and the role of Christians as computer science and engineering professionals. Foundational concepts of Western moral philosophy are presented. Major ethical issues, such as privacy, piracy, liability, equity, and whistle-blowing are explored. Professional society codes of conduct are examined and discussed. Legal and ethical issues such as piracy, copyright, and fair use related to media are also addressed. Ethical concerns of computer science and systems analysis and their relationship to one's faith are an integral part of this course.

COS 320 **3 hours**
Algorithm Design
An advanced algorithms and data structures course with emphasis on runtime analysis and correctness proving. Greedy algorithms, dynamic programming, network flow, and graph algorithms are discussed. *Prerequisites: COS 265 and MAT 215.*

COS 321H **3 hours**
Ethics and Technology
A study of the ethical implications of computing technology in society and the role of Christians as users, people impacted by, and shapers of computing technology. Foundational concepts of Western moral philosophy are presented. Major ethical issues, such as privacy, piracy, liability, equity, and whistle-blowing are explored. Professional society codes of conduct are examined and discussed. Legal and ethical issues such as piracy, copyright, and fair use related to media are also addressed. Ethical concerns of computer science and systems analysis and their relationship to one's faith are an integral part of this course. *This course is intended for students in the Honors Guild but will also meet the COS 311 requirement for majors in computer science and engineering. Meets foundational core computation requirement.*

COS 323 **3 hours**
Computer and Network Security II
A study of operating system, network, and application security. This course is a continuation of COS 232 (Computer and Network Security). Major areas of exploration include software reverse engineering, static and dynamic program analysis, basic cryptanalysis, and related current topics. *Prerequisite: COS 232. Offered Spring semester.*

COS 326 **3 hours**
Data Visualization
This course introduces explanatory and exploratory data visualization, including principles, techniques, and tools, that facilitate understanding and action based on very big data sets. Principles from graphic design, visual perception, and cognitive science are considered. Students employ modern tools and languages to access, analyze, and visualize Internet-scale data. *Participants are encouraged to take MAT 311 and a statistics course before enrolling. Prerequisites: COS 120 or SYS 120; and COS 143.*

COS 331 **3 hours**
Data Communications
A study of the nature and applications of data communications in use today. Fundamental concepts of types, modes, and media of transmission are studied. Communication protocols and their encompassing architectures are analyzed and compared. Practical applications of data communications concepts are demonstrated through networking projects and development of communications software. *Prerequisite: COS 121.*

COS 333 **3 hours**
Missions Computing
Combining computer science and service to the missions community, students travel to an international location during Interterm to undertake software development and systems analysis for a missions partner. Students design, construct, test, document, and deploy a non-trivial software system that meets the partner's requirements. Students experience the local culture and participate in direct ministry as opportunities arise. *Meets foundational core cross-cultural requirement. Prerequisite: COS 121 or COS 143; and instructor permission.*

COS 340 **3 hours**
Software Engineering
A study of the concepts, tools, best practices, and lifecycle phases associated with developing large software systems, in groups, over prolonged durations. Using an agile software development process, students gather requirements, design, and begin construction of a non-trivial software system. *Prerequisite: COS 121. Offered Fall semester.*

COS 343 **3 hours**
Database Systems
A study of the fundamental concepts of how database technologies work. An emphasis on relational databases will be explored, including normalization, advanced SQL queries, indexing, physical data storage, performance and tuning strategies, and concurrency control. Students will be introduced to other database technologies, possibly including object-oriented databases, NoSQL, replication, etc. *Prerequisites: COS 121 and MAT 215.*

COS 350 **3 hours**
Computer Graphics
An introductory course in computer graphics with an emphasis on 3D image production using a variety of approaches, including ray tracing and raster graphics. Applied linear algebra and basic algorithms for graphics are introduced. *Prerequisite: COS 121.*

COS 351 **3 hours**
Computer Vision
A study of the fundamental concepts of digital image acquisition, manipulation, enhancement, representation, analysis, and understanding. *Prerequisite: COS 121. Offered Spring semester of even years.*

COS 355 **3 hours**
Mobile Application Development
A study of the concepts, principles, tools, and constraints related to developing mobile applications, including power-performance tradeoffs, sensor management, location acquisition, and responsive user interface design. Students will develop mobile applications within large software ecosystems (mobile operating system APIs and web services) and as a result gain significant experience using current software development tools, asynchronous programming techniques, and object-oriented design patterns. *Prerequisite: COS 265.*

COS 360 **1-4 hours**
Independent Study
An individualized, directed study involving a specified topic.

COS 370 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

COS 380 **3 hours**
Natural Language Processing
A study of the automation of human communication abilities, covering both textual and vocal aspects. Major topics include language parsing, understanding, representation, enhancement, generation, translation, and speaker/author recognition. *Prerequisite: COS 280.*

COS 381 **3 hours**
Computer Architecture
A study of the hardware structure of computer systems, including arithmetic/logic units, memory organization, control unit design, pipelining, and instruction set design. A brief introduction to advanced topics, such as out-of-order execution, branch prediction, multi-core systems, and parallel processing cache coherency will prepare the student for graduate level courses in architecture. *Prerequisite: COS 284.*

COS 382 **3 hours**
Language Structures
A study of the features and implementation issues of programming languages, including a survey of language paradigms. Grammars, syntax, semantics, translation, lexical analysis, and parsing are introduced. *Prerequisite: COS 265.*

COS 393 **1-4 hours**
Practicum
Supervised learning involving a first-hand field experience or a project. Generally, one hour of credit is awarded for a minimum of 40 hours of practicum experience. *Grade only. Practicum course credit requires a minimum of 320 hours of work experience. Offered primarily during Summer.*

COS 394 **1-4 hours**
Advanced Project
Students complete an open-ended software development project or laboratory experiment project. The individual project depends on students and faculty interest. Specific learning outcomes vary depending on faculty, student, and project selected. Independent or small group projects are possible. *May be taken by any Computer Science major with instructor permission. May be taken multiple times for credit.*

COS 411 **3 hours**
Digital Forensics
A study of the concepts, tools, methodologies, and analysis techniques used for host, media, and network forensic investigations. Students will learn how to capture, decipher, reconstruct, and analyze digital data. *Prerequisite: COS 331. Offered Fall semester of even years.*

COS 421 **3 hours**
Operating Systems
A study of the design considerations of computer operating systems and their interaction with hardware features. Topics covered include process management, storage management, protection and security, file systems, and concurrency. *Prerequisites: COS 265 and COS 284.*

COS 424 **3 hours**
Surfaces and Modeling
An advanced graphics course with emphasis on curve and surface representation and geometric modeling. Graphics algorithms and data structures are studied. Topics may include curves and surfaces, geometric modeling techniques, implicit surface generation, and topology editing. *Prerequisite: COS 350.*

COS 425 **3 hours**
Animation
An advanced graphics course with emphasis on techniques for rendering and animation. Mathematics and algorithms are studied. Topics include light and illumination models, ray tracing, methods to enhance realism, and standard animation techniques. A professional software package will be used to create a significant animation. *Prerequisite: COS 350.*

COS 432 **3 hours**
Software Reverse Engineering and Analysis
A study of defensive programming techniques, platform security, secure software engineering, software reverse engineering, and vulnerability analysis. Students will perform static and dynamic software analysis, identify and analyze malicious software, and apply tools and techniques for identifying software vulnerabilities. *Prerequisite: COS 284. Offered Fall semester of odd years.*

COS 433 **3 hours**
Missions Computing Senior Project
Combining computer science and service to the missions community, students travel to an international location during Interterm to undertake software development and systems analysis for a missions partner. Students design, construct, test, document, and deploy a non-trivial software system that meets the partner's requirements. Students experience the local culture and participate in direct ministry as opportunities arise. Students share their experience on campus in a formal paper, presentation, and poster. Satisfies the senior project requirement. *Meets foundational core cross-cultural requirement. Prerequisites: senior standing and instructor permission.*

COS 435 **3 hours**
Theory of Computation
A theoretical treatment of what can be computed and how efficiently computation can be done. Topics include models of computation and automata, deterministic and non-deterministic computations, and formal language theory. *Prerequisite: COS 265.*

COS 436 **3 hours**
Parallel and Distributed Computing
A study of concepts and models of distributed and parallel computing, including concurrency, synchronization, algorithms, hardware organization, and common programming environments. Implementation of parallel algorithms on multicore CPUs and many-core GPUs. *Prerequisites: COS 265 and COS 284.*

COS 450 **1-4 hours**
Directed Research
Investigative learning involving closely directed research and the use of such facilities as the library or laboratory. *Independent or small group projects. May be taken by any COS major with instructor approval. May be taken multiple times for credit.*

COS 452 **3 hours**
Research I
Participation in a research project under faculty direction. *Prerequisite: COS 310 or instructor permission.*

COS 453 **3 hours**
Research II
Participation in a research project under faculty direction. A formal presentation of results is required. *Prerequisite: COS 452 or instructor permission.*

COS 480 **1-4 hours**
Seminar
A limited-enrollment course designed especially for upper-class majors with emphasis on directed readings and discussion.

COS 486 **3 hours**
Game Engine Architecture
An exploration of the architecture and design underlying modern game engines. Systems covered include physics, graphics, human interfaces, and audio. Students implement from scratch a game engine with several games as demos. *Prerequisite: COS 265. COS 350 is strongly recommended.*

COS 490 **1-2 hours**
Honors
Individualized study or research of an advanced topic within a student's major. *Open to students with at least a 3.00 GPA in the major field.*

COS 491 **1 hour**
Computer Science Senior Capstone
A survey of topics useful for graduates of the department, but not covered by other courses. The emphasis is on non-technical issues such as making a budget, finding a church, balancing career and family, etc. The course is conducted as a trip off-campus to further strengthen relationships with the department. *Prerequisite: Senior status.*

COS 492 **3-4 hours**
Senior Project
Designed to exercise each senior's technical analysis, design, and development skills and showcase his/her documentation and presentation skills. The student develops a project through multiple phases of the software lifecycle frequently beginning at the design stage. The project is typically chosen to reflect the student's area of concentration. *Prerequisite: Senior status.*

COS 493 **2 hours**
Engineering Senior Capstone I
The first of a three course culminating experience preparing students for engineering practice through a major design and implementation project. *Prerequisite: Senior status, CEN major. Offered Fall semester.*

COS 494 **3 hours**
Engineering Senior Capstone II
The second in a three course culminating experience preparing students for engineering practice through a major design and implementation project. *Prerequisite: COS 493. Offered January interterm.*

COS 495 **1 hour**
Engineering Senior Capstone III
The third of a three course culminating experience preparing students for engineering practice through a major design and implementation project. It includes the Engineering poster session for assessment of the project. *Prerequisite: COS 494. Offered Spring semester.*

Systems Courses

SYS 101 **3 hours**
Introduction to Systems
This course provides a foundational understanding of systems thinking and the principles involved in designing, developing, and managing complex systems. Students learn how to identify and analyze systems components, their relationships, and system performance. Key topics include systems modeling, quality, systems thinking, and problem solving. Students will also learn about relational database concepts and structured query language (SQL), which are essential for managing data in modern systems. *Meets foundational core computation requirement.*

SYS 120 **4 hours**
Introduction to Problem Solving
An introduction to problem solving strategies applied to problems from numerous domains, resulting in the development of algorithms that are programmed in Python. The basic control structures, functions and parameter passing, and the concept of abstraction are all emphasized. Simple data structures (e.g., lists and dictionaries) and basic file processing are introduced. Incremental construction of large programs is practiced. *Three hours of lecture and two hours of lab per week. Meets foundational core computation requirement.*

SYS 125 **2 hours**
Introduction to Object Oriented Programming
This course is an introduction to object oriented design and programming. Students will apply problem solving strategies to devise OOD descriptions of problems formerly solved via procedural coding methods. Implementation of increasingly complex OOD solutions will be carried out in the Python programming language. *Prerequisite: COS 120 or SYS 120.*

SYS 170 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

SYS 214 **3 hours**
Principles of Human Computer Interaction
This course discusses the analysis, design, development, and evaluation of interfaces allowing humans to interact with computers and the presentation of information in formats designed for human understanding. People-centered design is emphasized through prototyping and information visualization are also discussed.

SYS 270 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

SYS 310 **3 hours**
E-Commerce
Examines the development of and future prospects for electronic commerce. It focuses on the use of electronic transmissions to engage in exchange of products and services. Students will consider the emerging changes in business as well as the new opportunities for entrepreneurship brought on by e-commerce. They will explore the dynamics of technical innovations as well as the organizational and societal consequences of moving commerce electronically. They will also evaluate the operations of a variety of web-based businesses. Guest speakers from industry will lecture regarding the technical, economic, and political/regulatory aspects of e-commerce. *Prerequisites: COS 120 or COS 130 or COS 143 or SYS 120; and COS 102 or SYS 101.*

SYS 330 **3 hours**
Human Relations in Organizations
The necessity of constructive conflict in organizations and the inevitability of destructive personal conflict are the reasons for studying human relations. Five books, some classics like Carnegie's How to Win Friends and Influence People, some near classics like Covey's The Seven Habits of Effective People, and possible future classics like Sande's The Peacemaker, are read and discussed. The goal is to improve understanding of conflict: That constructive conflict is healthy and necessary, how creative conflict can degenerate into destructive personal conflict, the causes of team dysfunction, how to achieve team synergy, and personal techniques for engaging in constructive conflict, avoiding destructive conflict and redeeming it should it happen. The Bible is used as a discussion resource. The pre-supposition of the course is that evangelical Christian culture encourages conflict avoidance within the culture and often without. Some strive to be "meek and mild" like Jesus, an aspiration that belies an incomplete understanding of Jesus' character and behavior. This is a writing course with a strong emphasis on discussion. *Meets foundational core social science requirement.*

SYS 352 **3 hours**
Knowledge Based Systems
Prominent knowledge-based system approaches are introduced including crisp production rule systems and fuzzy logic systems. Principles of knowledge acquisition are taught and applied. Various forms of knowledge representation are experienced, including rules, nets, frames, and predicate logic. Programming is primarily in CLIPS. *Prerequisites: COS 121; and COS 102 or SYS 101.*

SYS 360 **1-4 hours**
Independent Study
An individualized, directed study involving a specified topic.

SYS 370 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

SYS 390 **3 hours**
Information Systems Analysis
A study of the knowledge and skills needed to conduct the definition and analysis phases of an information system project. Central concepts are quality management and business process reengineering. Problem definition, information gathering, user experience modeling, data and process modeling, and specification of logical system requirements using a business event methodology are emphasized. Learning is by doing: a major project is begun in this course and completed in SYS 394. *Prerequisites: Junior standing; COS 120 or COS 130 or COS 143 or SYS 120; and COS 102 or SYS 101.*

SYS 393 **1-4 hours**
Practicum
Supervised learning involving a first-hand field experience or a project. Generally, one hour of credit is awarded for a minimum of 40 hours of practicum experience. *Offered primarily during Summer.*

SYS 394 **4 hours**
Information Systems Design
A study of the knowledge and skills needed to conduct the design and construction of an information system project. Central concepts are translating requirements into a physical design, project management, and deployment of information systems architectures. Students will learn and use application technologies empowering modern business systems. Learning is by doing; the major project defined and analyzed in SYS 390 will be designed and built. *Prerequisites: COS 120 or COS 130 or SYS 120; COS 121 or COS 143; and SYS 390.*

SYS 402 **3 hours**
Modeling and Simulation
A study of mathematical modeling and simulation methods, focusing on discrete systems. Simil and pysym are used in hands on exercises. Many applications are surveyed and group term projects are carried out. *Prerequisites: COS 121 or COS 143; MAT 210 or MAT 352; MAT 151.*

SYS 411 **3 hours**
Machine Learning
Classification learning systems of various types are explored. These include statistical pattern recognition, neural networks, genetic algorithms, and methods for inducing decision trees and production rules. Industry standard ML modules are utilized. Group term projects allow development of and experimentation with small ML solutions of interest. *Prerequisites: COS 121; and MAT 210 or MAT 352. COS 265 is strongly recommended.*

SYS 450 **1-4 hours**
Directed Research
Investigative learning involving closely directed research and the use of such facilities as the library or laboratory.

SYS 480 **1-4 hours**
Seminar
A limited-enrollment course designed especially for upper-class majors with emphasis on directed readings and discussion.

SYS 490 **1-2 hours**
Honors
Individualized study or research of an advanced topic within a student's major. *Open to students with at least a 3.00 GPA in the major field.*

Kinesiology

Chair, Assistant Professor B. Dykstra
Professors M. Harber, E. Hayes
Associate Professor B. Kendall
Assistant Professor S. Fenstermacher
Instructor G. Wolfe

The Kinesiology Department has two major purposes: (1) to prepare competent, caring, and reflective Christian leaders for world service in exercise science; and (2) to help students acquire the skills and attitudes for lifetime wellness, as well as wholesome and active use of their leisure time.

Baccalaureate degrees are offered with a major in Exercise Science or Human Physiology and Preventive Medicine. Candidates for the Bachelor of Arts degree must complete two years of a foreign language.

The three credits required in the foundational core curriculum are typically met by taking KIN 100 plus KIN 200 or one of the following to substitute for KIN 200: KIN 300, 302, 333, 334, or EXS 280 or EDU 250. Exercise Science majors complete this requirement by taking EXS 111, 316, and 318. Pre-Med and allied health students who are not Exercise Science majors are recommended to take KIN 221 to fulfill the three credits required for the foundational core curriculum. The Elementary Education major requires EDU 250, which along with KIN 100, will fulfill the foundational core requirement.

One aspect of professors' work at a Christian liberal arts university is to build relationships with students to participate in God's work of preparing students for a well-lived and meaningful life. The Kinesiology Department aims to fulfill this educational calling through a whole-person focused curriculum. The Living Well course will provide specific instruction in the more technical aspects of caring for the human body as part of the created order including rest/shalom, nutrition, and physical activity. As such, this course will serve as the foundation for an understanding of basic principles of a well-lived embodied life. The connections between mind, body, and spirit will be explored knowing that we are living, breathing, touchable souls made by a mysterious union of the sacred dust of God and the sacred breath of God.

Exercise Science

Brandon Dykstra, Scott Fenstermacher, and Brad Kendall, Advisors

Our mission is to develop Christ-like servant-leaders who possess the wisdom, technical skills, and relational abilities to lead others towards holistic health.

Exercise Science (BA)

The Bachelor of Arts degree with a major in Exercise Science requires two years of sequential study in one foreign language and 47 hours in the major. Students must complete the senior comprehensive requirement by completing 4 credits of directed research or internship. *All major courses must be completed with a grade of C- or better and are included in the major GPA.*

Major Requirements

BIO 201	4	Biology I: Foundations of Cell Biology and Genetics
BIO 310	4	Human Anatomy and Physiology I
BIO 311	4	Human Anatomy and Physiology II
EXS 111	3	Foundations of Exercise Science
EXS 274	1	Introduction to Exercise Testing
EXS 290	3	Principles of Strength Training and Conditioning
EXS 306	3	Physiology of Exercise
EXS 316	3	Applied Nutrition
EXS 318	3	Therapeutic Exercise and Pharmacotherapy
EXS 353	3	Physical Fitness Assessment
EXS 381	3	Kinesiology
EXS 453	3	Physical Fitness Prescription
KIN 355	3	Research Methods

Select <u>one</u> course from the following:

EXS 450	4	Directed Research
KIN 492	4	Internship

Select <u>one</u> course from the following:

PSY 395	3	Health Psychology
PSY 410	3	Motivation

Suggested Courses for Areas of Specialization

BIO 203	4	Principles of Genetics
BIO 210	3	Medical Terminology
BIO 331	4	Comparative Anatomy
BIO 471	4	Microbiology and Immunology
CHE 201/211	4	General, Organic, & Biochemistry I/College Chemistry I
CHE 202/212	4	General, Organic, & Biochemistry II/College Chemistry II
CHE 311	4	Organic Chemistry I
CHE 312	4	Organic Chemistry II
CHE 411	3	Biochemistry I
CHE 412	3	Biochemistry II
EXS 217	3	Health Promotion Program Planning
EXS 273	1	Introduction to Exercise Science Research
EXS 317	2	EKG and Stress Testing
EXS 393	1	Practicum
EXS 482	3	Lifespan and Environmental Physiology
HPH 310	3	Cardiorespiratory Physiology and Chronic Disease
HPH 315	3	Pathophysiology of Immunological and Metabolic Chronic Diseases
HPH 320	3	Neuromuscular Physiology and Chronic Disease
KIN 223	3	Emergency Health Care
KIN 324	2	Motor Learning
KIN 360	1-4	Independent Study (*approved by advisor*)
KIN 370	1-4	Selected Topics (*approved by advisor*)
MAT 140	3	Fundamental Calculus for Applications
MAT 145	3	Introduction to Functions and Calculus
MAT 146	3	Functions and Calculus
MAT 151	4	Calculus I
MAT 210	4	Introductory Statistics
PBH 100	3	Introduction to Public Health
PBH 213	2	Substance Education
PBH 346	3	Community Health Education
PHI 201	3	Logic
PHI 311	3	Medical Ethics
PHY 203/211	4	General Physics I/University Physics I
PHY 204/212	4-5	General Physics II/University Physics II
PSY 100	3	Introductory Psychology
PSY 220	3	Sport Psychology
PSY 250	3	Life Span Development
PSY 275	3	Introductory Statistics
PSY 300	3	Abnormal Psychology
PSY 395	3	Health Psychology
PSY 410	3	Motivation
PSY 441	3	Physiological Psychology
SMA 351	3	Sport Public Relations
SMA 352	3	Event and Facility Management

Exercise Science (BS)

The Bachelor of Science degree with a major in Exercise Science requires 65 hours in the major. Students must complete the senior comprehensive requirement by completing 4 credits of directed research or internship. *All major courses must be completed with a grade of C- or better and are included in the major GPA.*

Major Requirements

BIO 201	4	Biology I: Foundations of Cell Biology and Genetics
BIO 310	4	Human Anatomy and Physiology I
BIO 311	4	Human Anatomy and Physiology II
EXS 111	3	Foundations of Exercise Science
EXS 274	1	Introduction to Exercise Testing
EXS 290	3	Principles of Strength Training and Conditioning
EXS 306	3	Physiology of Exercise
EXS 316	3	Applied Nutrition
EXS 318	3	Therapeutic Exercise and Pharmacotherapy
EXS 353	3	Physical Fitness Assessment
EXS 381	3	Kinesiology
EXS 453	3	Physical Fitness Prescription
KIN 355	3	Research Methods

Select <u>one</u> course from the following:

EXS 450	4	Directed Research
KIN 492	4	Internship

Select <u>one</u> course from the following:

PSY 395	3	Health Psychology
PSY 410	3	Motivation

Electives

Select at least <u>18</u> hours from:

BIO 203	4	Principles of Genetics
BIO 210	3	Medical Terminology
BIO 331	4	Comparative Anatomy
BIO 471	4	Microbiology and Immunology
CHE 201/211	4	General, Organic, & Biochemistry I/College Chemistry I
CHE 202/212	4	General, Organic, & Biochemistry II/College Chemistry II
CHE 311	4	Organic Chemistry I
CHE 312	4	Organic Chemistry II
CHE 411	3	Biochemistry I
CHE 412	3	Biochemistry II
EXS 217	3	Health Promotion Program Planning
EXS 273	1	Introduction to Exercise Science Research
EXS 317	2	EKG and Stress Testing
EXS 393	1	Practicum
EXS 482	3	Lifespan and Environmental Physiology
HPH 310	3	Cardiorespiratory Physiology and Chronic Disease
HPH 315	3	Pathophysiology of Immunological and Metabolic Chronic Diseases
HPH 320	3	Neuromuscular Physiology and Chronic Disease
KIN 223	3	Emergency Health Care
KIN 324	2	Motor Learning
KIN 360	1-4	Independent Study (*approved by advisor*)
KIN 370	1-4	Selected Topics (*approved by advisor*)
MAT 140	3	Fundamental Calculus for Applications
MAT 145	3	Introduction to Functions and Calculus
MAT 146	3	Functions and Calculus
MAT 151	4	Calculus I
MAT 210*	4	Introductory Statistics
PBH 100	3	Introduction to Public Health
PBH 213	2	Substance Education
PBH 346	3	Community Health Education
PHI 201	3	Logic
PHI 311	3	Medical Ethics
PHY 203/211	4	General Physics I/ University Physics I
PHY 204/212	4-5	General Physics II/University Physics II
PSY 100	3	Introductory Psychology
PSY 220	3	Sport Psychology
PSY 250	3	Life Span Development
PSY 275*	3	Introductory Statistics
PSY 300	3	Abnormal Psychology
PSY 395‡	3	Health Psychology
PSY 410‡	3	Motivation
PSY 441	3	Physiological Psychology
SMA 351	3	Sport Public Relations
SMA 352	3	Event and Facility Management

**A maximum of 4 credits from these courses may count toward elective hours.*
‡Course may not double-count as requirement and elective.

Coaching Minor

The department offers a 18-19-hour Coaching minor for any student interested in preparing for the coaching profession. Students from any major are eligible for this course of study. The minor helps prepare students for opportunities in coaching, leading camps, youth athletic ministry, and recreational leadership. *All minor courses must be completed with a grade of C- or better and are included in the minor GPA.*

Minor Requirements

EXS 290	3	Principles of Strength Training and Conditioning
KIN 220	3	Principles of Coaching
KIN 223	3	Emergency Health Care
KIN 367	3	Coaching Methods
KIN 393	4	Practicum (*approved by advisor—Coaching*)

Select <u>one</u> course from the following:

KIN 472	2	Psychology of Coaching
PSY 220	3	Sport Psychology

Human Physiology and Preventive Medicine

Erik Hayes and Brian Dewar, Advisors

Human Physiology and Preventive Medicine is designed specifically for students seeking to enter into professional schools related to health care (e.g., medical school, physician assistant, physical therapist, occupational therapist, nursing). It first explores a basic foundation of human anatomy, physiology, cellular biology, and chemistry followed by more in depth physiology courses related specifically to physiological systems, the pathophysiology of chronic disease of those systems, and the scientific evidence and mechanism for prevention of disease through lifestyle modification. Students will gain a basic background in human nutrition, health psychology, and public health preparing them for work as health educators in our local medical clinic working to help members of the community prevent and treat chronic disease. The major is intentionally small enough to allow students space to meet all the prerequisite requirements for professional school entrance exams and professional school admission requirements. In addition, students will have room to pursue semester abroad experiences, faculty mentored research, and clinical internships.

Students wishing to follow more traditional paths to professional schools in medicine and health care (e.g., biology or chemistry) or choosing majors that would not typically be associated directly with health care but are nonetheless related to human health and flourishing (e.g., social work, music therapy, missions) may choose to complete a minor in Preventive Medicine.

Human Physiology and Preventive Medicine (BS)

The Bachelor of Science degree with a major in Human Physiology and Preventive Medicine requires 55-56 major hours. *Students must also complete at least 160 clinical hours as approved and verified by the department. All major courses must be completed with a grade of C- or better and are included in the major GPA.*

Major Requirements

BIO 201	4	Biology I: Foundations of Cell Biology and Genetics
BIO 310	4	Human Anatomy and Physiology I
BIO 311	4	Human Anatomy and Physiology II
EXS 316	3	Applied Nutrition
HPH 493	3	Human Physiology Capstone
KIN 221	3	Exercise as Medicine
NAS 230	2	Health Education for Behavior Change
PBH 100	3	Introduction to Public Health
PHI 311	3	Medical Ethics
PSY 100	3	Introductory Psychology
PSY 395	3	Health Psychology

Select <u>one</u> of the following chemistry course combinations:

CHE 201	4	General, Organic, and Biochemistry I
CHE 202	4	General, Organic, and Biochemistry II
or		
CHE 211†‡	4	College Chemistry I
CHE 212†‡	4	College Chemistry II

Select <u>one</u> course from the following:

BIO 381	3	Research Methods
KIN 355	3	Research Methods

Select <u>two</u> courses from the following:

HPH 310	3	Cardiorespiratory Physiology and Chronic Disease
HPH 315	3	Pathophysiology of Immunological and Metabolic Chronic Diseases
HPH 320	3	Neuromuscular Physiology and Chronic Disease

Select <u>one</u> additional course from the following:

BIO 300	4	Human Medical Physiology
EXS 482	3	Lifespan and Environmental Physiology
HPH 310	3	Cardiorespiratory Physiology and Chronic Disease
HPH 315	3	Pathophysiology of Immunological and Metabolic Chronic Diseases
HPH 320	3	Neuromuscular Physiology and Chronic Disease
PSY 441	3	Physiological Psychology

Recommended Courses

Students may choose to select any of the following courses based upon consultation with advisor and contact with specific graduate or professional school to ensure all entrance requirements are met; recommended courses are not counted toward major requirements nor major GPA.

BIO 203†‡	4	Principles of Genetics
BIO 210‡	3	Medical Terminology
BIO 312†‡	4	Cellular and Molecular Biology
BIO 471‡	4	Microbiology and Immunology
CHE 311†‡	4	Organic Chemistry I
CHE 312†	4	Organic Chemistry II
CHE 411†	3	Biochemistry I
IAS 210‡	3	Medical Terminology
MAT 210†‡	4	Introductory Statistics
PHY 203†	4	General Physics I
PHY 204†	4	General Physics II
PSY 250	3	Life Span Development
PSY 275	3	Introductory Statistics
PSY 300	3	Abnormal Psychology
SOC 100†	3	Introduction to Sociology
SOC/ANT	3-4	*Sociology or Anthropology Course*

†*Recommended for Medical School*

‡*Recommended for Physician Assistant*

Preventive Medicine Minor

A minor in Preventive Medicine requires 20 hours. *Students must also complete two semesters of 80 clinical hours each semester as approved and verified by department. All minor courses must be completed with a grade of C- or better and are included in the minor GPA.*

Minor Requirements

EXS 316	3	Applied Nutrition
KIN 221	3	Exercise as Medicine
NAS 230	2	Health Education for Behavior Change
PBH 100	3	Introduction to Public Health
PHI 311	3	Medical Ethics
PSY 100	3	Introductory Psychology
PSY 395	3	Health Psychology

Exercise Science Courses

EXS 111 **3 hours**
Foundations of Exercise Science
This course is an introduction to the field of exercise science. The content includes definitions, objectives, and philosophies of the field; basic content of components of exercise science, contemporary issues and research, and potential career options. This introduction to the field of exercise science will have a foundation of the Christian perspective of vocational gifting, calling, preparation and service to humankind. O*ffered Fall and Spring semesters.*

EXS 170 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

EXS 214 **3 hours**
Health and Sexuality
This course is designed to prepare future health educators to teach the relationship between health and human sexuality. The class activities will include lectures/discussions, peer teaching, development of an abstinence-based curriculum, and lectures by outside resource personnel.

EXS 215 **2 hours**
Health, Exercise, and Aging
The course is designed to examine common health-related physiological changes, current issues, and concerns as they pertain to the aging individual. *Prerequisite: EXS 111 or permission of instructor.*

EXS 217 **3 hours**
Health Promotion Program Planning
This course is a study of the philosophy, goals, objectives, organization, content, and methods of wellness programs. Characteristics of various clientele and how programs can be developed to meet their specific needs will be studied. *Prerequisite: EXS 111.*

EXS 270 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

EXS 273 **1 hour**
Introduction to Exercise Science Research
Students will gain a basic introduction to research through a field experience in an exercise science research project. Students will help with data collection, data entry, and data analysis portions of the study. *May be repeated once for credit. By permission of instructor only.*

EXS 274 **1 hour**
Introduction to Exercise Testing
This course will introduce students to the basic skills of cardiovascular disease risk assessment, anthropometric measures, basic muscle strength and endurance assessment, EKG preparation, and data collection.

EXS 280 **1 hour**
Exercise Techniques for Physical Fitness
A course designed to teach various motor skills needed to effectively improve physical fitness such as proper running mechanics, basic lifting techniques, and common stretches. Students will also develop presentation and group exercise leadership skills. *Meets foundational core stewardship of the body requirement beyond KIN 100. Exercise Science majors and Coaching minors only.*

EXS 290 **3 hours**
Principles of Strength Training and Conditioning
This course is the study of the essentials of strength training and conditioning for practitioners and prepares students for certification with the National Strength and Conditioning Association (NSCA). The course will cover the following: biomechanics of exercise, rehabilitation, bioenergetics of training, aerobic exercise prescription, resistance training, and speed and plyometric training. *Prerequisites: EXS 111 or permission of instructor.*

EXS 306 **3 hours**
Physiology of Exercise
A study of how the body adapts and responds to acute and chronic exercise. Attention is given to skeletal muscle structure and function, neurological control of movement, metabolic systems, and cardiovascular and pulmonary systems. *Prerequisite: BIO 310 or permission of instructor.*

EXS 316 **3 hours**
Applied Nutrition
This course is a study of basic principles of human nutrition including fundamentals of digestion, absorption, and metabolism; nutrients and their roles for the lifespan; eating disorders; and nutrition for performance. *Exercise Science, Pre-Nursing, and Human Physiology and Preventative Medicine majors only or by permission of instructor. Offered Fall and Spring semesters.*

EXS 317 **2 hours**
EKG and Stress Testing
This course is designed to provide the undergraduate exercise science student with the basic knowledge and skills needed to interpret resting and exercise EKG's. Emphasis will be placed on 1) learning normal vs. abnormal EKG patterns at rest and during exercise; and, 2) the effects of cardiovascular medication on the resting or exercise EKG and various physiologic responses to exercise testing. An additional purpose of the course is to introduce the undergraduate exercise student to selected cardiac assessment techniques. *Prerequisite: EXS 306 or permission of instructor.*

EXS 318 **3 hours**
Therapeutic Exercise and Pharmacotherapy
A detailed study of the role exercise plays in preventing and treating chronic diseases and conditions including metabolic diseases, obesity, cardiovascular conditions, systemic inflammatory diseases, neurological diseases, cancer, orthopedic conditions, and aging. *Prerequisite: EXS 306 or permission of instructor. Offered January interterm.*

EXS 320 **3 hours**
Community Health Promotion
This course introduces students to health promotion in a community setting. The content explores the theoretical and practical issues of the field of community health that enable students to identify and apply health education principles to health challenges facing individuals, groups, and communities. Local cultures will be explored throughout the trip and students will be expected to reflect on their experience. *Meets foundational core cross-cultural requirement. Prerequisite: Permission of instructor.*

EXS 353 **3 hours**
Physical Fitness Assessment
This course will provide a comprehensive study of the components of physical fitness and methods of assessing fitness levels within each component. Health assessment and risk analysis instruments will also be examined. The course consists of classroom work, practical assessment projects, and some field experiences. Each student will participate in "hands-on" fitness assessments of various population groups. *Prerequisites: EXS 111, EXS 274, and EXS 306; or permission of instructor. Offered Fall and Spring semesters.*

EXS 360 **1-4 hours**
Independent Study
An individualized, directed study involving a specified topic.

EXS 370 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

EXS 381 **3 hours**
Kinesiology
An analysis of human movement based on anatomic and mechanical principles. Emphasis is given to the application of these principles to the understanding of athletic performance. *Prerequisites: BIO 310 or permission of instructor.*

EXS 393 **1-4 hours**
Practicum
Supervised learning involving a first-hand field experience or a project. Generally, one hour of credit is awarded for a minimum of 40 hours of practicum experience. *Prerequisite: Permission of KIN department.*

EXS 450 **1-4 hours**
Directed Research
Investigative learning involving closely directed research and the use of such facilities as the library or laboratory. *Prerequisite: Permission of instructor.*

EXS 453 **3 hours**
Physical Fitness Prescription
This course provides a study of the prescription and development of appropriate exercise programs based on accurate assessment of each component. Appropriate programs for various populations groups will be considered. The course will consist of classroom work, practical prescription projects, and some field experiences. Each student will participate in "hands-on" prescription and program development for a variety of individuals. *Prerequisite: EXS 306.*

EXS 480 **2 hours**
Seminar
A limited-enrollment course designed especially for upper-class majors with emphasis on directed readings and discussion.

EXS 482 **3 hours**
Lifespan and Environmental Physiology
This is a seminar-style course which will examine the differences in pediatric physiology and geriatric physiology as well as address physiological adaptations to different natural environments. A variety of topics related to pediatric and geriatric physiology will be explored including growth, maturation and aging, underlying mechanisms for changes in fitness in children and older adults, and specific health challenges facing these populations. Topics relevant to environmental physiology that will be explored include adaptations related to hot, humid, and hypoxic environments. *Prerequisite: EXS 306.*

EXS 490 **1-2 hours**
Honors
Individualized study or research of an advanced topic within a student's major. *Open to students with at least a 3.00 GPA in the major field.*

Human Physiology Courses

HPH 310 **3 hours**
Cardiorespiratory Physiology and Chronic Disease
This course explores the physiology of the cardiac, respiratory, and vascular systems, pathophysiology of the most common cardiorespiratory diseases, and current evidence and mechanisms for disease prevention through lifestyle modification. *Prerequisites: BIO 201; BIO 310; BIO 311; and CHE 202 or CHE 212.*

HPH 315 **3 hours**
Pathophysiology of Immunological & Metabolic Chronic Diseases
This course explores the pathophysiology of immunological and metabolic chronic diseases with specific emphasis on cancer, hyperlipidemia, diabetes, obesity, and frailty, as well as the major organ systems most commonly impacted by those diseases and current evidence and mechanisms for disease prevention through lifestyle modification. *Prerequisites: BIO 201; BIO 310; BIO 311; and CHE 202 or CHE 212.*

HPH 320 **3 hours**
Neuromuscular Physiology and Chronic Disease
This course explores the physiology of the central and peripheral nervous system with specific emphasis on neuromuscular control, the pathophysiology of the most common neurological and neuromuscular diseases (e.g., stroke, Parkinson's, Alzheimer's, mental illness), and the current evidence and mechanisms for disease prevention through lifestyle modification. *Prerequisites: BIO 201; BIO 310; BIO 311; and CHE 202 or CHE 212.*

HPH 493 **3 hours**
Human Physiology Capstone
This course will revisit and add to the theological and philosophical underpinnings of human health and medicine that were initially explored in KIN 221 Exercise as Medicine. Students will review their reflective writings from their freshmen year and develop an updated philosophy of human health and flourishing and the practice of medicine. In addition, students will be required to research a specific chronic disease and present an in depth presentation of the current scientific evidence for disease prevention. This course will culminate in a multi-day retreat where students will give their presentations and engage their peers and faculty in discussions centered around their philosophy papers. *Must be a graduating senior to enroll. Offered Interterm.*

Kinesiology Courses

KIN 100 **2 hours**
Living Well
This course will assist students in developing an understanding of human flourishing founded on biblical principles and scientific evidence in the areas of sleep, stress and time management, nutrition, and various aspects of physical fitness. Students will engage in various assignments and physical activities related to these areas with the purpose of providing the abilities to make healthy lifestyle and behavior choices. *This course satisfies two of the three hours of foundational core requirements for stewardship of the body.*

KIN 150 **3 hours**
Faith and the Embodied Life
The main objective of this course is to aid students in understanding how their faith intersects with an embodied existence. Throughout the course, students will engage in physical (cloister walks, etc.), mental, and spiritual exercises to assist them in the formation of their personal health philosophies. Students will gain a better understanding of how care (or lack thereof) for our bodies has spiritual ramifications and that we may worship the One who created our bodies through proper care and respect of them. *Meets the 3-hour foundational core stewardship of the body requirement.*

KIN 170 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

KIN 200I **1 hour**
Individualized Physical Education
The individualized physical education course is designed for students who fit into one of the following categories: (1) the student has a physical problem that prohibits completion of another KIN 200 course; (2) the student would like to do an activity that is not offered as a KIN 200 course; or (3) the student is near graduation and cannot schedule another KIN 200 course. Students design a program with the instructor's supervision and then engage in that program throughout the semester. Physical fitness assessments may be included as well as cognitive assignments. *Students must apply for acceptance into the class and be approved by the instructor in order to register for the course. Prerequisite: EXS 111, KIN 100, or KIN 221.*

KIN 200Z **1 hour**
Athletic Participation
The athletic participation course is designed for students who compete on an NAIA intercollegiate athletic team**.** *Students must be approved by the athletic department to receive academic credit for this course. Credit is awarded only during the sport season and credit will not be granted retroactively for athletic participation from a previous season.*

KIN 200 **1 hour**
General Physical Education Activity Courses
These courses encourage students to adopt an active physical lifestyle and maintain physical fitness and wellness throughout their lives. Students learn about activities and develop skills for participation in lifetime activities. *One KIN 200 course is taken after KIN 100 to meet the three-hour foundational core requirement. Prerequisite: EXS 111, KIN 100, or KIN 221.*

KIN 200A	Aerobic Conditioning
KIN 200AW	Aerobic Walking
KIN 200B	Badminton
KIN 200C	Weight Control and Fitness
KIN 200CC	Camping and Canoeing
KIN 200D	Square Dance
KIN 200DF	Self Defense/Safety for Women
KIN 200F	Softball
KIN 200FD	Folk Dances of Other Cultures
KIN 200FF	Fly Fishing
KIN 200FN	Functional Fitness
KIN 200G	Golf
KIN 200H	Beginning Horsemanship
KIN 200J	Acting
KIN 200JG	Jogging
KIN 200K	Basketball
KIN 200KT	Karate
KIN 200L	Bowling
KIN 200M	Challenge Adventures
KIN 200N	Total Fitness
KIN 200P	Personal Fitness
KIN 200PB	Pickleball
KIN 200Q	Outdoor Activities
KIN 200R	Racquetball
KIN 200RU	Running
KIN 200S	Soccer
KIN 200SB	Beginning Swimming
KIN 200SF	Fitness Swimming
KIN 200T	Tennis
KIN 200U	Circuit Training
KIN 200V	Volleyball
KIN 200W	Weight Training
KIN 200WA	Well Aerobics
KIN 200Y	Cycling
KIN 200YO	Yoga

KIN 220 **3 hours**
Principles of Coaching
This course is a study of the duties and responsibilities of coaches and the potential problems and issues they may face. The content will include the four major areas of coaching certification programs: medical aspects, physiological aspects, psychological aspects, and organizational and administrative aspects. Methods and strategies of handling the responsibilities and the problems will be studied.

KIN 221 **3 hours**
Exercise as Medicine
This class examines the impact of physical activity, exercise, nutrition, and lifestyle related factors on health and the prevention and treatment of chronic disease. Students will learn the physiological basis of cardiorespiratory and musculoskeletal fitness, how these are influenced by exercise and physical activity, and their relation to health and disease. The therapeutic effect of exercise will be compared to traditional pharmacological treatment approaches where applicable. In addition, students will be challenged to consider the personal, spiritual, and social responsibilities of maintaining an optimal level of fitness as they apply course content to their own life. *Meets the 3-hour foundational core stewardship of the body requirement. Open to Pre-Med students and Public Health, Pre-Nursing, and Human Physiology and Preventative Medicine majors only or by permission of instructor.*

KIN 223 **3 hours**
Emergency Health Care
Prevention, treatment, and emergency care of various health problems and injuries will be examined. Skills will be obtained in CPR, AED, first aid, blood and airborne pathogens, and use of PPEs according to guidelines of the Emergency Care and Safety Institute and American Red Cross.

KIN 231 **2 hours**
Officiating Sports
A study of the officiating skills and techniques needed for various sports. The opportunity to earn official's rating is provided.

KIN 270 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

KIN 271 **1 hour**
CPR for Healthcare Providers
Successful completion of this course will certify participants in the techniques of CPR and AED use for adults, children, and infants; foreign body obstruction; and cardiac emergency management according to American Red Cross standards. *Priority registration for this course is given to students in the KIN majors.*

KIN 300M **3 hours**
Marathon
This course consists of training for and completing a marathon. Students will follow a 15-week training plan culminating in successful completion of a sanctioned marathon at the end of the semester. Training for a marathon teaches many values, including but not limited to goal-setting, discipline, withstanding present discomfort for long-term success, accountability, and self-esteem. Training will be completed both individually and in a group, emphasizing the importance of individual ownership of challenge and success as well as the overwhelming importance of community in achieving personal goals. *Meets the 3-hour foundational core stewardship of the body requirement.*

KIN 302 **2 hours**
Lifeguard Training
This course is designed to train an individual in the proper methods for rescue, water safety, first aid, CPR, and other skills necessary for lifeguarding. *Meets foundational core stewardship of the body requirement beyond KIN 100. Prerequisite: KIN 100.*

KIN 307 **1 hour**
Basic Swimming Skills
For KIN majors who have satisfactorily completed a basic swimming, intermediate swimming, or emergency water safety course at another institution. Students will receive credit for basic proficiency in swimming skills and water safety upon submission of official transcript. *Meets foundational core stewardship of the body requirement beyond KIN 100.*

KIN 324 **2 hours**
Motor Learning
A study of the theories and research of the processes of learning motor skills. The application of appropriate methods of teaching motor skills is studied and practiced to enable the students to understand how they can be used effectively. *Prerequisite: EXS 111 or permission of instructor.*

KIN 333 **2 hours**
Water Safety Instructor
Instruction in the skills, terminology, and progressions of teaching swimming strokes and water safety. The course includes knowledge of the skills, physical performance of the skills, and teaching skills. Successful completion of the American Red Cross requirements leads to certification in Red Cross WSI. *Advanced swimming skills are necessary. Meets foundational core stewardship of the body requirement beyond KIN 100. Prerequisites: KIN 100 and permission of instructor.*

KIN 334 **1 hour**
Lifeguard Training Instructor
Acquisition of the skills, terminology, and progressions for teaching American Red Cross Lifeguard Instructor Training. The course includes both knowledge of the skills and physical performance of the skills. Successful completion of the American Red Cross requirements leads to certification as a Red Cross LGI. *Meets foundational core stewardship of the body requirement beyond KIN 100. Prerequisites: KIN 302 and permission of instructor.*

KIN 355 **3 hours**
Research Methods
An exploration of the basic methods of research and data collection in the realms of sport management, physical education, and exercise science in a lecture format. Topics include defining a research question, reviewing and analyzing past research, designing a research project, collecting and analyzing data, and interpreting results. Students will also learn basic statistics and Excel and PowerPoint table and figure making skills. *Prerequisite: EXS 111 or KIN 221. Exercise Science, Health Science, and Human Physiology and Preventative Medicine majors only. Offered Fall and Spring semesters.*

KIN 360 **1-4 hours**
Independent Study
An individualized, directed study involving a specified topic.

KIN 367 **3 hours**
Coaching Methods
This course will assist the student in learning how to teach the skills and strategies of selected sports and how to utilize that information to be an effective coach. The content includes basic sport skills, types of offenses and defenses, special situation strategies, and other strategies specific to selected sports. The student will learn correct techniques of skills and skill progressions as well as drills to teach skills and strategies.

KIN 370 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

KIN 393 **1-4 hours**
Practicum
Supervised learning involving a first-hand field experience or a project. Generally, one hour of credit is awarded for a minimum of 40 hours of practicum experience. *Prerequisite: Permission of KIN department.*

KIN 450 **1-4 hours**
Directed Research
Investigative learning involving closely directed research and the use of such facilities as the library or laboratory. *Prerequisite: Permission of instructor.*

KIN 472 **2 hours**
Psychology of Coaching
This course is a study of the role of psychology in coaching and how coaches can use psychology to enhance the performance of athletes and teams. Topics include psychology, philosophy of sport, motivation, self-confidence, goal setting, attention/concentration, imagery, arousal, self-talk, stress management, and mental skill methods/training. An application of appropriate mental skills will be addressed for each topic. Biblical principles of psychology will be integrated into topics.

KIN 480 **2 hours**
Seminar
A limited-enrollment course designed especially for upper-class majors with emphasis on directed readings and discussion. *Students examine contemporary issues in sport.*

KIN 490 **1-2 hours**
Honors
Individualized study or research of an advanced topic within a student's major. *Open to students with at least a 3.00 GPA in the major field.*

KIN 492 **4 hours**
Internship
This field experience is designed to have the students apply what they have learned in their courses and to extend that learning by working in an organization that is appropriate for their major. Students work on a regular basis at the organization under the supervision of approved staff members. Students are also under the supervision of a member of the Taylor University Department of Kinesiology. *Each student must comply with the guidelines for credit hours, clock hours, and other criteria that are specific for the internship in his/her major. To register for this internship, the student must submit a proposal for the internship and have it approved by the KIN department and the internship organization. Prerequisites: All designated prerequisites for the internship in that major.*

Public Health Courses

PBH 100 **3 hours**
Introduction to Public Health
This course is a foundational course for the major and an elective for students wishing only to be introduced to the field. The course is built upon a population perspective and ecological perspective on disease causation and prevention. As a general overview of the field, Introduction to Public Health provides an historical perspective on the role that public health has played in improving the health status of populations, both in the US and globally. Moving beyond the biologic mechanisms of disease causation, students will gain an understanding of the environmental, social and behavioral determinants of health for populations, and factors that contribute to disparities in health between subpopulations. Students will be introduced to the core functions and essential services of public health in the US and how these are met in less economically developed societies. The core disciplines of public health will be defined and described, including epidemiology, biostatistics, environmental health, policy and administration, and the social and behavioral sciences. Students will examine current public health challenges in the US and globally.

PBH 110 **3 hours**
Global Health
This course provides an overview of the determinants of health, burden of disease, risk factors, health systems, and key measures to address the burden of disease in populations for both industrialized and less developed nations. The course will have a global perspective, paying particular attention to links between health and development, environment, human rights, and culture.

PBH 170 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

PBH 210 **3 hours**
Human Diseases
Introduction to biomedical concepts associated with human diseases. Emphasis is on understanding the etiology, pathogenesis, diagnosis, treatment, and risk factors of diseases affecting public health and how this impacts the prevention and control of those diseases. *Offered Fall semester. Prerequisites: PBH 100 or PBH 110.*

PBH 213 **2 hours**
Substance Education
The course is designed to prepare professionals for drug education. The scope of the course is wide and includes the following basic areas: drug terminology, pharmacology, psychodynamics, legal and law enforcement perspectives, social and cultural determinants, ethical and moral alternatives, behavioral aspects, and educational strategies. A strong emphasis is placed on developing guidelines for decision making in our society. The purpose is to exchange the best amount of information on drug use, misuse, and abuse available. *Offered Spring semester of even years.*

PBH 224 **2 hours**
Healthy Aging
This course will provide an overview of issues related to public health and aging. Topics such as demography and epidemiology of aging, perceptions of aging as viewed in society today, myths and stereotypes of aging, and challenges faced by elders will be addressed. The course will support health promotion for older adults and highlight the roles played by families, government, health care providers, and advocates.

PBH 244 **3 hours**
Health and Human Sexuality
The course examines the basic foundations of human sexuality and incorporates topical issues of interest and importance. In addition to the dissemination of cognitive information, a strong emphasis of the course is placed on the psychosocial aspects of human sexuality and its impact on individuals and society. Students are encouraged to develop and maintain a personal philosophy concerning sexual decision-making and behavior. The broad goals of the course include an increased knowledge of the biological, developmental, and scientific aspects of human sexuality, in addition to developing a greater awareness of self and others.

PBH 270 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

PBH 320 **4 hours**
Epidemiology
Study of the distribution and determinants of disease occurrence, including core concepts such as incidence, prevalence, risk, risk factors, relative risk, attributable risk, sensitivity, specificity, and different types of epidemiologic study designs. Students will use data from epidemiologic case studies to calculate odds ratios, relative risk, and confidence intervals as well as calculate sensitivity and specificity of screening tests. *Offered Spring semester. Prerequisites: PBH 100; MAT 210 or SOC 355 or PSY 275.*

PBH 330 **3 hours**
Assessment for Program Planning
This course will examine intervention approaches in public health for the prevention of infectious disease, chronic disease, injury and disability, and the promotion of community health and wellbeing. Intervention approaches through environmental change, policy and systems change, social change, and behavioral change approaches will be studied. Case studies of interventions will be examined. *Offered Fall semester. Prerequisites: PBH 100.*

PBH 330L **1 hour**
Service Learning in Community Assessment
Students will participate in a neighborhood assessment and mapping project in a local community in partnership with a community organization. This will include neighborhood observations, neighborhood survey interviews, and participation in neighborhood events. *Offered Fall semester. Prerequisite: PBH 100.*

PBH 335 **4 hours**
Environmental Health
This course will explore how both the natural and built environment affect human health by looking at the impact of physical, chemical, biological, and socioeconomic factors external to humans. Environmental health is an interdisciplinary field that focuses on the theory and practice of recognizing, assessing, controlling, and preventing environmental and occupational hazards that may adversely affect the health of the present and future generations. *Prerequisites: PBH 100; SUS 200 or SUS 231.*

PBH 340 **4 hours**
Community Health Development in Practice
The course will examine the theory and practice of community health development as it is practiced by organizations doing this work internationally. The course will be offered in partnership with a non-governmental organization doing transformational development in one of the countries where they are working. The course will include a service component and discussions of those experiences will emphasize intercultural competencies. *Offered Interterm of odd years. Prerequisites: PBH 100 or PBH 110; PBH 330.*

PBH 345 **3 hours**
International Humanitarian Response
This course examines the international humanitarian response to disasters from a Christian and public health perspective. Current crises from around the world will be discussed, including causes; effects on population health; problems associated with population displacement; public health responses; and challenges to international collaboration between governments, international organizations, and non-governmental organizations.

PBH 346 **3 hours**
Community Health Education
This course illustrates how the health of populations is promoted and protected by organized public health practice. Students are acquainted with current evolving concepts and performance of these practices and are introduced to essential public health services. The problem-solving approach is emphasized through small-group interaction, case-study method, and critical thinking skills. *Meets foundational core civic engagement or general social science requirement. Offered Spring semester.*

PBH 347 **3 hours**
Health Policy and Law in National and Global Contexts
The course will provide a framework for understanding and analyzing a range of health policy issues in domestic and global contexts. The course will focus on the U.S. policy-making and legal system in the domestic context. It will provide additional focus on global law and policy as it relates to vulnerable populations of refugees, displaced populations, and populations living in poverty. The course will consider essential issues in health policy and law including health insurance, health economics, individual rights in health care, gender equity, and health care access and quality.

PBH 350 **3 hours**
Determinants of Health and Health Equity
The focus of this course will be on examining the broad range of environmental, social, cultural, and policy factors that contribute to disparate outcomes between population groups. This course will introduce students to the literature and methods of social epidemiology. Structured in a seminar format, with readings and case studies, students will examine specific cases of disparate health outcomes within communities including an analysis of the determinants of those disparities. Approaches to health equity will be discussed. *Offered Spring semester. Prerequisites: PBH 100 and PBH 320; MAT 210 or SOC 355 or PSY 275.*

PBH 360 **1-4 hours**
Independent Study
An individualized, directed study involving a specified topic.

PBH 370 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

PBH 393 **1-4 hours**
Practicum
Supervised learning involving a first-hand field experience or a project. Generally, one hour of credit is awarded for a minimum of 40 hours of practicum experience. *Offered primarily during Summer following junior year or Fall of senior year. Prerequisites: PBH 100, PBH 110, PBH 210, PBH 320, PBH 330, PBH 340, and PBH 350.*

PBH 425 **1 hour**
CHES Preparation Seminar
This course provides a detailed review of the analysis and application of the Seven Areas of Responsibilities and Competencies. Focus is on helping increase knowledge of the concepts and successfully pass the Certified Health Education Specialist (CHES) examination in either the Fall or Spring semester of the senior year. It is designed to review the health educator responsibilities, competencies, and sub-competencies and also provide an overview of the national certification examination. Additional work will be required by the student to maximize success on the exam. *Prerequisite: Senior in Public Health major or permission of instructor. Pass/fail only.*

PBH 450 **1-4 hours**
Directed Research
Investigative learning involving closely directed research and the use of such facilities as the library or laboratory.

PBH 480 **1-4 hours**
Seminar
A limited-enrollment course designed especially for upper-class majors with emphasis on directed readings and discussion.

PBH 490 **1-2 hours**
Honors
Individualized study or research of an advanced topic within a student's major. *Open to students with at least a 3.00 GPA in the major field.*

PBH 493 **2 hours**
Public Health Senior Capstone
This course will be structured as a seminar, pulling together the experiences of all the students into a broad public health framework. Major challenges faced during practicum will be discussed. Readings, videos, guest lectures, and optional workshops will support the discussions that take place in class. An integrative senior paper will provide the structure for students to integrate their faith, public health coursework, and practicum experiences. Part of the comprehensive exam, paper, or project required for graduation will be completed during the practicum. *Offered Spring semester. Prerequisites: PBH 100, PBH 110, PBH 210, PBH 320, PBH 330, PBH 393; and PBH 340 or PBH 350.*

Notes

Mathematics

Chair, Professor P. Eggleton
Professors J. Case, M. Colgan, M. Maxwell, D. Thompson
Associate Professor D. Rodman
Assistant Professor A. Mishra
Visiting Assistant Professor K. Shipley

The major purposes of the Mathematics Department are to help students increase their knowledge and understanding of mathematical concepts, develop their reasoning ability and problem-solving skills, and improve their ability to apply mathematics in a variety of areas. The department prepares students to become teachers of mathematics; to enter careers in actuarial science, business, industry, and government; and to pursue graduate study in mathematics and related areas.

The student expecting to major in Mathematics should have four years of high school mathematics, including two years of high school algebra, geometry, trigonometry and preferably calculus. In the freshman year, students planning to major in mathematics and those preparing for scientific work, including engineering, should be qualified to begin with MAT 151 or MAT 230. The department offers five majors: Data Science; Mathematics; Mathematics/Computer Science Education; Mathematics Education; and Mathematics–Interdisciplinary.

Students interested in actuarial science should consider the Actuarial Science certificate and major in Mathematics-Interdisciplinary with a minor in Accounting, Economics, or Finance, or they should major in Data Science. They should take MAT 352, MAT 382, and MAT 385 as preparation for the first two actuarial exams. Students can also receive VEE credit (Validation by Educational Experience) from the Society of Actuaries with grades of B- or higher in ECO 201, ECO 202, FIN 361, and MAT 382. See the guidelines from the Society of Actuaries webpage for further details.

Each semester, the Mathematics Department offers at least four sanctioned events such as special lectures or colloquiums. All majors are required to attend at least 15 sanctioned events for graduation and at least 12 sanctioned events before taking the MAT 493 course.

Data Science (BS)

The Bachelor of Science degree with a major in Data Science requires a minimum of 76-83 hours including a concentration and attendance at 15 sanctioned events. *All major courses, including concentration courses, must be completed with a grade of C- or better and are included in the major GPA.*

Computer Science Core Requirements

COS 120	4	Introduction to Computational Problem Solving
COS 121	4	Foundations of Computer Science
COS 143	3	Interactive Webpage Development
COS 265	4	Data Structures and Algorithms
COS 280	3	Introduction to Artificial Intelligence
COS 326	3	Data Visualization
COS 343	3	Database Systems
SYS 411	3	Machine Learning

Mathematics Core Requirements

MAT 180	3	Problem Solving
MAT 230	4	Calculus II
MAT 240	4	Calculus III
MAT 255	3	Justifications in Mathematics
MAT 311	3	Introduction to Data Science
MAT 345	4	Linear Algebra
MAT 352	4	Mathematical Statistics
MAT 382	3	Advanced Statistical Methods
MAT 392	1	Mathematics Seminar
MAT 393	3	Practicum
MAT 493	3	Senior Capstone

Select <u>one</u> course from the following:

COS 243	3	Multi-tier Web Application Development
COS 380	3	Natural Language Processing
MAT 310	3	Mathematical Modeling with Numerical Analysis
MAT 340	4	Advanced Calculus
MAT 455	3	Abstract Algebra

Concentrations *– Students must select <u>one</u> of the following concentrations:*

Biology

BIO 203	4	Principles of Genetics
BIO 306	3	Introduction to Bioinformatics
ENS 204	4	Principles of Ecology

Chemistry

Select <u>one</u> course from the following:

CHE 201	4	General, Organic, and Biochemistry I
CHE 211	4	College Chemistry I

Select <u>one</u> course from the following:

CHE 202	4	General, Organic, and Biochemistry II
CHE 212	4	College Chemistry II

Select <u>one</u> course from the following:

CHE 301	4	Analytical Chemistry I
CHE 431	4	Physical Chemistry I

Select <u>one</u> course from the following:

CHE 302	4	Analytical Chemistry II
CHE 432	4	Physical Chemistry II

Physics

PHY 211	5	University Physics I
PHY 212	5	University Physics II

Select <u>one</u> course from the following:

PHY 310	3	Modern Physics
PHY 311	4	Modern Physics

Select <u>one</u> course from the following:

PHY 321	3	Electricity and Magnetism
PHY 412	3	Quantum Mechanics

Political Science

POS 100	3	American Politics
POS 245	3	Research in Political Studies
POS 331	3	Public Policy
POS 344	3	Campaigns and Elections

Psychology

PSY 100	3	Introductory Psychology
PSY 272	3	Research Methods in Psychology
PSY 425	3	Industrial-Organizational Psychology

Select <u>one</u> course from the following:

PSY 321	3	Social Psychology
PSY 422	3	Psychological Testing

Data Science requirements continued on next page

Data Science requirements continued from previous page

Sociology

SOC 210	3	Contemporary Social Issues
SOC 250	2	Principles of Research and Analysis
SOC 315	3	Social Inequality and Stratification
SOC 350	3	Social Research Methods

Select <u>one</u> course from the following:

SOC 100	3	Introduction to Sociology
SOC 110	3	Introduction to Global Societies

Sport Management

SMA 115	3	Introduction to Sport Management
SMA 210	3	Introduction to Sport Technology and Analytics
SMA 352	3	Event and Facility Management
SMA 354	3	Sport Finance

Systems

MAT 401	3	Operations Research
SYS 101	3	Introduction to Systems
SYS 390	3	Information Systems Analysis
SYS 394	4	Information Systems Design

Data Science Minor

A Data Science minor requires a minimum of 31-32 hours. *All minor courses must be completed with a grade of C- or better and are included in the minor GPA.*

Minor Requirements

COS 121	4	Foundations of Computer Science
COS 143	3	Interactive Webpage Development
COS 326	3	Data Visualization
MAT 151	4	Calculus I
MAT 311	3	Introduction to Data Science
MAT 382	3	Advanced Statistical Methods

Select <u>one</u> course from the following:

MAT 210	4	Introductory Statistics
MAT 352	4	Mathematical Statistics

Select <u>one</u> course from the following:

COS 120	4	Introduction to Computational Problem Solving
SYS 120	4	Introduction to Problem Solving

Select <u>one</u> course from the following:

COS 265	4	Data Structures and Algorithms
COS 343	3	Database Systems
SYS 411	3	Machine Learning

Mathematics (BA)

The Bachelor of Arts degree with a major in Mathematics requires two years of one foreign language and 46-47 hours (42-43 math hours), attendance at 15 sanctioned events, and is designed for students planning to attend graduate school. *All major courses must be completed with a grade of C- or better and are included in the major GPA.*

Major Requirements

MAT 180	3	Problem Solving
MAT 230	4	Calculus II
MAT 240	4	Calculus III
MAT 255	3	Justifications in Mathematics
MAT 340	4	Advanced Calculus
MAT 345	4	Linear Algebra
MAT 352	4	Mathematical Statistics
MAT 392	1	Mathematics Seminar
MAT 455	3	Abstract Algebra
MAT 461	3	Real Analysis
MAT 493	3	Senior Capstone

Select <u>one</u> course from the following:

MAT 251	4	Differential Equations
MAT 306	3	Introduction to Bioinformatics
MAT 310	3	Mathematical Modeling with Numerical Analysis
MAT 311	3	Introduction to Data Science
MAT 382	3	Advanced Statistical Methods
MAT 385	3	Mathematics of Finance

Electives

Select <u>3</u> hours of mathematics electives—MAT 216 or higher, excluding MAT 301, 302, 309

Additional Major Requirements

Select <u>one</u> course in biology, chemistry, or physics from:

BIO 203	4	Principles of Genetics
CHE 201	4	General, Organic, and Biochemistry I
CHE 211	4	College Chemistry I
PHY 211	4	University Physics I

Mathematics/Computer Science Education (BA/BS)

The Bachelor of Science degree with a major in Mathematics/Computer Science Education requires 60 hours in addition to education courses and attendance at least 18 Mathematics or Computer Science and Engineering sanctioned events. Optional concentrations are available in SpEd Mild-Moderate P-12 Licensure, SpEd Intense P-12 Licensure, and TESOL P-12 Licensure. The Bachelor of Arts degree requires two years of one foreign language. *All major courses, including education curriculum courses, must be completed with a grade of C- or better and are included in the major GPA.*

Mathematics Core

MAT 180	3	Problem Solving
MAT 230	4	Calculus II
MAT 240	4	Calculus III
MAT 255	3	Justifications in Mathematics
MAT 280	3	Mathematics in the Junior High/Middle School
MAT 312	4	College Geometry
MAT 345	4	Linear Algebra
MAT 352	4	Mathematical Statistics
MAT 392	1	Mathematics Seminar
MAT 493	3	Senior Capstone

Computer Science Core

COS 102	3	Fundamentals of Systems and Computing
COS 109	3	Computer and Network Operations
COS 120	4	Introduction to Computational Problem Solving
COS 121	4	Foundations of Computer Science
COS 143	3	Interactive Webpage Development
COS 265	4	Data Structures and Algorithms
COS 326	3	Data Visualization
COS 343	3	Database Systems

Mathematics/Computer Science Education requirements continued on next page

Mathematics/Computer Science Education requirements continued from previous page

Professional Education

EDU 150	3	Education in America
EDU 222	3	Literacy in the Content Area for Secondary Teachers
EDU 260	3	Educational Psychology
EDU 307	2	Discipline and Classroom Management for Secondary Teachers
EDU 309	1	Methods of Instruction and Assessment in Secondary Education
EDU 332	2	The Junior High/Middle School
EDU 384	1	Perspectives on Diversity
EDU 431	17	Supervised Internship in Secondary Schools
MAT 285	3	Technology for Mathematics Education
MAT 309	2	Teaching Math in Secondary Schools
SED 220	3	Exceptional Children

Additional Education Requirements

ENG 110	3	College Composition
PSY 340	3	Adolescent Psychology

Select <u>one</u> course from the following:

CAC 160	3	Integrative Communication
COM 210	3	Public Speaking

Mathematics—Interdisciplinary (BS)

The Bachelor of Science degree with a major in Mathematics—Interdisciplinary requires a minimum of 51-55 hours, attendance at 15 sanctioned events, and the completion of a minor (or major) in any area outside of the Mathematics Department not including the Scripture Engagement minor. Recommended areas include Accounting, Biology, Chemistry, Computer Engineering, Computer Science, Cybersecurity, Economics, Engineering, Environmental Science, Finance, Information Systems, Political Science, or Physics. Minor (or major) requirements are listed under the offering department. The practicum may be in a supporting area (major or minor) instead of mathematics. *All major courses must be completed with a grade of C- or better and are included in the major GPA; additional courses from other major (or minor) are not included in this major GPA unless also required for this major.*

Major Requirements

MAT 180	3	Problem Solving
MAT 230	4	Calculus II
MAT 240	4	Calculus III
MAT 251	4	Differential Equations
MAT 255	3	Justifications in Mathematics
MAT 345	4	Linear Algebra
MAT 352	4	Mathematical Statistics
MAT 382	3	Advanced Statistical Methods
MAT 392	1	Mathematics Seminar
MAT 393	2-4	Practicum
MAT 493	3	Senior Capstone

Select <u>one</u> course from the following:

MAT 310	3	Mathematical Modeling with Numerical Analysis
MAT 311	3	Introduction to Data Science

Select <u>one</u> course from the following:

MAT 340	4	Advanced Calculus
MAT 455	3	Abstract Algebra

Additional Major Requirements

Select <u>one</u> course from the following:

COS 120	4	Introduction to Computational Problem Solving
COS 130	3	Computational Problem Solving for Engineers
SYS 120	4	Introduction to Problem Solving

Electives

Select <u>3</u> hours of mathematics electives—MAT 216 or higher, excluding MAT 301, 302, 309

Select <u>one</u> of the following biology, chemistry, or physics courses:

BIO 203	4	Principles of Genetics
CHE 201	4	General, Organic, and Biochemistry I
CHE 211	4	College Chemistry I
PHY 211	4	University Physics I

Mathematics Education (BA/BS)

The Bachelor of Science degree in Mathematics Education requires 50-51 hours in addition to education courses and attendance at 15 sanctioned events. Optional concentrations are available in SpEd Mild-Moderate P-12 Licensure, SpEd Intense P-12 Licensure, and TESOL P-12 Licensure. The Bachelor of Arts degree requires two years of one foreign language. *All major courses, including education curriculum courses, must be completed with a grade of C- or better and are included in the major GPA.*

Mathematics Requirements

MAT 180	3	Problem Solving
MAT 230	4	Calculus II
MAT 240	4	Calculus III
MAT 255	3	Justifications in Mathematics
MAT 280	3	Mathematics in the Junior High/Middle School
MAT 312	4	College Geometry
MAT 340	4	Advanced Calculus
MAT 345	4	Linear Algebra
MAT 352	4	Mathematical Statistics
MAT 392	1	Mathematics Seminar
MAT 455	3	Abstract Algebra
MAT 493	3	Senior Capstone

Additional Major Requirements

Select <u>one</u> course from the following:

COS 120	4	Introduction to Computational Problem Solving
MAT 251	4	Differential Equations
MAT 285	3	Technology for Mathematics Education
MAT 306	3	Introduction to Bioinformatics
MAT 310	3	Mathematical Modeling with Numerical Analysis
MAT 311	3	Introduction to Data Science
MAT 370	3	Selected Topics *(approved by advisor)*
MAT 382	3	Advanced Statistical Methods
MAT 385	3	Mathematics of Finance
PHY 341	3	Math Methods in Physics and Engineering
SYS 120	4	Introduction to Problem Solving

Select <u>3</u> hours of mathematics electives—MAT 216 or higher, excluding MAT 301, 302, 309

Select <u>one</u> of the following biology, chemistry, or physics courses:

BIO 203	4	Principles of Genetics
CHE 201	4	General, Organic, and Biochemistry I
CHE 211	4	College Chemistry I
PHY 211	4	University Physics I

Professional Education

EDU 150	3	Education in America
EDU 222	2	Literacy in the Content Area for Secondary Teachers
EDU 260	3	Educational Psychology
EDU 307	2	Discipline and Classroom Management for Secondary Teachers
EDU 309	1	Methods of Instruction and Assessment in Secondary Education
EDU 332	2	The Junior High/Middle School
EDU 384	1	Perspectives on Diversity
EDU 431	17	Supervised Internship in Secondary Schools
MAT 309	2	Teaching Math in Secondary Schools
SED 220	3	Exceptional Children

Select <u>one</u> course from the following:

EDU 344	1	Educational Technology in Secondary Education
MAT 285	3	Technology for Mathematics Education

Additional Education Requirements

ENG 110	3	College Composition
PSY 340	3	Adolescent Psychology

Select <u>one</u> course from the following:

CAC 160	3	Integrative Communication
COM 210	3	Public Speaking

Mathematics Minor

A Mathematics minor requires a minimum of 23-25 hours. *All minor courses must be completed with a grade of C- or better and are included in the minor GPA.*

Minor Requirements

MAT 230	4	Calculus II

Select <u>one</u> option from the following:

MAT 151	4	Calculus I
MAT 145†	3	Introduction to Functions and Calculus
and		
MAT 146†	3	Functions and Calculus

†MAT 145 & 146 count as one option

Select an additional <u>15</u> hours of mathematics elective hours above MAT 151—MAT 205, 301, 302, and 309 do not count toward the minor.

Certificate in Actuarial Science

The department awards a certificate in Actuarial Science to students in any baccalaureate major. Students are required to complete 37 hours and pass at least one actuary exam. Students must complete an application and demonstrate passing a Society of Actuaries Exam no less than 30 days prior to graduation. Work in progress will be accepted. *This certificate is awarded by the department and does not include a transcript entry.*

Certificate Requirements

ACC 241	3	Accounting Principles I
ACC 242	3	Accounting Principles II
ECO 201	3	Principles of Microeconomics
ECO 202	3	Principles of Macroeconomics
FIN 361	3	Corporate Finance
MAT 151	4	Calculus I
MAT 230	4	Calculus II
MAT 240	4	Calculus III
MAT 352	4	Mathematical Statistics
MAT 382	3	Advanced Statistical Methods
MAT 385	3	Mathematics of Finance

Recommended Courses

MAT 353	1	Actuarial Exam Preparation (P1)
MAT 386	1	Actuarial Exam Preparation (FM1)

Mathematics Courses

MAT 100 1 hour
Mathematics Fundamentals
A study of the basic arithmetic operations, exponents, ratios, linear and quadratic equations, graphs, and story problems. This course is specifically designed to assist those students who need help for the mathematics proficiency examination. *Pass/fail only. Does not count toward a mathematics major or minor.*

NOTE: MAT 100 or proficiency by an approved exam is a prerequisite to all other Mathematics courses.

MAT 110 3 hours
Finite Mathematics
A study of selected topics from set theory, matrices, systems of linear equations and inequalities, linear programming, counting and probability, statistics, and mathematics of finance. *Prerequisite: A good understanding of algebra. Does not count toward a mathematics major or minor. Meets foundational core mathematics requirement.*

MAT 120 3 hours
Investigations in Mathematics
A course designed to engage students in relevant college-level mathematics and its connection to the Christian faith and everyday life. Students will experience interesting questions and real-life applications of mathematics from a variety of contexts while using appropriate technology. Emphasis will be on thinking, reasoning, and exploring patterns as well as communicating mathematical ideas. Topics will be chosen from data analysis, modeling, probability, statistics, mathematics of finance, logic, infinity, geometric applications, and fundamentals of problem solving. *Does not count toward a mathematics major or minor. Meets foundational core mathematics requirement.*

MAT 130 4 hours
Strategies for Calculus
Topics include rational, exponential, logarithmic, and trigonometric functions. Study of these functions include algebraic manipulation, graphing, applications, and trigonometric identities. Function concepts such as asymptotes, zeroes, domain, range, continuity, and function composition are also studied. *This course is only intended for students who need further preparation before taking MAT 151 Calculus I. Does not count toward a mathematics major or minor. Does not meet a foundational core requirement. Prerequisite: MAT 100 or equivalent proficiency. Online only.*

MAT 140 3 hours
Fundamental Calculus for Applications
An introductory study of derivatives, series, and integrals with a wide range of applications, including maximum and minimum problems. *Prerequisite: A good understanding of algebra. Does not count toward a mathematics major or minor. Meets foundational core mathematics requirement.*

MAT 145 3 hours
Introduction to Functions and Calculus
The MAT 145-146 sequence aims to provide a deep understanding of topics from precalculus and calculus as well as a strong sense of their usefulness. Fundamental ideas of calculus, specifically rates of change, are introduced early and used to provide a framework for the study of mathematical modeling involving algebraic, exponential, and logarithmic functions. Applications to business, economics, and science are emphasized. *Meets foundational core mathematics requirement. MAT 145-146 may be taken as a two-semester substitute for MAT 151.*

MAT 146 3 hours
Functions and Calculus
MAT 146 is the second of a two-course sequence which begins with MAT 145, and continues the investigation of functions, including trigonometric functions, and their rate of change. Students are introduced to integrals and methods of integrations with applications. Further topics, such as infinite series and differential equations are included. *Prerequisite: MAT 145. MAT 145-146 may be taken as a two-semester substitute for MAT 151.*

MAT 151 4 hours
Calculus I
A study of functions, including algebraic and trigonometric functions. An introduction to the algebraic, numerical, and graphical approaches to calculus, including limits, continuity, derivatives, integrals, and applications. *Prerequisite: A good understanding of algebra and trigonometry. Meets foundational core mathematics requirement. MAT 145 and MAT 146 may be taken as a two-semester substitute for MAT 151.*

MAT 170 1-4 hours
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

MAT 180 3 hours
Problem Solving
An introduction to the mathematical sciences through the study of problem solving. An overview of various methods of problem solving to discover patterns, construct and modify conjectures and develop proofs of those conjectures. There will be an emphasis on developing creativity, confidence, and concentration. Content areas studied will include algebra, combinatorics, number theory and calculus, all from a problem-solving point of view. *Prerequisite: MAT 151 or one semester of high school calculus. Meets foundational core mathematics requirement.*

MAT 205 2 hours
Explorations in Elementary School Mathematics
An introductory math course for elementary education majors that focuses on helping prospective teachers develop an understanding of the topics of algebra, probability, and data analysis as they relate to the elementary school curriculum. *Two hours of lecture and one hour of lab.*

MAT 210 **4 hours**
Introductory Statistics
A study of basic statistical methods with a focus on applied data analysis in a group setting using statistical software. Develops proficiency in the use of descriptive methods, sampling, linear regression and correlation, probability theory and distributions, statistical inference techniques for estimation and hypothesis testing and experimental design. *Meets foundational core mathematics requirement.*

MAT 215 **3 hours**
Discrete Mathematics for Computer Science
Discrete mathematics concepts are studied that are foundational for further study in computer science. Topics include propositional logic and quantifiers, proofs with emphasis on induction, relations and functions on sets, graph theory, solution of certain classes of recurrence and equivalence relations, combinatorics, and discrete probability. *Prerequisites: COS 120 or COS 130 or SYS 120; and MAT 146 or MAT 151.*

MAT 220 **3 hours**
Ways of Knowing
Topics studied include number, logic, Euclidean and non-Euclidean geometry, algebraic structures, dimension, and infinity. A study is made of the deductive method in mathematics and its relationship to ways of knowing in other areas. There is an emphasis on the beauty of mathematics and the relationship of mathematics to science and other forms of culture including the arts and religion. *Course is offered within the Honors Guild. Meets foundational core mathematics requirement. Offered Spring semester of even years.*

MAT 230 **4 hours**
Calculus II
A study of analytic geometry, functions, limits and derivatives, differentiation and integration of algebraic functions and elementary transcendental functions, applications of the integral, the definite integral, sequences, series, Taylor's formula, and special techniques of integration. *Prerequisite: MAT 146 or MAT 151.*

MAT 240 **4 hours**
Calculus III
This is the final course in the three-course sequence that is the standard complete introduction to the concepts and methods of calculus. The emphasis is on concepts and solving problems rather than on theory and proof. The course presents the concepts of calculus from three points of view: geometric, numeric, and algebraic. Topics typically include multivariable functions; contour diagrams and cross-sections; vectors; the dot product and the cross product; vector projection; partial derivatives; the gradient; directional derivatives; local linearity; local extrema and critical points; double integrals in Cartesian and polar coordinates; triple integrals in Cartesian, cylindrical, and spherical coordinates; parametric curves; vector fields; line integrals; gradient fields, path-independence, and the Fundamental Theorem of Calculus for Line Integrals; Green's Theorem; flux integrals; and the Divergence Theorem and Stokes' Theorem. *Prerequisite: MAT 230.*

MAT 251 **4 hours**
Differential Equations
This course is about analytic, graphical, and numerical techniques for solving ordinary differential equations and systems of ordinary differential equations. Students will also study "real world" phenomena using ordinary differential equations. Topics typically include separation of variables; slope fields; linear first-order equations and the method of integrating factors; Euler's method for both first- and second-order autonomous equations; phase lines; methods for solving second-order linear equations with constant coefficients having exponential, polynomial, or sinusoidal forcing functions, including the method of undetermined coefficients, the method of integrating factors, and the method of finding series solutions; spring-mass systems; linear systems of equations of the form x' = Ax; the trace-determinant plane; Laplace transforms; and existence and uniqueness theorems for various families of equations. *Prerequisite: MAT 240. Offered Spring semester.*

MAT 255 **3 hours**
Justifications in Mathematics
The purpose of this course is for students to acquire the ability to create and express mathematical arguments through the exploration of mathematical ideas. In addition to gaining an understanding and appreciation for important and interesting mathematics, students will develop an ability to think creatively, to analyze critically, and to communicate clearly and correctly using mathematical reasoning and argumentation. Students are introduced to logic, number theory, sets, functions, infinity, graph theory, and abstract algebra, with an emphasis on proof techniques throughout. *Prerequisite: MAT 151. Offered Fall semester.*

MAT 261 **1 hour**
Special Problems
Selected topics in mathematics. *Prerequisite: Consent of the department chair.*

MAT 270 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

MAT 280 **3 hours**
Mathematics in the Junior High/Middle School
An integrated content-methods course for middle school and introductory high school preparation. This course includes the mathematical strands of reasoning and algebra, rational numbers, geometry/measurement, and data analysis and probability, interwoven with the connections to appropriate pedagogical strategies for middle grades' teaching and learning. Should be taken with an education course with a field-based teaching lab component (e.g. JuMP, EDU 222, EDU 332). *Mathematics and elementary education majors only or permission of the instructor. Offered Spring semester of even years.*

MAT 285 **3 hours**
Technology for Mathematics Education
The course will cover effective use of technology in a mathematics classroom and the inextricable connection between technology, pedagogy, and content knowledge. Students will also explore and think critically about how technology use relates to their faith. The course will focus on free, web-based technologies and pedagogical principles that are relevant regardless of the technology used. All student artifacts (e.g., homework, lesson plans, and personal statement of technology) will be collected into a digital portfolio for future use. *Meets foundation core computation requirement. Prerequisites: MAT 151 and EDU 150; or permission of instructor.*

MAT 301 **3 hours**
Number Concepts for Elementary Teachers
A junior-level integrated content-methods course for elementary teacher preparation. The course includes a study of number systems and operations with emphasis on current standards and research-based pedagogical practices which focus on communication, reasoning, and representation standards. Each student will also participate in corresponding field experience (JuMP practicum). *Prerequisite: Approval into the teacher education program. Does not count toward a mathematics major or minor. Open to majors in elementary education. The MAT 301-302 sequence meets the mathematics foundational core requirement.*

MAT 302 **3 hours**
Geometry and Measurement for Elementary Teachers
A junior-level integrated content-methods course for elementary teacher preparation. The course utilizes a problem-solving approach to the study of geometry and measurement with emphasis on current standards and research-based pedagogical practices which focus on communication, reasoning, and representation. Each student will also participate in a corresponding field experience (JuMP practicum). *Prerequisite: approval into the teacher education program and MAT 301. Does not count toward a mathematics major or minor. Open to majors in elementary education. The MAT 301-302 sequence meets the mathematics foundational core requirement.*

MAT 306 **3 hours**
Introduction to Bioinformatics
This course is designed to introduce students to concepts of bioinformatics, as well as basic bioinformatics skills, using the R programming language. The course will explore methods and datasets spanning from the level of DNA (genomics) up to the organismal and ecosystem level. Bioinformatics is an interdisciplinary field combining concepts of biology, computer science, and statistics to analyze and interpret biological datasets and solve complex questions. *Two hours of lecture and one hour of one hour of coding/data analysis in a computer lab per week. Prerequisites: BIO 203 or instructor permission. Offered Fall semester of even years.*

MAT 309 **2 hours**
Teaching Math in Secondary Schools
This course is designed to assist teacher candidates in developing their pedagogical content knowledge in the area of mathematics. It addresses such topics as lesson planning, higher-order thinking, professional development, content-appropriate teaching strategies, standards-based instruction, assessment of student learning, educational technology, motivational techniques, and instructional resources. National and state math standards are examined as a basis for reflective teaching and best practices. Should be taken with an education course that has a field-based teaching lab component (e.g., EDU 222 or EDU 332). *Prerequisites: EDU 150 and EDU 260. Offered Spring semester of odd years.*

MAT 310 **3 hours**
Mathematical Modeling with Numerical Analysis
An introduction to modeling and the methods, techniques, and pitfalls in scientific computing and numerical analysis. The course will emphasize projects, writing, technology, and applications. Topics include iterative and algorithmic processes, error analysis, numerical integration and differentiation, curve fitting, and numerical solutions to different equations. *Prerequisites: COS 120 or COS 130 or SYS 120; and MAT 240. Offered Fall semester of even years.*

MAT 311 **3 hours**
Introduction to Data Science
Provides a practical foundation to data science through the data analysis cycle of data acquisition, cleaning, transforming, modeling, and interpretation. An introduction to data wrangling and management with real world applications. The statistical program R will be introduced. *Prerequisites: MAT 210 or MAT 240; COS 120 or SYS 120.*

MAT 312 **4 hours**
College Geometry
Advanced Euclidean plane geometry with a brief survey of some of the non-Euclidean geometries and vector and transformational geometry. *Prerequisites: MAT 180 or MAT 345. Offered Spring semester of odd years.*

MAT 340 **4 hours**
Advanced Calculus
An introduction to a rigorous development of the fundamental concepts of calculus. The real numbers and their standard topology, sequences, series, limits, differentiation, and integration are developed rigorously. *Prerequisites: MAT 240; MAT 180 or MAT 255. Offered Spring semester of even years.*

MAT 345 **4 hours**
Linear Algebra
A course on matrix theory, linear equations and linear dependence, vector spaces and linear transformations, characteristic equation, quadratic forms, and the singular value decomposition. *Prerequisite: MAT 240. Offered Spring semester.*

MAT 352 **4 hours**
Mathematical Statistics
A theoretical, as well as applied, study of counting outcomes, probability, probability distributions, sampling distributions, confidence intervals, tests of hypotheses, linear regression, and correlation. *Prerequisite: MAT 240. Offered Fall semester.*

MAT 353 **1 hour**
Actuarial Exam Preparation (P1)
The focus of the course is to prepare students to take the Society of Actuaries Exam P in probability. Topics include applications of calculus, probability, and statistics to risk management. Sitting for the Society of Actuaries Exam P is required for successful completion of the course. *Prerequisite: MAT 352 or equivalent.*

MAT 360 **1-4 hours**
Independent Study
An individualized, directed study involving a specified topic.

MAT 370 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

MAT 382 **3 hours**
Advanced Statistical Methods
Introduction to a variety of topics including nonparametric statistical methods linear models, with simple linear regression, multiple regression, and analysis of variance as special cases of the linear model. The emphasis will be on translating applied questions into an appropriate statistical model, checking model assumptions, and interpreting analyses in applied contexts. A brief introduction to time series is included. *Prerequisites: MAT 210 or MAT 352; and MAT 146 or MAT 151.*

MAT 385 **3 hours**
Mathematics of Finance
This course is an introduction to the mathematical models used in finance and economics with a focus on interest theory (discrete and continuous). The goal is to provide an understanding of the fundamental concepts of financial mathematics and how those concepts are applied in calculating present and accumulated values for various streams of cash flows. Topics include the mathematical foundations of interest theory, annuities, loans, stocks, financial markets, arbitrage, and financial derivatives. The course can be used as a foundation for the FM actuarial exam. *Prerequisite or corequisite: MAT 230. Offered Fall semester of odd years.*

MAT 386 **1 hour**
Actuarial Exam Preparation (FM1)
The focus of the course is to prepare students to take the Society of Actuaries Exam FM in Financial Mathematics. Topics include the fundamental concepts of financial mathematics, calculating present and accumulated values for various streams of cash flows. Sitting for the Society of Actuaries Exam FM is required for successful completion of the course. *Corequisite: MAT 385 or equivalent.*

MAT 392 **1 hour**
Mathematics Seminar
Each student in the seminar researches a mathematical topic and makes a presentation to the entire group. *Prerequisite: MAT 240. Offered Fall semester.*

MAT 393 **1-4 hours**
Practicum
Supervised learning involving a first-hand field experience or a project. Generally, one hour of credit is awarded for a minimum of 40 hours of practicum experience. *Offered primarily during the Summer.*

MAT 401 **3 hours**
Operations Research
An introduction to operations research (management science), which is quantitative decision making. Emphasis is on linear programming and its application to financial decisions, distribution problems, project scheduling, and other network problems. Decision analysis with probabilities and multi-goal decisions are discussed as well. *Prerequisites: COS 102 or SYS 101; COS 121 or COS 143; MAT 210 or MAT 352; MAT 151.*

MAT 450 **1-4 hours**
Directed Research
Investigative learning involving closely directed research and the use of such facilities as the library or laboratory.

MAT 455 **3 hours**
Abstract Algebra
The development of the postulates of group theory, rings, integral domains, and fields. Applications to cryptography. *Prerequisites: MAT 180 and MAT 240. Offered Spring semester of odd years.*

MAT 456 **3 hours**
Advanced Algebra
A continued study of Abstract and Linear Algebra. Topics include Galois Theory, cryptography, and field extensions. *Prerequisite: MAT 455.*

MAT 457 **3 hours**
Topology
This is a proof-based course in which students explore the fundamentals of point-set topology. Topics include topological spaces, bases, subspaces, product spaces, separation properties, compactness, continuity, and connectedness. *Prerequisite: MAT 255.*

MAT 461 **3 hours**
Real Analysis
A study of the Lebesgue integral and its consequences, including convergence theorems, function spaces, and introductions to measure theory and operator theory. Metric spaces, uniform convergence of functions, and topological approaches to continuity are also considered. *Prerequisite: MAT 340. Offered Fall semester of even years.*

MAT 480 **1-4 hours**
Seminar
A limited-enrollment course designed especially for upper-class majors with emphasis on directed readings and discussion.

MAT 490 **1-2 hours**
Honors
Individualized study or research of an advanced topic within a student's major. *Open to students with at least a 3.00 GPA in the major field.*

MAT 493 **3 hours**
Senior Capstone
An overview of mathematics with an emphasis on the integration of all areas in undergraduate mathematics with an exploration of the relationship between mathematics and the Christian faith. *Open to senior status mathematics majors only. Offered during January interterm.*

Natural Science

Science Research Training Program

The purpose of the Science Research Training Program is to stimulate students beyond "normal education" with hands-on practical experiences, promote real-world industrial relationships (careers), and prepare future graduate students. As faculty, students and staff, our goal is to pursue excellence (world leadership in selected research areas) and thereby stay on the cutting edge of scientific research and thought.

We encourage scholarly research and crossover interactions between various disciplines, and we promote publications in professional journals by Taylor University faculty and students. Where possible, we relate science with society and apply science and technology to various mission field needs. Research activities are carried on quietly and often on a long-range basis, but are essential to leadership and progress. During the summer months, when faculty and students can devote more time to independent research, student stipends are available for research one-on-one with a faculty member. These projects include the areas of biology, chemistry, computer science, engineering, environmental science, mathematics, and physics.

Natural Science Courses

NAS 125 **1 hour**
Preparing for a Career as a Health Professional
This course is designed to introduce beginning pre-medical students to the variety of careers available within the medical sciences. Speakers from different medical disciplines will discuss their careers, the types of opportunities available within these careers, and how to prepare for a career in their discipline. *This class does not meet any foundational core requirement and is not required for any major. It is recommended for freshman students taking the Pre-Medical options.*

NAS 170 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

NAS 201 **3 hours**
Nature of Science
A lecture and seminar based introduction to the nature of science in three main areas: life sciences, physical sciences, and earth and space sciences. The course will examine the scientific paradigm, the nature of science, and the characteristics of good science applied in these three main areas. The course will have three laboratory projects examining the nature of science in each area. *Offered Fall or Spring semesters. Meets any foundational core lab science requirement.*

NAS 220 **4 hours**
Natural Science Research Methods
To introduce general science research in the fields of biology, chemistry, computer science, engineering environmental science, mathematics, and physics. An overview of selected representative research topics, problem solving approaches, instrumentation, and analysis techniques. The lab emphasizes the use of scientific instrumentation and advanced computer software tools. *For students enrolled in pre-college summer experience. Meets any foundational core lab science requirement.*

NAS 230 **2 hours**
Health Education for Behavior Change
This course prepares students interested in various health care careers to perform health education in community settings. Topics include disease prevention, principles of exercise and movement, nutrition, helping skills, and behavior change theories. After successful completion of course, students are able to work in the Invitation Diabetes Prevention Program.

NAS 270 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

NAS 309 **2 hours**
Science Education Methods
This is a junior-level science education methods course for biology, chemistry, and physics majors obtaining certification in secondary education. This course covers the philosophy of science, science educational psychology, the science standards (both national and state), science curriculum development, classroom management and assessment, laboratory management and development, and technology and professional development in the sciences. *Prerequisites: EDU 150 and EDU 260.*

NAS 325 **1 hour**
Medical Career Admissions Preparation
The purpose of this course is to prepare students for the application and interview processes you will go through in pursuing a career in the medical professions. There are four tracks to the course, each focused on a specific career: medical school, dental school, optometry, and careers that require the GRE (e.g., veterinary, physical therapy).

NAS 360 **1-4 hours**
Independent Study
An individualized, directed study involving a specified topic.

NAS 370 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

NAS 393 **1-4 hours**
Practicum
Supervised learning involving a first-hand field experience or a project. Generally, one hour of credit is awarded for a minimum of 40 hours of practicum experience. *Offered primarily during Summer.*

NAS 450 **1-4 hours**
Directed Research
Investigative learning involving closely directed research and the use of such facilities as the library or laboratory.

NAS 480 **1 hour**
Seminar
A limited-enrollment course designed especially for upper-class majors with emphasis on directed readings and discussion. *Seminar focuses on the integration of topics from contemporary science with an emphasis on recent research reports of interdisciplinary interest. Guest lecturers, faculty, and student reports serve as the method of instruction. Offered Fall semester.*

NAS 490 **1-2 hours**
Honors
Individualized study or research of an advanced topic within a student's major. *Open to students with at least a 3.00 GPA in the major field.*

Physics and Engineering

Chair, Assistant Professor D. Nobles-Lookingbill
Professor K. Kiers
Associate Professors B. Lawson, P. Staritz
Assistant Professors A. Roth, J. Byers, P. Edgar, S. Inman, D. Peter, J. Zhang

The purpose of the Physics and Engineering Department is to provide an educational experience within a Christian context that equips students with the ability to obtain knowledge and understanding about the physical world for use in research, graduate studies, and careers and to positively impact society. The Physics and Engineering Department offers instruction in physics, engineering, astronomy, and physical science. Theoretical high-energy physics, advanced engineering instrumentation, smart grid technologies, power electronics, advanced heat exchange manufacturing technology, thermal management systems, and microelectronics provide the major research interests in the department.

Departmental majors include Engineering, Mechanical Engineering, Physics, Physics Science Education, and Physics/Mathematics Education.

Physics (BA)

The Bachelor of Arts degree with a major in Physics requires two years of one foreign language and 77-78 hours in the major. *All major courses must be completed with a grade of C- or better and are included in the major GPA.*

Major Requirements

PHY 211	5	University Physics I
PHY 212	5	University Physics II
PHY 311	4	Modern Physics
PHY 321	3	Electricity and Magnetism
PHY 322	4	Waves and Physical Optics
PHY 330	2	Advanced Lab
PHY 341	3	Math Methods in Physics and Engineering
PHY 342	3	Analytical Mechanics
PHY 350	4	Thermodynamics and Statistical Mechanics
PHY 412	3	Quantum Mechanics
PHY 493	3	Physics Senior Capstone

Additional Major Requirements

CHE 211	4	College Chemistry I
CHE 212	4	College Chemistry II
ENP 104	3	Introduction to Engineering and Software Tools
MAT 151	4	Calculus I
MAT 230	4	Calculus II
MAT 240	4	Calculus III
MAT 251	4	Differential Equations

Select <u>one</u> course from the following:

COS 120	4	Introduction to Computational Problem Solving
COS 130	3	Computational Problem Solving for Engineers
SYS 120	4	Introduction to Problem Solving

Electives

Select <u>8</u> hours from the following:

ENP 200-499	1-8	Engineering Physics Electives
COS 121	4	Foundations of Computer Science
COS 243	3	Multi-tier Web Application Development
COS 265	4	Data Structures and Algorithms
COS 280	3	Introduction to Artificial Intelligence
COS 284	3	Introduction to Computer Systems
COS 326	3	Data Visualization
MAT 311	3	Introduction to Data Science
MAT 345	4	Linear Algebra
PHY 201‡	4	Introductory Astronomy
PHY 313	2	Nuclear Radiation Experimental Methods
PHY 370	1-4	Selected Topics *(approved by advisor)*
PHY 393	2	Practicum
PHY 413	3	Quantum Mechanics II
PHY 441	3	Advanced Mathematical Methods in Physics
PHY 450	1-4	Directed Research
PHY 491	1	Preparation for the Physics GRE

‡Special lab section required. Please see the catalog course description for more details.

Physics (BS)

The Bachelor of Science degree with a major in Physics requires 90-93 hours in the major and participation in a weekend retreat for students in the department. *All major courses must be completed with a grade of C- or better and are included in the major GPA.*

Major Requirements

PHY 211	5	University Physics I
PHY 212	5	University Physics II
PHY 311	4	Modern Physics
PHY 321	3	Electricity and Magnetism
PHY 322	4	Waves and Physical Optics
PHY 330	2	Advanced Lab
PHY 341	3	Math Methods in Physics and Engineering
PHY 342	3	Analytical Mechanics
PHY 350	4	Thermodynamics and Statistical Mechanics
PHY 412	3	Quantum Mechanics
PHY 413	3	Quantum Mechanics II
PHY 441	3	Advanced Mathematical Methods in Physics
PHY 491	1	Preparation for the Physics GRE
PHY 493	3	Physics Senior Capstone

Select <u>one</u> course from the following:

PHY 393	2	Practicum
PHY 450	2-4	Directed Research

Additional Major Requirements

CHE 211	4	College Chemistry I
CHE 212	4	College Chemistry II
ENP 104	3	Introduction to Engineering and Software Tools
MAT 151	4	Calculus I
MAT 230	4	Calculus II
MAT 240	4	Calculus III
MAT 251	4	Differential Equations
MAT 345	4	Linear Algebra

Technical Electives

Select at least <u>8</u> additional hours from the following:

CHE 431	4	Physical Chemistry I
CHE 432	4	Physical Chemistry II
COS 121	4	Foundations of Computer Science
COS 243	3	Multi-tier Web Application Development
COS 265	4	Data Structures and Algorithms
COS 280	3	Introduction to Artificial Intelligence
COS 284	3	Introduction to Computer Systems
COS 326	3	Data Visualization
ENP 200-499	1-8	Engineering Physics Electives
MAT 311	3	Introduction to Data Science
MAT 340	4	Advanced Calculus
MAT 352	4	Mathematical Statistics
MAT 382	3	Advanced Statistical Methods
MAT 455	3	Abstract Algebra
MAT 456	3	Advanced Algebra
MAT 461	3	Real Analysis
PHY 201‡	4	Introductory Astronomy
PHY 300-499	1-8	Physics Electives

Select <u>one</u> course from the following:

COS 120	4	Introduction to Computational Problem Solving
COS 130	3	Computational Problem Solving for Engineers
SYS 120	4	Introduction to Problem Solving

‡Special lab section required. Please see the catalog course description for more details.

Physics/Mathematics Education (BA/BS)

The Physics/Mathematics Education major requires 60 hours in addition to education courses. Optional concentrations are available in SpEd Mild-Moderate P-12 Licensure, SpEd Intense P-12 Licensure, and TESOL P-12 Licensure. The Bachelor of Arts degree requires two years of one foreign language. *All major courses, including education curriculum courses, must be completed with a grade of C- or better and are included in the major GPA.*

Physics Core

ENP 231	4	Introduction to Electric Circuits
PHY 211	4	University Physics I
PHY 212	5	University Physics II
PHY 311	4	Modern Physics
SYS 120	4	Introduction to Problem Solving

Select <u>one</u> course from the following:

PHY 493	3	Physics Senior Capstone
MAT 493	3	Mathematics Senior Capstone

Mathematics Core

MAT 151	4	Calculus I
MAT 230	4	Calculus II
MAT 240	4	Calculus III
MAT 251	4	Differential Equations
MAT 280	3	Mathematics in the Junior High/Middle School
MAT 312	4	College Geometry
MAT 345	4	Linear Algebra
MAT 352	4	Mathematical Statistics

Electives

Select <u>5</u> hours of electives from the following:

ENP 252	4	Engineering Systems

ENP 300-/400-level courses
PHY 300-/400-level courses

Professional Education

EDU 150	3	Education in America
EDU 222	2	Literacy in the Content Area for Secondary Teachers
EDU 260	3	Educational Psychology
EDU 307	2	Discipline and Classroom Management for Secondary Teachers
EDU 309	1	Methods of Instruction and Assessment in Secondary Education
EDU 332	2	The Junior High/Middle School
EDU 344	1	Educational Technology in Secondary Education
EDU 384	1	Perspectives on Diversity
EDU 431	17	Supervised Internship in Secondary Schools
SED 220	3	Exceptional Children

Select <u>one</u> course from the following:

NAS 309	2	Science Education Methods
MAT 309	2	Teaching Math in Secondary Schools

Additional Education Requirements

ENG 110	3	College Composition
PSY 340	3	Adolescent Psychology

Select <u>one</u> course from the following:

CAC 160	3	Integrative Communication
COM 210	3	Public Speaking

Physics Science Education (BA/BS)

The Physics Science Education major requires 55 hours in addition to education. Optional concentrations are available in SpEd Mild-Moderate P-12 Licensure, SpEd Intense P-12 Licensure, and TESOL P-12 Licensure. The Bachelor of Arts degree requires two years of one foreign language. *All major courses, including education curriculum courses, must be completed with a grade of C- or better and are included in the major GPA.*

Major Requirements

CHE 211	4	College Chemistry I
ENP 231	4	Introduction to Electric Circuits
SYS 120	4	Introduction to Problem Solving

Additional Major Requirements

MAT 151	4	Calculus I
MAT 230	4	Calculus II
MAT 240	4	Calculus III
PHY 211	4	University Physics I
PHY 212	5	University Physics II
PHY 311	4	Modern Physics
PHY 330	2	Advanced Lab
PHY 493	3	Physics Senior Capstone

Electives

Select <u>13</u> hours of electives from the following:

ENP 252	4	Engineering Systems

ENP 300-/400-level courses
PHY 300-/400-level courses

Professional Education

EDU 150	3	Education in America
EDU 222	2	Literacy in the Content Area for Secondary Teachers
EDU 260	3	Educational Psychology
EDU 307	2	Discipline and Classroom Management for Secondary Teachers
EDU 309	1	Methods of Instruction and Assessment in Secondary Education
EDU 332	2	The Junior High/Middle School
EDU 344	1	Educational Technology in Secondary Education
EDU 384	1	Perspectives on Diversity
EDU 431	17	Supervised Internship in Secondary Schools
NAS 309	2	Science Education Methods
SED 220	3	Exceptional Children

Additional Education Requirements

ENG 110	3	College Composition
PSY 340	3	Adolescent Psychology

Select <u>one</u> course from the following:

CAC 160	3	Integrative Communication
COM 210	3	Public Speaking

Applied Physics Minor

A minor in Applied Physics consists of 20 hours. This minor may not be awarded with any Physics or Engineering major or minor. *All minor courses must be completed with a grade of C- or better and are included in the minor GPA.*

Minor Requirements

PHY 211	4-5	University Physics I
PHY 212	5	University Physics II

Electives

Select <u>6</u> hours from the following:

ENP ___	1-6	*Any Engineering course*

Select enough elective credit hours of engineering courses or upper-division (300- or 400-level) physics courses to reach <u>20</u> credit hours.

Physics Minor

A minor in Physics consists of 20 hours. This minor may not be awarded with a major or minor from within the department. *All minor courses must be completed with a grade of C- or better and are included in the minor GPA.*

Minor Requirements

PHY 211	4-5	University Physics I
PHY 212	5	University Physics II

Electives

Select enough elective credit hours of upper-division (300- or 400-level) physics courses to reach <u>20</u> credit hours.

Engineering (BS)

The Bachelor of Science degree with a major in Engineering requires the completion of 103-105 hours and participation in a weekend retreat for students in the department. It is a general engineering degree which prepares students for industry practice and/or graduate study in a variety of engineering disciplines. Students select one or two* of four concentrations to align with individual interests and career goals. This program is accredited by the Engineering Accreditation Commission of ABET, https://www.abet.org. Courses may not be used to fulfill more than one major requirement: core, concentration, elective. *Engineering students may elect any double concentration, provided (1) they meet the requirements of both concentrations, (2) neither of the concentrations is General engineering, and (3) the total number of concentration credits (non-core) is at least 32 (34 if Physics is one concentration). These restrictions mean that any double concentration will require at least 8 Tier B credit hours beyond the credit hours required for a single concentration. *All major courses, including those in the concentration(s), must be completed with a grade of C- or better and are included in the major GPA.*

Program Objectives:

1. Prepare our graduates to serve others dependably, most importantly their employer, customers, and community.
2. Prepare our graduates to practice technical competence, producing trustworthy engineering designs.
3. Prepare our graduates to exercise creativity in their work, fostering innovative solutions.
4. Prepare our graduates to pursue growth in their faith, social understanding, and technical competence so that they can adapt to meet the needs of an ever-changing world.

Engineering Core Requirements (36)

COS 130	3	Computational Problem Solving for Engineers
ENP 104	3	Introduction to Engineering and Software Tools
ENP 231	4	Introduction to Electric Circuits
ENP 301	3	Statics
ENP 332	4	Control Systems
ENP 351	3	Engineering Thermodynamics
ENP 352	3	Materials Science
ENP 392	3	Junior Engineering Project
ENP 393	2	Practicum
ENP 405	1	Engineering Ethics
ENP 491	1	Review of the Fundamentals of Engineering
ENP 493	2	Engineering Senior Capstone I
ENP 494	3	Engineering Senior Capstone II
ENP 495	1	Engineering Senior Capstone III

Science and Math Core Requirements (37)

CHE 211	4	College Chemistry I
MAT 151	4	Calculus I
MAT 230	4	Calculus II
MAT 240	4	Calculus III
MAT 251	4	Differential Equations
PHY 211	5	University Physics I
PHY 212	5	University Physics II
PHY 341	3	Math Methods in Physics and Engineering

Select <u>one</u> course from the following:

MAT 210	4	Introductory Statistics
MAT 352	4	Mathematical Statistics

Additional Core Requirements (6)

ECO 201	3	Principles of Microeconomics
SYS 330	3	Human Relations in Organizations

Select <u>one or two*</u> concentration areas: Electrical, General, Mechanical, Physics

Electrical (24)

ENP 253	4	Electrical Circuits II
ENP 261	3	Digital Systems Design
ENP 321	2	Applied Electromagnetics
ENP 341	4	Microcomputer Interfacing
ENP 431	4	Advanced Electronics and Microcircuits
PHY 311	4	Modern Physics
PHY 321	3	Electricity and Magnetism

Mechanical (24)

ENP 252	4	Engineering Systems
ENP 302	3	Mechanics of Materials
ENP 303	3	Dynamics
ENP 355	3	Fluid Mechanics and Water Flow
ENP 357	3	Heat Transfer
ENP 359	2	Mechanical Engineering Laboratory

Select <u>6</u> additional hours from Tier B: Engineering, Mathematics, and Science Electives

General (24)

Select <u>one</u> course from the following:

ENP 252	4	Engineering Systems
ENP 253	4	Electrical Circuits II

Select <u>15</u> additional hours from Tier A: Engineering Electives

Select <u>5</u> additional hours from Tier B: Engineering, Mathematics, and Science Electives

Physics (26)

ENP 253	4	Electrical Circuits II
PHY 311	4	Modern Physics
PHY 321	3	Electricity and Magnetism
PHY 322	4	Waves and Physical Optics
PHY 412	3	Quantum Mechanics I

Select <u>8</u> additional hours from Tier A: Engineering Electives

<u>Tier A: Engineering Electives</u>

COS 121	4	Foundations of Computer Science
ENP 261	3	Digital Systems Design
ENP 302	3	Mechanics of Materials
ENP 303	3	Dynamics
ENP 321	2	Applied Electromagnetics
ENP 341	4	Microcomputer Interfacing
ENP 355	3	Fluid Mechanics and Water Flow
ENP 357	3	Heat Transfer
ENP 359	2	Mechanical Engineering Laboratory
ENP 394	1-4	Advanced Engineering Project
ENP 431	4	Advanced Electronics and Microcircuits

<u>Tier B: Engineering, Mathematics, and Science Electives</u>

BIO 201	4	Biology I: Foundations of Cell Biology and Genetics
BIO 203	4	Principles of Genetics
CHE 212	4	College Chemistry II
COS 121	4	Foundations of Computer Science
COS 230	3	Missions Technology
ENP 261	3	Digital Systems Design
ENP 360	1-4	Independent Study
ENP 370	1-4	Selected Topics
ENP 386	3	Shop Machining and Fabrication
ENP 450	1-4	Directed Research
ENS 241	4	Physical Geology
MAT 345	4	Linear Algebra
BIO ___	1-10	*Any 300/400 electives not used in major*
CHE ___	1-10	*Any 300/400 electives not used in major*
COS ___	1-10	*Any 300/400 electives not used in major*
ENP ___	1-10	*Any 300/400 electives not used in major*
ENS ___	1-10	*Any 300/400 electives not used in major*
MAT ___	1-10	*Any† 300/400 electives not used in major*
PHY ___	1-10	*Any 300/400 electives not used in major*
SYS ___	1-10	*Any 300/400 electives not used in major*

†Excluding MAT 301, 302, 309

Mechanical Engineering (BS)

The Bachelor of Science degree with a major in Mechanical Engineering requires the completion of 103 hours and participation in a weekend retreat for students in the department. Courses may not be used to fulfill more than one major requirement: core, concentration, elective. *All major courses, including those in the concentration(s), must be completed with a grade of C- or better and are included in the major GPA.*

Program Objectives:

1. Prepare our graduates to serve others dependably, most importantly their employer, customers, and community.
2. Prepare our graduates to practice technical competence, producing trustworthy engineering designs.
3. Prepare our graduates to exercise creativity in their work, fostering innovative solutions.
4. Prepare our graduates to pursue growth in their faith, social understanding, and technical competence so that they can adapt to meet the needs of an ever-changing world.

Engineering Core Requirements

COS 130	3	Computational Problem Solving for Engineers
ENP 104	3	Introduction to Engineering and Software Tools
ENP 231	4	Introduction to Electric Circuits
ENP 301	3	Statics
ENP 332	4	Control Systems
ENP 351	3	Engineering Thermodynamics
ENP 352	3	Materials Science
ENP 392	3	Junior Engineering Project
ENP 393	2	Practicum
ENP 405	1	Engineering Ethics
ENP 491	1	Review of the Fundamentals of Engineering
ENP 493	2	Engineering Senior Capstone I
ENP 494	3	Engineering Senior Capstone II
ENP 495	1	Engineering Senior Capstone III

Mechanical Engineering Requirements

ENP 252	4	Engineering Systems
ENP 302	3	Mechanics of Materials
ENP 303	3	Dynamics
ENP 355	3	Fluid Mechanics and Water Flow
ENP 357	3	Heat Transfer
ENP 359	2	Mechanical Engineering Laboratory

Select 6 additional hours from Tier B: Engineering, Mathematics, and Science Electives listed under Engineering major.

Science and Math Core Requirements

CHE 211	4	College Chemistry I
MAT 151	4	Calculus I
MAT 230	4	Calculus II
MAT 240	4	Calculus III
MAT 251	4	Differential Equations
PHY 211	5	University Physics I
PHY 212	5	University Physics II
PHY 341	3	Math Methods in Physics and Engineering

Select one course from the following:

MAT 210	4	Introductory Statistics
MAT 352	4	Mathematical Statistics

Additional Core Requirements

ECO 201	3	Principles of Microeconomics
SYS 330	3	Human Relations in Organizations

Computer Engineering

Computer Engineering is an interdisciplinary major offered jointly by the Physics and Engineering and the Computer Science and Engineering Departments. *For program details, refer to the **Computer Science and Engineering** section of this catalog.*

Engineering Courses

ENP 104 3 hours
Introduction to Engineering and Software Tools
This course introduces the students to the engineering discipline, providing a hands-on overview of the tools they will acquire and use over the course of their major. These tools include process and methodology tools, analytical tools, software tools, and hardware tools. A goal of the course is to provide the students with a framework for their engineering studies along with a practical 'hands-on' example of what engineering might "look like." This framework should help the student better understand the role, need, and benefit of each successive course in their major. A group hardware project will be carried out as part of the course, helping to engage the students' learning and interest, and re-enforcing the concepts taught in class. *One hour of lecture and three hours of lab. Offered January interterm. Prerequisite: PHY 211.*

ENP 170 1-4 hours
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

ENP 231 4 hours
Introduction to Electric Circuits
First course in electric circuits, where DC, time-dependent, and AC circuits are each introduced. Network analysis, network reduction techniques, time-domain solutions to simple 1st and 2nd order circuits, and steady-state analysis of sinusoidally excited circuits are each developed. Weekly lab introduces breadboarding, debugging, and testing of basic electric and electronic circuits using common test equipment. An introduction and use of basic electronic devices such as op-amps, the Shockley diode and BJT or MOSFET transistors is also included. An emphasis is placed on SPICE circuit simulation throughout the semester. A course project introduces students to ECAD software, where they create, build, and test a custom printed circuit board (PCB) circuit. *Prerequisites: PHY 212 and ENP 104, or permission of instructor. Offered Fall semester.*

ENP 252 4 hours
Engineering Systems
This course focuses on the mathematical modeling and analysis of lumped-element physical systems—translational and rotational mechanical systems, electrical systems, heat transfer systems, and fluid systems. Unifying concepts of flow, effort, and impedance are emphasized, along with the use of transfer function descriptions, frequency domain analysis, and Laplace Transform analysis. The laboratory component focuses on modeling and simulation, design of experiments with a directed design process, and software skill development, including MATLAB and Simulink. This course includes a major project component. A formal presentation of technical work including research, analysis, critical thinking, and original thought is required. *Prerequisite: ENP 231. Corequisite: MAT 251. Offered Spring semester. Offered Spring semester.*

ENP 253 4 hours
Electrical Circuits II
Building on the foundations of electric circuits, this second course focuses on topics including operational amplifiers (ideal and non-ideal), transient responses of circuits, frequency response of operational amplifiers, frequency domain analysis, transfer functions, filters, Bode plots, and Laplace Transform analysis. The laboratory component focuses on modeling and simulation, design of experiments with a directed design process, and software skill development, including MATLAB and Simulink. This course includes a major project component. A formal presentation of technical work including research, analysis, critical thinking, and original thought is required. *Prerequisite: ENP 231. Corequisite: MAT 251. Offered Spring semester.*

ENP 261 3 hours
Digital Systems Design
Digital Systems are explored, including combinational (e.g., multiplexors and decoders) and sequential (e.g., flip-flops and registers) logic. Circuit minimization techniques such as Boolean algebra and Karnaugh maps are examined. Mealy and Moore finite state machines will be developed to model systems. Designs will culminate in projects that simulate circuits with a hardware description language and then synthesized on an FPGA. *Offered Spring semester of even years.*

ENP 270 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

ENP 301 **3 hours**
Statics
This course is a one-semester introduction to the statics of particles and rigid bodies. Topics include forces, moments, equilibrium, and structures in equilibrium. Course makes applications to engineering and uses software tools for engineering mechanics. *Prerequisites: PHY 211 and MAT 230. Offered Fall semester.*

ENP 302 **3 hours**
Mechanics of Materials
Course investigates the fundamentals of the mechanics and strength of materials. Topics covered include stress-strain relationships, Mohr's circle, axial loading, torsion, beam loading, and linear buckling. *Prerequisite: ENP 301. Offered Spring semester of even years.*

ENP 303 **3 hours**
Dynamics
This course covers the basic principles of dynamic mechanical systems, as derived from Newtonian mechanics. The main topics covered include kinematics of particles, kinetics of particles (using both force and energy/momentum methods), kinetics of systems of particles, kinematics of rigid bodies, and 2-D kinetics (plane motion) of rigid bodies (using both force and energy/momentum methods). *Prerequisite: ENP 301. Offered Spring semester of odd years.*

ENP 321 **2 hours**
Applied Electromagnetics
The course considers the application and technology of electromagnetic field theory to computing and communications systems. Topics may include wave propagation, transmission lines, fiber optics, high frequency communication networks, antennas, and satellite communications. *Prerequisites: ENP 252, MAT 251, and ENP 231. Offered Spring semester of odd years.*

ENP 332 **4 hours**
Control Systems
This is an introductory course in Signals, Systems and Controls. A selection of topics is chosen from a conventional two-course sequence of "Signals and Systems" and "Automatic Control". Mathematical tools for studying linear time invariant (LTI) continuous time systems are developed. These include describing and analyzing LTI systems according to their 1) differential equation, 2) impulse response, 3) state-space representation, and 4) frequency response representation. Transform methods including Fourier series, Fourier Transform, and Laplace Transform are also developed as needed. The Controls portion of the course includes time-domain transient response, steady-state response, and stability tests. Frequency domain analysis such as root-locus and Nyquist stability are also introduced. *Prerequisites: ENP 252 and MAT 251. Offered Spring semester.*

ENP 341 **4 hours**
Microcomputer Interfacing
Course develops the student's ability to design, build and test embedded systems. Hardware architecture and software programming of microcontrollers and other embedded system devices are studied. Operation and use of LCDs, A to D and D to A converters, keypads and other interface devices are investigated. Serial communication through I2C, OneWire, USB, and RS232 are used. In addition, networking and RF techniques and protocols are studied. *Prerequisite: ENP 231 or permission of instructor. Offered Fall semester of even years.*

ENP 351 **3 hours**
Engineering Thermodynamics
Course develops engineering thermodynamics including use of the first and second law, phase diagrams, properties, heat transfer, second law consequences, power and refrigeration cycles as well as other selected topics. *Prerequisites: ENP 252, MAT 251, and PHY 212. Offered Fall semester.*

ENP 352 **3 hours**
Materials Science
The structure, processing, and properties of engineering materials are studied with an emphasis on metallic systems. This includes crystal structure, defects, diffusion, phase transformations, deformation mechanisms, strength, and fracture toughness. Also covered are material selection, linear elastic fracture mechanics, and dislocation theory. *Prerequisite: ENP 252. Offered Fall semester of odd years.*

ENP 355 **3 hours**
Fluid Mechanics and Water Flow
An introduction to the basic properties of fluids in motion. Topics include Differential fluid equations, streamlines, continuity, energy and linear angular momentum, incompressible viscous flow, potential flow, Navier-Stokes equations, open channel flow, pipe flow, laminar and turbulent boundary layers. *Prerequisite: ENP 252. Corequisite: MAT 251. Offered Fall semester.*

ENP 357 **3 hours**
Heat Transfer
Course investigates the fundamentals of heat transfer and applies those fundamentals to engineering applications. Topics covered include modeling of conduction, convection, radiation, and mixed mode heat transfer problems. Course covers both steady state and transient response. *Prerequisites: ENP 252, ENP 351, and ENP 355. Offered Spring semester.*

ENP 359 **2 hours**
Mechanical Engineering Laboratory
In this course, laboratory experiments reinforce key concepts encountered in mechanical engineering. Topics include materials science, fluid mechanics, thermodynamics, heat transfer, dynamics, and mechanics of materials. Students actively participate in the configuration of sensors and build data acquisition programs as they develop familiarity with various aspects of experimental measurements. Laboratory exercises include elements of data analysis, assessment of experimental uncertainty, and technical writing. *Prerequisite: ENP 252. Offered every semester.*

ENP 360 **1-4 hours**
Independent Study
An individualized, directed study involving a specified topic.

ENP 370 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

ENP 386 **3 hours**
Shop Machining and Fabrication
Through hands-on engineering projects and instruction, this course provides skills and knowledge in machining, metal fabrication techniques, and proper safety and PPE practices. Students learn and use machines such as a metal lathe, knee mill, CNC mill, MIG, TIG, and stick welders, and a CNC plasma cutter. *Prerequisite: ENP 104 and an Engineering major or instructor approval. Offered Fall semester.*

ENP 392 **2-4 hours**
Junior Engineering Project
In the context of completing an engineering project, students learn and practice: elements of the design process, the ability to be innovative and think creatively, the ability to acquire new knowledge and skills, the ability to solve engineering problems, the application of analytical and software tools to engineering problems, and the ability to communicate effectively. Focus on the "thoughtful design process" is particularly emphasized. *Prerequisite: ENP 252. Offered Spring semesters.*

ENP 393 **1-4 hours**
Practicum
Supervised learning involving a first-hand field experience or a project. Generally, one hour of credit is awarded for a minimum of 40 hours of practicum experience. *Practicum must involve significant engineering work experience and preference is given to an experience away from the Taylor campus. Offered primarily during Summer. Prerequisite: ENP 252 and junior or senior status.*

ENP 394 **1-4 hours**
Advanced Engineering Project
Students complete an open-ended project, laboratory experiment or research project. The individual project depends on student and faculty interest. Many projects are externally funded. Specific learning outcomes vary depending on faculty, student, and project selected. *Prerequisite: ENP 252.*

ENP 405 **1 hour**
Engineering Ethics
Course introduces students to the ethical requirements of the engineering profession and the ethical issues associated with living in a technological intense digital society. Through the course, students should: appreciate the ethical use of computers and dangers of computer misuses, have knowledge of professional codes of ethics, be aware of the impact of technology on society, have an appreciation for the needs of society and how engineering can meet those needs, and begin developing an understanding of how their Christian faith integrates with their engineering practice. *Prerequisite: ENP 493 or COS 493. Offered Spring semester.*

ENP 431 **4 hours**
Advanced Electronics and Microcircuits
Modeling and analysis of basic electronic devices—primarily diodes and transistors. Applications are made to various analog and digital circuits, including single and multi-stage amplifiers. *Prerequisites: ENP 231 and ENP 252. Offered Fall semester of odd years.*

ENP 450 **1-4 hours**
Directed Research
Investigative learning involving closely directed research and the use of such facilities as the library or laboratory.

ENP 470 **2-4 hours**
Advanced Special Topics in Engineering
This course provides advanced engineering topics and coursework to all engineering majors. The topics serve to better equip students for specific engineering fields or are designed to provide advanced technical knowledge. *This course may be repeated with different advanced topics.*

ENP 480 **1-4 hours**
Seminar
A limited-enrollment course designed especially for upper-class majors with emphasis on directed readings and discussion.

ENP 490 **1-2 hours**
Honors
Individualized study or research of an advanced topic within a student's major. Open to students with at least a 3.00 GPA in the major field.

ENP 491 **1 hour**
Review of the Fundamentals of Engineering
Course reviews the fundamentals of engineering and prepares students to enter the engineering profession. Depending on students' incoming ability, the course will review subjects from chemistry, computers, dynamics, electric circuits, engineering economics, ethics, fluid mechanics, materials science, mathematics, mechanics of materials, statics, and thermodynamics. *Prerequisite: Senior status. Offered Spring semester.*

ENP 493 **2 hours**
Engineering Senior Capstone I
The first of a three-course culminating experience, this course prepares students for engineering practice through a major design experience based on knowledge and skills acquired in earlier course work. Incorporating engineering standards and realistic constraints, this course places value on economic, environmental, sustainability, manufacturability, ethical, health and safety, social, and political considerations. *Prerequisite: Senior Engineering major. Offered Fall semester.*

ENP 494 **3 hours**
Engineering Senior Capstone II
The second of a three-course culminating experience, this course prepares students for engineering practice through a major design experience based on knowledge and skills acquired in earlier course work. Incorporating engineering standards and realistic constraints, this course places value on economic, environmental, sustainability, manufacturability, ethical, health and safety, social, and political considerations. This course also prepares students to serve God and humanity through active service to their family, church, employer, and global community. *Prerequisite: ENP 493. Offered January interterm.*

ENP 495 **1 hour**
Engineering Senior Capstone III
The third of a three-course culminating experience, this course prepares students for engineering practice through a major design experience based on knowledge and skills acquired in earlier course work. Incorporating engineering standards and realistic constraints, this course places value on economic, environmental, sustainability, manufacturability, ethical, health and safety, social, and political considerations. In this third course of the sequence, the focus is on technical documentation and presentation of work completed in the first two courses of the capstone experience. A formal presentation of technical work including research, analysis, critical thinking, and original thought is required. *Prerequisite: ENP 494. Offered Spring semester.*

Physics Courses

PHY 120 **4 hours**
Renewable Energy Principles
Intended for non-science majors. The continuum of energy use drives society to consider renewable and sustainable resource models based on physical principles, chemistry, and Earth science while connecting to theology and the "big picture" of the universe. *Three hours of lecture and two hours of lab (focusing on renewable energy) each week. Meets foundational core physical science requirements.*

PHY 170 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

PHY 201 **3-4 hours**
Introductory Astronomy
A descriptive course about the solar system, stars and stellar evolution, galaxies, and the universe. Recent findings of space exploration and radio astronomy are included. Telescopes are provided for viewing sessions. Two or three hours of lecture and two hours of lab. *Physics majors wishing to take PHY 201 for elective credit must take the "majors-only" lab section that is offered intermittently. Students interested in this option should consult with the department chair to determine availability of this special lab section. Students taking PHY 201 for elective credit should also check to ensure that they maintain the required minimum number of upper-division credit hours. Meets foundational core earth science requirement.*

PHY 203 **4 hours**
General Physics I
A study of mechanics, thermodynamics, waves and sound, electricity, magnetism, and optics. Assumes mathematics at the algebra-trigonometry level. For majors that do not require a calculus-based treatment of physics. *Meets foundational core physical science requirement. Three hours of lecture and two hours of lab. Offered annually.*

PHY 204 **4 hours**
General Physics II
See PHY 203.

PHY 211 **4-5 hours**
University Physics I
A calculus-based study of mechanics, waves and sound, electricity and magnetism, optics, fluids, and the structure of matter. *The 4 hour course consists of four hours of lecture (for three-quarters of the term) and two hours of lab (for the entire term). The five-hour version also incorporates the study of thermodynamics and consists of four hours of lectures and two hours of lab. Meets foundational core physical science requirement. Corequisite: MAT 146 or MAT 151. Offered annually.*

PHY 212 **5 hours**
University Physics II
Four hours of lecture and two hours of lab. See PHY 211. Prerequisite: PHY 211. Corequisite: MAT 230.

PHY 270 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

PHY 310 **3 hours**
Modern Physics
An introduction to modern physics, including special relativity and quantum mechanics. Topics covered include time dilation, length contraction, the Lorentz transformation, particle decay kinematics, and wave mechanics in one dimension. *Three hours of lecture per week. Prerequisites: PHY 211 and PHY 212. Offered Fall semester.*

PHY 311 **4 hours**
Modern Physics
An introduction to modern physics, including special relativity and quantum mechanics. Topics covered include time dilation, length contraction, the Lorentz transformation, particle decay kinematics, and wave mechanics in one dimension. *Three hours of lecture and two hours of lab per week. Prerequisites: PHY 211 and PHY 212. Offered Fall semester.*

PHY 313 **2 hours**
Nuclear Radiation Experimental Methods
A study of nuclear radiation and detection and experimental methods of measuring nuclear radiation. *One hour of lecture and two hours of lab per week. Prerequisites: PHY 211 and PHY 212. Offered intermittently.*

PHY 321 **3 hours**
Electricity and Magnetism
The vector field approach to electromagnetic theory. Includes electrostatics, magnetostatics, induction, dielectric and magnetic materials, and Maxwell's equations. *Co-requisites: MAT 251 and PHY 341. Prerequisites: PHY 211 and PHY 212. Offered Fall semester of even years.*

PHY 322 **4 hours**
Waves and Physical Optics
Applications of Maxwell's equations, including electromagnetic waves, wave guides, diffraction, and Fourier optics. *Three hours of lecture and three hours of lab per week. Prerequisites: PHY 211, PHY 212, and PHY 321. Offered Spring semester of odd years.*

PHY 330 **1-2 hours**
Advanced Lab
Students complete an open-ended project, laboratory experiment or research project. The individual project depends on student and faculty interests. Specific learning outcomes vary depending on faculty, student and project selected. *Prerequisites: ENP 252 or ENP 301 or PHY 311 and junior classification. Offered as needed for physics and engineering physics majors.*

PHY 341 **3 hours**
Math Methods in Physics and Engineering
An application of analytical and computational methods to various mathematical topics, including linear algebra, matrices, eigenequations, vector field theory, partial differential equations, Fourier series and transforms, orthogonal functions, and complex analysis. Use of a computer application such as MATLAB is required. *Prerequisite: PHY 212. Corequisite: MAT 251. Offered Spring semester.*

PHY 342 **3 hours**
Analytical Mechanics
A formal treatment of mechanics covering harmonic motion, the translation and rotation of rigid bodies, non-inertial reference frames, and gravitation. The course concludes with the Hamiltonian and Lagrangian formulations of mechanics. *Prerequisites: PHY 211, PHY 212, and PHY 341. Offered Spring semester of even years.*

PHY 350 **4 hours**
Thermodynamics and Statistical Mechanics
Develops thermal physics and statistical mechanics, with application to solid state physics. In the thermal physics portion of the course, the three laws of thermodynamics are developed and applied to problems. In the statistical mechanics portion, the development of the partition function is accomplished through the microcanonical formalism. The partition function is then applied to various problems, such as: Bose-Einstein and Fermi-Dirac statistics, Bose-Einstein condensation, blackbody radiation, and the behavior of electrons and phonons in solid materials. *Prerequisite: PHY 341.*

PHY 360 **1-4 hours**
Independent Study
An individualized, directed study involving a specified topic.

PHY 370 **1-4 hours**
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering.

PHY 393 **1-4 hours**
Practicum
Supervised learning involving a first-hand field experience or a project. Generally, one hour of credit is awarded for a minimum of 40 hours of practicum experience. *Offered primarily during Summer.*

PHY 412 **3 hours**
Quantum Mechanics
An in-depth treatment of several topics in quantum mechanics, including spin, matrix mechanics, angular momentum, time evolution, addition of angular momentum, quantum entanglement, and wave mechanics in one dimension. Dirac notation is used extensively. *Prerequisites: PHY 211, PHY 212, PHY 311, and PHY 341. Offered Spring semester of odd years.*

PHY 413 **3 hours**
Quantum Mechanics II
An in-depth treatment of several advanced topics in quantum mechanics. Topics covered include the harmonic oscillator (including raising and lowering operators), the two-body problem, wave mechanics in three dimensions, orbital angular momentum, the Hydrogen atom, time-independent perturbation theory, and an introduction to photons in the context of quantum field theory. *Prerequisite: PHY 412. Offered Fall semester of odd years.*

PHY 441 **3 hours**
Advanced Mathematical Methods in Physics
Application of analytical and computational methods to various advanced mathematical topics in physics, such as: group theory, complex analysis, partial differential equations, Green's functions, the Gamma function, Bessel functions, Legendre functions, and Fourier analysis. *Prerequisite: PHY 341. Offered Fall semester of even years.*

PHY 450 **1-4 hours**
Directed Research
Investigative learning involving closely directed research and the use of such facilities as the library or laboratory.

PHY 480 **1-4 hours**
Seminar
A limited-enrollment course designed especially for upper-class majors with emphasis on directed readings and discussion.

PHY 490 **1-2 hours**
Honors
Individualized study or research of an advanced topic within a student's major. *Open to students with at least a 3.00 GPA in the major field.*

PHY 491 **1 hour**
Preparation for the Physics GRE
A review of topics covered in the undergraduate physics curriculum. The purpose of the course is to help students prepare for the GRE Subject Test in Physics. Topics reviewed include Classical Mechanics (including the Lagrangian formalism), Modern Physics (including Quantum Mechanics and Special Relativity), Electricity and Magnetism, Optics, Thermodynamics, and Electronics. *Prerequisite: junior or senior status.*

PHY 493 **3 hours**
Physics Senior Capstone
A capstone course in which each senior's technical, analytical, and laboratory skills, along with coursework knowledge, are applied to an intensive physics or engineering project. Three weeks are devoted to the completion of the project, and the remainder of the term is spent off-campus, strengthening interpersonal relationships, integrating faith and learning, and examining topics critical to post-baccalaureate life. *Prerequisite: Senior status.*

Notes