



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	Technology
Applied Statistics	Mathematical Biology
Archaeology	Mathematics
Astronomy	Occupational Safety and Health
Biology	Physics
Chemistry	Social Science
Earth Science	Sustainability Studies
Engineering Science	Telecommunications Systems Management
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 I¹
- WSC 694 Sustainability Practicum II¹

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

•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 Analysis¹
- BIO 221 Zoology: Animal Form and Function¹
- BIO 222 Botany: Plant Form and Function¹
- 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 I²
- PHY 131 General Physics I Laboratory²

•University Studies Electives

- CHE 202 General Chemistry and Qualitative Analysis²

Required Courses 47 hrs

- BIO 100T Transitions
- BIO 115 The Cellular Basis of Life
- BIO 216 Biological Inquiry and Analysis³
- BIO 221 Zoology: Animal Form and Function^{2,3}
- or*
- BIO 222 Botany: Plant Form and Function³
- BIO 290 Biomedical Research I
- BIO 300 Introductory Microbiology
- BIO 321 Cell Biology: Mechanisms⁴
- or*
- BIO 323 Cell Biology: Systems⁴
- 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
<i>or</i>	
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
<i>or</i>	
PHY 235	Mechanics, Heat and Wave Motion <i>and</i>
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
<i>or</i>	
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
<i>or</i>	
PHY 255	Electricity, Magnetism and Light ¹ <i>and</i>
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
<i>or</i>	
MAT 250	Calculus and Analytic Geometry I
PHY 130	General Physics I
PHY 131	General Physics I Laboratory
<i>or</i>	
PHY 235	Mechanics, Heat and Wave Motion <i>and</i>
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 Statistics¹
- PHY 132 General Physics II¹
- PHY 133 General Physics II Laboratory¹
- PSY 260 Lifespan Development
- SOC 133 Introduction to Sociology¹

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

Required Courses 40 hrs

- BIO 100T Transitions
- BIO 115 The Cellular Basis of Life
- BIO 120 Scientific Etymology
- BIO 216 Biological Inquiry and Analysis¹
- BIO 220 Clinical Terminology
- BIO 221 Zoology: Animal Form and Function¹
- BIO 222 Botany: Plant Form and Function¹
- 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 Statistics¹
- 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 Life¹
- 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
or
- BIO 584 Wildlife Policy and Administration
- BIO 582 Fisheries Management
- BIO 586 Limnology
or
- 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
and
- 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 I¹
- 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

•University Studies Electives

- EDU 103 Issues and Practices of American Education¹
- PHY 130 General Physics I²
- PHY 131 General Physics I Laboratory²

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 II⁵
- PHY 133 General Physics II Laboratory⁵

Required for Secondary Certification⁶ 33 hrs

- EDU 303 Strategies of Teaching
- EDU 403 Structures and Foundations of Education
- EDU 405 Evaluation and Measurement in Education⁷
- REA 427 Teaching Content Area Literacy in the Secondary School
- SEC 420 Practicum in Secondary Schools⁷
- SEC 421 Student Teaching in the Secondary School
- SEC 422 Extended Practicum⁸
- 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
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 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
 - 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

Wildlife Biology Track 17 hrs

- GSC 202 Introduction to Geographical Information Science
*and a minimum of 13 hours from the following:*²
 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

or

- CHE 201 General College Chemistry
 MAT 150 Algebra and Trigonometry

or

- 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

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

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

- AGR 329 Veterinary Hematology and Microbiology

- AGR 332 Veterinary Nursing

- BIO 240 Biological Applications in GIS

- BIO 300 Introductory Microbiology

- BIO 322 Animal Physiology

- BIO 467 General Parasitology

- BIO 538 Animal Behavior

- BIO 539 Animal Behavior Laboratory

- BIO 548 Principles of Managing Diseases in Wildlife

- BIO 570 Ichthyology

- BIO 572 Herpetology

- BIO 573 Ornithology

- BIO 574 Mammalogy

- BIO 577 Population and Conservation Genetics

- 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.

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 Courses58 hrs

- BIO 221 Zoology: Animal Form and Function²
 BIO 227 Human Anatomy

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 Skills

MAT 250 Calculus and Analytic Geometry I¹

PHY 130 General Physics I¹ and

PHY 131 General Physics I Laboratory¹

PHY 132 General Physics II¹ and

PHY 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 and

PHY 131 General Physics I Laboratory¹

PHY 132 General Physics II¹ and

PHY 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 I¹
- PHY 130 General Physics I¹
- PHY 131 General Physics I Laboratory¹
- PHY 132 General Physics II¹
- PHY 133 General Physics II Laboratory¹

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 I¹
- PHY 130 General Physics I¹ and
- PHY 131 General Physics I Laboratory¹
- PHY 132 General Physics II¹ and
- PHY 133 General Physics II Laboratory¹

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 I¹ and
- PHY 131 General Physics I Laboratory¹
- PHY 132 General Physics II¹ and
- PHY 133 General Physics II Laboratory¹

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 I¹
 PHY 235 Mechanics, Heat and Wave Motion¹
 PHY 236 Mechanics, Heat and Wave Motion Laboratory¹
 PHY 255 Electricity, Magnetism and Light¹
 PHY 256 Electricity, Magnetism and Light Laboratory¹

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 I²
 PHY 130 General Physics I²
 PHY 131 General Physics I Laboratory²
 PHY 132 General Physics II²
 PHY 133 General Physics II Laboratory²
•Social and Self-Awareness and Responsible Citizenship
 ECO 231 Principles of Microeconomics

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 Practicum²
- 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 Archaeology¹
- GSC 100T Transitions
- GSC 101 The Earth and the Environment²
- GSC 102 Earth through Time²
- GSC 110 World Geography¹
- 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 Paleocology
- 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 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/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

Required Courses 44 hrs

- ARC 150 Introduction to Archaeology¹
- 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 Environment²
 - GSC 110 World Geography¹
 - 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
- Five credit hours chosen from the following:*
- 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 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/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 Archaeology¹
- GSC 100T Transitions
- GSC 101 The Earth and the Environment²
- GSC 110 World Geography¹
- GSC 125 Weather and Climate²
- 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 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.

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 Paleocology
- 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, Hildebrant, 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 Analysis²
- 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 Equations²

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

•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

•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[†]
- 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

• **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/Internship¹

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 x UGPA) + GMAT ≥ 1,000

GRE Users: GRE ≥ 321 - (11.66 x 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 Requirements **42-43 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 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.

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
-----	-----	--------------------

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

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

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

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 Health^l (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).

