



Jesse D. Jones College of Science, Engineering and Technology

10

Steve Cobb, Dean
201A Collins Center for Industry and Technology
(270) 809-2888

DEPARTMENTS

Biological Sciences	172	Mathematics and Statistics	204
Chemistry	182	Occupational Safety and Health	208
Geosciences	186		
Institute of Engineering	193		

PROGRAMS

UNDERGRADUATE

Associate

Civil Engineering Technology
Industrial Technology

Baccalaureate

Applied Physics
Biology
Chemistry
Civil Engineering Technology
Electromechanical Engineering Technology
Engineering Graphics and Design
Engineering Physics
Geosciences
Manufacturing Engineering Technology
Mathematics
Occupational Safety and Health
Physics
Telecommunications Systems Management
Wildlife and Conservation Biology

Minor

Actuarial Science	Industrial and Engineering Technology
Anthropology	Mathematical Biology
Applied Statistics	Mathematics
Archaeology	Occupational Safety and Health
Astronomy	Physics
Biology	Social Science
Chemistry	Sustainability Studies
Earth Science	Telecommunications Systems Management
Engineering Science	
Environmental Geology	
Environmental Technology	
Geographic Information Science	

Certificate

Geographic Information Science

GRADUATE

Master's

Applied Engineering and Technology Management
Biology
Chemistry
Geosciences
Mathematics
Occupational Safety and Health
Sustainability Science
Telecommunications Systems Management

Certificate

Geospatial Data Science

Jesse D. Jones College of Science, Engineering and Technology

The departments in the Jesse D. Jones College of Science, Engineering and Technology have a proud history of preparing students for careers in biology, chemistry, engineering, engineering technology, geosciences, industrial technology, mathematics, occupational safety and health, physics, statistics, sustainability science, and telecommunications.

The college's faculty are talented educators who make quality instruction a priority. They make themselves accessible to students and help them achieve their academic, professional, and career goals. Faculty continuously refine the curriculum which ensures that our degree programs are current and timely in addressing the needs and expectations of our students. The faculty are also recognized scholars who carry out interesting research projects with funding from a variety of national, state, and private agencies. Like some of the finest liberal arts colleges in the country, we use our research program to enhance the learning environment for our undergraduate and graduate students. Many Murray State students have the opportunity to work side-by-side with faculty trying to solve some of the most interesting questions facing the scientific community today. Our students, both undergraduate and graduate, have published the results of their research in national journals and presented their work at regional and national conferences. In addition, students at Murray State have the opportunity to gain valuable hands-on experience through our co-op and internship programs. These kinds of experiences give our graduates the edge they need when applying for graduate school, professional school, or when entering the job market.

Our students study in comfortable, modern facilities, including the new Gene W. Ray science campus. The departments of biology and chemistry are housed in two beautiful state-of-the-art buildings, the Biology Building and Jesse D. Jones Hall. A third building housing the engineering and physics programs completes this attractive campus. The college also enjoys excellent facilities in the Collins Center for Industry and Technology, Faculty Hall, and Blackburn Science Building.

Murray State's designation as a Commonwealth Center of Excellence for Reservoir Research and the Program of Distinction in Telecommunication Systems Management adds to our distinctiveness both in the state and in the national and international academic communities.

Your academic experience in our college will be different from that found at many universities. The student-centered faculty, excellent facilities, and attractive curricular tracks offered here will provide you with an education that you will value throughout your life and career.

Programs and Facilities

Program of Distinction in Telecommunication Systems Management. The telecommunications field, which incorporates networks of leading-edge technologies such as fiber optic systems, satellites, wireless, telephony and cable, is rapidly changing and growing. The changes taking place in this field are dramatically influencing how individuals and institutions communicate and how they conduct business. Technological advances in the telecommunications area have profoundly affected government, retail, finance, health care, education, industry and entertainment sectors. Murray State's exciting program in telecommunications systems management is helping prepare our graduates to become the leaders in this important emerging field.

Watershed Studies Institute. Murray State University hosts one of the five designated Centers of Excellence in the Commonwealth of Kentucky. With funding support from agencies like the National Science Foundation, Department of Energy, Environmental Protection Agency, Tennessee Valley Authority and the Kentucky Department for Natural Resources, Murray State's research program in ecosystem sciences is both nationally and internationally recognized.

The Watershed Studies Institute provides outstanding research opportunities for scientists from around the world to study the region's unique environment. The Institute also provides Murray State University undergraduate and graduate students with an opportunity to engage in hands-on research with faculty who are at the vanguard of ecosystem science.

Three distinct components make up the Institute: the Hancock Biological Station (HBS), the Mid-America Remote Sensing Center (MARC), and the Chemical Services Laboratory (CSL). The Institute's primary mission is to provide the infrastructure, support, and intellect for education and research of watershed ecosystems.

• **Mid-America Remote Sensing Center.** Since the late 1970s when Murray State was declared the Commonwealth's technology transfer agent for NASA's Landsat satellite, MARC has distinguished itself in the area of remote sensing and Geographic Information Systems (GIS). Students from around the world have received classroom instruction and have been mentored in research by the MARC Associates, a group of faculty and staff with expertise in a wide variety of application areas, many of which are focused on natural and cultural resource areas including land cover mapping, archaeological site analysis, mineral exploration, water quality and wildlife habitat mapping, emergency preparedness, and demographic modeling. Research projects have been conducted for local, state, and federal agencies, the private sector, and the university. MARC provides training in remote sensing and GIS and acts as a resource center for those within and beyond the university. MARC is one component of the Watershed Studies Institute and, as such, maintains a GIS for the lower reaches of the Kentucky Lake drainage basin.

• **Hancock Biological Station.** A year-round research and teaching facility located on beautiful Kentucky Lake, the HBS is one of the finest centers of its kind in the Midwest. HBS acts as the field research focal point for the Watershed Studies Institute and for the Ecological Consortium of Mid-America. The facilities, which include both faculty and student housing, are available year-round to all scientists interested in ecosystem research. Hancock Biological Station contains state-of-the-art laboratories for aquatic chemistry, scanning electron microscopy, ecology, wildlife and fisheries. A full-time technical staff operates the facilities. Field-oriented classes at the station attract students from around the nation. A wide variety of formal classes are offered each summer. These may include ecology, ornithology, limnology, field botany, stream ecology, reservoir ecology, scanning electron microscopy and vertebrate ecology. Independent research topics provide opportunities for individualized instruction and close interactions with researchers. Classes are open to undergraduates, graduate students, teachers and others interested in enhancing their knowledge of ecology, ecosystems and the natural environment.

• **Chemical Services Laboratory.** The Chemical Services Laboratory offers analytical laboratory services for industries and institutions in the west Kentucky and greater Ohio Valley region. Services include analyses for environmental chemistry, ecotoxicology, trace element, and acid-deposition studies. In addition to serving the needs of the region, this laboratory offers an opportunity for instruction and training at both the undergraduate and graduate levels.

Note: L=literature; R=research; PT=professional training. See page 58.

Sustainability Studies Minor

The Sustainability Studies minor is an interdisciplinary exploration of sustainability issues focusing on the environment and/or sustainable development. Integrating knowledge and experiences from the sciences, engineering, agriculture, business, humanities, and arts, the minor is designed to complement any major area of study by focusing on ecological health, sustainable agriculture, and economic sustainability.

MINOR:

Sustainability Studies

Total Minor Requirements 22-24 hrs

Required Courses 10 hrs

BIO	103	Saving Planet Earth
ENG	371	Literature and the Environment
IDC	150	Issues in Sustainability Studies
PHI	376	Environmental Ethics

Restricted Electives..... 6 hrs

Choose two of the following:

AGR	353	World Food, Agriculture and Society
CET	284	Sustainable Design and Construction
REC	450	Recreational Use of Natural Resources

Unrestricted Electives..... 6-8 hrs

Chosen from the following with program coordinator approval:
AGR 345, 378, 455; ANT 320; ARC 314; BIO 112, 330, 506, 578; CHE 502, 513; ECO 345, 410; ENT 286; GSC 424, 507; PSY 373; SOC 325, 380, 455.

Note: Six hours of the minor must be upper-level courses.

Sustainability Science

Graduate Coordinator - Howard Whiteman

(270) 809-6753

The Sustainability Science program is an interdisciplinary master's program within the Jones College of Science, Engineering, and Technology designed to prepare students for careers in sustainability or closely related fields that have sustainability needs. The course of study allows specialization in one of four tracks: Agricultural Sustainability, Environmental Sustainability, Industrial and Technical Sustainability, and Sustainability Education. All students must complete a core curriculum, two restricted electives, and advanced courses in their area of interest.

Requirements for Admission

Applicants must meet all Murray State University requirements (see *Graduate Admissions*). Additional requirements for unconditional and conditional admission are listed below.

Unconditional

- Baccalaureate degree in science-related field.
- At least a 3.0 undergraduate GPA.
- Composite GRE score of at least 297 (148 verbal + 149 quantitative).
- International students: TOEFL score of at least 527; iBT TOEFL of 71; or IELTS score of 6.0.

Conditional

Recommendation of the advisory committee; international students must meet minimum testing scores described above.

Master of Science

Sustainability Science

CIP 30.3301

Total Course Requirements 30-32 hours

Core Requirements..... 17 hrs

CET	687	Sustainable Environmental Technology
GSC	601	Understanding Scientific Communication
GSC	607	Land Use Planning
WSC	601	Seminar in Sustainability Science
WSC	693	Sustainability Practicum I ¹
WSC	694	Sustainability Practicum II ¹

Restricted Electives..... 6-7 hrs

Choose two of the following:

AGR	643	Sustainable Agriculture
ARC	615	Environmental Archaeology
BIO	665	Biogeochemistry
STA	665	Applied Statistics I

Unrestricted Electives..... 6-9 hrs

Choose elective hours from one of the following emphasis areas:

Agricultural Sustainability

AGR	636	Seminar in International Agriculture Systems
AGR	649	Weeds and Their Control
AGR	652	Agricultural Policy
AGR	655	Advanced Soil Fertility
AGR	661	Sustainable Agriculture
AGR	662	Principles of Agroecology
AGR	671	Advanced Precision Agriculture
AGR	674	Agricultural Irrigation and Water Systems
CHE	604	Fundamentals of Toxicology
CHE	613	Environmental Chemistry
GSC	612	Remote Sensing
GSC	621	Geographic Information Systems

Environmental Sustainability

AGR	662	Principles of Agroecology
ARC	610	Landscape Archaeology
ARC	615	Environmental Archaeology
BIO	635	Biogeography
BIO	642	Watershed Ecology
BIO	665	Biogeochemistry
BIO	675	Invasion Ecology
BIO	678	Conservation Biology
BIO	685	Restoration Ecology
BIO	690	Disturbance Ecology
CHE	604	Fundamentals of Toxicology
CHE	613	Environmental Chemistry
GSC	612	Remote Sensing
GSC	621	Geographic Information Systems

Industrial and Technical Sustainability

CET	655	Environmental Regulatory Affairs
CET	681	Pollution Assessment and Control
CET	682	Industrial Ecology
CET	686	Environmental Assessment and Remediation
CET	687	Sustainable Environmental Technology
CET	688	Waste Minimization and Pollution Prevention
CHE	600	Chemistry of Fuels
CHE	604	Fundamentals of Toxicology
CHE	613	Environmental Chemistry
IET	619	Industrial Energy Management

OSH	622	Toxicology of Industrial Materials
OSH	646	Fundamentals of Risk Control
OSH	687	Wastewater Treatment
OSH	689	Solid and Hazardous Waste Treatment

Sustainability Education

EDU	615	Introduction to Environmental Education
EDU	664	Techniques of Teaching Environmental Education
EDU	665	Field Experiences in Environmental Education
EDU	667	International Environmental Education
EDU	668	Agriculture and the Environment in the Classroom

Department of Biological Sciences

2112 Biology Building
270-809-2786

Chair: Claire Fuller. **Faculty:** Arkov, Beckers, Canning, Derting, Flinn, Gagnon, He, Nakamura, Saar, Spier, Sullivan-Beckers, Trzepacz, Weinberger, White, Whiteman, Wright, ZeRuth.

The Department of Biological Sciences offers baccalaureate programs with a major in biology (pre-medicine, pre-dentistry, pre-optometry, pre-physical therapy, pre-physician assistant, molecular biology, fisheries, aquatic biology, secondary certification, and watershed science tracks are available) or an area of concentration in wildlife and conservation biology. These programs are designed to prepare students for professional or graduate work in the life sciences, such as the M.S. in biology offered by the department. Curricula provide students with a basic core of science courses plus advanced biology courses in their particular field of interest. The department also offers a two-year, pre-professional program in pharmacy and a minor in biology.

The department has offices, classrooms, laboratories, and research facilities in the Biology Building and on the second floor of the newly constructed Engineering and Physics Building. The department also has two off-campus resources which are utilized in field-oriented teaching and research programs. One of these, Murphy's Pond, is a 300-acre preserve in Hickman County with one of the few remaining cypress swamps in western Kentucky. The other, Hancock Biological Station, is a modern classroom/laboratory complex located on the western shore of Kentucky Lake, 17 miles from the main campus. The station is ideally located in an area of diverse aquatic habitats and is the focal point for the reservoir research on Kentucky Lake and Lake Barkley.

MAJOR:

Biology

Bachelor of Science/Bachelor of Arts

CIP 26.0101

University Studies Requirements¹..... 38-44 hrs
(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

CHE	201	General College Chemistry
CHE	202	General Chemistry and Qualitative Analysis
MAT	150	Algebra and Trigonometry

or

MAT	250	Calculus and Analytic Geometry I
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•University Studies Electives

PHY	130	General Physics I
PHY	131	General Physics I Laboratory

or

PHY	235	Mechanics, Heat and Wave Motion
PHY	236	Mechanics, Heat and Wave Motion Laboratory

Required Courses 41 hrs

BIO	100T	Transitions
BIO	115	The Cellular Basis of Life
BIO	216	Biological Inquiry and Analysis ¹
BIO	221	Zoology: Animal Form and Function ¹
BIO	222	Botany: Plant Form and Function ¹
BIO	305	Introduction to Evolutionary Principles
BIO	330	Principles of Ecology
BIO	333	Genetics
BIO	499	Senior Biology Seminar
BIO electives, 300-level or above (13 hrs) ²		

Co-Requirements for Biology Major 7-8 hrs

Group 1:

CHE	312	Organic Chemistry I
CHE	320	Organic Chemistry II

or Group 2:

CHE	210	Brief Organic Chemistry ^{1,3}
CHE	215	Chemistry Laboratory ^{1,3}
CHE	330	Basic Biochemistry

Required Minor⁴ 3-21 hrs

Unrestricted Electives 17-28 hrs

Total Curriculum Requirements 120 hrs

¹May be used to fulfill University Studies requirements.

²A maximum of three hours total from BIO 483, 484 and BIO 491, 492, 493, 494 may be used. BIO 488 and 489 will not count here.

³This course does not apply toward the chemistry minor.

⁴Chemistry co-requirements may apply toward the requirements for a minor in chemistry.

AREA:

Biology/Biomedical Sciences Track¹

Bachelor of Science/Bachelor of Arts

CIP 26.0101

University Studies Requirements 42-43 hrs
(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

CHE	201	General College Chemistry
MAT	250	Calculus and Analytic Geometry I
PHY	130	General Physics I ²
PHY	131	General Physics I Laboratory ²

•University Studies Electives

CHE	202	General Chemistry and Qualitative Analysis ²
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Required Courses 47 hrs

BIO	100T	Transitions
BIO	115	The Cellular Basis of Life
BIO	216	Biological Inquiry and Analysis ³
BIO	221	Zoology: Animal Form and Function ^{2,3}
or		
BIO	222	Botany: Plant Form and Function ³
BIO	290	Biomedical Research I
BIO	300	Introductory Microbiology
BIO	321	Cell Biology: Mechanisms ⁴
or		
BIO	323	Cell Biology: Systems ⁴
BIO	322	Animal Physiology

BIO	333	Genetics
BIO	388	Biomedical Research II
BIO	389	Biomedical Research III
BIO	438	Biomedical Research IV
BIO	439	Biomedical Research V
BIO	499	Senior Biology Seminar
BIO	533	Molecular Genetics

Co-Requirements for Area 18 hrs

CHE	312	Organic Chemistry I
CHE	320	Organic Chemistry II
CHE	530	Fundamentals of Biochemistry I
CHE	540	Fundamentals of Biochemistry II
PHY	132	General Physics II ^{2,3}
PHY	133	General Physics II Laboratory ^{2,3}

Restricted Electives..... 15 hrs

Choose from the following:

BIO	308	Ethics in Biology ³
BIO	320	Comparative Vertebrate Anatomy
BIO	321	Cell Biology: Mechanisms ⁴
or		
BIO	323	Cell Biology: Systems ⁴
BIO	421	Vertebrate Histology
BIO	501	Immunology
BIO	504	Medical Cell Biology
BIO	521	Cell Biology Laboratory
BIO	528	Neurobiology
BIO	534	Molecular Genetics Laboratory
BIO	597	Topics in Advanced Molecular Biology
CHE	305	Analytical Chemistry
CHE	325	Organic Chemistry II Laboratory
CHE	403	Basic Physical Chemistry
PHY	370	Introduction to Modern Physics

Total Curriculum Requirements 120 hrs

¹A freshman must have a math ACT score of 25 or higher to declare a major in Biomedical Sciences. However, any student may apply to the program and must have completed 32 credit hours with a GPA of 3.0, and must have taken BIO 115, 216, CHE 201, 202 and MAT 250 with grades of B or better. Any student wishing to seek this degree (whether declared as a freshman or not) must apply to the Biomedical Sciences committee for admission into the program.

²Required for area if not taken as a University Studies elective.

³May be used to fulfill University Studies requirements.

⁴Required for area as either Core choice or as a Restricted Elective.

MAJOR:

Biology/Molecular Biology Track

Bachelor of Science/Bachelor of Arts CIP 26.0101

University Studies Requirements 42-43 hrs
(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

CHE	201	General College Chemistry
MAT	250	Calculus and Analytic Geometry I
PHY	130	General Physics I
PHY	131	General Physics I Laboratory
or		
PHY	235	Mechanics, Heat and Wave Motion and
PHY	236	Mechanics, Heat and Wave Motion Laboratory
•University Studies Electives		
CHE	202	General Chemistry and Qualitative Analysis

Required Courses 37 hrs

BIO	100T	Transitions
BIO	115	The Cellular Basis of Life
BIO	216	Biological Inquiry and Analysis ¹
BIO	221	Zoology: Animal Form and Function ¹
BIO	222	Botany: Plant Form and Function ¹
BIO	300	Introductory Microbiology
BIO	321	Cell Biology: Mechanisms
or		
BIO	323	Cell Biology: Systems
BIO	333	Genetics
BIO	499	Senior Biology Seminar
BIO	533	Molecular Genetics
BIO	534	Molecular Genetics Laboratory
BIO	597	Topics in Advanced Molecular Biology

Co-Requirements for Biology Major²..... 21 hrs

CHE	312	Organic Chemistry I
CHE	320	Organic Chemistry II
CHE	530	Fundamentals of Biochemistry I
CHE	540	Fundamentals of Biochemistry II
PHY	132	General Physics II ¹
PHY	133	General Physics II Laboratory ¹
or		
PHY	255	Electricity, Magnetism and Light ¹ and
PHY	256	Electricity, Magnetism and Light Laboratory ¹
STA	554	Statistical Methods

Required Minor² 0-21 hrs

Unrestricted Electives..... 11-20 hrs

Total Curriculum Requirements 120 hrs

¹May be used to fulfill University Studies requirements.

²Chemistry co-requirements may apply toward chemistry minor.

MAJOR:

Biology/Pre-Medical/Pre-Dental Track

Bachelor of Science/Bachelor of Arts CIP 26.0101

University Studies Requirements 42-43 hrs
(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

CHE	201	General College Chemistry
MAT	150	Algebra and Trigonometry
or		
MAT	250	Calculus and Analytic Geometry I
PHY	130	General Physics I
PHY	131	General Physics I Laboratory
or		
PHY	235	Mechanics, Heat and Wave Motion and
PHY	236	Mechanics, Heat and Wave Motion Laboratory
•Social and Self-Awareness and Responsible Citizenship		
PSY	180	General Psychology (<i>recommended</i>)
•University Studies Electives		
CHE	202	General Chemistry and Qualitative Analysis

Required Courses 40 hrs

BIO	100T	Transitions
BIO	115	The Cellular Basis of Life
BIO	216	Biological Inquiry and Analysis ¹
BIO	221	Zoology: Animal Form and Function ¹
BIO	222	Botany: Plant Form and Function ¹

BIO 321 Cell Biology: Mechanisms
or
BIO 323 Cell Biology: Systems
BIO 322 Animal Physiology
BIO 333 Genetics
BIO 499 Senior Biology Seminar
BIO electives, 300-level or above (12 hrs)²

Co-Requirements for Biology Major..... 12 hrs

CHE 312 Organic Chemistry I
CHE 320 Organic Chemistry II
PHY 132 General Physics II¹
PHY 133 General Physics II Laboratory¹
or
PHY 255 Electricity, Magnetism and Light¹ and
PHY 256 Electricity, Magnetism and Light Laboratory¹

Required Minor³ 3-21 hrs

Unrestricted Electives⁴ 8-21 hrs

Total Curriculum Requirements 120 hrs

¹May be used to fulfill University Studies requirements.
²A maximum of three hours total from BIO 483, 484 and BIO 491, 492, 493, 494 may be used. BIO 488 and 489 will not count here.
³Chemistry co-requirements may apply toward chemistry minor.
⁴ENG 204 strongly recommended. Electives other than ENG 204 must be at the 300-level or above.

MAJOR:

Biology/Pre-Optometry Track

Bachelor of Science/Bachelor of Arts CIP 26.0101

University Studies Requirements 41-42 hrs

(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

MAT 250 Calculus and Analytic Geometry I
PHY 130 General Physics I
PHY 131 General Physics I Laboratory
and
PHY 132 General Physics II
PHY 133 General Physics II Laboratory
or
PHY 235 Mechanics, Heat and Wave Motion
PHY 236 Mechanics, Heat and Wave Motion Laboratory
and
PHY 255 Electricity, Magnetism and Light
PHY 256 Electricity, Magnetism and Light Laboratory
•Social and Self-Awareness and Responsible Citizenship
PSY 180 General Psychology
•University Studies Electives
CHE 201 General College Chemistry

Required Courses 41 hrs

BIO 100T Transitions
BIO 115 The Cellular Basis of Life
BIO 216 Biological Inquiry and Analysis¹
BIO 221 Zoology: Animal Form and Function¹
BIO 222 Botany: Plant Form and Function¹
BIO 300 Introductory Microbiology
BIO 322 Animal Physiology
BIO 333 Genetics
BIO 499 Senior Biology Seminar
BIO electives, 300-level or above (12 hrs)²

Co-Requirements for Biology Major..... 23 hrs

CHE 202 General Chemistry and Qualitative Analysis¹
CHE 312 Organic Chemistry I
CHE 320 Organic Chemistry II
CHE 330 Basic Biochemistry
or
CHE 530 Fundamentals of Biochemistry I
ENG 204 Advanced Expository Writing¹
STA 135 Introduction to Probability and Statistics¹

Required Minor³ 0-21 hrs

Unrestricted Electives 0-15 hrs

Total Curriculum Requirements 120 hrs

¹May be used to fulfill University Studies requirements.
²A maximum of three hours total from BIO 483, 484 and BIO 491, 492, 493, 494 may be used. BIO 488 and 489 will not count here.
³Chemistry co-requirements may apply toward chemistry minor.

MAJOR:

Biology/Pre-Physical Therapy Track

Bachelor of Science/Bachelor of Arts CIP 26.0101

University Studies Requirements 42-43 hrs

(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

CHE 201 General College Chemistry
MAT 150 Algebra and Trigonometry
or
MAT 250 Calculus and Analytic Geometry I
PHY 130 General Physics I
PHY 131 General Physics I Laboratory

•Social and Self-Awareness and Responsible Citizenship

PSY 180 General Psychology
•University Studies Electives
CHE 202 General Chemistry and Qualitative Analysis

Required Courses 39-44 hrs

BIO 100T Transitions
BIO 115 The Cellular Basis of Life
BIO 216 Biological Inquiry and Analysis¹
BIO 120 Scientific Etymology
BIO 221 Zoology: Animal Form and Function¹
BIO 222 Botany: Plant Form and Function¹
BIO 220 Clinical Terminology
BIO 300 Introductory Microbiology
or
BIO 321 Cell Biology: Mechanisms
BIO 320 Comparative Vertebrate Anatomy
or
BIO 227 Human Anatomy
and
BIO 228 Human Anatomy Laboratory
BIO 322 Animal Physiology
BIO 333 Genetics
BIO 499 Senior Biology Seminar
BIO electives, approved by advisor, 300-level or above (9 hrs)²
(If BIO 320 is taken, only four hours of 300-level or above.)

Co-Requirements for Biology Major 24-25 hrs

BIO	450	Exercise Physiology
CHE	312	Organic Chemistry I
CHE	320	Organic Chemistry II
PSY	300	Principles and Methods of Statistical Analysis
or		
STA	135	Introduction to Probability and Statistics ¹
PHY	132	General Physics II ¹
PHY	133	General Physics II Laboratory ¹
PSY	260	Lifespan Development
SOC	133	Introduction to Sociology ¹

Required Minor³ 3-21 hrs

Unrestricted Electives 0-12 hrs

Total Curriculum Requirements 120 hrs

¹May be used to fulfill University Studies requirements.
²A maximum of three hours total from BIO 483, 484 and BIO 491, 492, 493, 494 may be used. BIO 488 and 489 will not count here.
³Chemistry co-requirements may apply toward chemistry minor.

MAJOR:

Biology/Pre-Physician Assistant Track

Bachelor of Science/Bachelor of Arts CIP 26.0101

University Studies Requirements 42 hrs
 (See *Academic Degrees and Programs*.)

University Studies selections must include:

•**Scientific Inquiry, Methodologies, and Quantitative Skills**

CHE	201	General College Chemistry
MAT	150	Algebra and Trigonometry
or		
MAT	250	Calculus and Analytic Geometry I
PHY	130	General Physics I
PHY	131	General Physics I Laboratory

•**Social and Self-Awareness and Responsible Citizenship**

PSY	180	General Psychology
SOC	133	Introduction to Sociology
or		
SOC	231	Social Problems

•**University Studies Electives**

CHE	202	General Chemistry and Qualitative Analysis
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Required Courses 40 hrs

BIO	100T	Transitions
BIO	115	The Cellular Basis of Life
BIO	120	Scientific Etymology
BIO	216	Biological Inquiry and Analysis ¹
BIO	220	Clinical Terminology
BIO	221	Zoology: Animal Form and Function ¹
BIO	222	Botany: Plant Form and Function ¹
BIO	300	Introductory Microbiology
BIO	321	Cell Biology: Mechanisms
or		
BIO	323	Cell Biology: Systems
BIO	333	Genetics
BIO	499	Senior Biology Seminar
BIO electives, 300-level or above (10 hrs) ² [BIO 488 and 489 will not count here]		

Co-Requirements for Biology Major 18-20 hrs

BIO	227	Human Anatomy
BIO	228	Human Anatomy Laboratory

BIO	229	Human Physiology
BIO	230	Human Physiology Laboratory
CHE	210	Brief Organic Chemistry
and		
CHE	215	Organic Chemistry Laboratory
or		
CHE	312	Organic Chemistry I
PSY	300	Principles and Methods of Statistical Analysis
or		
STA	135	Introduction to Probability and Statistics ¹
PSY	260	Lifespan Development

Required Minor³ 6-21 hrs

Unrestricted Electives 0-14 hrs

Total Curriculum Requirements 120 hrs

¹May be used to fulfill University Studies requirements.
²A maximum of three hours total from BIO 483, 484 and BIO 491, 492, 493, 494 may be used. BIO 488 and 489 will not count here.
³Chemistry co-requirements may apply toward chemistry minor.

AREA:

Biology/Fisheries and Aquatic Biology Track¹

Bachelor of Science/Bachelor of Arts CIP 26.0101

University Studies Requirements 43 hrs
 (See *Academic Degrees and Programs*.)

University Studies selections must include:

•**Scientific Inquiry, Methodologies, and Quantitative Skills**

CHE	201	General College Chemistry
MAT	150	Algebra and Trigonometry
or		
MAT	250	Calculus and Analytic Geometry I
PHY	130	General Physics I
PHY	131	General Physics I Laboratory

•**Social and Self-Awareness and Responsible Citizenship**

One of the following:

BIO	103	Saving Planet Earth
BIO	308	Ethics in Biology
COM	260	Communication Ethics
PHI	202	Ethics
POL	140	American National Government

•**University Studies Electives**

STA	135	Introduction to Probability and Statistics
and one of the following:		
COM	131	Interpersonal Communication
ENG	224	Writing in the Professions

Required Courses 71-79 hrs

BIO	100T	Transitions
BIO	115	The Cellular Basis of Life ¹
BIO	216	Biological Inquiry and Analysis
BIO	221	Zoology: Animal Form and Function
BIO	222	Botany: Plant Form and Function
BIO	240	Biological Applications of GIS
or		
GSC	202	Introduction to GIS
BIO	330	Principles of Ecology
BIO	333	Genetics
BIO	499	Senior Biology Seminar
BIO	549	Fisheries Techniques
BIO	570	Ichthyology

BIO	578	Conservation Biology
		<i>or</i>
BIO	584	Wildlife Policy and Administration
BIO	582	Fisheries Management
BIO	586	Limnology
		<i>or</i>
BIO	588	Reservoir Ecology
CHE	202	General Chemistry and Qualitative Analysis
CHE	210	Brief Organic Chemistry
CHE	215	Brief Organic Chemistry Laboratory

and four of the following not selected previously:

BIO	305	Introduction to Evolutionary Principles
BIO	467	Parasitology
BIO	493	Undergraduate Research III
BIO	542	Watershed Ecology
BIO	546	Stream Ecology
BIO	561	Freshwater Invertebrates
BIO	563	Aquatic Entomology
BIO	568	Wetland Ecology
BIO	572	Herpetology
BIO	573	Ornithology
BIO	574	Mammalogy
BIO	578	Conservation Biology
BIO	584	Wildlife Policy and Administration
BIO	586	Limnology
BIO	587	Freshwater Biology
BIO	588	Reservoir Ecology
BIO	595	Internship

and 3-5 credits from the following:

AGR	328	Statistics for Food and Agriculture
AGR	345	Soil Science
		<i>and</i>
AGR	346	Soil Science Lab
CHE	330	Biochemistry
CSC	101	Introduction to Problem Solving using Computers
GSC	125	Weather and Climate
GSC	199	Earth Science
GSC	200	Introduction to Oceanography
GSC	210	Hydrology
GSC	303	Introduction to Water Science
GSC	305	Introduction to Cartography
GSC	312	Introduction to Remote Sensing
GSC	314	Sediments and Soils
GSC	424	Conservation and Environmental Geosciences
GSC	512	Remote Sensing
GSC	521	Geographic Information Systems
MAT	250	Calculus and Analytic Geometry I ¹
PHY	235	Mechanics, Heat and Wave Motion
PHY	255	Electricity, Magnetism, and Light
PSY	300	Principles and Methods of Statistical Analysis
STA	235	Introduction to Probability and Statistics

Unrestricted Electives..... 0-6 hrs

Total Curriculum Requirements 120 hrs

¹Upon completion of the Fisheries and Aquatic Biology track, students can be certified by the American Fisheries Society (if MAT 250 is taken as part of the program.)

MAJOR:

Biology/Secondary Certification (Grades 8-12) Track

Bachelor of Science/Bachelor of Arts

CIP 26.0101

University Studies Requirements..... 43-44 hrs
(See *Academic Degrees and Programs.*)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

CHE	201	General College Chemistry
CHE	202	General Chemistry and Qualitative Analysis
MAT	150	Algebra and Trigonometry

•Social and Self-Awareness and Responsible Citizenship

EDP	260	Psychology of Human Development
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•University Studies Electives

EDU	103	Issues and Practices of American Education ¹
PHY	130	General Physics I ²
PHY	131	General Physics I Laboratory ²

Note: Certification requires a grade of B or better in one English composition course and a B or better in a University Studies math course, public speaking, and EDU 103 or equivalent course. Additional requirements for admission to teacher education and student teaching must be met. See advisor and/or Office of Teacher Education Services for details.

Required Courses 38 hrs

BIO	100T	Transitions
BIO	115	The Cellular Basis of Life
BIO	216	Biological Inquiry and Analysis
BIO	221	Zoology: Animal Form and Function
BIO	222	Botany: Plant Form and Function
BIO	300	Introductory Microbiology
BIO	320	Comparative Vertebrate Anatomy
BIO	322	Animal Physiology
BIO	330	Principles of Ecology
BIO	333	Genetics
BIO	499	Senior Biology Seminar

Co-Requirements for Biology Major..... 11-12 hrs

Chemistry Requirement

Group 1:

CHE	312	Organic Chemistry I
CHE	320	Organic Chemistry II

or Group 2:

CHE	210	Brief Organic Chemistry ^{3,4}
CHE	215	Brief Organic Chemistry Laboratory ^{3,4}
CHE	330	Basic Biochemistry

Physics Requirement

PHY	132	General Physics II ⁵
PHY	133	General Physics II Laboratory ⁵

Required for Secondary Certification⁶ 33 hrs

EDU	303	Strategies of Teaching
EDU	403	Structures and Foundations of Education
EDU	405	Evaluation and Measurement in Education ⁷
REA	427	Teaching Content Area Literacy in the Secondary School
SEC	420	Practicum in Secondary Schools ⁷
SEC	421	Student Teaching in the Secondary School
SEC	422	Extended Practicum ⁸
SED	300	Educating Students with Disabilities

Required Minor⁹ 3-21 hrs

Total Curriculum Requirements 123-148 hrs⁹

¹With a grade of B or better.

²PHY 235 and 236 will also meet this requirement.

³May be used to fulfill University Studies requirements.

⁴This course does not apply toward the chemistry minor.

⁵PHY 255 and 256 will also meet this requirement.

⁶PRAXIS Exam required during last semester before student teaching. Certification requires a grade of B or better in one English composition course and a grade of B or better in a University Studies math course, public speaking, and EDU 103 or equivalent course. Additional requirements for admission to teacher education and student teaching must be met. See advisor and/or Office of Teacher Education Services for details.

⁷EDU 405 and SEC 420 must be taken together and two semesters before student teaching.

⁸Must be taken one semester before student teaching.

⁹Chemistry co-requirements may apply toward chemistry minor.

AREA:

Wildlife and Conservation Biology/ Conservation Biology Track

Bachelor of Science/Bachelor of Arts

CIP 03.0601

University Studies Requirements 42-43 hrs
(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Global Awareness, Cultural Diversity, and the World's Artistic Traditions

POL 250 Introduction to International Relations

•Scientific Inquiry, Methodologies, and Quantitative Skills

STA 135 Introduction to Probability and Statistics

CHE 105 Introductory Chemistry

or

CHE 201 General College Chemistry

MAT 150 Algebra and Trigonometry

or

MAT 250 Calculus and Analytical Geometry I

•Social and Self-Awareness and Responsible Citizenship

ECO 231 Principles of Microeconomics

•University Studies Electives

BIO 216 Biological Inquiry and Analysis

ENG 224 Writing for the Professions

Core Courses¹ 62-65 hrs

BIO 100T Transitions

BIO 115 The Cellular Basis of Life

BIO 149 Introduction to Wildlife and Conservation Biology

BIO 221 Zoology: Animal Form and Function

BIO 222 Botany: Plant Form and Function

BIO 310 Vertebrate Natural History

BIO 330 Principles of Ecology

BIO 333 Genetics

BIO 380 Wildlife Techniques

BIO 499 Senior Biology Seminar

BIO 578 Conservation Biology

BIO 580 Principles of Wildlife Management

BIO 584 Wildlife Policy and Administration

BIO 554 Dendrology and Forest Conservation

and

BIO 350 Systematic Botany

or

BIO 553 Field Botany

and one of the following:

BIO 382 Scientific Communication for the Biologist

ENG 324 Technical Writing

and one of the following:

BIO 572 Herpetology

BIO 573 Ornithology

BIO 574 Mammalogy

and two of the following:

AGR 345 Soil Science

AGR 350 Soil Survey

AGR 455 Soil Management

CHE 210 Brief Organic Chemistry

and

CHE 215 Organic Chemistry Laboratory

GSC 199 Earth Science

GSC 314 Sediments and Soils

PHY 130 General Physics I

and

PHY 131 General Physics I Laboratory

Conservation Biology Track..... 17 hrs

GSC 202 Introduction to Geographical Information Science

and one of the following:

ECO 310 Issues in the Global Economy

ECO 345 Environmental Economics

and a minimum of ten hours from the following:²

ANT 320 Human Ecology

BIO 240 Biological Applications in GIS

BIO 300 Introductory Microbiology

BIO 308 Ethics in Biology

BIO 525 Biogeography

BIO 548 Principles of Managing Diseases in Wildlife

BIO 568 Wetland Ecology

BIO 570 Ichthyology

BIO 572 Herpetology

BIO 573 Ornithology

BIO 574 Mammalogy

BIO 577 Population and Conservation Genetics

BIO 581 Applied Wildlife Economics, Policy, and Administration

BIO 590 Disturbance Ecology

GSC 312 Introduction to Remote Sensing

GSC 350 Field Techniques in Geosciences

GSC 512 Remote Sensing

GSC 521 Geographic Information Systems

PLN 507 Land Use Planning

SOC 455 Environmental Sociology

Total Curriculum Requirements 121-125 hrs

¹Meets course requirements for Associate Wildlife Biologist Certification from The Wildlife Society.

²Only one course from BIO 572, 573, and 574 (if not taken as a core course) will count toward this requirement.

AREA:

Wildlife and Conservation Biology/

Conservation Education and Interpretation Track

Bachelor of Science/Bachelor of Arts

CIP 03.0601

University Studies Requirements 42-43 hrs
(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

STA 135 Introduction to Probability and Statistics

CHE 105 Introductory Chemistry

or

CHE 201 General College Chemistry

MAT 150 Algebra and Trigonometry

or

MAT 250 Calculus and Analytical Geometry I

•Social and Self-Awareness and Responsible Citizenship

EDP 260 Psychology of Human Development

HIS 221 American Experience to 1865

or

HIS 222 American Experience since 1865

•University Studies Electives

BIO 216 Biological Inquiry and Analysis

ENG 224 Writing for the Professions

Core Courses¹ 62-65 hrs

BIO 100T Transitions

BIO 115 The Cellular Basis of Life

BIO 149 Introduction to Wildlife and Conservation Biology

BIO 221 Zoology: Animal Form and Function

BIO 222 Botany: Plant Form and Function

BIO 310 Vertebrate Natural History

BIO 330 Principles of Ecology

BIO 333 Genetics

BIO 380 Wildlife Techniques

BIO 499 Senior Biology Seminar

BIO 578 Conservation Biology

BIO 580 Principles of Wildlife Management

BIO 584 Wildlife Policy and Administration

BIO 554 Dendrology and Forest Conservation

and

BIO 350 Systematic Botany

or

BIO 553 Field Botany

and one of the following:

BIO 382 Scientific Communication for the Biologist

ENG 324 Technical Writing

and one of the following:

BIO 572 Herpetology

BIO 573 Ornithology

BIO 574 Mammalogy

and two of the following:

AGR 345 Soil Science

AGR 350 Soil Survey

AGR 455 Soil Management

CHE 210 Brief Organic Chemistry

and

CHE 215 Organic Chemistry Laboratory

GSC 199 Earth Science

GSC 314 Sediments and Soils

PHY 130 General Physics I

and

PHY 131 General Physics I Laboratory

Conservation Education and Interpretation Track 17 hrs

EDU 404 Teaching Environmental Education

REC 202 Recreation Program Planning

and a minimum of 13 hours from the following:²

BIO 240 Biological Applications in GIS

BIO 525 Biogeography

BIO 542 Watershed Ecology

BIO 546 Stream Ecology

BIO 561 Freshwater Invertebrates

BIO 563 Aquatic Entomology

BIO 564 Entomology

BIO 568 Wetland Ecology

BIO 570 Ichthyology

BIO 572 Herpetology

BIO 573 Ornithology

BIO 574 Mammalogy

BIO 590 Disturbance Ecology

GSC 202 Introduction to Geographical Information Science

GSC 306 Landscapes of the National Parks

GSC 350 Field Techniques in Geosciences

GSC 512 Remote Sensing

GSC 521 Geographic Information Systems

PLN 507 Land Use Planning

REC 411 Curriculum Development in Adventure Education

REC 450 Recreational Use of Natural Resources

REC 465 Interpretation of Cultural and Natural Resources

Total Curriculum Requirements 121-125 hrs

¹Meets course requirements for Associate Wildlife Biologist Certification from The Wildlife Society.

²Only one course from BIO 572, 573, and 574 (if not taken as a core course) will count toward this requirement.

AREA:

Wildlife and Conservation Biology/

Conservation Law Enforcement Track

Bachelor of Science/Bachelor of Arts

CIP 03.0601

University Studies Requirements 42-43 hrs
(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

STA 135 Introduction to Probability and Statistics

CHE 105 Introductory Chemistry

or

CHE 201 General College Chemistry

MAT 150 Algebra and Trigonometry

or

MAT 250 Calculus and Analytical Geometry I

•Social and Self-Awareness and Responsible Citizenship

CRJ 140 Introduction to Criminal Justice

PSY 180 General Psychology

•University Studies Electives

BIO 216 Biological Inquiry and Analysis

ENG 224 Writing for the Professions

Core Courses¹ 62-65 hrs

BIO 100T Transitions

BIO 115 The Cellular Basis of Life

BIO 149 Introduction to Wildlife and Conservation Biology

BIO 221 Zoology: Animal Form and Function

BIO 222 Botany: Plant Form and Function

BIO	310	Vertebrate Natural History
BIO	330	Principles of Ecology
BIO	333	Genetics
BIO	380	Wildlife Techniques
BIO	499	Senior Biology Seminar
BIO	578	Conservation Biology
BIO	580	Principles of Wildlife Management
BIO	584	Wildlife Policy and Administration
BIO	554	Dendrology and Forest Conservation
		<i>and</i>
BIO	350	Systematic Botany
		<i>or</i>
BIO	553	Field Botany
		<i>and one of the following:</i>
BIO	382	Scientific Communication for the Biologist
ENG	324	Technical Writing
		<i>and one of the following:</i>
BIO	572	Herpetology
BIO	573	Ornithology
BIO	574	Mammalogy
		<i>and two of the following:</i>
AGR	345	Soil Science
AGR	350	Soil Survey
AGR	455	Soil Management
CHE	210	Brief Organic Chemistry
		<i>and</i>
CHE	215	Organic Chemistry Laboratory
GSC	199	Earth Science
GSC	314	Sediments and Soils
PHY	130	General Physics I
		<i>and</i>
PHY	131	General Physics I Laboratory

Conservation Law Enforcement Track 17 hrs

CRJ	220	Law Enforcement
CRJ	300	Crime and Criminals

and a minimum of eleven hours from the following:²

BIO	240	Biological Applications in GIS
BIO	548	Principles of Managing Diseases in Wildlife
BIO	570	Ichthyology
BIO	572	Herpetology
BIO	573	Ornithology
BIO	574	Mammalogy
BIO	581	Applied Wildlife Economics, Policy, and Administration
BIO	582	Fisheries Management
CRJ	240	Corrections
CRJ	346	Crime Investigation
CRJ	365	Interviewing and Interrogation
CRJ	445	Criminal Justice Diversity
GSC	202	Introduction to Geographical Information Science
REC	465	Interpretation of Cultural and Natural Resources

Total Curriculum Requirements 121-125 hrs

¹Meets course requirements for Associate Wildlife Biologist Certification from The Wildlife Society.

²Only one course from BIO 572, 573, and 574 (if not taken as a core course) will count toward this requirement.

AREA:

**Wildlife and Conservation Biology/
Wildlife Biology Track**

Bachelor of Science/Bachelor of Arts

CIP 03.0601

University Studies Requirements 42-43 hrs
(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

STA	135	Introduction to Probability and Statistics
CHE	105	Introductory Chemistry

or

CHE	201	General College Chemistry
MAT	150	Algebra and Trigonometry

or

MAT	250	Calculus and Analytical Geometry I
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•Social and Self-Awareness and Responsible Citizenship

ECO	231	Principles of Microeconomics
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•University Studies Electives

BIO	216	Biological Inquiry and Analysis
ENG	224	Writing for the Professions

Core Courses¹ 62-65 hrs

BIO	100T	Transitions
BIO	115	The Cellular Basis of Life
BIO	149	Introduction to Wildlife and Conservation Biology
BIO	221	Zoology: Animal Form and Function
BIO	222	Botany: Plant Form and Function
BIO	310	Vertebrate Natural History
BIO	330	Principles of Ecology
BIO	333	Genetics
BIO	380	Wildlife Techniques
BIO	499	Senior Biology Seminar
BIO	578	Conservation Biology
BIO	580	Principles of Wildlife Management
BIO	584	Wildlife Policy and Administration
BIO	554	Dendrology and Forest Conservation
		<i>and</i>
BIO	350	Systematic Botany
		<i>or</i>
BIO	553	Field Botany
		<i>and one of the following:</i>
BIO	382	Scientific Communication for the Biologist
ENG	324	Technical Writing
		<i>and one of the following:</i>
BIO	572	Herpetology
BIO	573	Ornithology
BIO	574	Mammalogy
		<i>and two of the following:</i>
AGR	345	Soil Science
AGR	350	Soil Survey
AGR	455	Soil Management
CHE	210	Brief Organic Chemistry
		<i>and</i>
CHE	215	Organic Chemistry Laboratory
GSC	199	Earth Science
GSC	314	Sediments and Soils
PHY	130	General Physics I
		<i>and</i>
PHY	131	General Physics I Laboratory

Wildlife Biology Track 17 hrs

GSC	202	Introduction to Geographical Information Science
<i>and a minimum of 13 hours from the following:²</i>		
AGR	240	Crop Science
BIO	240	Biological Applications in GIS
BIO	320	Comparative Vertebrate Anatomy
BIO	525	Biogeography
BIO	548	Principles of Managing Diseases in Wildlife
BIO	568	Wetland Ecology
BIO	570	Ichthyology
BIO	572	Herpetology
BIO	573	Ornithology
BIO	574	Mammalogy
BIO	577	Population and Conservation Genetics
BIO	581	Applied Wildlife Economics, Policy, and Administration
BIO	582	Fisheries Management
EDU	404	Teaching Environmental Education
GSC	312	Introduction to Remote Sensing
GSC	512	Remote Sensing
GSC	521	Geographic Information Systems
MAT	554	Statistical Methods
PLN	507	Urban and Regional Land Use Planning
REC	465	Interpretation of Cultural and Natural Resources

Total Curriculum Requirements 121-125 hrs

¹Meets course requirements for Associate Wildlife Biologist Certification from The Wildlife Society.

²Only one course from BIO 570, 572, 573, and 574 (if not taken as a core course) will count toward this requirement.

AREA:

**Wildlife and Conservation Biology/
Zoological Conservation Track**

Bachelor of Science/Bachelor of Arts

CIP 03.0601

University Studies Requirements 42-43 hrs

(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

STA	135	Introduction to Probability and Statistics
CHE	105	Introductory Chemistry
<i>or</i>		
CHE	201	General College Chemistry
MAT	150	Algebra and Trigonometry
<i>or</i>		
MAT	250	Calculus and Analytical Geometry I

•University Studies Electives

BIO	216	Biological Inquiry and Analysis
ENG	224	Writing for the Professions

Core Courses¹ 62-65 hrs

BIO	100T	Transitions
BIO	115	The Cellular Basis of Life
BIO	149	Introduction to Wildlife and Conservation Biology
BIO	221	Zoology: Animal Form and Function
BIO	222	Botany: Plant Form and Function
BIO	310	Vertebrate Natural History
BIO	330	Principles of Ecology
BIO	333	Genetics
BIO	380	Wildlife Techniques
BIO	499	Senior Biology Seminar
BIO	578	Conservation Biology
BIO	580	Principles of Wildlife Management
BIO	584	Wildlife Policy and Administration
BIO	554	Dendrology and Forest Conservation

and

BIO	350	Systematic Botany
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or

BIO	553	Field Botany
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and one of the following:

BIO	382	Scientific Communication for the Biologist
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ENG	324	Technical Writing
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and one of the following:

BIO	572	Herpetology
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BIO	573	Ornithology
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BIO	574	Mammalogy
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and two of the following:

AGR	345	Soil Science
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AGR	350	Soil Survey
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AGR	455	Soil Management
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CHE	210	Brief Organic Chemistry
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and

CHE	215	Organic Chemistry Laboratory
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GSC	199	Earth Science
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GSC	314	Sediments and Soils
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PHY	130	General Physics I
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and

PHY	131	General Physics I Laboratory
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Zoological Biology Track..... 17 hrs

AGR	300	Principles of Animal Nutrition
AGR	310	Applications in Animal Technology
AGR	322	Veterinary Laboratory Principles
EDU	404	Teaching Environmental Education

and a minimum of seven hours from the following:²

AGR	324	Veterinary Diagnostic Imaging
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AGR	329	Veterinary Hematology and Microbiology
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AGR	332	Veterinary Nursing
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BIO	240	Biological Applications in GIS
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BIO	300	Introductory Microbiology
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BIO	322	Animal Physiology
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BIO	467	General Parasitology
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BIO	538	Animal Behavior
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BIO	539	Animal Behavior Laboratory
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BIO	548	Principles of Managing Diseases in Wildlife
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BIO	570	Ichthyology
-----	-----	-------------

BIO	572	Herpetology
-----	-----	-------------

BIO	573	Ornithology
-----	-----	-------------

BIO	574	Mammalogy
-----	-----	-----------

BIO	577	Population and Conservation Genetics
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REC	465	Interpretation of Cultural and Natural Resources
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Total Curriculum Requirements 121-125 hrs

¹Meets course requirements for Associate Wildlife Biologist Certification from The Wildlife Society.

²Only one course from BIO 572, 573, and 574 (if not taken as a core course) will count toward this requirement.

Biology Minor..... 21 hrs

Complete BIO 115, 216, and either 221 or 222 (or both). A maximum of three hours total from BIO 483, 484, 491, 492, 493, or 494 may be used. Remaining BIO hours should be chosen with advisor's approval (BIO 330 and 333 are highly recommended). BIO 101, 488, 489, and 499 will not count toward this minor. Six hours must be upper-level (300 and greater) courses.

Pre-Pharmacy Curriculum¹

Required Courses 58 hrs

BIO	221	Zoology: Animal Form and Function ²
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BIO	227	Human Anatomy
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BIO	228	Human Anatomy Laboratory
BIO	300	Introductory Microbiology
CHE	201	General College Chemistry ²
CHE	202	General Chemistry and Qualitative Analysis ²
CHE	312	Organic Chemistry I
CHE	320	Organic Chemistry II
CHE	325	Organic Chemistry II Laboratory
ECO	231	Principles of Microeconomics ²
ENG	105	Reading, Writing and Inquiry ²
ENG	204	Advanced Expository Writing ²
MAT	250	Calculus and Analytic Geometry I ²
PHY	130	General Physics I ²
PHY	131	General Physics I Laboratory ²
PHY	132	General Physics II ²
PHY	133	General Physics II Laboratory ²
STA	135	Introduction to Probability and Statistics ²
Elective hours:		
Cross-cultural ³ (3) General electives (4) Humanities ⁴ (6)		
Social and Self-Awareness and Responsible Citizenship (3)		

Total Curriculum Requirements 74 hrs

¹The above program is based on the current admission requirements of the College of Pharmacy, University of Kentucky. Other colleges of pharmacy will have somewhat different requirements from those listed above. The curriculum can be modified to meet the requirements of most professional programs. Pre-pharmacy students desiring a four year program to receive the B.S. degree should follow the pre-medicine track and include all the courses listed above. The pre-pharmacy advisor should be consulted.

²May be used to fulfill University Studies requirements if completing a B.A. or B.S. degree.

³A course focusing on the study of a developing or non-Western country.

⁴Must be a two-course series.

Graduate Program

Graduate Coordinator - Michael Flinn

The Department of Biological Sciences offers the Master of Science degree. The M.S. program is designed to prepare the student to assume an active career in teaching and/or research or to pursue further graduate studies.

Requirements for Admission

Applicants must meet the Murray State University requirements (see *Graduate Admissions*). A faculty member must agree to mentor the student. Additional requirements for unconditional and conditional admission are as follows.

Unconditional

- Undergraduate courses in botany, zoology, ecology, and genetics.
- Eight undergraduate hours in chemistry.
- Composite GRE score of 300 (V+Q) or higher on current scale or 1,000 (V+Q) or higher on prior scale.

Conditional

Recommendation of the advisory committee.

Master of Science

Biology

CIP 26.0101

Within the guidelines, the individual's program is developed by an advisory committee to ensure proficiency in the basic areas of zoology, botany, ecology and genetics. The thesis track is strongly recommended for anyone considering further research or graduate activities.

THESIS REQUIREMENTS

Total Course Requirements 30 hours

BIO	689	Introduction to Graduate Study
BIO	696	Understanding Scientific Communication ¹
BIO	697	Seminar
BIO	698-699	Thesis ^R
BIO 600-level and above courses (9-20 hrs)		
Graduate advisor/committee approved courses in related fields (0-11 hrs)		

Other Degree Requirements

- Proficiency in quantitative methods through MAT 665 or a graduate course in bioinformatics, such as BIO 657.
- A preliminary examination will be given in the student's first semester to assess the student's understanding of principles across the diverse disciplines of biology.
- Oral defense of thesis.

NON-THESIS REQUIREMENTS

Total Course Requirements 36 hours

BIO	689	Introduction to Graduate Study
BIO	696	Understanding Scientific Communication ¹
BIO	697	Seminar
BIO 600-level and above courses (16-32 hrs)		
Graduate advisor/committee approved courses in related fields (0-16 hrs)		

Other Degree Requirements

Proficiency in quantitative methods through STA 665 or a graduate course in bioinformatics, such as BIO 657.

A preliminary examination will be given in the student's first semester to assess the student's understanding of principles across the diverse disciplines of biology.

Optional Degree Requirement

BIO 695 Biological Research (4) with prior approval of the research topic by the student's graduate committee; results to be presented while enrolled in BIO 697. Research credits can be counted toward the 36-hour requirement.

Master of Science

Biology/Watershed Science Concentration CIP 26.0101

Total Course Requirements 30 hours

Required Courses 10 hours

BIO	642	Watershed Ecology (same as GSC 642)
BIO	689	Introduction to Graduate Study
BIO	696	Understanding Scientific Communication ¹
BIO	697	Seminar
BIO	698-699	Thesis ^R

Restricted Electives 17 hours

Courses must be approved by the advisory committee and represent at least two disciplines, one of which must be BIO.

AGR	674	Agricultural Irrigation and Water Systems
BIO	625	Biogeography
BIO	630	Animal Ecology
BIO	631	Plant Ecology
BIO	632	Quantitative Ecology
BIO	646	Stream Ecology
BIO	661	Freshwater Invertebrates
BIO	663	Aquatic Entomology
BIO	668	Wetland Ecology
BIO	669	Biological Limnology

BIO	670	Limnological Analysis Laboratory
BIO	671	Ichthyology
BIO	672	Herpetology
BIO	678	Conservation Biology
BIO	682	Waterfowl Management
BIO	683	Fisheries Management
BIO	686	Limnology
BIO	687	Freshwater Biology
BIO	688	Reservoir Ecology
BIO	690	Disturbance Ecology
CET	655	Environmental Regulatory Affairs
CET	681	Pollution Assessment and Control
CET	685	Remediation Technology
CHE	613	Environmental Chemistry
CHE	617	Advanced Organic Chemistry
CHE	627	Chemical Separations
CHE	628	Mass Spectrometry
CHE	665	Biogeochemistry
GSC	612	Remote Sensing
GSC	621	Geographic Information Systems
GSC	640	Advanced Remote Sensing
GSC	641	Digital Image Processing Research
GSC	662	Hydrogeology
GSC	665	Physical/Chemical Limnology
GSC	680	Advanced Geographic Information Systems

Other Degree Requirements

Successful completion of STA 665.

Written and oral comprehensive examinations as specified by the advisory committee in broad aspects of watershed science and area of concentration (usually taken in third semester of residence).

Defense of thesis.

Master of Arts in Education

Secondary Teacher Leader with Biology Concentration

CIP 13.1205

The Department of Biological Sciences provides instruction in support of the M.A.Ed. in Secondary Teacher Leader with a concentration in biology. Prospective students should contact the graduate coordinator in the College of Education and Human Services for details on advising and graduate program design.

Department of Chemistry

1201 Jesse D. Jones Hall

270-809-2584

Chair: Harry Fannin. **Faculty:** Allenbaugh, Clear, Cox, Fannin, Fawzy, Johnson, Loganathan, McCreary, Miller, Revell, Subedi, Volp, Whittaker.

The Department of Chemistry is certified by the American Chemical Society's Committee on Professional Training. The department offers an area in chemistry or a major with tracks in biochemistry, forensics, polymer and materials science, pre-medical, pre-dental, pre-pharmacy, pre-MBA, or teacher certification.

The chemistry area program is designed for students planning careers in engineering, the chemical industry, or for those who plan to pursue graduate study following the baccalaureate degree. Upon completion of this program, graduates are certified as professional chemists. Alumni with the area are well prepared to succeed in nationally recognized Ph.D. programs in chemistry.

The chemistry major program is recommended for students planning careers in medicine, dentistry, veterinary medicine, pharmacy, secondary education, toxicology, or biochemistry.

The department offers a minor in chemistry as well as a Master of Science in Chemistry.

Murray State has nationally recognized chemistry student organizations, the Student Members of the American Chemical Society, the Forensic Science Student Association, and a national chemistry honor society-Gamma Sigma Epsilon.

The department is closely aligned with the Chemical Services Laboratory (CSL), the Watershed Studies Institute (WSI), and efforts to enhance environmental and biomedical sciences at Murray State University.

An excellent undergraduate research program is maintained that allows students to become involved in research projects during their first semester at MSU or later if they so desire. Students present posters or talks each semester at local and/or national meetings.

Students interested in chemistry, should contact the chair of the Department of Chemistry, Murray State University, 1201 Jesse D. Jones Hall, Murray, KY 42071-3300, Phone: (270) 809-2584 Fax: (270) 809-6474, or visit our website at www.murraystate.edu/chemistry.

AREA:

Chemistry

Bachelor of Science/Bachelor of Arts

CIP 40.0501

ACCREDITED BY: American Chemical Society

University Studies Requirements 43-46 hrs
(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

MAT	250	Calculus and Analytic Geometry I ¹
PHY	235	Mechanics, Heat and Wave Motion ¹
PHY	236	Mechanics, Heat and Wave Motion Lab ¹
PHY	255	Electricity, Magnetism and Light ¹
PHY	256	Electricity, Magnetism and Light Lab ¹

Required Courses 65 hrs

CHE	100T	Transitions
CHE	201	General College Chemistry
CHE	202	General Chemistry and Qualitative Analysis
CHE	305	Analytical Chemistry
CHE	312	Organic Chemistry I
CHE	320	Organic Chemistry II
CHE	325	Organic Chemistry II Laboratory
CHE	400	Chemical Literature
CHE	401	Ethics for the Chemist
CHE	410	Physical Chemistry I
CHE	420	Physical Chemistry II
CHE	509	Advanced Inorganic Chemistry I
CHE	510	Inorganic Chemistry Laboratory
CHE	519	Instrumental Analysis
CHE	530	Fundamentals of Biochemistry I
CHE	576	Polymer Chemistry
CSC	235	Programming in C++ ²
MAT	308	Calculus and Analytic Geometry II
MAT	309	Calculus and Analytic Geometry III

Required Limited Electives³ 3 hrs

CHE	488	Cooperative Education/Internship
or		
CHE	495	Senior Research

Unrestricted Electives..... 6-9 hrs**Total Curriculum Requirements 120 hrs**¹Required for area if not taken as a University Studies elective.²CSC 232 or EGR 140 may be substituted.

³In conjunction with this program it is possible through careful course selection to obtain an M.S. degree with one additional year of study following the awarding of the B.S. degree. Students interested in this M.S. concentration should contact the graduate coordinator in the department no later than during the junior year.

**MAJOR:
Chemistry**

Bachelor of Science/Bachelor of Arts

CIP 40.0501

University Studies Requirements 41-44 hrs(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative SkillsMAT 250 Calculus and Analytic Geometry I¹PHY 130 General Physics I¹ andPHY 131 General Physics I Laboratory¹PHY 132 General Physics II¹ andPHY 133 General Physics II Laboratory¹**Required Courses 35 hrs**

CHE 100T Transitions

CHE 201 General College Chemistry

CHE 202 General Chemistry and Qualitative Analysis

CHE 305 Analytical Chemistry

CHE 312 Organic Chemistry I

CHE 320 Organic Chemistry II

CHE 352 Basic Chemical Instrumentation

CHE 403 Basic Physical Chemistry

CSC 235 Programming in C++²**Required Limited Electives..... 3 hrs**

CHE 488 Cooperative Education/Internship

or

CHE 495 Senior Research

Required Minor 21 hrs**Electives³ 17-20 hrs****Total Curriculum Requirements 120 hrs**¹Required for major if not taken as a University Studies elective.²CSC 232 or EGR 140 may be substituted.

³At least one three-hour free elective must be chosen from outside Chemistry and may not be counted as a University Studies requirement.

MAJOR:**Chemistry/Secondary Certification (Grades 8-12) Track**

Bachelor of Science/Bachelor of Arts

CIP 40.0501

NOTE: Requirements for teacher certification are established by the Kentucky Education Professional Standards Board. Students are cautioned that requirements may change. For current information, students should check with an advisor in the Department of Adolescent, Career and Special Education.

University Studies Requirements 41-50 hrs(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

MAT 250 Calculus and Analytic Geometry

PHY 130 General Physics I¹ andPHY 131 General Physics I Laboratory¹PHY 132 General Physics II¹ andPHY 133 General Physics II Laboratory¹**•Social and Self-Awareness and Responsible Citizenship**EDP 260 Psychology of Human Development²**•University Studies Electives**CSC 199 Introduction to Information Technology^{3,4}EDU 103 Issues and Practices of American Education²

Note: Certification requires a grade of B or better in one English composition course and a B or better in a University Studies math course, public speaking, and EDU 103 or equivalent course. Additional requirements for admission to teacher education and student teaching must be met. See advisor and/or Office of Teacher Education Services for details.

Required Courses 30 hrs

CHE 100T Transitions

CHE 120 Chemical Laboratory Safety

CHE 201 General College Chemistry

CHE 202 General Chemistry and Qualitative Analysis

CHE 305 Analytical Chemistry

CHE 312 Organic Chemistry I

CHE 320 Organic Chemistry II

CHE 403 Basic Physical Chemistry

Required Limited Electives..... 3-4 hrs*Select from the following:*

CHE 330 Basic Biochemistry

CHE 352 Basic Chemical Instrumentation

CHE 504 Fundamentals of Toxicology

CHE 513 Environmental Chemistry

Secondary Certification Courses 33 hrs

EDU 303 Strategies of Teaching

EDU 403 Structures and Foundations of Education

EDU 405 Evaluation and Measurement in Education⁵

REA 427 Teaching Content Area Literacy in the
Secondary School

SEC 420 Practicum in Secondary Schools⁵

SEC 421 Student Teaching in the Secondary School

SEC 422 Extended Practicum⁶

SED 300 Educating Students with Disabilities

Required Minor 21 hrs**Total Curriculum Requirements 128-138 hrs**

¹Required for major if not taken as a University Studies elective. Students pursuing a Physics minor may substitute PHY 235/236 and 255/256 for PHY 130/131 and 132/133.

²Required for secondary certification if not taken as a University Studies elective.

³May substitute CSC 232 or EGR 140, but these will not count for University Studies electives.

⁴With a grade of C or better.

⁵EDU 405 and SEC 420 must be taken together and two semesters before student teaching.

⁶Must be taken one semester before student teaching.**Chemistry Teaching Specialization**

The teaching specialization in chemistry is a path to secondary certification in chemistry, designed to accompany certification in another science content area. (All College of Education and Human Services secondary certification course requirements must be met.) The teaching specialization in chemistry meets and exceeds Murray

State University's requirements for a minor in chemistry. **Note:** Even though this program exceeds Murray State University's requirements for a chemistry minor, in order for a chemistry minor to appear on a transcript, a minor must be declared, and all residential and graduation requirements must be met.

Requirements for teacher certification are established by the Kentucky Education Professional Standards Board. Students are cautioned that changes in these requirements may occur. Therefore, for the most current information, students should check with an advisor in the College of Education and Human Services.

Chemistry Teaching Specialization 24 hrs

CHE	120	Chemical Laboratory Safety
CHE	201	General College Chemistry
CHE	202	General Chemistry and Qualitative Analysis
CHE	305	Analytical Chemistry
CHE	312	Organic Chemistry I

Choose one elective from the following:

CHE	320	Organic Chemistry II
CHE	352	Basic Chemical Instrumentation
CHE	330	Basic Biochemistry
CHE	403	Basic Physical Chemistry

MAJOR:

Chemistry/Pre-Medical/Pre-Dental Track

Bachelor of Science/Bachelor of Arts

CIP 40.0501

University Studies Requirements 41-44 hrs

(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

MAT	250	Calculus and Analytic Geometry I ¹
PHY	130	General Physics I ¹
PHY	131	General Physics I Laboratory ¹
PHY	132	General Physics II ¹
PHY	133	General Physics II Laboratory ¹

Required Courses 38 hrs

CHE	100T	Transitions
CHE	201	General College Chemistry
CHE	202	General Chemistry and Qualitative Analysis
CHE	305	Analytical Chemistry
CHE	312	Organic Chemistry I
CHE	320	Organic Chemistry II
CHE	352	Basic Chemical Instrumentation
CHE	403	Basic Physical Chemistry
CHE	530	Fundamentals of Biochemistry I
CSC	235	Programming in C++ ²
ENG	204	Advanced Expository Writing
	or	
ENG	324	Technical Writing

Required Minor³ 21 hrs

Unrestricted Electives 17-20 hrs

Total Curriculum Requirements 120 hrs

¹Required for major if not taken as a University Studies elective.

²CSC 232 or EGR 140 may be substituted.

³Biology minor strongly recommended.

MAJOR:

Chemistry/Biochemistry Track

Bachelor of Science/Bachelor of Arts

CIP 40.0501

University Studies Requirements 41-44 hrs

(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

MAT	250	Calculus and Analytic Geometry I ¹
PHY	130	General Physics I ¹ and
PHY	131	General Physics I Laboratory ¹
PHY	132	General Physics II ¹ and
PHY	133	General Physics II Laboratory ¹

Required Courses 44 hrs

CHE	100T	Transitions
CHE	201	General College Chemistry
CHE	202	General Chemistry and Qualitative Analysis
CHE	305	Analytical Chemistry
CHE	312	Organic Chemistry I
CHE	320	Organic Chemistry II
CHE	352	Basic Chemical Instrumentation
CHE	403	Basic Physical Chemistry
CHE	530	Fundamentals of Biochemistry I
CHE	537	Experimental Biochemistry
CHE	540	Fundamentals of Biochemistry II
CSC	235	Programming in C++ ²

Required Minor³ 21 hrs

Electives 11-14 hrs

Total Curriculum Requirements 120 hrs

¹Required for major if not taken as a University Studies elective.

²CSC 232 or EGR 140 may be substituted.

³Biology minor is strongly recommended.

MAJOR:

Chemistry/Forensics Track

Bachelor of Science/Bachelor of Arts

CIP 40.0501

University Studies Requirements 41-44 hrs

(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

MAT	250	Calculus and Analytic Geometry I
PHY	130	General Physics I ¹ and
PHY	131	General Physics I Laboratory ¹
PHY	132	General Physics II ¹ and
PHY	133	General Physics II Laboratory ¹

Required Courses 34 hrs

CHE	100T	Transitions
CHE	201	General College Chemistry
CHE	202	General Chemistry and Qualitative Analysis
CHE	305	Analytical Chemistry
CHE	312	Organic Chemistry I
CHE	320	Organic Chemistry II
CHE	325	Organic Chemistry II Laboratory
CHE	403	Basic Physical Chemistry I
CSC	235	Programming in C++ ²

Required Limited Electives..... 10 hrs

ARC	335	Forensic Archaeology
CHE	330	Basic Biochemistry
CHE	352	Basic Chemical Instrumentation

Criminal Justice Minor³ 21 hrs
CRJ 220, 333, and 346 are required selections.**Unrestricted Electives..... 11-14 hrs****Total Curriculum Requirements 120 hrs**¹Required for major if not taken as a University Studies elective.²CSC 232 or EGR 140 may be substituted.³A second major in Criminal Justice can substitute for the minor.**MAJOR:****Chemistry/Polymer and Materials Science Track**

Bachelor of Science/Bachelor of Arts CIP 40.0501

University Studies Requirements 38-44 hrs
(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

MAT	250	Calculus and Analytic Geometry I ¹
PHY	235	Mechanics, Heat and Wave Motion ¹
PHY	236	Mechanics, Heat and Wave Motion Laboratory ¹
PHY	255	Electricity, Magnetism and Light ¹
PHY	256	Electricity, Magnetism and Light Laboratory ¹

Required Courses 51 hrs

CHE	100T	Transitions
CHE	201	General College Chemistry
CHE	202	General Chemistry and Qualitative Analysis
CHE	305	Analytical Chemistry
CHE	312	Organic Chemistry I
CHE	320	Organic Chemistry II
CHE	352	Basic Chemical Instrumentation
CHE	503	Industrial Chemistry
CHE	576	Polymer Chemistry
CSC	235	Programming in C++ ²
EGR	240	Thermodynamics I
EGR	375	Materials Science
MAT	308	Calculus and Analytic Geometry II
PHY	370	Introduction to Modern Physics

Required Limited Electives..... 3 hrs

CHE	488	Cooperative Education/Internship
	or	
CHE	495	Senior Research

Required Minor³ 11-21 hrs**Unrestricted Electives..... 1-17 hrs****Total Curriculum Requirements 120 hrs**¹Required for major if not taken as a University Studies elective.²CSC 232 or EGR 140 may be substituted.³PHY 235, 236, 255, and 256 count toward a physics minor, with 11 additional hours remaining; otherwise, 21 hours are required to complete a minor.**MAJOR:****Chemistry/Pre-Pharmacy Track¹**

Bachelor of Science/Bachelor of Arts

CIP 40.0501

University Studies Requirements 41-44 hrs
(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

MAT	250	Calculus and Analytic Geometry I ²
PHY	130	General Physics I ²
PHY	131	General Physics I Laboratory ²
PHY	132	General Physics II ²
PHY	133	General Physics II Laboratory ²

•Social and Self-Awareness and Responsible Citizenship

ECO	231	Principles of Microeconomics
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Required Courses 46 hrs

CHE	100T	Transitions
CHE	201	General College Chemistry
CHE	202	General Chemistry and Qualitative Analysis
CHE	305	Analytical Chemistry
CHE	312	Organic Chemistry I
CHE	320	Organic Chemistry II
CHE	325	Organic Chemistry II Laboratory
CHE	330	Basic Biochemistry
CHE	352	Basic Chemical Instrumentation
CHE	403	Basic Physical Chemistry I
CSC	235	Programming in C++ ³
STA	135	Introduction to Probability and Statistics

Required Minor⁴ 21 hrs**Unrestricted Electives..... 9-12 hrs****Total Curriculum Requirements 120 hrs**¹Colleges of pharmacy will have somewhat different requirements from those listed above. The curriculum can be modified to meet the requirements of most professional programs.²Required for major if not taken as a University Studies elective.³CSC 232 or EGR 140 may be substituted.⁴Biology minor is strongly recommended.**Chemistry Minor 21 hrs**

CHE 201, 202 and electives selected from the following chemistry courses: 305, 312, 320, 325, 352, 400, 401, 403, 410, 420, 488, 495, and 330 or 530, but not both. A maximum of three hours may be counted from CHE 488. At least 21 hours is required. Six hours must be 300-level or above courses.

Graduate Programs

Graduate Coordinator - Rachel Allenbaugh

Master of Science Chemistry

CIP 40.0501

Requirements for Admission

Applicants must meet the Murray State University requirements (see *Graduate Admissions*). Additional information regarding unconditional and conditional admission is given below.

Unconditional

To qualify for unconditional admission, an applicant must have:

1. an undergraduate degree in chemistry;
2. an overall undergraduate GPA of 3.0/4.0 or higher;
3. minimum GRE scores of: 140 verbal, 150 quantitative, 2.5 analytical writing;
4. for international students, minimum scores of: TOEFL 527, iBT TOEFL 71, with no band less than 16, or IELTS 6.0 with no band less than 5.0.

If the undergraduate degree does not conform to an ACS-certified program, students may be required to correct any deficiency in their undergraduate preparation.

Conditional

In exceptional cases (such as extensive work or research experience), students falling slightly below one of the unconditional admission benchmarks may still be considered for conditional admission. Applicants with TOEFL scores between 500 and 526 may be admitted on a conditional basis, but their proficiency in English will be further evaluated upon their arrival on campus, and they may be required to undertake additional study of English prior to beginning graduate work in chemistry.

THESIS REQUIREMENTS

Total Course Requirements..... 30 hours

- CHE 601 Seminar^{L1}
 CHE 602 Seminar¹
 CHE 609 Advanced Inorganic Chemistry I
 CHE 617 Advanced Organic Chemistry
 CHE 681 Advanced Physical Chemistry

Research and Other Requirements

- CHE 698^R-699^{PT} Thesis Research
 600-level courses (13 hrs)

(Up to six hours may be selected from courses other than CHE.)

¹Each student is required to prepare and present one seminar based on a thorough search of the chemical literature and one based on the student's thesis research.

Other Degree Requirements

Successful completion of an advanced instrumental analysis course (CHE 619 or equivalent).

Submission and defense of a satisfactory thesis.

NON-THESIS REQUIREMENTS

Total Course Requirements..... 36 hours¹

- CHE 601 Seminar^{L2}
 CHE 602 Seminar²
 CHE 609 Advanced Inorganic Chemistry I
 CHE 617 Advanced Organic Chemistry
 CHE 681 Advanced Physical Chemistry
 600-level courses (22 hrs)

(Up to nine hours may be selected from courses other than CHE.)

¹CHE 691, 692, and 693 will not count toward completion of this degree.

²Each student is required to prepare and present two seminars based on a thorough search of the chemical literature.

Other Degree Requirements

Successful completion of an advanced instrumental analysis course (CHE 619 or equivalent).

CHE 600-level electives to total 36 hours.

Master of Arts in Education

Secondary Teacher Leader with Chemistry Concentration
 CIP 13.1205

The Department of Chemistry provides instruction in support of the M.A.Ed. in Secondary Teacher Leader with a concentration in chemistry. Prospective students should contact the graduate coordinator in the College of Education and Human Services for details on advising and graduate program design.

Department of Geosciences

334 Blackburn Science Building
 270-809-2591

Chair: Robin Zhang. **Faculty:** Benson, Busby, Casey, Cetin, El-Masri, Hong, Ortmann, Stinchcomb, Zhang.

An area in geosciences with tracks in earth science, earth science teacher certification, environmental geology, geoarchaeology, and geographic information science are provided by the department faculty. Minors are offered in anthropology, archaeology, earth science, environmental geology, and geographic information science. A certificate in geographic information science and an M.S. in Geosciences may also be earned.

In addition to the more traditional curricula, geosciences students have access to the Murray State Archaeology Lab, a summer field archaeology school, and the Mid-America Remote sensing Center (MARC), a core entity in the Murray State University Watershed Studies Institute (WSI).

Geosciences majors are encouraged to participate in internships and cooperative education experiences. Graduates have outstanding opportunities for employment as archaeologists, planners, cartographers, environmental geologists, remote sensing/GIS professionals, and other mapping science positions in business, government, and education.

AREA:

Geosciences/Earth Science Track

Bachelor of Science

CIP 40.0601

University Studies Requirements..... 38-43 hrs
 (See *Academic Degrees and Programs*.)

Required Courses 47 hrs

- ARC 150 Introduction to Archaeology¹
 AST 115 Introductory Astronomy
 AST 116 Introductory Astronomy Laboratory
 GSC 100T Transitions
 GSC 101 The Earth and the Environment²
 GSC 102 Earth through Time²
 GSC 110 World Geography¹
 GSC 125 Weather and Climate²
 GSC 202 Introduction to Geographic Information Sciences
 GSC 301 Understanding Scientific Communication
 GSC 303 Introduction to Water Science
 GSC 305 Introduction to Cartography
 GSC 312 Introduction to Remote Sensing

- GSC 336 Principles of Geomorphology
 GSC 339 Field Geology
 or
 GSC 350 Field Techniques in Geosciences

Required Limited Electives..... 11 hrs

Choose from the following approved electives:

- BIO 101 Biological Concepts
 CHE 105 Introductory Chemistry
 CHE 201 General College Chemistry
 GSC 210 Hydrology
 GSC 306 Landscapes of the National Parks
 GSC 310 Rock and Mineral Resources
 GSC 314 Sediments and Soils
 GSC 330 Economic Geography
 GSC 390 Geoarchaeology
 GSC 424 Conservation and Environmental Geosciences
 GSC 489 Cooperative Education/Internship
 GSC 507 Land Use Planning
 GSC 512 Remote Sensing
 GSC 521 Geographic Information Systems
 GSC 522 Digital Cartography
 GSC 533 Paleoecology
 GSC 536 Soils and Geomorphology
 GSC 562 Hydrogeology
 GSC 578 Terrestrial Ecosystem Modeling
 GSC 579 Remote Sensing of Vegetation
 GSC 591 Special Problems
 GSC 592 Special Problems
 GSC 593 Special Problems
 PHY 235 Mechanics, Heat and Wave Motion
 PHY 236 Mechanics, Heat and Wave Motion Laboratory

Collateral Requirement..... 7-8 hrs

- CSC 101³ Introduction to Problem Solving Using Computers
 or
 CSC 199³ Introduction to Information Technology
 MAT 150² Algebra and Trigonometry (or above)
 or
 STA 135² Introduction to Probability and Statistics (or above)

Unrestricted Electives..... 11-17 hrs

Total Curriculum Requirements 120 hrs

¹Will count towards University Studies Global Awareness, Cultural Diversity, and the World's Artistic Tradition requirements.

²Will count towards University Studies Scientific Inquiry, Methodologies, and Quantitative Skills requirements.

³This is a University Studies electives writing-intensive or technology-intensive course.

AREA:

**Geosciences/Earth Science Secondary Certification Track
 (Grades 8-12)**

Bachelor of Science Degree

CIP 40.0601

University Studies Requirements 44 hrs

(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

- GSC 101 The Earth and the Environment
 GSC 102 Earth through Time
 MAT 150 Algebra and Trigonometry

•Global Awareness, Cultural Diversity and the World's Artistic Traditions

- GSC 110 World Geography

•Social and Self-Awareness and Responsible Citizenship

- EDP 260 Psychology of Human Development

•University Studies Electives

- ARC 150 Introduction to Archaeology
 CSC 101 Introduction to Problem Solving Using Computers
 EDU 103 Issues and Practices of American Education

Note: Certification requires a grade of B or better in one English composition course and a B or better in a University Studies math course, public speaking, and EDU 103 or equivalent course. Additional requirements for admission to teacher education and student teaching must be met. See advisor and/or Office of Teacher Education Services for details.

Required Courses 33 hrs

- AST 115 Introductory Astronomy
 AST 116 Introductory Astronomy Laboratory
 GSC 100T Transitions
 GSC 125 Weather and Climate²
 GSC 202 Introduction to Geographic Information Sciences
 GSC 301 Understanding Scientific Communication
 GSC 303 Introduction to Water Science
 GSC 305 Introduction to Cartography
 GSC 312 Introduction to Remote Sensing
 GSC 336 Principles of Geomorphology
 GSC 339 Field Geology
 or
 GSC 350 Field Techniques in Geosciences

Required Limited Electives..... 10 hrs

Select upper-level courses from the list of approved electives shown under the Environmental Geology Track.

Note: The National Science Teachers Association (NSTA) recommends a minimum of one course from each of the following three areas, with total of recommended supplemental science hours to include no fewer than 16 semester hours.

A. Biology

- BIO 101 Biological Concepts
 BIO 112 Field Biology
 BIO 221 Zoology: Animal Form and Function
 BIO 222 Botany: Plant Form and Function

B. Chemistry

- CHE 101 Consumer Chemistry
 CHE 105 Introductory Chemistry
 CHE 201 General College Chemistry
 CHE 202 General Chemistry and Qualitative Analysis

C. Physics

- PHY 235 Mechanics, Heat and Wave Motion
 and
 PHY 236 Mechanics, Heat and Wave Motion Laboratory
 PHY 255 Electricity, Magnetism and Light
 and
 PHY 256 Electricity, Magnetism and Light Laboratory

Required for Secondary Certification 33 hrs

- EDU 303 Strategies of Teaching
 EDU 403 Structures and Foundations of Education
 EDU 405 Evaluation and Measurement in Education¹
 REA 427 Teaching Content Area Literacy in the
 Secondary School
 SEC 420 Practicum in Secondary Schools¹
 SEC 421 Student Teaching in the Secondary School

SEC	422	Extended Practicum ²
SED	300	Educating Students with Disabilities

Total Curriculum Requirements 120 hrs

¹Must be taken together and two semesters before student teaching.

²Must be taken one semester before student teaching.

Earth Science Teaching Specialization

The teaching specialization in earth science is a path to secondary certification in earth science designed to accompany certification in another science content area (biology/chemistry/physics). All College of Education and Human Services secondary certification course requirements must be met. **Note:** Even though this program exceeds Murray State University's requirements for an earth science minor, in order for a earth science minor to appear on a transcript, a minor must be declared, and all residential and graduation requirements must be met.

Requirements for teacher certification are established by the Kentucky Education Professional Standards Board. Students are cautioned that changes in these requirements may occur. Therefore, for the most current information, students should check with an advisor in the College of Education and Human Services.

Earth Science Teaching Specialization 30 hrs

AST	115	Introductory Astronomy
AST	116	Introductory Astronomy Laboratory
GSC	101	The Earth and the Environment
GSC	102	Earth through Time
GSC	125	Weather and Climate
GSC	202	Introduction to Geographic Information Sciences
GSC	303	Introduction to Water Science
GSC	336	Principles of Geomorphology
GSC	339	Field Geology
	or	
GSC	350	Field Techniques in Geosciences

AREA:

Geosciences/Environmental Geology Track

Bachelor of Science Degree

CIP 40.0601

University Studies Requirements 38-43 hrs
(See *Academic Degrees and Programs*.)

Required Courses..... 46 hrs

ARC	150	Introduction to Archaeology ¹
GSC	100T	Transitions
GSC	101	The Earth and the Environment ²
GSC	102	Earth through Time ²
GSC	110	World Geography ¹
GSC	202	Introduction to Geographic Information Sciences
GSC	210	Hydrology
GSC	301	Understanding Scientific Communication
GSC	305	Introduction to Cartography
GSC	310	Rock and Mineral Resources
GSC	312	Introduction to Remote Sensing
GSC	314	Sediments and Soils
GSC	336	Principles of Geomorphology
GSC	562	Hydrogeology

Required Limited Electives..... 12 hrs

Choose from the following approved electives:

ARC	300	Archaeology Method and Theory
ARC	302	Archaeological Field Work I
ARC	304	Archaeology Laboratory Methods
ARC	320	Human Ecology

ARC	390	Geoarchaeology
BIO	101	Biological Concepts
CET	280	Plane Surveying
CHE	105	Introductory Chemistry
CHE	201	General College Chemistry
CHE	202	General Chemistry and Qualitative Analysis
GSC	200	Introduction to Oceanography
GSC	303	Introduction to Water Science
GSC	306	Landscapes of the National Parks
GSC	330	Economic Geography
GSC	339	Field Geology
GSC	350	Field Techniques in Geosciences
GSC	388	International Experience in the Geosciences
GSC	424	Conservation and Environmental Geosciences
GSC	489	Cooperative Education/Internship
GSC	507	Land Use Planning
GSC	512	Remote Sensing
GSC	521	Geographic Information Systems
GSC	522	Digital Cartography
GSC	533	Paleoecology
GSC	534	Invertebrate Paleontology
GSC	536	Soils and Geomorphology
GSC	542	Watershed Ecology
GSC	578	Terrestrial Ecosystem Modeling
GSC	579	Remote Sensing of Vegetation
GSC	591	Special Problems
GSC	592	Special Problems
GSC	593	Special Problems
PHY	130	General Physics I
PHY	131	General Physics I Laboratory

Collateral Requirement..... 7-8 hrs

CSC	101 ³	Introduction to Problem Solving Using Computers
	or	
CSC	199 ³	Introduction to Information Technology
MAT	150 ²	Algebra and Trigonometry (or above)
	or	
STA	135 ²	Introduction to Probability and Statistics (or above)

Unrestricted Electives..... 11-17 hrs

Total Curriculum Requirements 120 hrs

¹Will count towards University Studies Global Awareness, Cultural Diversity, and the World's Artistic Tradition requirements.

²Will count towards University Studies Scientific Inquiry, Methodologies, and Quantitative Skills requirements.

³This is a University Studies electives writing-intensive or technology-intensive course.

AREA:

Geosciences/Geoarchaeology Track

Bachelor of Science

CIP 40.0601

University Studies Requirements 38-43 hrs
(See *Academic Degrees and Programs*.)

University Studies selection must include:

•**Social and Self-Awareness and Responsible Citizenship**

ANT	140	Introduction to Cultural Anthropology
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Required Courses 44 hrs

ARC	150	Introduction to Archaeology ¹
ARC	300	Archaeological Method and Theory
ARC	304	Archaeological Laboratory Methods
ARC	330	North American Archaeology

ARC	390	Geoarchaeology
GSC	100T	Transitions
GSC	101	The Earth and the Environment ²
GSC	110	World Geography ¹
GSC	202	Introduction to Geographic Information Sciences
GSC	301	Understanding Scientific Communication
GSC	305	Introduction to Cartography
GSC	312	Introduction to Remote Sensing
GSC	336	Principles of Geomorphology
<i>Five credit hours chosen from the following:</i>		
ARC	302	Archaeological Field Work I
ARC	402	Archaeological Field Work II
ARC	510	Advanced Archaeological Field Work

Required Limited Electives..... 14 hrs

Choose from the following approved electives:

ANT	311	Anthropology of Complex Societies
ANT	325	Biological Anthropology
ANT	329	North American Indians
ARC	314	Sediments and Soils
ARC	315	Special Topics in Archaeology
ARC	320	Human Ecology
ARC	321	Ancient Civilizations
ARC	335	Forensic Archaeology
ARC	340	Archaeology of Africa
ARC	350	Public Archaeology
ARC	355	Pottery and People
ARC	357	Lithic Analyses
ARC	360	Historical Archaeology
ARC	370	Archaeology of the Eastern Woodlands
ARC	385	Archaeology of Eastern Asia
ARC	389	Archaeology and Political Ecology of Empires
ARC	395	Archaeology of Religion
ARC	402	Archaeological Field Work II
ARC	425	Advanced Archaeological Laboratory Methods
ARC	488	Cooperative Education/Internship
ARC	489	Cooperative Education/Internship
ARC	500	Directed Studies
ARC	510	Advanced Archaeological Field Work
ARC	556	Geophysical Surveying
CET	280	Plane Surveying
GSC	306	Landscapes of the National Parks
GSC	310	Rock and Mineral Resources
GSC	350	Field Techniques in Geosciences
GSC	388	International Experience in the Geosciences
GSC	521	Geographic Information Systems

Collateral Requirement..... 7-8 hrs

CSC	101 ³	Introduction to Problem Solving Using Computers
<i>or</i>		
CSC	199 ³	Introduction to Information Technology
MAT	150 ²	Algebra and Trigonometry (or above)
<i>or</i>		
STA	135 ²	Introduction to Probability and Statistics (or above)

Unrestricted Electives..... 11-17 hrs

Total Curriculum Requirements 120 hrs

¹Will count towards University Studies Global Awareness, Cultural Diversity, and the World's Artistic Tradition requirements.

²Will count towards University Studies Scientific Inquiry, Methodologies, and Quantitative Skills requirements.

³This is a University Studies electives writing-intensive or technology-intensive course.

AREA:

Geosciences/Geographic Information Science Track

Bachelor of Science

CIP 40.0601

University Studies Requirements 38-43 hrs
(See *Academic Degrees and Programs*.)

Required Courses 44 hrs

ARC	150	Introduction to Archaeology ¹
GSC	100T	Transitions
GSC	101	The Earth and the Environment ²
GSC	110	World Geography ¹
GSC	125	Weather and Climate ²
GSC	202	Introduction to Geographic Information Sciences
GSC	301	Understanding Scientific Communication
GSC	305	Introduction to Cartography
GSC	312	Introduction to Remote Sensing
GSC	330	Economic Geography
GSC	336	Principles of Geomorphology
GSC	512	Remote Sensing
GSC	521	Geographic Information Systems

Required Limited Electives 14 hrs

Choose from the following approved electives:

GSC	210	Hydrology
GSC	303	Introduction to Water Science
GSC	306	Landscapes of the National Park
GSC	310	Rock and Mineral Resources
GSC	314	Sediments and Soils
GSC	350	Field Techniques in Geosciences
GSC	390	Geoarchaeology
GSC	424	Conservation and Environmental Geosciences
GSC	488	Cooperative Education/Internship
GSC	489	Cooperative Education/Internship
GSC	507	Land Use Planning
GSC	522	Digital Cartography
GSC	562	Hydrogeology
GSC	578	Terrestrial Ecosystem Modeling
GSC	579	Remote Sensing of Vegetation
GSC	591	Special Problems
GSC	592	Special Problems
GSC	593	Special Problems

Collateral Requirement..... 7-8 hrs

CSC	101 ³	Introduction to Problem Solving Using Computers
<i>or</i>		
CSC	199 ³	Introduction to Information Technology
MAT	150 ²	Algebra and Trigonometry (or above)
<i>or</i>		
STA	135 ²	Introduction to Probability and Statistics (or above)

Unrestricted Electives..... 11-17 hrs

Total Curriculum Requirements 120 hrs

¹Will count towards University Studies Global Awareness, Cultural Diversity, and the World's Artistic Tradition requirements.

²Will count towards University Studies Scientific Inquiry, Methodologies, and Quantitative Skills requirements.

³This is a University Studies electives writing-intensive or technology-intensive course.

Anthropology Minor 21 hrs

ANT 140, ANT 325, ARC 150, plus 12 hours of ANT 300-level or above electives. Electives may include ARC 321, 325, 330, 335, 340, 385, 389, and 395. Electives may substitute up to six hours selected from the

following as approved by advisor: HIS 309, 354, 370, 451, SOC 300, 325, 337, and 465. Six hours must be upper-level courses.

Archaeology Minor **21 hrs**
ARC 150, 300, 302, 304, 350, plus six hours of ARC electives 300-level or above. Six hours must be upper-level courses.

Earth Science Minor **21 hrs**
GSC 101, 102, 125, and 339 or 350. Six additional hours selected from the following: AST 115, 116; GSC 202, 210, 303, 310, 312, 336, 591, 592, 593. Six hours must be upper-level courses.

Environmental Geology Minor **21 hrs**
GSC 101, 102, 202, and three additional geology courses chosen with the advice and consent of the chair of the Department of Geosciences. Six hours must be upper-level courses.

Geographic Information Science Minor **21 hrs**
GSC 110, 125, 202, 305, and seven hours of electives selected from the following: GSC 312, 350, 507, 512, 521, 522, 591, 592, 593. Six hours must be upper-level courses.

Social Science Minor **24 hrs**
Open only to majors in economics, geosciences, history, or political science who seek secondary certification in social studies. ECO 231, GSC 110, HIS 221, POL 140, SOC 133; and six hours of upper level courses (300 or above) from the social science disciplines with approval of advisor. Courses required for a major may not be counted toward the minor; substitutions must be from a social science discipline other than the major and be approved by the advisor; and requirements for certification for teaching secondary school social studies, grades 8 through 12 through the College of Education must also be met. Six hours must be upper-level courses.

CERTIFICATE:

Geographic Information Science

CIP 45.0702

The certificate in GIScience program is designed to provide students fundamental knowledge of geographic information science necessary for today's diverse array of fields and disciplines. The certification program will provide students experience in data collection, data management methods and techniques, data visualization, data analysis and interpretation, and the principles and techniques to remote sensing. Student will gain experience using industry standard hardware and software to develop a variety of projects and explore sever GIScience applications.

Total Course Requirements 15 hours¹

GSC	202	Introduction to Geographic Information Science
GSC	512	Remote Sensing
GSC	521	Geographic Information Systems

One elective course from the following:

AGR	471	Applications in Precision Agriculture
CIS	307	Decision Support Technologies
CIS	317	Principles of Information Systems Analysis and Design
CSC	145	Introduction to Programming
CSC	232	Visual Basic Programming
CSC	310	Data Administration
CSC	345	Data Structures
GSC	305	Introduction to Cartography
GSC	507	Land Use Planning
GSC	522	Digital Cartography
GSC	570	Computer Applications in Geosciences
MKT	585	Integrated Business GIS

¹A grade of C or better must be earned in all courses.

Graduate Program

Graduate Coordinator - Haluk Cetin

The Department of Geosciences offers a Master of Science degree in Geosciences. Students choose the thesis or the non-thesis option. Four concentrations are offered for the thesis option: Environmental Geology, Geoarchaeology, Geoinformatics, and Watershed Sciences. Each student's program is developed in consultation with the graduate coordinator.

The **Environmental Geology Concentration** is an interdisciplinary master's program within the Jones College of Science, Engineering and Technology designed to prepare students for further graduate studies or careers in either the public or private sector. This concentration focuses on the chemical, physical, and biological aspects of environmental change both in the present and in the geologic past.

The **Geoarchaeology Concentration** is an interdisciplinary master's degree program designed to prepare students for further graduate studies or careers in the public or private sector. The geoarchaeology concentration offers students a broad range of options to develop a curriculum that matches their particular interests and needs. The geoarchaeology concentration emphasizes the relationship between human culture and the natural environment and provides opportunities to apply the principles and methods of geoscience research in an archaeological context.

The **Geoinformatics Concentration** is designed to prepare students for further graduate studies or careers in the field of geospatial information science and technology. Geospatial technology is a fast growing field with broad and multidisciplinary applications that has penetrated every aspect of our daily lives. The Geoinformatics Concentration provides students with up-to-date training on geospatial theory, application, and technology.

The **Watershed Science Concentration** is jointly sponsored between the Department of Geosciences and the Watershed Studies Institute (WSI). The Watershed Studies Institute program in Watershed Science is an interdisciplinary master's program within the Jones College of Science, Engineering and Technology designed to prepare students for careers or for further graduate studies in the broader aspects of watershed management and science. The student's program is developed in consultation with the graduate coordinator. Visit the Watershed Studies Institute site to learn more.

Geosciences is closely associated with the Mid-America Remote sensing Center (MARC) where hardware and software related to remote sensing and geographic information science are located. Students also have the opportunity to conduct research through activities of the department's Archaeology Laboratory.

Requirements for Admission

Applicants must meet the Murray State University requirements (see *Graduate Admissions*). The department requires that three letters of recommendation and GRE scores accompany application materials. A letter discussing reasons for the applicant's interest in the program should also be forwarded. Additional requirements for unconditional and conditional admission are as follows.

Unconditional

To qualify for unconditional admission, an applicant must have an overall grade point average of 3.0 (on a 4.0 scale) in a geoscience (or related) field and a composite GRE score (V+Q) of 1,000 old scale or 300 new scale.

Conditional

Students admitted conditionally are admitted to full standing after completing (1) any remedial courses required by the graduate

faculty and (2) one semester of graduate work with an overall grade point average of 3.0 or above.

Master of Science Geosciences

CIP 40.0699

Total Course Requirements 30 hours

GSC	612	Remote Sensing
GSC	619	Seminar in Research Techniques
GSC	621	Geographic Information Systems
GSC	680	Advanced Geographic Information Systems
GSC	696	Understanding Scientific Communication

Electives 14 hours

GSC courses, at 600-level (9-10 hrs)
GSC or related courses at 600-level (4-5)

Other Degree Requirements

Written and oral comprehensive examinations.

Master of Science Geosciences/ Environmental Geology Concentration

CIP 40.0699

Total Course Requirements 30 hours

GSC	619	Seminar in Research Techniques ^{PT}
GSC	621	Geographic Information Systems
GSC	696	Understanding Scientific Communication
GSC	698	Thesis Research ^{L, R}
GSC	699	Thesis Research ^{L, R}

Environmental Geology Restricted Electives 15 hours

Choose any two courses of the following (6-7 hours):

BIO	686	Limnology
CHE	665	Biogeochemistry
GSC	616	Isotope Geochemistry
GSC	633	Paleoecology
GSC	642	Watershed Ecology
GSC	680	Advanced Geographic Information Systems

Eight to nine hours from the following:

ARC	615	Environmental Archaeology
BIO	623	Physiological Ecology
BIO	625	Biogeography
BIO	632	Quantitative Ecology
BIO	646	Stream Ecology
BIO	678	Conservation Biology
BIO	690	Disturbance Ecology
CET	655	Environmental Regulatory Affairs
CET	681	Pollution Assessment and Control
CHE	613	Environmental Chemistry
GSC	636	Soils and Geomorphology
GSC	662	Hydrogeology
GSC	665	Physical/Chemical Limnology
GSC	691	Special Problems
GSC	692	Special Problems
GSC	693	Special Problems
MAT	665	Applied Statistics I
WSC	601	Seminar in Sustainability Studies

Other Degree Requirements

Defense of thesis.

Master of Science Geosciences/ Geoarchaeology Concentration

CIP 40.0699

Total Course Requirements 30 hours

ARC	600	Graduate Seminar in Archaeology
GSC	619	Seminar in Research Techniques ^{PT}
GSC	621	Geographic Information Systems
GSC	696	Understanding Scientific Communication
GSC	698	Thesis Research ^{L, R}
GSC	699	Thesis Research ^{L, R}

Geoarchaeology Restricted Electives 12 hours

Choose one course from the following:

ARC	602	Graduate Archaeological Field Work
GSC	636	Soils and Geomorphology
GSC	656	Geophysical Surveying

Choose nine hours from the following:

ARC	604	Archaeological Laboratory Systems
ARC	605	Archaeological Information Systems
ARC	610	Landscape Archaeology
ARC	615	Environmental Archaeology
GSC	612	Remote Sensing
GSC	680	Advanced Geographic Information Systems
GSC	691	Special Problems
GSC	692	Special Problems
GSC	693	Special Problems
MAT	665	Applied Statistics I
WSC	601	Seminar in Sustainability Studies

Other Degree Requirements

Defense of thesis.

Master of Science Geosciences/ Geoinformatics Concentration

CIP 40.0699

Total Course Requirements 30 hours

GSC	619	Seminar in Research Techniques ^{PT}
GSC	621	Geographic Information Systems
GSC	696	Understanding Scientific Communication
GSC	698	Thesis Research ^{L, R}
GSC	699	Thesis Research ^{L, R}

Required Concentration Courses 10 hours

GSC	612	Remote Sensing
GSC	640	Advanced Remote Sensing
GSC	680	Advanced Geographic Information Systems

Geoinformatics Restricted Electives 5 hours

Choose from the following:

CIS	609	Data Warehouses and Business Intelligence
CIS	615	Information System Security
GSC	622	Digital Cartography
GSC	641	Digital Image Processing Research
GSC	656	Geophysical Surveying
GSC	660	Spatial Analysis Techniques
GSC	661	Precision GIS/GPS Applications
GSC	678	Terrestrial Ecosystem Modeling
GSC	679	Remote Sensing of Vegetation
GSC	691	Special Problems
GSC	692	Special Problems
GSC	693	Special Problems
MAT	665	Applied Statistics I

Other Degree Requirements

Defense of thesis.

**Master of Science Geosciences/
Watershed Science Concentration**

CIP 40.0699

Total Course Requirements..... 30 hours

GSC	619	Seminar in Research Techniques ^{PT}
GSC	621	Geographic Information Systems
GSC	642	Watershed Ecology
GSC	696	Understanding Scientific Communication
GSC	698	Thesis Research ^{L, R}
GSC	699	Thesis Research ^{L, R}

Watershed Science Restricted Electives 5 hours

Courses must be approved by the advisory committee and represent at least two disciplines.

AGR	674	Agricultural Irrigation and Water Systems
BIO	625	Biogeography
BIO	630	Animal Ecology
BIO	631	Plant Ecology
BIO	632	Quantitative Ecology
BIO	646	Stream Ecology
BIO	661	Freshwater Invertebrates
BIO	663	Aquatic Entomology
BIO	668	Wetland Ecology
BIO	669	Biological Limnology
BIO	670	Limnological Analysis Laboratory
BIO	671	Ichthyology
BIO	672	Herpetology
BIO	678	Conservation Biology
BIO	682	Waterfowl Management
BIO	683	Fisheries Management
BIO	686	Limnology
BIO	687	Freshwater Biology
BIO	688	Reservoir Ecology
BIO	690	Disturbance Ecology
CET	655	Environmental Regulatory Affairs
CET	681	Pollution Assessment and Control
CET	685	Remediation Technology
CHE	613	Environmental Chemistry
CHE	617	Advanced Organic Chemistry
CHE	627	Chemical Separations
CHE	628	Mass Spectrometry
CHE	665	Biogeochemistry
GSC	616	Isotope Geochemistry
GSC	636	Soils and Geomorphology
GSC	640	Advanced Remote Sensing
GSC	641	Digital Image Processing Research
GSC	643	Soil Micromorphology
GSC	662	Hydrogeology
GSC	665	Physical/Chemical Limnology
GSC	678	Terrestrial Ecosystem Modeling
GSC	679	Remote Sensing of Vegetation
GSC	680	Advanced Geographic Information Systems

Other Degree Requirements

Successful completion of MAT 665 Applied Statistics I if substituted for GSC 619.

Written and oral comprehensive examinations as specified by the advisory committee in broad aspects of watershed science and area of concentration (usually taken in third semester of residence).

Defense of thesis.

CERTIFICATE:**Geospatial Data Science**

CIP 45.0702

The Certificate in Geospatial Data Science (cGDS) program is designed to complement interdisciplinary graduate and professional degree programs in data science and to provide specialized set of courses emphasizing geospatial science and technology for students to gain professional skills and/or knowledge. The certification program will support professionals working in geospatial field and will provide experience using industry and federal data standards and methodologies for data acquisition/input, manipulation, analysis, modeling and output. It will also add value to traditional computer science and geography discipline areas, such as big data analytics, remote sensing, geographic information systems (GIS) and science, and CyberGIS.

A grade of C or better must be achieved in all courses for successful completion of the certificate program. Students may transfer up to six credit hours of equivalent graduate courses into the program.

Requirements for Admission

Students who hold an undergraduate or a graduate degree, or are currently enrolled in a graduate or professional degree program may apply for the Certificate in Geospatial Data Science program. Applicants must comply with the Murray State University requirements (see *Graduate Admissions*).

Unconditional Admission

To qualify for unconditional admission, an applicant must have an overall grade point average of 3.0 (on a 4.0 scale).

Conditional Admission

Students admitted conditionally are admitted to full standing after completing

(1) any remedial courses required by the Program Coordinator and

(2) one semester of graduate work with an overall grade point average of 3.0 or above.

Total Course Requirements..... 14 hours

GSC	612	Remote Sensing
GSC	621	Geographic Information Systems
GSC	693	Special Problems

Required Limited Electives..... 3 hours

Choose from the following approved electives:

BUS	684	Seminar in Geospatial Tools in Business
CIS	609	Data Warehouses and Business Intelligence
CIS	643	Advanced Business Analytics
CIS	646	Manager's Guide to Database
CIS	695	Comprehensive Project in Computer Information Systems
GSC	640	Advanced Remote Sensing
GSC	660	Spatial Analysis Techniques
GSC	678	Terrestrial Ecosystem Modeling
GSC	679	Remote Sensing of Vegetation
GSC	680	Advanced Geographic Information Systems (GIS)
GSC	691	Special Problems
GSC	692	Special Problems
GSC	696	Understanding Scientific Communication
MKT	685	Seminar in Marketing Location Analytics
TSM	615	Information System Security

Institute of Engineering

263A Collins Center
270-809-3392

Chair: Danny Claiborne. **Faculty:** Bahadir, Bunget, Claiborne, Crofton, Ford, Giltner, Hereford, Hildebrandt, Kemp, Kobraei, Leedy, Lopez, Martin, Okuda, Ottway, Palmer, Payne, Perry, Ridley, Rogers, Schneiderman, Siebold, Thiede, Tubbs, Yarali, Zirbel.

The Institute of Engineering offers undergraduate programs in engineering, engineering technology, engineering graphics and design, physics and telecommunications systems management. It also offers a graduate program in applied engineering and technology management.

Murray State University offers a Bachelor of Science in Engineering (B.S.E.) as a major in engineering physics. The Engineering Physics program has four tracks in mechanical engineering, electrical engineering, biomedical engineering and advanced physics. In all of these areas, students will learn to use advanced analytical techniques in solving engineering problems, and will develop the applied background to attack new engineering challenges.

Murray State's Engineering Physics degree is an engineering program accredited by the Engineering Accreditation Commission of ABET (EAC/ABET). This accreditation will place a student on the pathway to become a licensed engineer in Kentucky and throughout the country. Recognition by this organization has been earned by 22 Engineering Physics programs nationwide.

The Institute of Engineering offers strong undergraduate programs in engineering technology, which are: architectural engineering technology, civil engineering technology, construction engineering technology, electromechanical engineering technology, environmental engineering technology, manufacturing engineering technology, and surveying engineering technology. Graduates from these programs are prepared to succeed in a modern industrial environment.

The Institute also offers an engineering graphics and design program. Graduates from this program are able to apply product and process design for products related to manufacturing or mechanical design.

Students interested in physics have two degree options. The traditional physics major is accompanied by a flexible area in applied physics, where a student can design curricular choices to fit their chosen professional goals. These degrees are well-suited to students desiring teaching certification, or intending to pursue graduate degrees or corporate/industrial research positions.

Kentucky's Program of Distinction in Telecommunications Systems Management (TSM) is also offered by the Institute of Engineering. The TSM program is actually an interdisciplinary program between the Jesse D. Jones College of Science, Engineering and Technology and the Arthur J. Bauernfeind College of Business. The TSM program prepares graduates to work on cutting-edge information technologies related to wireless technology, security, and network administration while also applying concepts toward business decisions and critical strategic planning as it relates to telecommunications systems.

Engineering Accreditation

The B.S.E. in Engineering Physics (including all tracks in biomedical, electrical, mechanical and advanced physics) is an engineering program accredited by the Engineering Accreditation Commission of ABET, <http://www.abet.org>. This accreditation will place a student on the pathway to become a licensed engineer in Kentucky and throughout the country.

Engineering Technology Accreditation

The Engineering Technology Accreditation Commission of ABET (ETAC/ABET) accredits Murray State programs in civil and construction engineering technology. The Civil Engineering Technology/General Track and the Civil Engineering Technology/Construction Track programs are accredited by the Engineering Technology Accreditation Commission of ABET, <http://www.abet.org>.

AREA:

Engineering Physics¹

Bachelor of Science in Engineering

CIP 14.1201

ACCREDITED BY: Engineering Accreditation Commission of ABET, <http://www.abet.org>

University Studies Requirements 42 hrs
(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

CHE 201 General College Chemistry²

MAT 250 Calculus and Analytic Geometry I²

PHY 235 Mechanics, Heat and Wave Motion

•Social and Self-Awareness and Responsible Citizenship

ECO 231 Principles of Microeconomics

or

HON 232 Honors Seminar in Economics

•University Studies Electives

MAT 308 Calculus and Analytic Geometry II²

PHY 236 Mechanics, Heat and Wave Motion Laboratory

Core Courses 56 hrs

EGR 100T Transitions

EGR 101 Introduction to Engineering

EGR 140 Introduction to Computing Applications in Science and Engineering

EGR 240 Thermodynamics I

EGR 259 Statics

EGR 264 Linear Circuits I

EGR 330 Dynamics

EGR 363 Signals and Systems

EGR 375 Materials Science

EGR 390 Engineering Measurements

EGR 460 Electricity and Magnetism I

EGR 498 Senior Engineering Design I

EGR 499 Senior Engineering Design II

MAT 309 Calculus and Analytic Geometry III²

MAT 338 Ordinary Differential Equations²

PHY 255 Electricity, Magnetism and Light

PHY 256 Electricity, Magnetism and Light Laboratory

PHY 370 Introduction to Modern Physics

PHY 470 Optics

Technical Electives³ 18 hrs

Each student must complete at least 18 hours of technical electives. A minimum of 12 technical elective credit hours must be EGR courses. Completion of a track is encouraged but not required. Twelve credit hours must be exclusive to each track for multi-track students. A maximum of six technical elective credit hours may come from combinations of EGR/PHY 488, 489, 520, and EGR 388.

Advanced Physics

Select nine hours of 300-level and above PHY courses beyond the core course requirements.

Completion of at least 18 hours is required in this track (12 hours must be EGR prefix courses).

Aerospace Engineering

EGR 320 Fundamentals of Flight
 EGR 359 Mechanics of Materials
 EGR 420 Aerodynamics
and one of the following:
 EGR 422 Propulsion
 EGR 440 Thermal and Fluid Systems Laboratory
 PHY 316 Introductory Astrophysics and Space Physics
 or

any mechanical engineering track course

Completion of at least 18 hours is required in this track (12 hours must be EGR prefix courses). Remaining six hours of electives must be advisor approved.

Biomedical Instrumentation³

BIO 115 The Cellular Basis of Life
 CHE 202 General Chemistry and Qualitative Analysis
 EGR 310 Fundamentals of Biomedical Engineering
and one of the following:
 EGR 392 Nondestructive Testing
 EGR 425 Bio-inspired Intelligent Systems
 any electrical engineering track course

Completion of at least 18 hours is required in this track (12 hours must be EGR prefix courses). Remaining four hours of electives must be advisor approved.

Electrical Engineering

Select four of the following courses:

EGR 360 Electric Machines
 EGR 366 Analog Electronics I
 EGR 376 Computational Analysis in Engineering
 EGR 378 Logic Design I
 EGR 425 Bio-inspired Intelligent Systems
 EGR 461 Electricity and Magnetism II
 EGR 463 Power Systems
 EGR 466 Power Electronics
 EGR 468 Digital Signal Processing

Completion of at least 18 hours is required in this track (12 hours must be EGR prefix courses). Remaining five to six hours of electives must be advisor approved.

Mechanical Engineering

EGR 344 Fluid Mechanics
 EGR 359 Mechanics of Materials

Select two of the following courses:

EGR 342 Thermodynamics II
 EGR 346 Heat Transfer
 EGR 392 Nondestructive Testing
 EGR 430 Mechanical Vibrations
 EGR 433 Control Systems
 EGR 450 Mechanics and Materials Laboratory
 EGR 459 Mechanical Design
 EGR 475 Solid-State Physics and Engineering
 ITD 102 CAD Applications

Any aerospace engineering track course

Completion of at least 18 hours is required in this track (12 hours must be EGR prefix courses). Remaining six hours of electives must be advisor approved.

Mathematics Depth Elective⁴ 3-4 hrs

Each student must complete a mathematics depth elective chosen from MAT 335, 440, 442, 460, 508, 512, 513, 522, 523, 524, 525, 535, 538, 542, 545, 570; STA 450, 540, 541, 554 or as approved by the department chair.

Unrestricted Elective 0-1 hrs

The use of an unrestricted elective will depend on the number or hours taken from Technical Electives or the Mathematics Depth Elective.

Total Curriculum Requirements 120 hrs

¹This degree program has been approved by the Kentucky Education Professional Standards Board as a track for secondary education certification in physics. Students seeking certification via this track must complete the Engineering Physics curriculum and the courses required for secondary certification. For current information, students should consult an advisor in the Department of Adolescent, Career and Special Education and with Teacher Education Services.

²This course is considered a program corequisite and may be shared with a minor or second major.

³Students completing the track in biomedical instrumentation and intending to seek admission to medical school are encouraged to complete the following: BIO 321, 322, 333; CHE 312, 320, 325.

⁴Technical Electives must come from the courses listed in the elective tracks or EGR/PHY courses, 300-level and above, or as approved by department chair.

Engineering Science Minor 22 hrs

EGR 240, 259, 264, and 330, plus nine additional hours of engineering-related courses approved by an advisor in the Department of Engineering and Physics. Six hours must be upper-level courses.

Pre-Engineering Curriculum (64 hrs)

CHE 201 General College Chemistry
 CHE 202 General Chemistry and Qualitative Analysis
 EGR 140 Introduction to Computing Applications in Science and Engineering
 MAT 250 Calculus and Analytic Geometry I
 MAT 308 Calculus and Analytic Geometry II
 MAT 309 Calculus and Analytic Geometry III
 MAT 338 Ordinary Differential Equations
 PHY 235 Mechanics, Heat and Wave Motion
 PHY 236 Mechanics, Heat and Wave Motion Laboratory
 PHY 255 Electricity, Magnetism and Light
 PHY 256 Electricity, Magnetism and Light Laboratory
 University Studies courses
 Discipline-specific courses

MAJOR:

Physics

Bachelor of Science/Bachelor of Arts

CIP 40.0801

University Studies Requirements 38-44 hrs

(See *Academic Degrees and Programs*.)

Note: See required courses below before selecting Scientific Inquiry, Methodologies, and Quantitative Skills University Studies electives.

Required Courses 32 hrs

EGR 140 Introduction to Computing Applications in Science and Engineering
 EGR 240 Thermodynamics I
 EGR 390 Engineering Measurements
 PHY 100T Transitions
 PHY 235 Mechanics, Heat and Wave Motion
 PHY 236 Mechanics, Heat and Wave Motion Laboratory
 PHY 255 Electricity, Magnetism and Light
 PHY 256 Electricity, Magnetism and Light Laboratory
 PHY 460 Electricity and Magnetism I
 PHY 470 Optics
 PHY 530 Mechanics I
 PHY 580 Modern Physics I

Co-requirements for Major..... 6 hrs		
CHE	201	General College Chemistry ^{1,2}
CHE	202	General Chemistry and Qualitative Analysis ^{1,2}
CSC	420	Numerical Analysis I
or		
MAT	442	Introduction to Numerical Analysis ²
MAT	250	Calculus and Analytic Geometry I ^{1,2}
MAT	308	Calculus and Analytic Geometry II ^{1,2}
MAT	309	Calculus and Analytic Geometry III ^{1,2}
MAT	338	Ordinary Differential Equations ²

Required Limited Electives..... 3 hrs
 PHY/EGR courses numbered 300 or above.

Required Minor 3-21 hrs²

Unrestricted Electives..... 14-20 hrs

Total Curriculum Requirements 120 hrs

¹Fulfill University Studies requirements. Required for major if not taken as a University Studies requirement.

²CHE 201 and 202 fulfill requirements for a minor in chemistry; MAT 250, 308, 309, 338, and 442 fulfill requirements for a minor in math.

MAJOR:

Physics/Secondary Certification (Grades 8-12)

Bachelor of Science/Bachelor of Arts

CIP 40.0801

NOTE: Requirements for teacher certification are established by the Kentucky Education Professional Standards Board. Students are cautioned that changes in these requirements may occur. For current information, student should check with an advisor in the Department of Adolescent, Career and Special Education and with Teacher Education Services.

University Studies Requirements 38-44 hrs
 (See *Academic Degrees and Programs*.)

University Studies selections must include:

•Social and Self-Awareness and Responsible Citizenship

EDP 260 Psychology of Human Development

Note: Certification requires a grade of B or better in one English composition course and a B or better in a University Studies math course, public speaking, and EDU 103 or equivalent course. Additional requirements for admission to teacher education and student teaching must be met. See advisor and/or Office of Teacher Education Services for details.

Required Courses 32 hrs

EGR	140	Introduction to Computing Applications in Science and Engineering
EGR	240	Thermodynamics I
EGR	390	Engineering Measurements
PHY	100T	Transitions
PHY	235	Mechanics, Heat and Wave Motion
PHY	236	Mechanics, Heat and Wave Motion Laboratory
PHY	255	Electricity, Magnetism and Light
PHY	256	Electricity, Magnetism and Light Laboratory
PHY	460	Electricity and Magnetism I
PHY	470	Optics
PHY	530	Mechanics I
PHY	580	Modern Physics I

Co-requirements for Major..... 6 hrs

CHE	201	General College Chemistry ^{1,2}
CHE	202	General Chemistry and Qualitative Analysis ^{1,2}
CSC	420	Numerical Analysis I
or		
MAT	442	Introduction to Numerical Analysis ²

MAT	250	Calculus and Analytic Geometry I ^{1,2}
MAT	308	Calculus and Analytic Geometry II ^{1,2}
MAT	309	Calculus and Analytic Geometry III ^{1,2}
MAT	338	Ordinary Differential Equations ²

Required Limited Electives..... 3 hrs
 PHY/EGR courses numbered 300-level or above.

Required for Secondary Certification 35 hrs

EDU	103	Issues and Practices of American Education ³
EDU	303	Strategies of Teaching
EDU	403	Structures and Foundations of Education
EDU	405	Evaluation and Measurement in Education ⁴
REA	427	Teaching Content Area Literacy in the Secondary School
SEC	420	Practicum in Secondary Schools ⁴
SEC	421	Student Teaching in the Secondary School
SEC	422	Extended Practicum ⁵
SED	300	Educating Students with Disabilities

Required Minor 3-21 hrs²

Total Curriculum Requirements 120-123 hrs

¹Fulfill University Studies requirements. Required for major if not taken as a University Studies requirement.

²CHE 201 and 202 fulfill requirements for a minor in chemistry; MAT 250, 308, 309, 338 and 442 fulfill requirements for a minor in math.

³With a grade of B or better.

⁴EDU 405 and SEC 420 must be taken together and two semesters before student teaching.

⁵Must be taken one semester before student teaching.

Physics Teaching Specialization

The teaching specialization in physics is a path to secondary certification in physics, designed to accompany certification in another science content area. (All College of Education and Human Services secondary certification course requirements must be met.)

Note: Even though this program exceeds Murray State University's requirements for a physics minor, in order for a physics minor to appear on a transcript, a minor must be declared, and all residential and graduation requirements must be met.

Requirements for teacher certification are established by the Kentucky Education Professional Standards Board and changes in these requirements may occur. Students should check with an advisor in the College of Education and Human Services for the most current information.

AST	115	Introductory Astronomy
AST	116	Introductory Astronomy Laboratory
MAT	250	Calculus and Analytic Geometry I ¹
MAT	308	Calculus and Analytic Geometry II ²
PHY	235	Mechanics, Heat and Wave Motion
PHY	236	Mechanics, Heat and Wave Motion Laboratory
PHY	255	Electricity, Magnetism and Light
PHY	256	Electricity, Magnetism and Light Laboratory
PHY	370	Introduction to Modern Physics

Required Limited Electives..... 9 hrs
 PHY/EGR courses numbered 300-level or above.

Physics Teaching Specialization 36 hrs

¹Corequisite of PHY 235.

²Corequisite of PHY 255.

AREA:

Applied Physics

Bachelor of Science/Bachelor of Arts

CIP 40.0801

University Studies Requirements 38-44 hrs

(See *Academic Degrees and Programs*.)

Note: See required courses below before selecting Scientific Inquiry, Methodologies, and Quantitative Skills University Studies electives.

Required Courses 33 hrs

EGR	140	Introduction to Computing Applications in Science and Engineering
EGR	240	Thermodynamics I
EGR	264	Linear Circuits I
PHY	100T	Transitions
PHY	235	Mechanics, Heat and Wave Motion
PHY	236	Mechanics, Heat and Wave Motion Laboratory
PHY	255	Electricity, Magnetism and Light
PHY	256	Electricity, Magnetism and Light Laboratory
PHY	370	Introduction to Modern Physics
or		
PHY	580	Modern Physics I
PHY	460	Electricity and Magnetism I
PHY	470	Optics
PHY	530	Mechanics I

Co-requirements for Area 6 hrs

CHE	201	General College Chemistry ^{1,2}
CHE	202	General Chemistry and Qualitative Analysis ^{1,2}
CSC	420	Numerical Analysis I
or		
MAT	442	Introduction to Numerical Analysis ²
MAT	250	Calculus and Analytic Geometry I ^{1,2}
MAT	308	Calculus and Analytic Geometry II ^{1,2}
MAT	309	Calculus and Analytic Geometry III ^{1,2}
MAT	338	Ordinary Differential Equations ²

Technical Electives³ 24 hrs

Unrestricted Electives 13-19 hrs

Total Curriculum Requirements 120 hrs

¹Fulfill University Studies requirements. Required for area if not taken as a University Studies requirement.

²This course is considered a program corequisite and may be shared with a minor or second major.

³The technical electives are to be a coherent set of courses chosen to supply depth and breadth necessary for the pursuit of a particular career objective. The chosen electives must be approved by a departmental curriculum committee.

AREA:

Applied Physics/Pre-MBA Track

Bachelor of Science/Bachelor of Arts

CIP 40.0801

Students who wish to complete a scientific course of study and qualify for admission to Murray State's Master of Business Administration program may follow the Applied Physics Curriculum/Pre-MBA track. Course requirements are identical to those listed under the Applied Physics program, with the exception of technical electives. Technical electives must be chosen in accordance with MBA admission guidelines, and are as follows:

Pre-MBA Required Electives 27 hrs

ACC	200	Principles of Financial Accounting
ACC	201	Principles of Managerial Accounting

BUS	355	Information Systems and Decision Making
CIS	443	Business Statistics III
ECO	230	Principles of Macroeconomics
ECO	231	Principles of Microeconomics
FIN	330	Principles of Finance
MGT	350	Fundamentals of Management
MKT	360	Principles of Marketing

Unrestricted Electives 6 hrs

Astronomy Minor 21 hrs

AST 115, 116, 316; PHY 130, 131, 132, 133, and six additional hours of approved astronomy courses numbered 300 and above. PHY 235 and 255 may be substituted for PHY 130 and 132 with approval from the department chair. Physics majors must take CHE 201 and GSC 101 in place of PHY 130, 131, 132, and 133. Six hours must be upper-level courses.

Physics Minor 22 hrs

PHY 235, 236, 255, 256, 370, and nine additional hours of approved physics (PHY) or engineering physics (EGR) courses numbered 300 and above. PHY 130 and 131 may be substituted for PHY 235 and 236; PHY 132 and 133 may be substituted for 255 and 256, with approval from the department chair. Six hours must be upper-level courses.

Engineering Technology Accreditation

The Technology Accreditation Commission of ABET (TAC/ABET) accredits Murray State programs in civil and construction engineering technology. The Civil Engineering Technology/General Track and the Civil Engineering Technology/Construction Track programs are accredited by the Technology Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012. Phone (410) 347-7700.

Professional Licensure

Students interested in pursuing a career as a professional land surveyor must complete courses specified by the Kentucky Board of Licensure for Professional Engineering and Land Surveyors (www.boels.ky.gov). Required courses may be taken as electives by students in the Civil Engineering Technology program under the supervision of an advisor. Students completing Board requirements normally sit for the Fundamentals of Surveying exam in their last semester at Murray State University.

Engineering Technology

The Engineering Technology programs are: Architectural Engineering Technology, Civil Engineering Technology, Construction Engineering Technology, Electromechanical Engineering Technology, and Environmental Engineering Technology.

Civil Engineering Technology

A baccalaureate degree in civil engineering technology provides students with a background in the design of steel and concrete structures, surveying, soil mechanics and foundations, construction materials, and engineering mechanics. Potential employers include construction companies, consulting engineering and architectural firms, state and federal governments, municipalities, testing laboratories, surveying firms, utilities, and materials suppliers.

The civil engineering technology program prepares graduates for careers in design (working with a team of engineers or architects in the preparation of engineering or architectural design documents), construction (as a field engineer, project engineer, or surveyor), or technical sales. An associate degree in civil engineering technology may also be obtained from Murray State University.

Architectural Engineering Technology

A baccalaureate degree in architectural engineering technology provides students with a background in architectural design, computer-aided design, building structures and structural design, steel and concrete structures, surveying and site planning, and construction estimating. Potential employers include architectural firms, construction (design/build) companies, consulting engineering firms, state and federal governments, municipalities, materials suppliers, and utilities. Architectural engineering technologists are educated in the process of taking a project from the drawing to the completed structure. Working together with architects and engineers, they assist in producing drawings and specifications for major construction projects. Architectural engineering technology prepares graduates for careers in architectural design, planning, development, and construction as well as technical or sales positions in a variety of manufacturing organizations associated with the building industry. An architectural engineering technology graduate seeking registration/licensure as an architect would usually pursue a Master of Architecture degree, typically requiring two or three years of additional study.

Construction Engineering Technology

A baccalaureate degree in construction engineering technology provides students with experience in construction, estimating, project management, scheduling, surveying, building structures, construction materials, and engineering mechanics. The curriculum stresses the application of technical knowledge, construction methods, problem-solving ability, and communication skills toward the completion of large-scale construction projects. Career opportunities for the construction-engineering technologist are as diverse as the industry. Potential employers include construction companies, general contractors, subcontractors, construction equipment and materials suppliers, testing laboratories, governments, industrial companies, and utilities.

The construction engineering technology program prepares graduates for supervisory and managerial careers within the construction industry. With a degree in construction engineering technology, the student will be qualified for an entry-level position as a construction project engineer, project manager, estimator, sales engineer, or field engineer.

Environmental Engineering Technology

A baccalaureate degree in environmental engineering technology provides graduates with backgrounds in municipals and industrial water and wastewater treatment system design and operations, water pollution control, solid and hazardous waste management and site remediation, air pollution control, and environmental regulatory compliance. Course work includes field and laboratory sampling and analysis plus design of pollution control systems.

Graduates obtain careers with industries, environmental consultants and remediation contractors, municipalities, testing laboratories, state or federal government agencies, and chemical manufacturing corporations.

Electromechanical Engineering Technology

A baccalaureate degree in electromechanical engineering technology provides students with backgrounds in mechanical and electrical systems, fluid power, controls, and industrial networks. Electromechanical graduates work in manufacturing and process plant engineering, operation, maintenance, new product design, systems design, system analysis, and systems integration.

The electromechanical engineering technologist is a blend of mechanical and electrical engineering technology, computer science, information technology, and control systems. Graduates have broad application backgrounds in automation, electronics, data acquisition, controls, programming, and mechanical and electrical science prin-

ciples. This allows students to understand the design and operation of systems found in the plant environment.

Manufacturing Engineering Technology

A baccalaureate degree in manufacturing engineering technology provides students with a broad range of knowledge and skills related to industry and industrial supervision. Graduates from this program are exposed to the applied aspects of industrial processes, production systems, production management, computer integrated design, manufacturing systems, human relations and human resource development. The graduates from this program will generally work in one of a variety of industries working directly with engineers, designers, and production personnel as supervisors and technical support, utilizing skills in computer numerical control, hydraulics, machine tool processes, CAD, CAM, computer integration, industrial automation and system integration. Additional skills in electrical systems, accounting, marketing, human resource management and business management allows graduates to work in a variety of industrial environments.

Civil Engineering Technology

Associate of Science

CIP 15.0201

University Studies Requirements 23 hrs
(See *Academic Degrees and Programs*.)

University Studies selections must include:

•**Scientific Inquiry, Methodologies, and Quantitative Skills**

PHY 130 General Physics I
PHY 131 General Physics I Laboratory

Required Courses 32 hrs

CET 280 Plane Surveying
CET 284 Sustainable Design and Construction
CET 385 Construction Estimating I
ENG 324 Technical Writing
ENT 100T Transitions
ENT 287 Statics for Technology
ENT 358 Mechanical and Electrical Systems
ITD 107 Introduction to Technical Drawing and Computer-Aided Drafting

Support Courses 13 hrs

GSC 101 The Earth and the Environment
MAT 130 Technical Math I
PHY 132 General Physics II
PHY 133 General Physics II Laboratory

Total Curriculum Requirements 62 hrs

AREA:

Civil Engineering Technology/General Track

Bachelor of Science

CIP 15.0201

This track is ACCREDITED BY: Engineering Technology Accreditation Commission of ABET, <http://www.abet.org>

University Studies Requirements 44 hrs
(See *Academic Degrees and Programs*.)

University Studies selections must include:

•**Scientific Inquiry, Methodologies, and Quantitative Skills**

MAT 130 Technical Math I
PHY 130 General Physics I and
PHY 131 General Physics I Laboratory
PHY 132 General Physics II and
PHY 133 General Physics II Laboratory

•**Social and Self-Awareness and Responsible Citizenship**

ECO 230 Principles of Macroeconomics

•**University Studies Electives**

GSC 101 The Earth and the Environment

MAT 230 Technical Math II

Core Courses 41 hrs

CET 280 Plane Surveying

CET 284 Sustainable Design and Construction

CET 385 Construction Estimating I

CET 480 Construction Planning and Management

ENG 324 Technical Writing

ENT 100T Transitions

ENT 287 Statics for Technology

ENT 358 Mechanical and Electrical Systems

ENT 382 Hydraulics

ENT 393 Engineering Economy

ENT 419 Senior Project I

IOE 125 Analytic Methods in Engineering Technology

IOE 399 Professional Development Seminar I

IOE 488 Cooperative Education/Internship

ITD 107 Introduction to Technical Drawing and
Computer-Aided Drafting

Required Courses 26 hrs

CET 298 Strength of Materials

CET 370 Route Surveying

CET 410 Transportation Systems and Design

CET 481 Structural Steel Design

CET 482 Reinforced Concrete Design

CET 483 Construction Materials

CET 484 Soil Mechanics and Foundations

ENT 286 Introduction to Environmental Engineering Technology

Emphasis 9-11 hrs

Choose one area of emphasis below:

Civil

GSC 202 Introduction to Geographic Information Science

GSC 507 Land Use Planning

ITD 301 Architectural Design Studio I

Construction

CET 386 Construction Estimating II

CET 490 Construction Scheduling and Methods

ITD 301 Architectural Design Studio I

Environmental

CET 330 Water Quality Technology I

CET 331 Water Quality Technology II

CET 585 Remediation Technology

Total Curriculum Requirements 120-122 hrs

**AREA: Civil Engineering Technology/
Architectural Engineering Technology Track**

Bachelor of Science

CIP 15.0201

University Studies Requirements 44 hrs

(See *Academic Degrees and Programs*.)

University Studies selections must include:

•**Scientific Inquiry, Methodologies, and Quantitative Skills**

MAT 130 Technical Math I

PHY 130 General Physics I

PHY 131 General Physics I Laboratory

PHY 132 General Physics II

PHY 133 General Physics II Laboratory

•**Social and Self-Awareness and Responsible Citizenship**

ECO 230 Principles of Macroeconomics

•**University Studies Electives**

GSC 101 The Earth and the Environment

MAT 230 Technical Math II

Core Courses 41 hrs

CET 280 Plane Surveying

CET 284 Sustainable Design and Construction

CET 385 Construction Estimating I

CET 480 Construction Planning and Management

ENG 324 Technical Writing

ENT 100T Transitions

ENT 287 Statics for Technology

ENT 358 Mechanical and Electrical Systems

ENT 382 Hydraulics

ENT 393 Engineering Economy

ENT 419 Senior Project I

IET 125 Analytical Methods in Engineering Technology

IET 399 Professional Development Seminar I

IET 488 Cooperative Education/Internship

ITD 107 Introduction to Technical Drawing and
Computer-Aided Drafting

Track Courses 35 hrs

CET 298 Strength of Materials

CET 310 Anatomy of Buildings

CET 481 Structural Steel Design

CET 482 Reinforced Concrete Design

CET 483 Construction Materials

ITD 104 Computer Aided Design

ITD 301 Architectural Design I

ITD 401 Architectural Design II

ITD 503 Architectural Design III

Total Curriculum Requirements 120 hrs

**AREA: Civil Engineering Technology/
Construction Engineering Technology Track**

Bachelor of Science

CIP 15.0201

This track is ACCREDITED BY: Engineering Technology Accreditation
Commission of ABET, <http://www.abet.org>

University Studies Requirements 44 hrs

(See *Academic Degrees and Programs*.)

University Studies selections must include:

•**Scientific Inquiry, Methodologies, and Quantitative Skills**

MAT 130 Technical Math I

PHY 130 General Physics I

PHY 131 General Physics I Laboratory

PHY 132 General Physics II

PHY 133 General Physics II Laboratory

•**Social and Self-Awareness and Responsible Citizenship**

ECO 230 Principles of Macroeconomics

•**University Studies Electives**

GSC 101 The Earth and the Environment

MAT 230 Technical Math II

Core Courses 41 hrs

CET 280 Plane Surveying

CET 284 Sustainable Design and Construction

CET	385	Construction Estimating I
CET	480	Construction Planning and Management
ENG	324	Technical Writing
ENT	100T	Transitions
ENT	287	Statics for Technology
ENT	358	Mechanical and Electrical Systems
ENT	382	Hydraulics
ENT	393	Engineering Economy
ENT	419	Senior Project
IET	125	Analytical Methods in Engineering Technology
IET	399	Professional Development Seminar I
IET	488	Cooperative Education/Internship
ITD	107	Introduction to Technical Drawing and Computer-Aided Drafting

Track Courses 35 hrs

ACC	200	Principles of Financial Accounting
CET	298	Strength of Materials
CET	310	Anatomy of Buildings
CET	386	Construction Estimating II
CET	481	Structural Steel Design
CET	482	Reinforced Concrete Design
CET	483	Construction Materials
CET	484	Soil Mechanics and Foundations
CET	490	Construction Scheduling and Methods
MGT	350	Fundamentals of Management
OSH	384	Construction Safety

Total Curriculum Requirements 120 hrs

**AREA: Civil Engineering Technology/
Environmental Engineering Technology Track**

Bachelor of Science CIP 15.0201

University Studies Requirements 44 hrs
(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

MAT	130	Technical Math I
PHY	130	General Physics I
PHY	131	General Physics I Laboratory
PHY	132	General Physics II
PHY	133	General Physics II Laboratory

•Social and Self-Awareness and Responsible Citizenship

ECO	230	Principles of Macroeconomics
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•University Studies Electives

GSC	101	The Earth and the Environment
MAT	230	Technical Math II

Core Courses 41 hrs

CET	280	Plane Surveying
CET	284	Sustainable Design and Construction
CET	385	Construction Estimating I
CET	480	Construction Planning and Management
ENG	324	Technical Writing
ENT	100T	Transitions
ENT	287	Statics for Technology
ENT	358	Mechanical and Electrical Systems
ENT	382	Hydraulics
ENT	393	Engineering Economy
ENT	419	Senior Project
IET	125	Analytical Methods in Engineering Technology
IET	399	Professional Development Seminar I

IET	488	Cooperative Education/Internship
ITD	107	Introduction to Technical Drawing and Computer-Aided Drafting

Track Courses 37 hrs

CET	330	Water Quality Technology I
CET	331	Water Quality Technology II
CET	342	Air Quality Technology
CET	353	Solid and Hazardous Waste Management
CET	555	Environmental Regulatory Affairs
CET	585	Remediation Technology
CHE	111	Essentials of Chemistry and Biochemistry
ENT	286	Introduction to Environmental Engineering Technology
ENT	400	Energy Management
GSC	202	Introduction to Geographic Information Science
STA	135	Probability and Statistics

Total Curriculum Requirements 122 hrs

**AREA: Civil Engineering Technology/
Surveying Engineering Technology Track**

Bachelor of Science

CIP 15.0201

University Studies Requirements 44 hrs
(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

MAT	130	Technical Math I
PHY	130	General Physics I
PHY	131	General Physics I Laboratory
PHY	132	General Physics II
PHY	133	General Physics II Laboratory

•Social and Self-Awareness and Responsible Citizenship

ECO	230	Principles of Macroeconomics
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•University Studies Electives

GSC	101	The Earth and the Environment
MAT	230	Technical Math II

Core Courses 41 hrs

CET	280	Plane Surveying
CET	284	Sustainable Design and Construction
CET	385	Construction Estimating I
CET	480	Construction Planning and Management
ENG	324	Technical Writing
ENT	100T	Transitions
ENT	287	Statics for Technology
ENT	358	Mechanical and Electrical Systems
ENT	382	Hydraulics
ENT	393	Engineering Economy
ENT	419	Senior Project
IET	125	Analytical Methods in Engineering Technology
IET	399	Professional Development Seminar I
IET	488	Cooperative Education/Internship
ITD	107	Introduction to Technical Drawing and Computer-Aided Drafting

Track Courses 35 hrs

CET	370	Route Surveying
CET	381	Boundary Surveying I
CET	410	Transportation Systems and Design
CET	460	Geodesy
CET	486	Boundary Surveying II
CSC	202	Introduction to Geographic Information Science

GSC 521 Geographic Information Systems
 PHI 202 Ethics
 Technical Electives (5 hrs)

Total Curriculum Requirements 120 hrs

AREA:

Electromechanical Engineering Technology

Bachelor of Science

CIP 15.0403

University Studies Requirements 43-47 hrs
 (See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

MAT 130 Technical Math I

or

PHY 130 General Physics I

and

PHY 131 General Physics I Laboratory

STA 135 Introduction to Probability and Statistics

•Social and Self-Awareness and Responsible Citizenship

ECO 230 Principles of Macroeconomics

or

ECO 231 Principles of Microeconomics

•University Studies Electives

MAT 230 Technical Math II

PHY 132 General Physics II

and

PHY 133 General Physics II Laboratory

Core Courses 69 hrs¹

EMT 110 Electrical Systems I

EMT 210 Electrical Systems II

EMT 201 Engineering Technology Simulation

EMT 202 Engineering Technology Analysis

EMT 261 Introduction to Fluid Power Systems

EMT 262 Introduction to Fluid Power Systems Laboratory

EMT 305 Electrical Machinery and Controls

EMT 310 Programmable Logic Controllers

EMT 312 Industrial Instrumentation

EMT 320 Mechatronics

EMT 351 Industrial and Commercial Power Distribution

EMT 365 Dynamics for Technology

EMT 455 Manufacturing Control Systems

EMT 461 Motion Controls

ENG 324 Technical Writing

ENT 100T Transitions

ENT 287 Statics for Technology

ENT 393 Engineering Economy

ENT 419 Senior Project I

IET 399 Professional Develop Seminar I

IET 488 Cooperative Education/Internship

ITD 102 CAD Applications

TSM 301 Physical Network Theory

Technical Electives 7 hrs

Total Curriculum Requirements 120 hrs

¹A minimum grade of C is required in all EMT, ENT, and TSM prefix courses.

AREA:

Manufacturing Engineering Technology

Bachelor of Science

CIP 15.0613

University Studies Requirements 45 hrs
 (See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

MAT 130 Technical Math I

PHY 130 General Physics I

PHY 131 General Physics I Laboratory

STA 135 Introduction to Probability and Statistics

•Social and Self-Awareness and Responsible Citizenship

ECO 230 Principles of Macroeconomics

or

ECO 231 Principles of Microeconomics

•University Studies Electives

CSC 199 Introduction to Information Technology

MAT 230 Technical Math II

Core Courses 64 hrs

EMT 110 Electrical Systems I

EMT 261 Introduction to Fluid Power Systems

EMT 262 Introduction to Fluid Power Systems Laboratory

EMT 310 Programmable Logic Controllers

EMT 312 Industrial Instrumentation

EMT 351 Power Distribution

ENG 324 Technical Writing

ENT 100T Transitions

ENT 393 Engineering Economy

IET 399 Professional Development Seminar I

IET 488 Cooperative Education/Internship

IOE 350 Technology Management

ITD 102 CAD Applications

ITD 130 Manufacturing Processes and Materials

ITD 204 Parametric Modeling and Rendering

ITD 330 Machine Tool Processes

MET 310 Manufacturing Analysis

MET 320 Control Systems

MET 400 Lean Manufacturing Systems

MET 410 Sustainable Management

MET 440 Quality Management Systems

MET 450 Systems Project Management

Technical Electives 13 hrs

Total Curriculum Requirements 120 hrs

Engineering Graphics and Design

A baccalaureate degree in engineering graphics and design provides students with the fundamentals of design principles, computer aided design, and commercial/industrial design standards. Graduates will be prepared to work with engineers and architects in designing, constructing and manufacturing in modern industrial and architectural corporations.

This broad based program emphasizes computer aided design, and design graphics including: mechanical engineering drawings, renderings, technical animations and 3D parametric design. Applied engineering and engineering design/CAD are typical job descriptors for engineering graphics and design graduates. Graduates typically find jobs in manufacturing companies, engineering consulting firms, and architectural firms utilizing cutting edge computer graphic design capabilities and applied engineering concepts in the design of modern processes, components and structures.

AREA:

Engineering Graphics and Design

Bachelor of Science

CIP 15.1302

University Studies Requirements 42 hrs
(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

CHE 105 Introductory Chemistry

MAT 230 Technical Math II

PHY 130 General Physics I

PHY 131 General Physics I Laboratory

•Social and Self-Awareness and Responsible Citizenship

ECO 231 Principles of Microeconomics

•University Studies Electives

CSC 199 Introduction to Information Technology

STA 135 Introduction to Probability and Statistics

Core Courses 78 hrs

CET 298 Strength of Materials

ENG 324 Technical Writing

ENT 287 Statics for Technology

IOE 350 Technology Management

IOE 399 Professional Development Seminar I

IOE 488 Cooperative Education/Internship

IOE 587 Quality Control

ITD 100T Transitions

ITD 101 Introduction to Design and Graphic Communications

ITD 104 Computer Aided Design

ITD 130 Manufacturing Processes and Materials

ITD 204 Parametric Modeling and Rendering

ITD 302 Applied Technical Drawing

ITD 303 Advanced Parametric Modeling

ITD 306 Engineering Graphics

ITD 330 Machine Tool Processes

ITD 333 ANSI Fundamentals for Mechanical Product Design

TD 403 Product and Tooling Design

ITD 404 Computer-Aided Engineering Design Graphics

ITD 498 Senior Design

MAT 130 Technical Math I

Technical Electives 8 hrs

Total Curriculum Requirements 120 hrs

Industrial Technology

Associate of Science

CIP 15.0612

University Studies Requirements 22 hrs
(See *Academic Degrees and Programs*.)

University Studies selections must also include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

MAT 130 Technical Math I

PHY 130 General Physics I

PHY 131 General Physics I Laboratory

•Social and Self-Awareness and Responsible Citizenship

ECO 231 Principles of Microeconomics

Required Courses 28 hrs

EMT 261 Introduction to Fluid Power Systems

EMT 262 Introduction to Fluid Power Systems Laboratory

IET 399 Professional Development Seminar I

ITD 100T Transitions

ITD 101 Introduction to Design and Graphic Communications

ITD 104 Computer Aided Design

ITD 130 Manufacturing Processes and Materials

ITD 204 Parametric Modeling and Rendering

ITD 330 Machine Tool Processes

TSM 110 Electrical Systems I

Technical Electives 14 hrs

Total Curriculum Requirements 64 hrs

Environmental Technology Minor 21 hrs

CET 284, 330, 331, 342, 353, 555, and ENT 286. Prerequisite courses are not applicable to this minor. Six hours must be upper-level courses.

Industrial and Engineering Technology Minor 21 hrs

Program must be approved by an advisor with at least six hours of courses at 300-level or above.

Graduate Program

Graduate Coordinator - Michael Kemp

The Department of Industrial and Engineering Technology offers the Master of Science degree in Applied Engineering and Technology Management. This degree is designed for individuals who wish to further their knowledge of management, leadership, and technology. The program is appropriate for graduates with backgrounds in technology, engineering, science, and mathematics and other related fields who have significant business/industrial work experience.

The applied engineering and technology management degree places emphasis on the involvement with real situations and problems for an industrial setting. A broad range of selections are provided in the areas of resource management, supervision and training, quality control, environment and safety management, business and finance, research, communications, and information systems.

Requirements for Admission

Applicants must meet the Murray State University requirements (see *Graduate Admissions*). Additional requirements for unconditional and conditional admission are as follows. The Graduate Record Examination (GRE) is not required for admission to this program.

Unconditional

Admission to the Master of Science degree in Applied Engineering and Technology Management is open to persons holding a baccalaureate or higher degree from a regionally accredited college in engineering, engineering technology, science, or related fields. Persons holding degrees in other fields may also apply if the nature of the professional employment has provided significant technology-related experience. Courses included in the program of study may require prerequisite course work.

Unconditional admission requires a 2.75 grade point average (GPA based on an A equals 4.0).

Conditional

Students denied unconditional admission to Master of Science degree programs in the Department of Industrial and Engineering Technology, but who meet University requirements for conditional admission, may petition for conditional admission. Conditional admission is usually reserved for applicants whose previous education and/or experience is evaluated by the department chair to indicate

a likelihood of success. Students applying for conditional admission must have a GPA of 2.25 to 2.74. A student accepted conditionally will be expected to complete nine hours of prescribed work with a minimum 3.0/4.0 GPA. These initial nine hours are assigned by the advisor and may be in addition to the student's program of study. After completion of these nine hours the Departmental Graduate Committee will evaluate the student's progress. The first nine hours may include undergraduate or graduate courses as directed by the department. Depending on the student's undergraduate preparation, undergraduate courses may be required before enrolling in any graduate courses. Graduate courses may be allowed concurrently with these undergraduate courses in special situations.

Language Proficiency

Applicants whose native tongue is not English or who did not graduate from an English speaking college or university must demonstrate language proficiency. Applicants must adhere to the university's guidelines for language proficiency.

Master of Science

Applied Engineering and Technology Management

CIP 15.0000

The Applied Engineering and Technology Management program is designed for individuals who are seeking positions of increased leadership and responsibility in business, industry, and government. Emphasis is placed on involvement with real situations and problems. The student, in consultation with an advisor, will develop an interdisciplinary plan of study to increase skills in a specific technical area and to strengthen abilities to communicate effectively in the management of technical functions.

Total Course Requirements 30 hours¹

CET	682	Industrial Environmental Management
IET	684	Engineering Economic Analysis
IET	691	Industrial Operations ¹
IET	693	Systems Management Technology
IET	695	Industrial Supervision ^{PT}
IET	697	Research in Industrial and Engineering Technology ^{R,1}

Electives 12 hrs

Select four electives with advisor approval. (No more than two courses total may be taken with the following prefixes: ACC, BUS, CIS, FIN, MGT, or MKT.)

Other Degree Requirements

- A written comprehensive examination is required as a component of graduation requirements.
- Independent study, special problems, and workshop courses may only be taken in special circumstances and with prior advisor and instructor approval.

¹A basic statistics course or equivalent is required prior to enrolling in IET 697.

Telecommunications Systems Management

Telecommunications systems are networks of leading-edge technologies that allow organizations and individuals throughout business and industry to communicate instantaneously around the world. Telecommunications systems provide the architectural structure for such activities as electronic commerce, electronic banking, video teleconferencing, distance learning, telemedicine, data interchange, on-demand video, wireless technology, information security, and a host of other traditional and new uses for business and industry.

Students in the baccalaureate program will have the insight and ability to function in all areas of Telecommunications Systems Management (TSM) but will choose a program option that will support the aspect of management which interests them most - the physical system and its components, the software that drives the system, or the business structure and operations that depend on the system. In addition, they will be prepared to move on to the Master of Science in Telecommunications Systems Management if they so choose.

Telecommunications Systems Management is an interdisciplinary program drawing upon the strengths of the Bauernfeind College of Business and the Jesse D. Jones College of Science, Engineering and Technology. These programs which are jointly administered by the two colleges provide students a unique opportunity to develop both technical expertise and management expertise in this dynamic field.

AREA:

Telecommunications Systems Management

Bachelor of Science

CIP 11.0401

University Studies Requirements 41 hrs
(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

MAT	140	College Algebra
PHY	125	Brief Introductory Physics
PHY	126	Brief Introductory Physics Laboratory
STA	135	Introduction to Probability and Statistics

•Social and Self-Awareness and Responsible Citizenship

ECO	231	Principles of Microeconomics
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•University Studies Electives

CSC	101	Introduction to Problem Solving Using Computers
CSC	199	Introduction to Information Technology

Required Courses 58 hrs

ACC	200	Principles of Financial Accounting
CIS	307	Decision Support Technologies
CIS	317	Principles of Information Systems Analysis and Design
CSC	232	Programming in C#
ENG	324	Technical Writing
FIN	330	Principles of Finance
IET	399	Professional Development Seminar I
IOE	350	Technology Management
MKT	360	Principles of Marketing
TSM	100T	Transitions
TSM	134	Introduction to Telecommunications Systems Management
TSM	232	Operating Systems
TSM	233	Network Services
TSM	241	Networking Fundamentals
TSM	301	Physical Network Theory
TSM	320	Introduction to Wireless Technology
TSM	343	Protocol Analysis

TSM	351	Principles of Information Security
TSM	411	Network Design, Operations and Management
TSM	443	Telephone Technology
TSM	488	Cooperative Education/Internship ¹

Selected Emphasis..... 21 hrs

Choose **one** of the methods of completion below:

- 1) Select 21 hours from any of the classes listed below or
- 2) Select two emphasis areas and complete at least 21 hours

Note: When selecting courses for an area of emphasis or as an elective, a maximum of nine hours may be selected from courses with a business prefix including: MGT or MKT. Adherence to course prerequisites is critical.

Wireless Communications Electronics

TSM	321	Wireless Communications
TSM	322	Wireless Communications II
TSM	323	Wireless Mobile Internet
TSM	421	Mobile Satellite Communications

Network Security

TSM	352	System Security
TSM	353	Network Security
TSM	440	Information Policy and Security Auditing
TSM	441	Advanced Information Security

System Administration

CSC	310	Database Administration
CSC	360	Scripting Languages
TSM	450	Telecommunications Policy and Management
TSM	517	Systems Planning

Approved Electives

CSC	370	Introduction to Artificial Intelligence
ECO	335	Economics and Public Policy of Telecommunications Industry
LSC	443	Fundamentals of Operations and Technology
MGT	358	Entrepreneurial Business Plan Development
MKT	475	Marketing Strategies in E-Commerce
TSM	360	Virtualized Enterprise Systems
TSM	444	Enterprise Networks

Total Curriculum Requirements 120 hrs

¹Maximum of three hours Internship or Cooperative Education counts toward a degree.

Telecommunications Systems Minor 22 hrs

TSM 134, 135, 232, 233, and 241. Nine hours of advisor approved electives. Six hours must be 300- or 400-level courses.

Graduate Program

Graduate Coordinator - Michael Bowman
270-809-6218

The master's program in telecommunications systems management provides students a core of fundamental courses and the concentration of choosing a specialization within the curriculum. Although students in the master's program will have the insight and ability to manage all aspects of telecommunications systems, the program concentration choice will support the aspect of management which interests them most, the physical systems and its components or the business structure and operations that depend on the system.

Requirements for Admission

Applicants must meet the Murray State University requirements (see *Graduate Admissions*).

Unconditional

For a TSM applicant to be unconditionally admitted to the program, an applicant must satisfy one of two formulas:

GMAT Users: $(200 \times \text{UGPA}) + \text{GMAT} \geq 1,000$

GRE Users: $\text{GRE} \geq 321 - (11.66 \times \text{GPA})$ - (Combined quantitative and verbal sections only.)

Note: The GRE formula uses the combined score from the quantitative and verbal sections only. Ask the Educational Testing Service (ETS) to send scores directly to Murray State University using our institution code: 1494.

In addition, candidates must take the TOEFL and score at least 550 on the paper-based exam (or 213 on the computerized version) if English is not their native language or they have not graduated from an accredited English speaking university.

Conditional

Applicants to the TSM graduate program may be admitted conditionally if their overall GPA is 2.75 or higher, or at least 3.0 for their last 60 hours of undergraduate study. Full admission to the program will be granted in one of only two ways, namely:

1) The applicant takes TSM 601, TSM 610 and one other core course (ACC 604, MGT 651, TSM 602, TSM 603, or TSM 630) as their first nine hours of the program and earns a GPA not less than 3.33 from the three core courses; or

2) the applicant takes the GMAT or GRE and meets the unconditional admission formula within their first semester in the program.

If neither of these two conditions is met, the student will be dropped from the program even if they have already taken graduate coursework.

International Admission

Applicants, from any country where English is a second language, will be required to demonstrate English language proficiency. This can be done by taking the Test of English as a Foreign Language (TOEFL) exam and score at least:

1) 550 pBT (paper-based test)

2) Minimum of 20 in each band iBT (internet-based test)

3) International English Language Testing System (IELTS) exam and score 6.0 on the academic test (with no band <5.5) to be fully admitted into the program.

Master of Science

Telecommunications Systems Management CIP 11.0401

NON-THESIS REQUIREMENTS ONLY

Total Course Requirements 30 hours

ACC	604	Quantitative Financial Controls
TSM	601	Telecommunications Principles
TSM	602	Telecommunications Systems
TSM	603	Telecommunications Project Management
TSM	607	Advanced Telecommunications Project Management
TSM	610	Telecommunication Networks Management
TSM	630	Telecommunications Legal Environment: Law, Policy and Regulations
TSM	680	Telecommunications Solution Development
Electives (6 hrs)		

Only one elective can be an ACC, BUS, CIS, FIN, MGT, or MKT prefix. Prefixes with no restrictions include: ECO, IET, and TSM. Other prefixes may be used with director's approval. Check course descriptions for prerequisites. Not all 600-level courses are offered online.

Department of Mathematics and Statistics

6C9 Faculty Hall
270-809-2311

Chair: Ed Thome. **Faculty:** Adongo, Alverson, Collins, Donnelly, Donovan, Fister, Gibson, Ivansic, Kramer, Lewis, McCarthy, McKendree, Mecklin, Pathak, Pearson, Polega, Porter, Pritchett, Roach, Schroeder, Taylor, Thome, Yayenie, Zhang.

The mission of the Department of Mathematics and Statistics is to engage the larger mathematical community through scholarship and research, to provide our service region with mathematical and statistical support for its educational and industrial objectives, and to equip our students with mathematical skills which they may apply in further degree programs and careers requiring expertise in mathematics. In particular, through our instruction and guidance we endeavor to provide our students with an understanding of mathematical ideas, and the ability to reason mathematically, analyze real world problems with mathematical techniques, and continue to read, learn, and communicate mathematics.

The department offers a major in mathematics, an area in mathematics with secondary certification, a major in mathematics with secondary certification, an area in applied mathematics, and an area in mathematics with a pre-MBA track. In these programs the student will learn mathematics as a fundamental discipline and as an essential tool in most other disciplines. Mathematics is also quite useful as a minor or second major. Additionally, the common awareness that mathematics is a substantial subject will enhance the prospects of any student who demonstrates a facility with the material. The minors offered by the department are actuarial science, applied statistics, mathematical biology, and mathematics.

Graduates with a major have gone on to careers in teaching, science, and industry. Some have improved their entry level prospects via graduate study at Murray State and/or in nationally known Ph.D. programs.

The area in applied mathematics will prepare the student for a career in business, industry, government or academics. The area consists of a core of applied mathematics courses and a 18-hour track in a related field. Each track contains further mathematical training, computer programming experience, and a broad study of a discipline which illustrates applications of mathematics. The program is flexible and, by its interdisciplinary nature, will provide the student with an understanding and experience in modeling and solving relative problems.

MAJOR:

Mathematics

Bachelor of Science/Bachelor of Arts

CIP 27.0101

University Studies Requirements 38-44 hrs
(See *Academic Degrees and Programs*.)

Required Courses 25 hrs

MAT 100T Transitions
MAT 250 Calculus and Analytic Geometry I¹
MAT 308 Calculus and Analytic Geometry II¹
MAT 309 Calculus and Analytic Geometry III¹
MAT 312 Mathematical Reasoning²
MAT 335 Matrix Theory and Linear Algebra
STA 540 Mathematical Statistics I³

Required Limited Electives..... 15 hrs
Five MAT courses (3 or 4 credit hour) selected from MAT 338 and MAT or STA courses numbered 400 or above including:

at least one of the following:

MAT 513 Modern Algebra I
MAT 516 Introduction to Topology
MAT 525 Advanced Calculus I

and at least one of the following:

MAT 442 Introduction to Numerical Analysis
MAT 506 Mathematical Modeling I
MAT 524 Boundary Value Problems
STA 541 Mathematical Statistics II

Co-Requirements..... 3 hrs

One course in computer programming selected from: CSC 145, 232, 235, or EGR 140.

Required Minor 21 hrs

Electives..... 12-18 hrs

Total Curriculum Requirements 120 hrs

¹May be taken as a University Studies elective.

²This is a University Studies writing intensive course.

³This is a University Studies technology intensive course.

AREA:

Mathematics/Secondary Certification (Grades 8-12) Track

Bachelor of Science/Bachelor of Arts

CIP 27.0101

University Studies Requirements42-43 hrs
(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

MAT 250 Calculus and Analytic Geometry I
MAT 308 Calculus and Analytic Geometry II

•Social and Self-Awareness and Responsible Citizenship

PSY 180 General Psychology

•University Studies Electives

EDP 260 Psychology of Human Development
EDU 103 Issues and Practices of American Education¹

Note: Certification requires a grade of B or better in one English composition course and a B or better in a University Studies math course, public speaking, and EDU 103 or equivalent course. Additional requirements for admission to teacher education and student teaching must be met. See advisor and/or Office of Teacher Education Services for details.

Required Courses 24 hrs

MAT 100T Transitions
MAT 309 Calculus and Analytic Geometry III
MAT 312 Mathematical Reasoning²
MAT 335 Matrix Theory and Linear Algebra
MAT 517 Foundations of Geometry
MAT 550 Teaching Mathematics
MAT 551 Mathematics for Teachers
STA 540 Mathematical Statistics I³

Required Limited Electives..... 18-20 hrs

Three MAT courses (3 or 4 credit hour) selected from MAT 338 and MAT or STA courses numbered 400 or above including:

at least one of the following:

MAT 513 Modern Algebra I
MAT 516 Introduction to Topology
MAT 525 Advanced Calculus I

and at least one of the following:

- MAT 442 Introduction to Numerical Analysis
- MAT 506 Mathematical Modeling I
- MAT 524 Boundary Value Problems
- STA 541 Mathematical Statistics II

An additional course (at least 3 credit hours) selected from MAT 338 and MAT or STA courses numbered 400 or above.

and

At least three (3 or 4 credit hour) courses selected from courses numbered 400 or above or from courses related to the application of mathematics selected from a list approved by the Department of Mathematics and Statistics.

Co-Requirement 3 hrs

One course in computer programming selected from: CSC 145, 232, 235, or EGR 140.

Required for Secondary Certification 33 hrs

- EDU 303 Strategies of Teaching
- EDU 403 Structures and Foundations of Education
- EDU 405 Evaluation and Measurement in Education⁴
- REA 427 Teaching Content Area Literacy in the Secondary School
- SEC 420 Practicum in Secondary Schools⁴
- SEC 421 Student Teaching in the Secondary School
- SEC 422 Extended Practicum⁵
- SED 300 Educating Students with Disabilities

Total Curriculum Requirements 120-123 hrs

¹With a grade of B or better.

²This is a University Studies writing intensive course.

³This is a University Studies technology intensive course.

⁴EDU 405 and SEC 420 must be taken together and two semesters before student teaching.

⁵Must be taken one semester before student teaching.

MAJOR:

Mathematics/Secondary Certification (Grades 8-12) Track

Bachelor of Science/Bachelor of Arts

CIP 27.0101

University Studies Requirements 42-45 hrs

(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

- MAT 250 Calculus and Analytic Geometry I
- MAT 308 Calculus and Analytic Geometry II

•Social and Self-Awareness and Responsible Citizenship

- PSY 180 General Psychology

•University Studies Electives

- EDP 260 Psychology of Human Development
- EDU 103 Issues and Practices of American Education¹

Note: Certification requires a grade of B or better in one English composition course and a B or better in a University Studies math course, public speaking, and EDU 103 or equivalent course. Additional requirements for admission to teacher education and student teaching must be met. See advisor and/or Office of Teacher Education Services for details.

Required Courses 21 hrs

- MAT 100T Transitions
- MAT 309 Calculus and Analytic Geometry III
- MAT 312 Mathematical Reasoning²
- MAT 335 Matrix Theory and Linear Algebra
- MAT 517 Foundations of Geometry
- MAT 550 Teaching Mathematics
- STA 540 Mathematical Statistics I³

Required Limited Electives..... 9 hrs

Three MAT courses (3 or 4 credit hour) selected from MAT 338 and MAT or STA courses numbered 400 or above including:

at least one of the following:

- MAT 513 Modern Algebra I
- MAT 516 Introduction to Topology
- MAT 525 Advanced Calculus I

and at least one of the following:

- MAT 442 Introduction to Numerical Analysis
- MAT 506 Mathematical Modeling I
- MAT 524 Boundary Value Problems
- STA 541 Mathematical Statistics II

and an additional course (at least 3 credit hours) selected from MAT 338 and MAT or STA courses numbered 400 or above.

Co-Requirement 3 hrs

One course in computer programming selected from: CSC 145, 232, 235, or EGR 140.

Required Minor 21 hrs

Required for Secondary Certification 33 hrs

- EDU 303 Strategies of Teaching
- EDU 403 Structures and Foundations of Education
- EDU 405 Evaluation and Measurement in Education⁴
- REA 427 Teaching Content Area Literacy in the Secondary School
- SEC 420 Practicum in Secondary Schools⁴
- SEC 421 Student Teaching in the Secondary School
- SEC 422 Extended Practicum⁵
- SED 300 Educating Students with Disabilities

Total Curriculum Requirements 129-133 hrs

¹With a grade of B or better.

²This is a University Studies writing intensive course.

³This is a University Studies technology intensive course.

⁴EDU 405 and SEC 420 must be taken together and two semesters before student teaching.

⁵Must be taken one semester before student teaching.

AREA:

Mathematics/Applied Mathematics Track

Bachelor of Science/Bachelor of Arts

CIP 27.0101

University Studies Requirements 38-44 hrs

(See *Academic Degrees and Programs*.)

Required Courses 31 hrs

- MAT 100T Transitions
- MAT 250 Calculus and Analytic Geometry I¹
- MAT 308 Calculus and Analytic Geometry II¹
- MAT 309 Calculus and Analytic Geometry III¹
- MAT 312 Mathematical Reasoning²
- MAT 335 Matrix Theory and Linear Algebra
- MAT 338 Ordinary Differential Equations
- MAT 442 Introduction to Numerical Analysis
- STA 540 Mathematical Statistics I³

Required Limited Electives..... 27-28 hrs

A. Three (3 or 4 credit hour) courses selected from MAT courses numbered 400 or above.

B. Five or six courses related to the application of mathematics. Must total at least 18 hours and be approved by the advisory committee.⁴

Co-Requirements..... 6 hrs
Two courses in computer programming selected from a list approved by the Department of Mathematics and Statistics.

Unrestricted Electives..... 11-18 hrs

Total Curriculum Requirements 120 hrs

¹May be taken as a University Studies elective.

²This is a University Studies writing intensive course.

³This is a University Studies technology intensive course.

⁴The program is very flexible. For example, an emphasis in either biology, chemistry, computer science, engineering physics, geoscience, statistics and finance, or actuarial science.

AREA:

Mathematics/Pre-MBA Track

Bachelor of Science/Bachelor of Arts

CIP 27.0101

University Studies Requirements 43-53 hrs
 (See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

MAT 250 Calculus and Analytic Geometry I

MAT 308 Calculus and Analytic Geometry II

•Social and Self-Awareness and Responsible Citizenship

ECO 230 Principles of Macroeconomics

•University Studies Electives

ECO 231 Principles of Microeconomics

MAT 309 Calculus and Analytic Geometry III

Required Courses 39 hrs

ACC 200 Principles of Financial Accounting

ACC 201 Principles of Managerial Accounting

BUS 355 Information Systems and Decision Making

CSC 199 Introduction to Information Technology¹

FIN 330 Principles of Finance

MAT 100T Transitions

MAT 312 Mathematical Reasoning²

MAT 335 Matrix Theory and Linear Algebra

MGT 350 Fundamentals of Management

MGT 443 Management of Operations and Technology

MKT 360 Principles of Marketing

STA 540 Mathematical Statistics I³

STA 565 Applied Statistics I

Required Limited Electives..... 12-13 hrs
Four (3 or 4-credit hour) courses selected from MAT 338 and MAT courses numbered 400 or above.

Co-Requirements..... 3 hrs
One course in computer programming selected from: CSC 145, 232, 235, or EGR 140.

Unrestricted Electives..... 12-23 hrs

Total Curriculum Requirements 120 hrs

¹This is a University Studies technology intensive course.

²This is a University Studies writing intensive course.

³Will be a University Studies technology intensive course.

Actuarial Science Minor..... 21-22 hrs

MAT 250, 308, 309, 543, STA 540. Students already taking MAT 250, 308, 309, and STA 540 for another program may substitute these courses with: ECO 230, 231, FIN 330, MAT 555, STA 565, 567. Six hours must be upper-level courses.

Applied Statistics Minor..... 22-23 hrs
 MAT 250, STA 135, 235, 565, plus at least two courses from the list MAT 308, 555 STA 450, 540, 541, 566, 567, 568, 569. For students already taking MAT 250, 308, STA 540 for another program, the recommended coursework is: STA 135, 235, 541, 565, 567, 568, and one of MAT 555, STA 566, 569. Six hours must be upper-level courses.

Mathematical Biology Minor 21 hrs
 Students not in a mathematics program take one or two of STA 135, 235 or 540 and one of MAT 250, 308 or 338. All students take BIO/MAT 460 and 461, and at least one of BIO 115, 216, 221, 222, 300, 305, 330, 333, 532, 557 so that the total number of hours in the minor is at least 21. Six hours must be upper-level courses.

Mathematics Minor..... 23 hrs
 MAT 250, 308, 309 and nine hours of selected mathematics courses numbered above 309 (except for MAT 330, 399 or STA 554). Departmental approval required. Six hours must be upper-level courses.

Graduate Program

Graduate Coordinator - Timothy Schroeder

The Master of Science and Master of Arts degrees are designed to provide students with the opportunity to study graduate level mathematics so that they may (1) obtain preferred employment in mathematics with government or industry, (2) teach at the junior college level or be better prepared to teach at the secondary school level, or (3) continue working toward a doctor of philosophy degree.

The Master of Arts program is a broadly based program which includes a study of algebra, analysis, topology, and the foundations of mathematics. The Master of Science program consists of a core of applied mathematics together with a core (at most nine hours) in an allied field such as business, computer science, or physics. The program is flexible and is particularly suited to meet the needs of students preparing for careers in business, industry, or government.

The department also offers the Master of Arts in teaching degree in mathematics. This program is designed for certified teachers who wish to strengthen their discipline-based background and keep up with current information in educational theory, curriculum, and research.

All graduate programs in mathematics are planned in close consultation with the department graduate committee and are subject to its approval.

Requirements for Admission

Applicants must meet the Murray State University requirements (see *Graduate Admissions*). Additional requirements for unconditional and conditional admission to M.S. or M.A. programs are as follows:

Unconditional

- Bachelor's degree from a regionally accredited college with a major (or equivalent) in mathematics or a related field;
- Overall GPA of 3.0 or above;
- Minimal GPA of 3.0 in all mathematics courses beginning with the first calculus course;
- Minimal GPA of 3.0 in all major courses; and
- If the major is in a related field (not mathematics), the student must have credit for three calculus courses (including a multi-variable calculus course), a proof-based course, a matrix/linear algebra course, and a differential equations course.

Conditional

Recommendation of the department graduate committee or

- A bachelor's degree from a regionally accredited college with a major in a related field and at least a 3.0 GPA in their major courses;
- Credit for three calculus courses (including a multivariable calculus course), a proof based course, and a matrix/linear algebra course with a 3.0 GPA in all mathematics courses beginning with the last elementary calculus course;
- GPA of 3.0 or above in all mathematics courses beginning with the last elementary calculus course; and
- Two letters of recommendation from college teachers addressing the candidate's ability to do mathematics graduate work.

**Master of Arts
Mathematics**

CIP 27.0101

THESIS REQUIREMENTS

Total Course Requirements 30 hours¹

MAT 725 Integration Theory

MAT or STA courses, 600- or 700-level (21 hrs)

MAT 798-799 Research and Thesis (6 hrs)

Other Degree Requirements

- Oral defense and examination of thesis.

NON-THESIS REQUIREMENTS

Total Degree Requirements 30 hours¹

MAT 725 Integration Theory

and six hours chosen from MAT 716, 721, 722, 723 or 726

MAT or STA courses, 600- or 700-level (21 hrs)

Other Degree Requirements

- Program of study must include MAT 614 or 721 and MAT 616 or 716.
- Comprehensive examinations over coursework.

¹All coursework must be approved by the department graduate committee. The student must complete two, two-course sequences. If the student has not completed two semesters of advanced calculus then one of the sequences must be MAT 625-626. At most, one of these sequences may be a completion of a sequence that was started as an undergraduate.

**Master of Science
Mathematics**

CIP 27.0101

THESIS REQUIREMENTS

Total Course Requirements 33 hours¹

MAT or STA courses, 700-level (3 hrs)

MAT or STA courses, 600 or 700-level (15-24 hrs)

Allied field, 600 or 700-level (0-9 hrs)

MAT 798-799 Research and Thesis (6 hrs)

Other Degree Requirements

- An advanced course in real analysis (MAT 725^{L, R}).
- Oral defense and examination of thesis.

NON-THESIS REQUIREMENTS

Total Course Requirements 33 hours¹

MAT or STA courses, 700-level (9 hrs)

MAT or STA courses, 600 or 700-level (15-24 hrs)

Allied field, 600 or 700-level (0-9 hrs)

Other Degree Requirements

- An advanced course in real analysis (MAT 725^{L, R}).
- Comprehensive examinations over coursework.

¹All coursework must be approved by the departmental graduate committee. The student must complete two, two-course sequences. If the student has not completed two semesters of advanced calculus then one of the sequences must be MAT 625-626. At most, one of these sequences may be a completion of a sequence that was started as an undergraduate.

Master of Arts in Teaching
Mathematics/Mathematics Teacher Leader CIP 27.0101

The Master of Arts in Teaching (M.A.T.) program is designed for certified teachers who wish to strengthen their background in mathematics and keep up with current information in educational theory, curriculum and research. The program provides for both reasonable depth in the mathematics area and graduate-level exposure in supporting disciplines. Completion of this program fulfills the requirements for Rank II classification. A student portfolio is required.

Requirements for Admission

Applicants must meet the Murray State University requirements (see *Graduate Admissions*). Additional requirements for unconditional and conditional admission to the M.A.T. program are as follows.

Unconditional

- Completion of requirements for teaching certification.
- Documentation of secondary teacher certification in the United States or comparable teacher qualification document from another country.
- Documentation of current certification for the duration of the program.
- Minor in mathematics with 3.0 minimum mathematics GPA.

Conditional

- See MSU requirements (see *Graduate Admissions*) and conditional admission requirements for certification (see *College of Education and Human Services*).
- Completion of requirements for teaching certification.
- Documentation of primary, middle, or secondary teacher certification in the United States or comparable teacher qualification document from another country.
- Documentation of current certification for the duration of the program.
- At least two calculus courses and two approved upper-level mathematics courses; and
- Two letters of recommendation from college teachers addressing the ability of the student to complete an M.A.T. degree in mathematics.

NON-THESIS REQUIREMENTS ONLY

Total Course Requirements 33 hours

MAT or STA courses, 600- or 700-level (18 hrs)

Education Courses

- EDU 600 Introduction to Teacher Leadership
- EDU 631 Classroom and Management and Student Motivation
- EDU 633 Curriculum Development
- EDU 637 Instruction for Diverse Learners
- EDU 639 Research to Improve Student Learning^{L, R}
- EDU 640 Exit Seminar in Teacher Leadership

Other Degree Requirements

Students must complete EDU 600 before enrolling in EDU 639.

Master of Arts in Education

Secondary Teacher Leader with Mathematics Concentration

CIP 13.1205

The Department of Mathematics and Statistics provides instruction in support of the M.A.Ed. in Secondary Teacher Leader with a concentration in mathematics. Prospective students should contact the graduate coordinator in the College of Education and Human Services for details on advising and graduate program design.

Department of Occupational Safety and Health

157 Collins Center
270-809-2488

Chair: Tracey Wortham. **Faculty:** Abulhassan, Atieh, Boyd, Byrd, Keller, Khalil, Medford, Morris, Spicer.

The Department of Occupational Safety and Health provides related curriculum offerings at the baccalaureate and master's levels. Service courses are offered for individuals majoring in other fields such as business, science, health, psychology, education, and engineering technology. The department also offers a technical minor and a Master of Science degree, including an online Master of Science program with an emphasis in safety management that is equivalent to the on-campus program. The degree programs are designed to provide the technical and professional knowledge required by individuals pursuing professional careers in accident prevention, loss-control management and supervision, inspection and control of occupational hazards, industrial hygiene or environmental health and safety.

Occupational Safety and Health Track

This track is designed to provide the technical and professional knowledge required by individuals pursuing professional careers in accident prevention, loss control management and supervision, inspection and control of occupational hazards, and industrial hygiene.

Environmental Health and Safety Track

This track is designed to provide the technical and professional knowledge required by individuals pursuing professional careers in environmental issues and affairs such as water quality, air quality, and solid and hazardous waste management.

Requirements for Admission

Students may declare OSH as their area of choice at any point. However students must be formally admitted into the OSH program before they can enroll in restricted classes which are OSH 353 and 400- (excluding 488) and 500-level OSH classes. In order to be admitted to the OSH program, a student must (1) have completed at least 30 credit hours of coursework directly applicable to an OSH degree from the OSH University Studies requirements, required core courses, non-restricted OSH classes at the 100-, 200- and 300-levels, and technical electives, with a minimum GPA of 2.50; (2) have no grade less than a C in an OSH class; (3) complete an application packet for admission to the program; (4) be successfully reviewed by the OSH program admissions committee; (5) apply by February 1 for summer/fall enrollment or by September 1 for spring enrollment; (6) follow the most current bulletin when admitted to the program. Admission is competitive and based on available space. Admission is subject to application and careful evaluation by the OSH program admissions committee.

Degree Requirements

All occupational safety and health majors and minors must earn a grade of C or better in all OSH courses. Any OSH course with a grade below a C must be repeated. The maximum number of times a student may enroll in an OSH class is twice; this includes audits and withdrawals after the first week of class. Exceptions would be made only if the student was forced to drop the class due to a life-changing event and not due to performance in the class. If a grade less than C is received in any OSH course for a second time, the course cannot be repeated and the student is dismissed from the program and is not eligible for readmission. A cumulative grade point average of at least 2.50 must be maintained to graduate.

AREA:

Occupational Safety and Health/ Occupational Safety and Health Track

Bachelor of Science

CIP 15.0701

ACCREDITED BY: Applied Science Accreditation Commission of ABET (ASAC/ABET), www.abet.org.

University Studies Requirements 42 hrs
(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

BIO 101 Biological Concepts
CHE 105 Introductory Chemistry
MAT 230 Technical Math II

•Social and Self-Awareness and Responsible Citizenship

PSY 180 General Psychology

•University Studies Electives

CSC 199 Introduction to Information Technology¹
STA 135 Introduction to Probability and Statistics

Required Core Courses 51 hrs

ITD 120 Manufacturing Processes and Materials
MGT 350 Fundamentals of Management
OSH 100T Transitions
OSH 192 Introduction to Occupational Safety and Health
OSH 299 Professional Development Seminar I
OSH 310 Fire and Emergency Preparedness Preplanning
OSH 311 Hazardous Materials and Emergency Planning
OSH 320 Environmental and Occupational Health Engineering Technology
OSH 353 Prevention of Musculoskeletal Disorders in the Workplace
OSH 387 OSHA Standards for General Industry and Construction
OSH 420 Fundamentals of Industrial Hygiene
OSH 425 Physical Agents
OSH 450 Practical Application Lab
OSH 452 Systems Approach to Hazard Control
OSH 488 Cooperative Education/Internship
OSH 550 Safety and Health Program Management and Training
OSH 591 Engineering and Technical Aspects of Safety
PHY 125 Brief Introductory Physics
PHY 126 Brief Introductory Physics Lab

Safety Courses 30 hrs

OSH 101 Emergency Medical Training
OSH 384 Construction Safety
OSH 445 Fundamentals of Loss Control
OSH 546 Fundamentals of Risk Control

Technical electives (15 hrs)

(Must be approved by advisor and chosen from the Technical Electives list below and/or the Environmental Health and Safety Track.)

Technical Electives (Choose from the following.)

CET	310	Anatomy of Buildings
CET	342	Air Quality Technology
CET	353	Solid Hazardous Waste Technology
CET	385	Construction Estimating I
CET	480	Construction Planning and Management
CET	555	Environmental Regulatory Affairs
CET	585	Remediation Technology
CHE	120	Chemical Laboratory Safety
CHE	210	Brief Organic Chemistry
CHE	215	Organic Chemistry Laboratory
CHE	330	Basic Biochemistry
COM	340	Intercultural Communication
COM	384	Communication Skills for Professionals
COM	439	Conflict and Communication
CRJ	140	Introduction to Criminal Justice
CRJ	355	Security in Business and Industry
ENG	228	Standard English Usage
MGT	550	Human Resource Management
MGT	555	Training and Development
MGT	575	Labor Management Relations
OSH	330	Global Issues in OSH ²
OSH	371	Professional Internship II
OSH	453	Human Factors in Safety Engineering
OSH	488	Cooperative Education/Internship ³
OSH	499	Professional Development Seminar I
OSH	536	Motor Fleet Safety
OSH	571	Problems in Safety and Health
OSH	578	Workshop in Safety and Health
PSY	405	Industrial and Organizational Psychology
SPA	106	Basic Spanish and Culture for Agriculture

Total Curriculum Requirements 123 hrs

¹CSC 199 can be substituted by another computer related course with advisor's approval.

²May be repeated for additional credit.

³May be repeated for a second experience.

AREA:

**Occupational Safety and Health/
Environmental Health and Safety Track**

Bachelor of Science

CIP 15.0701

ACCREDITED BY: Applied Science Accreditation Commission of ABET (ASAC/ABET), www.abet.org.

University Studies Requirements 42 hrs

(See *Academic Degrees and Programs*.)

University Studies selections must include:

•Scientific Inquiry, Methodologies, and Quantitative Skills

BIO	101	Biological Concepts
CHE	105	Introductory Chemistry
MAT	230	Technical Math II

•Social and Self-Awareness and Responsible Citizenship

PSY	180	General Psychology
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•University Studies Electives

CSC	199	Introduction to Information Technology ¹
STA	135	Introduction to Probability and Statistics

Required Core Courses 51 hrs

ITD	120	Manufacturing Processes and Materials
MGT	350	Fundamentals of Management
OSH	100T	Transitions
OSH	192	Introduction to Occupational Safety and Health

OSH	299	Professional Development Seminar I
OSH	310	Fire and Emergency Preparedness Preplanning
OSH	311	Hazardous Materials and Emergency Planning
OSH	320	Environmental and Occupational Health Engineering Technology
OSH	353	Prevention of Musculoskeletal Disorders in the Workplace
OSH	387	OSHA Standards for General Industry and Construction
OSH	420	Fundamentals of Industrial Hygiene
OSH	425	Physical Agents
OSH	450	Practical Application Lab
OSH	452	Systems Approach to Hazard Control
OSH	488	Cooperative Education/Internship
OSH	550	Safety and Health Program Management and Training
OSH	591	Engineering and Technical Aspects of Safety
PHY	125	Brief Introductory Physics
PHY	126	Brief Introductory Physics Lab

Environmental Health and Safety Courses 30 hrs

CET	330	Water Quality Technology I
CET	331	Water Quality Technology II
OSH	511	Hazardous Waste Site Operations
OSH	523	Occupational Diseases
OSH	527	Air Contaminants and Industrial Ventilation

Technical electives (15 hrs)

(Must be approved by advisor and chosen from the Technical Electives list below and/or the Occupational Safety and Health Track.)

Technical Electives (Choose from the following.)

CET	310	Anatomy of Buildings
CET	342	Air Quality Technology
CET	353	Solid Hazardous Waste Technology
CET	385	Construction Estimating I
CET	480	Construction Planning and Management
CET	555	Environmental Regulatory Affairs
CET	585	Remediation Technology
CHE	120	Chemical Laboratory Safety
CHE	210	Brief Organic Chemistry
CHE	215	Organic Chemistry Laboratory
CHE	330	Basic Biochemistry
COM	439	Conflict and Communication
COM	384	Communication Skills for Professionals
COM	340	Intercultural Communication
CRJ	140	Introduction to Criminal Justice
CRJ	355	Security in Business and Industry
ENG	228	Standard English Usage
MGT	550	Human Resource Management
MGT	555	Training and Development
MGT	575	Labor Management Relations
OSH	330	Global Issues in OSH ²
OSH	371	Professional Internship II
OSH	453	Human Factors in Safety Engineering
OSH	488	Cooperative Education/Internship ³
OSH	499	Professional Development Seminar II
OSH	536	Motor Fleet Safety
OSH	571	Problems in Safety and Health
OSH	578	Workshop in Safety and Health
PSY	405	Industrial and Organizational Psychology
SPA	106	Basic Spanish and Culture for Agriculture

Total Curriculum Requirements 123 hrs

¹CSC 199 can be substituted by another computer related course with advisor's approval.

²May be repeated for additional credit.

³May be repeated for a second experience.

Occupational Safety and Health Minor 21 hrs
OSH 192, 353, 387, 420, and nine hours from OSH 101, 320, 384, 425, 452. Six hours must be upper-level courses. Courses may require prerequisites.

Graduate Program

The graduate program in occupational safety and health is unique in this region. In light of an increased sensitivity to the safety of the work environment and to the overall health of all Americans, the program is a timely response to business and industry needs. Few programs of this type are found in higher education.

Requirements for Admission

Applicants must meet the Murray State University requirements (see *Graduate Admissions*). Additional requirements for unconditional and conditional admission are as follows.

Unconditional

Unconditional Admission status is granted only to students who graduate from Murray State University with a baccalaureate degree in occupational safety and health with an overall GPA of 3.00 or higher.

Conditional

Conditional Admission status is granted to students with an undergraduate GPA of 2.75 or higher, regardless of undergraduate baccalaureate degree field or major. To change to Unconditional status, the student must meet the university requirement of obtaining a 3.00 in the first nine hours of graduate work and additional criteria set forth by the Department of Occupational Safety and Health.

Students admitted from a different undergraduate field/discipline must complete the following course work in addition to the above GPA requirements. Undergraduate coursework is required in biology, chemistry, mathematics, and physics. The following courses are the minimum accepted requirements for pursuing a master's degree in occupational safety and health.

- BIO 101 • PHY 125 and 126
- CHE 105 • PSY 300 or STA 135
- MAT 130 or MAT 140 and 145 or 150

Students must also complete 15 prerequisite credit hours in occupational safety and health **and pass these courses with a grade of C or higher.**

Prerequisite Undergraduate Requirements 15 hours

OSH 192 Introduction to Occupational Safety and Health
OSH 353 Prevention of Musculoskeletal Disorders
in the Workplace

or

OSH 453 Human Factors in Safety Engineering
OSH 387 OSHA Standards for General Industry and Construction
OSH 420 Fundamentals of Industrial Hygiene

and

one of the following concentration-specific courses:

Safety Management

OSH 384 Construction Safety

Industrial Hygiene

OSH 425 Physical Agents

Environmental

OSH 320 Environmental and Occupational Health
Engineering Technology

Master of Science

Occupational Safety and Health

CIP 15.0701

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Within departmental guidelines, the individual student's program is developed in consultation with advisor.

THESIS REQUIREMENTS

Total Course Requirements 30 hours

Technical Requirements¹ 12 hrs

Choose four from the following:

- OSH 621 Industrial Hygiene and Safety Program Development
- OSH 623 Occupational Diseases
- OSH 626 Industrial Hygiene Sampling Strategies
- OSH 630 Global Issues in OSH
- OSH 636 Transportation Safety
- OSH 637 Biostatistics and Probability
- OSH 640 Safety and Health Program Management and Training
- OSH 645 Loss Control Measurement and Management
- OSH 646 Fundamentals of Risk Control
- OSH 654 Advanced Safety and Health Management
and Administration
- OSH 655 Legal Aspects of Safety and Health
- OSH 656 Ergonomics and Biomechanics
- OSH 658 Introduction to Occupational Epidemiology
- OSH 644 Cooperative Education^{PT}
(or approved elective with prior safety internship or equivalent)
- OSH 680 Graduate Seminar in Occupational Safety and Health

Thesis 6 hrs

OSH 698-699 Thesis

¹Technical requirements courses are selected based on the student's program concentration and must be approved by the graduate program advisor.

NON-THESIS REQUIREMENTS

Total Course Requirements 30 hours

Same as above with the following substitution for thesis:

- OSH 644 Cooperative Education^{PT}
(or approved elective with prior safety internship or equivalent)
- and one of the following according to concentration*
- OSH 657 Current Literature and Research in Safety and Health¹
(Safety Management)
- OSH 697 Research in Environmental Health and Safety^R
(Industrial Hygiene or Environmental)

All students (Thesis or Non-Thesis) must also complete 12 credit hours by selecting one of the following three concentrations. Substitutions within these concentrations can be made only with the approval of the advisor. Consult with advisor when choosing a concentration. Additional coursework may be required.

Safety Management Concentration 12 hrs

- OSH 621 Industrial Hygiene and Safety Program Development
- OSH 640 Safety and Health Program Management and Training
- OSH 650 Occupational Safety and Health Organizational
Leadership and Management
- OSH 655 Legal Aspects of Safety and Health

Industrial Hygiene Concentration 12 hrs

- OSH 621 Industrial Hygiene and Safety Program Development
- OSH 622 Toxicology of Industrial Materials
- OSH 627 Air Contaminants and Industrial Ventilation
- OSH 663 Applied Workplace Ergonomics

Environmental Concentration 12 hrs

- OSH 622 Toxicology of Industrial Materials
- OSH 627 Air Contaminants and Industrial Ventilation
- OSH 687 Wastewater Treatment
- OSH 689 Solid and Hazardous Waste Treatment

Other Degree Requirement

- Oral defense of thesis (Thesis track).

