Jesse D. Jones College of Science, Engineering and Technology

Claire Fuller, Interim Dean
201A Collins Center for Industry and Technology
(270) 809-2888

DEPARTMENTS

Biological Sciences	172	Mathematics and Statistics	203
Chemistry	181	Occupational Safety and Health	207
Earth and Environmental Sciences	185		
Institute of Engineering	192		

PROGRAMS

UNDERGRADUATE

Associate
Civil Engineering Technology
Industrial Technology

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

Minor

Actuarial Science
Anthropology
Applied Statistics
Archaeology
Astronomy
Biology
Cell Biology
Chemistry
Earth Science
Engineering Science
Environmental Geology
Environmental Technology
Geographic Information
  Science

Industrial and Engineering
Technology
Mathematical Biology
Mathematics
Occupational Safety
  and Health
Physics
Social Science
Sustainability Studies
Telecommunications Systems
  Management

Certificate
Geographic Information Science

GRADUATE

Master's
Applied Engineering and Technology Management
Biology
Chemistry
Earth and Environmental Sciences
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, earth and environmental sciences, engineering, engineering technology, 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 programs 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 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, and wireless communication, and cybersecurity 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 Mapping Applications and Resource 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.

•**Mapping Applications and Resource 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: See page 58 for graduate courses notated with [L, R,] or [PT].

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
Choose 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; EES 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
EES   601   Understanding Scientific Communication
EES   607   Land Use Planning
WSC   601   Seminar in Sustainability Science
WSC   693   Sustainability Practicum I[1]
WSC   694   Sustainability Practicum II[1]

Restricted Electives.. 6-7 hrs
Choose two of the following:
AGR   643   Sustainable Agriculture
ARC   615   Environmental Archaeology
BIO   665   Biogeochemistry
STA   665   Applied Statistics I

Unrestricted Electives... 6-9 hrs
Choose elective hours from one of the following emphasis areas:

Agricultural Sustainability
AGR   636   Seminar in International Agriculture Systems
AGR   649   Weeds and Their Control
AGR   652   Agricultural Policy
AGR   655   Advanced Soil Fertility
AGR   661   Sustainable Agriculture
AGR   662   Principles of Agroecology
AGR   671   Advanced Precision Agriculture
AGR   674   Agricultural Irrigation and Water Systems
CHE   604   Fundamentals of Toxicology
CHE   613   Environmental Chemistry
EES   612   Remote Sensing
EES   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
EES   612   Remote Sensing
EES   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
IOE   619   Industrial Energy Management

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

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

Interim Chair: Michael Flinn. **Faculty:** Arkov, Beckers, Canning, Darracq, Derting, Flinn, Gagnon, He, Nakamura, 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, 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 Requirements[1] .... 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 Analysis[1]
BIO   221   Zoology: Animal Form and Function[1]
BIO   222   Botany: Plant Form and Function[1]
BIO   305   Introduction to Evolutionary Principles
BIO   330   Principles of Ecology
BIO   333   Genetics
BIO   499   Senior Biology Seminar
BIO electives, 300-level or above (13 hrs)[2]

Co-Requirements for Biology Major .... 7-8 hrs
Group 1:
CHE   312   Organic Chemistry I
CHE   320   Organic Chemistry II
or Group 2:
CHE   210   Brief Organic Chemistry[1,3]
CHE   215   Chemistry Laboratory[1,3]
CHE   330   Basic Biochemistry

Required Minor[4] .... 3-21 hrs

Unrestricted Electives .... 17-28 hrs

Total Curriculum Requirements .... 120 hrs
   [1]May be used to fulfill University Studies requirements.
   [2]A maximum of three hours total from BIO 391, 392, 483, 484, 489, 493, 494 may be used. BIO 488 will not count here.
   [3]This course does not apply toward the chemistry minor.
   [4]Chemistry co-requirements may apply toward the requirements for a minor in chemistry.

AREA:

Biology/Biomedical Sciences Track[1]
Bachelor of Science/Bachelor of Arts   CIP 26.0101

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

University Studies selections must include:
•*Scientific Inquiry, Methodologies, and Quantitative Skills*
CHE   201   General College Chemistry
MAT   250   Calculus and Analytic Geometry I
PHY   130   General Physics I[2]
PHY   131   General Physics I Laboratory[2]
•*University Studies Electives*
CHE   202   General Chemistry and Qualitative Analysis[2]

Required Courses .... 47 hrs
BIO   100T   Transitions
BIO   115   The Cellular Basis of Life
BIO   216   Biological Inquiry and Analysis[3]
BIO   221   Zoology: Animal Form and Function[2,3]
      or
BIO   222   Botany: Plant Form and Function[3]
BIO   290   Biomedical Research I
BIO   300   Introductory Microbiology
BIO   321   Cell Biology: Mechanisms[4]
      or
BIO   323   Cell Biology: Systems[4]
BIO   322   Animal Physiology
BIO   333   Genetics

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

Co-Requirements for Area .... 18 hrs
CHE 312 Organic Chemistry I
CHE 320 Organic Chemistry II
CHE 530 Fundamentals of Biochemistry I
CHE 540 Fundamentals of Biochemistry II
PHY 132 General Physics II[2,3]
PHY 133 General Physics II Laboratory[2,3]

Restricted Electives.. 15 hrs
Choose from the following:
BIO 308 Ethics in Biology[3]
BIO 320 Comparative Vertebrate Anatomy
BIO 321 Cell Biology: Mechanisms[4]
    or
BIO 323 Cell Biology: Systems[4]
BIO 421 Vertebrate Histology
BIO 501 Immunology
BIO 504 Medical Cell Biology
BIO 521 Cell Biology Laboratory
BIO 528 Neurobiology
BIO 534 Molecular Genetics Laboratory
BIO 597 Topics in Advanced Molecular Biology
CHE 305 Analytical Chemistry
CHE 325 Organic Chemistry II Laboratory
CHE 403 Basic Physical Chemistry
PHY 370 Introduction to Modern Physics

Total Curriculum Requirements .... 120 hrs
[1]A 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.
[2]Required for area if not taken as a University Studies elective.
[3]May be used to fulfill University Studies requirements.
[4]Required for area as either Core choice or as a Restricted Elective.

MAJOR:
Biology/Pre-Medical/Pre-Dental Track
Bachelor of Science/Bachelor of Arts   CIP 26.0101

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

University Studies selections must include:
•*Scientific Inquiry, Methodologies, and Quantitative Skills*
CHE 201 General College Chemistry
MAT 150 Algebra and Trigonometry
    or
MAT 250 Calculus and Analytic Geometry I
PHY 130 General Physics I
PHY 131 General Physics I Laboratory
    or
PHY 235 Mechanics, Heat and Wave Motion *and*
PHY 236 Mechanics, Heat and Wave Motion Laboratory
•*Social and Self-Awareness and Responsible Citizenship*
PSY 180 General Psychology *(recommended)*

•*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 II[1]
PHY 133 General Physics II Laboratory[1]
    or
PHY 255 Electricity, Magnetism and Light[1] *and*
PHY 256 Electricity, Magnetism and Light Laboratory[1]

Required Minor[3] .... 3-21 hrs

Unrestricted Electives[4]... 8-21 hrs

Total Curriculum Requirements .... 120 hrs
[1]May be used to fulfill University Studies requirements.
[2]A maximum of three hours total from BIO 391, 392, 483, 484, 489, 493, 494 may be used. BIO 488 will not count here.
[3]Chemistry co-requirements may apply toward chemistry minor.
[4]ENG 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 Analysis[1]
BIO 221 Zoology: Animal Form and Function[1]
BIO 222 Botany: Plant Form and Function[1]
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 Analysis[1]
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 Writing[1]
STA 135 Introduction to Probability and Statistics[1]

Required Minor[3] .... 0-21 hrs

Unrestricted Electives .... 0-15 hrs

Total Curriculum Requirements .... 120 hrs
   [1]May be used to fulfill University Studies requirements.
   [2]A maximum of three hours total from BIO 391, 392, 483, 484, 489, 493, 494 may be used. BIO 488 will not count here.
   [3]Chemistry 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 Analysis[1]
BIO 120 Scientific Etymology
BIO 221 Zoology: Animal Form and Function[1]
BIO 222 Botany: Plant Form and Function[1]
BIO 220 Clinical Terminology
BIO 300 Introductory Microbiology
     or
BIO 321 Cell Biology: Mechanisms
BIO 320 Comparative Vertebrate Anatomy
     or
BIO 227 Human Anatomy
     and

BIO 228 Human Anatomy Laboratory
BIO 322 Animal Physiology
BIO 333 Genetics
BIO 499 Senior Biology Seminar
BIO electives, approved by advisor, 300-level or above (9 hrs)[2]
(If BIO 320 is taken, only four hours of 300-level or above.)

Co-Requirements for Biology Major .... 24-25 hrs
BIO 450 Exercise Physiology
CHE 312 Organic Chemistry I
CHE 320 Organic Chemistry II
PSY 300 Principles and Methods of Statistical Analysis
     or
STA 135 Introduction to Probability and Statistics[1]
PHY 132 General Physics II[1]
PHY 133 General Physics II Laboratory[1]
PSY 260 Lifespan Development
SOC 133 Introduction to Sociology[1]

Required Minor[3] .... 3-21 hrs

Unrestricted Electives .... 0-12 hrs

Total Curriculum Requirements .... 120 hrs
   [1]May be used to fulfill University Studies requirements.
   [2]A maximum of three hours total from BIO 391, 392, 483, 484, 489, 493, 494 may be used. BIO 488 will not count here.
   [3]Chemistry 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 Analysis[1]
BIO 220 Clinical Terminology
BIO 221 Zoology: Animal Form and Function[1]
BIO 222 Botany: Plant Form and Function[1]
BIO 300 Introductory Microbiology
BIO 321 Cell Biology: Mechanisms
     or
BIO 323 Cell Biology: Systems
BIO 333 Genetics

BIO   499   Senior Biology Seminar
BIO electives, 300-level or above (10 hrs)[2] *[BIO 488 and 489 will not count here.]*

Co-Requirements for Biology Major.............................. 18-20 hrs
BIO   227   Human Anatomy
BIO   228   Human Anatomy Laboratory
BIO   229   Human Physiology
BIO   230   Human Physiology Laboratory
CHE   210   Brief Organic Chemistry
       and
CHE   215   Organic Chemistry Laboratory
       or
CHE   312   Organic Chemistry I
PSY   300   Principles and Methods of Statistical Analysis
       or
STA   135   Introduction to Probability and Statistics[1]
PSY   260   Lifespan Development

Required Minor[3] .... 6-21 hrs

Unrestricted Electives.. 0-14 hrs

Total Curriculum Requirements .... 120 hrs
  [1]May be used to fulfill University Studies requirements.
  [2]A maximum of three hours total from BIO 391, 392, 483, 484, 489, 493, 494 may be used. BIO 488 will not count here.
  [3]Chemistry co-requirements may apply toward chemistry minor.

AREA:
Biology/Fisheries and Aquatic Biology Track[1]
Bachelor of Science/Bachelor of Arts   CIP 26.0101

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

University Studies selections must include:
•*Scientific Inquiry, Methodologies, and Quantitative Skills*
CHE   201   General College Chemistry
MAT   150   Algebra and Trigonometry
       or
MAT   250   Calculus and Analytic Geometry I
PHY   130   General Physics I
PHY   131   General Physics I Laboratory
•*Social and Self-Awareness and Responsible Citizenship*
One of the following:
BIO   103   Saving Planet Earth
BIO   308   Ethics in Biology
COM   260   Communication Ethics
PHI   202   Ethics
POL   140   American National Government
•*University Studies Electives*
STA   135   Introduction to Probability and Statistics
and one of the following:
COM   131   Interpersonal Communication
ENG   224   Writing in the Professions

Required Courses .... 71-79 hrs
BIO   100T   Transitions
BIO   115   The Cellular Basis of Life[1]
BIO   216   Biological Inquiry and Analysis
BIO   221   Zoology: Animal Form and Function
BIO   222   Botany: Plant Form and Function
BIO   240   Biological Applications of GIS
       or
EES   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
EES   125   Weather and Climate
EES   199   Earth Science
EES   200   Introduction to Oceanography
EES   210   Hydrology
EES   303   Introduction to Water Science
EES   305   Introduction to Cartography
EES   312   Introduction to Remote Sensing
EES   314   Sediments and Soils
EES   424   Conservation and Environmental Geosciences
EES   512   Remote Sensing
EES   521   Geographic Information Systems
MAT   250   Calculus and Analytic Geometry I[1]
PHY   235   Mechanics, Heat and Wave Motion
PHY   255   Electricity, Magnetism, and Light
PSY   300   Principles and Methods of Statistical Analysis
STA   235   Introduction to Probability and Statistics

Unrestricted Electives....................................... 0-6 hrs

Total Curriculum Requirements .... 120 hrs
  [1]Upon 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
• *University Studies Electives*
PHY   130   General Physics I[1]
PHY   131   General Physics I Laboratory[1]
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 180 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[2,3]
CHE   215   Brief Organic Chemistry Laboratory[2,3]
CHE   330   Basic Biochemistry

Physics Requirement
PHY   132   General Physics II[4]
PHY   133   General Physics II Laboratory[4]

Required for Secondary Certification[5] .... 33 hrs
EDU   180   Exploring the Teaching Profession
EDU   280   Educating for Human Development
EDU   380   Inclusive Teaching of Diverse Learners
EDU   480   Effective Pedagogy
EDU   485   Professional Perspectives for Teaching
SEC   420   Practicum in Secondary Schools[6]
SEC   421   Student Teaching in the Secondary School
SEC   422   Extended Practicum[7]

Required Minor .... 3-21 hrs[8]

Total Curriculum Requirements .... 128-148 hrs
[1]PHY 235 and 236 will also meet this requirement.
[2]May be used to fulfill University Studies requirements.
[3]This course does not apply toward the chemistry minor.
[4]PHY 255 and 256 will also meet this requirement.
[5]PRAXIS Exam required during last semester before student teaching. Certi-

fication 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 180 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.
[6]EDU 480 and SEC 420 must be taken together two semesters before student teaching.
[7]Must be taken one semester before student teaching.
[8]Chemistry 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 Courses[1] .... 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
EES	199	Earth Science
EES	314	Sediments and Soils
PHY	130	General Physics I
	and	
PHY	131	General Physics I Laboratory

Conservation Biology Track.. 17 hrs

| EES | 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 Administation
BIO	590	Disturbance Ecology
EES	312	Introduction to Remote Sensing
EES	350	Field Techniques in Geosciences
EES	512	Remote Sensing
EES	521	Geographic Information Systems
PLN	507	Land Use Planning
SOC	455	Environmental Sociology

Total Curriculum Requirements .... 121-125 hrs

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

[2]Only 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 Courses[1] .... 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
EES	199	Earth Science
EES	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
EES	202	Introduction to Geographical Information Science
EES	306	Landscapes of the National Parks
EES	350	Field Techniques in Geosciences
EES	512	Remote Sensing

EES   521   Geographic Information Systems
PLN   507   Land Use Planning
REC   411   Curriculum Development in Adventure Education
REC   450   Recreational Use of Natural Resoures
REC   465   Interpretation of Cultural and Natural Resources

Total Curriculum Requirements .... 121-125 hrs
   [1]Meets course requirements for Associate Wildlife Biologist Certification from The Wildlife Society.
   [2]Only 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 Courses[1] .... 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
EES   199   Earth Science
EES   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
EES   202   Introduction to Geographical Information Science
REC   465   Interpretation of Cultural and Natural Resources

Total Curriculum Requirements .... 121-125 hrs
   [1]Meets course requirements for Associate Wildlife Biologist Certification from The Wildlife Society.
   [2]Only 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 Courses[1] .... 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
EES	199	Earth Science
EES	314	Sediments and Soils
PHY	130	General Physics I

and

PHY	131	General Physics I Laboratory

Wildlife Biology Track .... 17 hrs

EES	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
EES	312	Introduction to Remote Sensing
EES	512	Remote Sensing
EES	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

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

[2]Only 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 Courses[1] .... 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
EES	199	Earth Science
EES	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
[1]Meets course requirements for Associate Wildlife Biologist Certification from The Wildlife Society.
[2]Only 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). Remaining BIO hours should be chosen with advisor's approval (BIO 330 and 333 are highly recommended). A maximum of three hours total from BIO 391, 392, 483, 484, 493, or 494 may be used. BIO 101, 488, 489, and 499 will not count toward this minor. Six hours must be upper-level (300 and greater) courses.

Cell Biology Minor .... 22-24 hrs
BIO 115, 321, 323, 330, 533 and six to eight hours from the following: BIO 300, 322, 420, 421, 461, 501, 504, 521, 522, 528, 534, 597. Six hours must be upper-level (300 and greater) courses.

Pre-Pharmacy Curriculum[1]
Required Courses ....58 hrs

BIO	221	Zoology: Animal Form and Function[2]
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
[1]The 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.
[2]May be used to fulfill University Studies requirements if completing a B.A. or B.S. degree.
[3]A course focusing on the study of a developing or non-Western country.
[4]Must 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[L]
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[L]
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 EES 642)
BIO   689   Introduction to Graduate Study
BIO   696   Understanding Scientific Communication[L]
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
EES   612   Remote Sensing
EES   621   Geographic Information Systems
EES   640   Advanced Remote Sensing
EES   641   Digital Image Processing Research
EES   662   Hydrogeology
EES   665   Physical/Chemical Limnology
EES   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: Kevin Revell. **Faculty:** Allenbaugh, Clear, Cox, Fannin, Fawzy, Johnson, Loganathan, 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, 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 Electives[3] .... 3 hrs
CHE   488   Cooperative Education/Internship
       or
CHE   495   Senior Research

Unrestricted Electives .... 6-9 hrs

Total Curriculum Requirements .... 120 hrs
   [1]Required for area if not taken as a University Studies elective.
   [2]CSC 232 or EGR 140 may be substituted.
   [3]In 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 I[1]
PHY   130   General Physics I[1] *and*
PHY   131   General Physics I Laboratory[1]
PHY   132   General Physics II[1] *and*
PHY   133   General Physics II Laboratory[1]

Required Courses .... 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

Electives[3] .... 17-20 hrs

Total Curriculum Requirements .... 120 hrs
   [1]Required for major if not taken as a University Studies elective.
   [2]CSC 232 or EGR 140 may be substituted.
   [3]At 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 I[1] *and*
PHY   131   General Physics I Laboratory[1]
PHY   132   General Physics II[1] *and*
PHY   133   General Physics II Laboratory[1]
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 180 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 180 Exploring the Teaching Profession[2]
EDU 280 Educating for Human Development[2]
EDU 380 Inclusive Teaching of Diverse Learners[2]
EDU 480 Effective Pedagogy[2,3]
EDU 485 Professional Perspectives for Teaching[2,4]
SEC 420 Practicum in Secondary Schools[3]
SEC 421 Student Teaching in the Secondary School
SEC 422 Extended Practicum[4]

Required Minor .... 21 hrs

Total Curriculum Requirements .... 128-138 hrs
[1]Required 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.
[3]With a grade of *B* or better.
[4]EDU 480 and SEC 420 must be taken together two semesters before student teaching.
[5]Must be taken one semester before student teaching.

Chemistry Teaching Specialization

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

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

Chemistry Teaching Specialization .... 24 hrs
CHE 120 Chemical Laboratory Safety
CHE 201 General College Chemistry
CHE 202 General Chemistry and Qualitative Analysis
CHE 305 Analytical Chemistry
CHE 312 Organic Chemistry I
Choose one elective from the following:
CHE 320 Organic Chemistry II
CHE 352 Basic Chemical Instrumentation
CHE 330 Basic Biochemistry
CHE 403 Basic Physical Chemistry

MAJOR:
Chemistry/Pre-Medical/Pre-Dental Track
Bachelor of Science/Bachelor of Arts   CIP 40.0501

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

University Studies selections must include:
•*Scientific Inquiry, Methodologies, and Quantitative Skills*
MAT 250 Calculus and Analytic Geometry I[1]
PHY 130 General Physics I[1]
PHY 131 General Physics I Laboratory[1]
PHY 132 General Physics II[1]
PHY 133 General Physics II Laboratory[1]

Required Courses .... 38 hrs
CHE 100T Transitions
CHE 201 General College Chemistry
CHE 202 General Chemistry and Qualitative Analysis
CHE 305 Analytical Chemistry
CHE 312 Organic Chemistry I
CHE 320 Organic Chemistry II
CHE 352 Basic Chemical Instrumentation
CHE 403 Basic Physical Chemistry
CHE 530 Fundamentals of Biochemistry I
CSC 235 Programming in C++[2]
ENG 204 Advanced Expository Writing
        or
ENG 324 Technical Writing

Required Minor[3] .... 21 hrs

Unrestricted Electives... 17-20 hrs

Total Curriculum Requirements .... 120 hrs
[1]Required for major if not taken as a University Studies elective.
[2]CSC 232 or EGR 140 may be substituted.
[3]Biology minor strongly recommended.

MAJOR:
Chemistry/Biochemistry Track
Bachelor of Science/Bachelor of Arts   CIP 40.0501

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

University Studies selections must include:
•*Scientific Inquiry, Methodologies, and Quantitative Skills*
MAT 250 Calculus and Analytic Geometry I[1]
PHY 130 General Physics I[1] *and*
PHY 131 General Physics I Laboratory[1]
PHY 132 General Physics II[1] *and*
PHY 133 General Physics II Laboratory[1]

Required Courses .... 44 hrs
CHE 100T Transitions
CHE 201 General College Chemistry
CHE 202 General Chemistry and Qualitative Analysis
CHE 305 Analytical Chemistry
CHE 312 Organic Chemistry I
CHE 320 Organic Chemistry II
CHE 352 Basic Chemical Instrumentation
CHE 403 Basic Physical Chemistry
CHE 530 Fundamentals of Biochemistry I

CHE 537 Experimental Biochemistry
CHE 540 Fundamentals of Biochemistry II
CSC 235 Programming in C++[2]

Required Minor[3] .... **21 hrs**

Electives .... **11-14 hrs**

Total Curriculum Requirements .... **120 hrs**
[1]Required for major if not taken as a University Studies elective.
[2]CSC 232 or EGR 140 may be substituted.
[3]Biology minor is strongly recommended.

MAJOR:
Chemistry/Forensics Track
Bachelor of Science/Bachelor of Arts   CIP 40.0501

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

University Studies selections must include:
•*Scientific Inquiry, Methodologies, and Quantitative Skills*
MAT 250 Calculus and Analytic Geometry I
PHY 130 General Physics I[1] *and*
PHY 131 General Physics I Laboratory[1]
PHY 132 General Physics II[1] *and*
PHY 133 General Physics II Laboratory[1]

Required Courses .... **34 hrs**
CHE 100T Transitions
CHE 201 General College Chemistry
CHE 202 General Chemistry and Qualitative Analysis
CHE 305 Analytical Chemistry
CHE 312 Organic Chemistry I
CHE 320 Organic Chemistry II
CHE 325 Organic Chemistry II Laboratory
CHE 403 Basic Physical Chemistry I
CSC 235 Programming in C++[2]

Required Limited Electives .... **10 hrs**
ARC 335 Forensic Archaeology
CHE 330 Basic Biochemistry
CHE 352 Basic Chemical Instrumentation

Criminal Justice Minor[3] .... **21 hrs**
CRJ 220, 333, and 346 are required selections.

Unrestricted Electives .... **11-14 hrs**

Total Curriculum Requirements .... **120 hrs**
[1]Required for major if not taken as a University Studies elective.
[2]CSC 232 or EGR 140 may be substituted.
[3]A second major in Criminal Justice can substitute for the minor.

MAJOR:
Chemistry/Polymer and Materials Science Track
Bachelor of Science/Bachelor of Arts   CIP 40.0501

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

University Studies selections must include:
•*Scientific Inquiry, Methodologies, and Quantitative Skills*
MAT 250 Calculus and Analytic Geometry I[1]
PHY 235 Mechanics, Heat and Wave Motion[1]
PHY 236 Mechanics, Heat and Wave Motion Laboratory[1]
PHY 255 Electricity, Magnetism and Light[1]
PHY 256 Electricity, Magnetism and Light Laboratory[1]

Required Courses .... **51 hrs**
CHE 100T Transitions
CHE 201 General College Chemistry
CHE 202 General Chemistry and Qualitative Analysis
CHE 305 Analytical Chemistry
CHE 312 Organic Chemistry I
CHE 320 Organic Chemistry II
CHE 352 Basic Chemical Instrumentation
CHE 503 Industrial Chemistry
CHE 576 Polymer Chemistry
CSC 235 Programming in C++[2]
EGR 240 Thermodynamics I
EGR 375 Materials Science
MAT 308 Calculus and Analytic Geometry II
PHY 370 Introduction to Modern Physics

Required Limited Electives .... **3 hrs**
CHE 488 Cooperative Education/Internship
       or
CHE 495 Senior Research

Required Minor[3] .... **11-21 hrs**

Unrestricted Electives .... **1-17 hrs**

Total Curriculum Requirements .... **120 hrs**
[1]Required for major if not taken as a University Studies elective.
[2]CSC 232 or EGR 140 may be substituted.
[3]PHY 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 Track[1]
Bachelor of Science/Bachelor of Arts   CIP 40.0501

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

University Studies selections must include:
•*Scientific Inquiry, Methodologies, and Quantitative Skills*
MAT 250 Calculus and Analytic Geometry I[2]
PHY 130 General Physics I[2]
PHY 131 General Physics I Laboratory[2]
PHY 132 General Physics II[2]
PHY 133 General Physics II Laboratory[2]
•*Social and Self-Awareness and Responsible Citizenship*
ECO 231 Principles of Microeconomics

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 Minor[4] .... 21 hrs

Unrestricted Electives.. 9-12 hrs

Total Curriculum Requirements .... 120 hrs
  [1]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.
  [2]Required for major if not taken as a University Studies elective.
  [3]CSC 232 or EGR 140 may be substituted.
  [4]Biology 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[L,1]
CHE   602   Seminar[1]
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.)
  [1]Each 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 hours[1]
CHE   601   Seminar[L,2]
CHE   602   Seminar[2]
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.)
   [1]CHE 691, 692, and 693 will not count toward completion of this degree.
   [2]Each 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 Earth and Environmental Sciences
334 Blackburn Science Building
270-809-2591

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

   An area in earth and environmental sciences with tracks in, archaeology, environmental science, environmental science, geography and geographic information science (GIS), geology, and earth science teacher certification are provided by the department faculty. Minors are offered in anthropology, archaeology, earth science, environmental geology, and geographic information science (GIS). A certificate in geographic information science (GIS) and an M.S. in Earth and Environmental Sciences may also be earned.

In addition to the more traditional curricula, students have access to the Murray State Archaeology Lab, a summer field archaeology school, and the Mapping Applications and Resource Center (MARC), a core entity in the Murray State University Watershed Studies Institute (WSI).

Earth and environmental sciences 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:
Earth and Environmental Sciences/Environmental Science Track

Bachelor of Science   CIP 40.0601

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

Required Courses .... 52 hrs
ARC   150   Introduction to Archaeology[1]
ARC   320   Human Ecology
BIO   103   Saving Planet Earth
CHE   105   Introductory Chemistry
ECO   231   Principles of Microeconomics
EES   100T Transitions
EES   101   The Earth and the Environment[2]
EES   110   World Geography[1]
EES   125   Weather and Climate[2]
EES   202   Introduction to Geographic Information Sciences
EES   210   Hydrology
EES   301   Understanding Scientific Communication
EES   312   Introduction to Remote Sensing
EES   336   Principles of Geomorphology
EES   350   Field Techniques in Geosciences
EES   424   Conservation and Environmental Geosciences

Required Limited Electives... 6 hrs
Choose from the following approved electives:
BIO   101   Biological Concepts
CHE   210   Brief Organic Chemistry
ECO   345   Environmental Economics
EES   200   Introduction to Oceanography
EES   303   Introduction to Water Science
EES   305   Introduction to Cartography
EES   314   Sediments and Soils
EES   426   Applied Meteorology
EES   489   Cooperative Education/Internship
EES   507   Land Use Planning
EES   536   Soils and Geomorphology
EES   542   Watershed Ecology
EES   562   Hydrogeology
EES   565   Biogeochemistry
EES   578   Terrestrial Ecosystem Modeling
EES   579   Remote Sensing of Vegetation
EES   591   Special Problems
EES   592   Special Problems
EES   593   Special Problems
ENG   371   Literature and the Environment
ENT   286   Introduction to Environmental Engineering Technology
PHI   376   Environmental Ethics

Collateral Requirement.. 7-8 hrs
CSC   101[3] Introduction to Problem Solving Using Computers
        or
CSC   199[3] Introduction to Information Technology
MAT   150[2] Algebra and Trigonometry (or above)
        or
STA   135[2] Introduction to Probability and Statistics (or above)

Unrestricted Electives... 11-17 hrs

Total Curriculum Requirements .... 120 hrs
  [1]Will count towards University Studies Global Awareness, Cultural Diversity, and the World's Artistic Tradition requirements.
  [2]Will count towards University Studies Scientific Inquiry, Methodologies, and Quantitative Skills requirements.
  [3]This is a University Studies electives writing-intensive or technology-intensive course.

AREA:
Earth and Environmental Sciences/Earth Science Secondary Certification Track (Grades 8-12)

Bachelor of Science   CIP 40.0601

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

University Studies selections must include:
•*Scientific Inquiry, Methodologies, and Quantitative Skills*
EES   101   The Earth and the Environment
EES   102   Earth through Time
MAT   150   Algebra and Trigonometry
•*Global Awareness, Cultural Diversity and the World's Artistic Traditions*
EES   110   World Geography
•*University Studies Electives*
ARC   150   Introduction to Archaeology
CSC   101   Introduction to Problem Solving Using Computers
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, and public speaking. 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
ARC   320   Human Ecology
AST   115   Introductory Astronomy
AST   116   Introductory Astronomy Laboratory
EES   100T Transitions
EES   125   Weather and Climate[2]
EES   202   Introduction to Geographic Information Sciences
EES   301   Understanding Scientific Communication
EES   303   Introduction to Water Science
EES   312   Introduction to Remote Sensing
EES   336   Principles of Geomorphology
EES   339   Field Geology
        or
EES   350   Field Techniques in Geosciences

Required Limited Electives... 12 hrs
Select upper-level courses from the list of approved electives shown under the 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 .... 31 hrs
EDU 180 Exploring the Teaching Profession[1]
EDU 280 Educating for Human Development[1]
EDU 380 Inclusive Teaching of Diverse Learners[1]
EDU 480 Effective Pedagogy[1,2]
EDU 485 Professional Perspectives for Teaching[1,3]
SEC 420 Practicum in Secondary Schools[2]
SEC 421 Student Teaching in the Secondary School
SEC 422 Extended Practicum[3]

Total Curriculum Requirements .... 120 hrs
[1]With a grade of *B* or better.
[2]Must be taken together and two semesters before student teaching.
[3]Must 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
EES 101 The Earth and the Environment
EES 102 Earth through Time
EES 125 Weather and Climate
EES 202 Introduction to Geographic Information Sciences
EES 303 Introduction to Water Science
EES 336 Principles of Geomorphology
EES 339 Field Geology
or
EES 350 Field Techniques in Geosciences

AREA:
Earth and Environmental Sciences/Geology Track
Bachelor of Science   CIP 40.0601

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

Required Courses .... 50 hrs
ARC 150 Introduction to Archaeology[1]
ARC 320 Human Ecology
CHE 105 Introductory Chemistry
EES 100T Transitions
EES 101 The Earth and the Environment[2]
EES 102 Earth through Time[2]
EES 110 World Geography[1]
EES 202 Introduction to Geographic Information Sciences
EES 210 Hydrology
EES 301 Understanding Scientific Communication
EES 310 Rock and Mineral Resources
EES 312 Introduction to Remote Sensing
EES 314 Sediments and Soils
EES 336 Principles of Geomorphology
EES 562 Hydrogeology

Required Limited Electives .... 8 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 390 Geoarchaeology
BIO 101 Biological Concepts
CET 280 Plane Surveying
CHE 201 General College Chemistry
CHE 202 General Chemistry and Qualitative Analysis
EES 200 Introduction to Oceanography
EES 303 Introduction to Water Science
EES 305 Introduction to Cartography
EES 306 Landscapes of the National Parks
EES 330 Economic Geography
EES 339 Field Geology
EES 350 Field Techniques in Geosciences
EES 388 International Experience in the Geosciences
EES 424 Conservation and Environmental Geosciences
EES 433 Structural Geology
EES 489 Cooperative Education/Internship
EES 507 Land Use Planning
EES 512 Remote Sensing
EES 521 Geographic Information Systems
EES 522 Advanced Cartography
EES 533 Paleoecology
EES 534 Invertebrate Paleontology
EES 536 Soils and Geomorphology
EES 542 Watershed Ecology
EES 578 Terrestrial Ecosystem Modeling
EES 579 Remote Sensing of Vegetation
EES 591 Special Problems
EES 592 Special Problems
EES 593 Special Problems
PHY 130 General Physics I
PHY 131 General Physics I Laboratory

Collateral Requirement .... 7-8 hrs
CSC 101[3] Introduction to Problem Solving Using Computers
or
CSC 199[3] Introduction to Information Technology

MAT 150[2] Algebra and Trigonometry (or above)
 or
STA 135[2] Introduction to Probability and Statistics (or above)

Unrestricted Electives.. 11-17 hrs

Total Curriculum Requirements .... 120 hrs
    [1]Will count towards University Studies Global Awareness, Cultural Diversity, and the World's Artistic Tradition requirements.
    [2]Will count towards University Studies Scientific Inquiry, Methodologies, and Quantitative Skills requirements.
    [3]This is a University Studies electives writing-intensive or technology-intensive course.

AREA:
Earth and Environmental Sciences/ Archaeology Track
Bachelor of Science   CIP 40.0601

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

University Studies selection must include:
• *Global Awareness, Cultural Diversity, and the World's Artistic Traditions*
ANT 140 Introduction to Cultural Anthropology

Required Courses .... 44 hrs
ARC 150 Introduction to Archaeology[1]
ARC 300 Archaeological Method and Theory
ARC 304 Archaeological Laboratory Methods
ARC 320 Human Ecology
ARC 330 North American Archaeology
ARC 390 Geoarchaeology
EES 100T Transitions
EES 101 The Earth and the Environment[2]
EES 110 World Geography[1]
EES 202 Introduction to Geographic Information Sciences
EES 301 Understanding Scientific Communication
EES 312 Introduction to Remote Sensing
EES 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 321 Ancient Civilizations
ARC 335 Forensic Archaeology
ARC 340 Archaeology of Africa
ARC 345 Archaeology of Ancient Mexico, Central America, and the Caribbean
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
EES 305 Introduction to Cartography
EES 306 Landscapes of the National Parks
EES 310 Rock and Mineral Resources
EES 350 Field Techniques in Geosciences
EES 388 International Experience in the Geosciences
EES 521 Geographic Information Systems

Collateral Requirement... 7-8 hrs
CSC 101[3] Introduction to Problem Solving Using Computers
 or
CSC 199[3] Introduction to Information Technology
MAT 150[2] Algebra and Trigonometry (or above)
 or
STA 135[2] Introduction to Probability and Statistics (or above)

Unrestricted Electives.. 11-17 hrs

Total Curriculum Requirements .... 120 hrs
    [1]Will count towards University Studies Global Awareness, Cultural Diversity, and the World's Artistic Tradition requirements.
    [2]Will count towards University Studies Scientific Inquiry, Methodologies, and Quantitative Skills requirements.
    [3]This is a University Studies electives writing-intensive or technology-intensive course.

AREA:
Earth and Environmental Sciences/Geography and GIS 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 Archaeology[1]
ARC 320 Human Ecology
EES 100T Transitions
EES 101 The Earth and the Environment[2]
EES 110 World Geography[1]
EES 125 Weather and Climate[2]
EES 202 Introduction to Geographic Information Sciences
EES 301 Understanding Scientific Communication
EES 305 Introduction to Cartography
EES 312 Introduction to Remote Sensing
EES 330 Economic Geography
EES 336 Principles of Geomorphology
EES 512 Remote Sensing
EES 521 Geographic Information Systems

Required Limited Electives .... 11 hrs
Choose from the following approved electives:
EES 210 Hydrology
EES 303 Introduction to Water Science
EES 306 Landscapes of the National Parks
EES 310 Rock and Mineral Resources
EES 314 Sediments and Soils

EES 350 Field Techniques in Geosciences
EES 390 Geoarchaeology
EES 424 Conservation and Environmental Geosciences
EES 488 Cooperative Education/Internship
EES 489 Cooperative Education/Internship
EES 507 Land Use Planning
EES 522 Advanced Cartography
EES 562 Hydrogeology
EES 578 Terrestrial Ecosystem Modeling
EES 579 Remote Sensing of Vegetation
EES 591 Special Problems
EES 592 Special Problems
EES 593 Special Problems

Collateral Requirement.. 7-8 hrs
CSC 101[3] Introduction to Problem Solving Using Computers
    or
CSC 199[3] Introduction to Information Technology
MAT 150[2] Algebra and Trigonometry (or above)
    or
STA 135[2] Introduction to Probability and Statistics (or above)

Unrestricted Electives.................................... 11-17 hrs

Total Curriculum Requirements .... 120 hrs
  [1]Will count towards University Studies Global Awareness, Cultural Diversity, and the World's Artistic Tradition requirements.
  [2]Will count towards University Studies Scientific Inquiry, Methodologies, and Quantitative Skills requirements.
  [3]This 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
EES 101, 102, 125, and 339 or 350. Six additional hours selected from the following: AST 115, 116; EES 202, 210, 303, 310, 312, 336, 591, 592, 593. Six hours must be upper-level courses.

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

Geographic Information Science Minor.............. 21 hrs
EES 110, 125, 202, 305, and seven hours of electives selected from the following: EES 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 earth and environmental sciences, economics, history, or political science who seek secondary certification in social studies. ECO 231, EES 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 second-ary school social studies, grades 8 through 12 through the College of Education and Human Services 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 hours[1]
EES 202 Introduction to Geographic Information Science
EES 512 Remote Sensing
EES 521 Geographic Information Systems

One elective course from the following:
AGR 471 Applications in Precision Agriculture
BIO 240 Biological Applications in GIS
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
EES 305 Introduction to Cartography
EES 507 Land Use Planning
EES 522 Advanced Cartography
EES 570 Computer Applications in Geosciences
MKT 585 Integrated Business GIS
  [1]A grade of *C* or better must be earned in all courses.

Graduate Program
Graduate Coordinator - Haluk Cetin

The Department of Earth and Environmental Sciences offers a Master of Science degree in Earth and Environmental Sciences. Students choose the thesis or the non-thesis option. Four concentrations are offered for the thesis option: environmental geology, geoarchaeology, geoinformatics, and watershed science. 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 **Archaeology 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 archaeology concentration offers students a broad range of options to develop a curriculum that matches their particular interests and needs. The archaeology concentration emphasizes the relationship between human culture and the natural environment and provides opportunities to apply the principles and methods of archaeology to reconstruct the past to better understand our cultural heritage.

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 Earth and Environmental Sciences 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.

Earth and Environmental Sciences is closely associated with the Mapping Applications and Resources 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 an earth and environmental sciences (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 Earth and Environmental Sciences

CIP 40.0699

NON-THESIS REQUIREMENTS
Total Course Requirements... 30 hours
EES 612 Remote Sensing
EES 619 Seminar in Research Techniques[PT]
EES 621 Geographic Information Systems
EES 680 Advanced Geographic Information Systems
EES 696 Understanding Scientific Communication

Electives .... 14 hours
EES courses, at 600-level (9-10 hrs)
EES or related courses at 600-level (4-5)

Other Degree Requirements
Written and oral comprehensive examinations.

Master of Science Earth and Environmental Sciences/ Environmental Geology Concentration
CIP 40.0699

Total Course Requirements... 30 hours
EES 619 Seminar in Research Techniques[PT]
EES 621 Geographic Information Systems
EES 696 Understanding Scientific Communication
EES 698 Thesis Research[L, R]
EES 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
EES 616 Isotope Geochemistry
EES 633 Paleoecology
EES 642 Watershed Ecology
EES 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
EES 636 Soils and Geomorphology
EES 662 Hydrogeology
EES 665 Physical/Chemical Limnology
EES 691 Special Problems
EES 692 Special Problems
EES 693 Special Problems
MAT 665 Applied Statistics I
WSC 601 Seminar in Sustainability Studies

Other Degree Requirements
Defense of thesis.

Master of Science Earth and Environmental Sciences/ Archaeology Concentration
CIP 40.0699

Total Course Requirements... 30 hours
ARC 600 Graduate Seminar in Archaeology
EES 619 Seminar in Research Techniques[PT]
EES 621 Geographic Information Systems
EES 696 Understanding Scientific Communication
EES 698 Thesis Research[L, R]
EES 699 Thesis Research[L, R]

Geoarchaeology Restricted Electives .... 12 hours
Choose one course from the following:
ARC 602 Graduate Archaeological Field Work
EES 636 Soils and Geomorphology
EES 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
ARC 620 Human Ecology

EES	612	Remote Sensing
EES	680	Advanced Geographic Information Systems
EES	691	Special Problems
EES	692	Special Problems
EES	693	Special Problems
MAT	665	Applied Statistics I
WSC	601	Seminar in Sustainability Studies

Other Degree Requirements
 Defense of thesis.

Master of Science Earth and Environmental Sciences/ Geoinformatics Concentration
CIP 40.0699

Total Course Requirements... 30 hours
EES	619	Seminar in Research Techniques[PT]
EES	621	Geographic Information Systems
EES	696	Understanding Scientific Communication
EES	698	Thesis Research[L, R]
EES	699	Thesis Research[L, R]

Required Concentration Courses.................................... 10 hours
EES	612	Remote Sensing
EES	640	Advanced Remote Sensing
EES	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
EES	622	Advanced Cartography
EES	641	Digital Image Processing Research
EES	656	Geophysical Surveying
EES	660	Spatial Analysis Techniques
EES	661	Precision GIS/GPS Applications
EES	678	Terrestrial Ecosystem Modeling
EES	679	Remote Sensing of Vegetation
EES	691	Special Problems
EES	692	Special Problems
EES	693	Special Problems
MAT	665	Applied Statistics I

Other Degree Requirements
 Defense of thesis.

Master of Science Earth and Environmental Sciences/ Watershed Science Concentration
CIP 40.0699

Total Course Requirements... 30 hours
EES	619	Seminar in Research Techniques[PT]
EES	621	Geographic Information Systems
EES	642	Watershed Ecology
EES	696	Understanding Scientific Communication
EES	698	Thesis Research[L, R]
EES	699	Thesis Research[L, R]

Watershed Science Restricted Electives .... 12 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
EES	616	Isotope Geochemistry
EES	636	Soils and Geomorphology
EES	640	Advanced Remote Sensing
EES	641	Digital Image Processing Research
EES	643	Soil Micromorphology
EES	662	Hydrogeology
EES	665	Physical/Chemical Limnology
EES	678	Terrestrial Ecosystem Modeling
EES	679	Remote Sensing of Vegetation
EES	680	Advanced Geographic Information Systems

Other Degree Requirements
 Successful completion of MAT 665 Applied Statistics I if substituted for EES 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**

EES	612	Remote Sensing
EES	621	Geographic Information Systems
EES	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
EES	640	Advanced Remote Sensing
EES	660	Spatial Analysis Techniques
EES	678	Terrestrial Ecosystem Modeling
EES	679	Remote Sensing of Vegetation
EES	680	Advanced Geographic Information Systems (GIS)
EES	691	Special Problems
EES	692	Special Problems
EES	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, Cobb, 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 through-

out 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 Physics[1]
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 Chemistry[2]
MAT	250	Calculus and Analytic Geometry I[2]
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 II[2]
PHY 236 Mechanics, Heat and Wave Motion Laboratory

Core Courses .... **50 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 III[2]
MAT 338 Ordinary Differential Equations[2]
PHY 255 Electricity, Magnetism and Light
PHY 256 Electricity, Magnetism and Light Laboratory
PHY 370 Introduction to Modern Physics
PHY 470 Optics

Technical Electives[3] .... **24 hrs**
Each student must complete at least 24 hours of technical electives. A minimum of 12 technical elective credit hours must be EGR courses. Completion of an emphasis is encouraged but not required. Fifteen credit hours must be exclusive to each emphasis for multi-emphasis students. Technical Electives must come from the courses listed in the elective emphases or EGR/PHY courses, 300-level and above, or as approved by department chair. A maximum of six technical elective credit hours may come from combinations of EGR/PHY 488, 489, 520, and EGR 388.

Advanced Physics Emphasis
EGR 330 Dynamics
EGR 460 Electricity and Magnetism I
Select nine hours of 300-level and above PHY courses beyond the core course requirements.
Completion of at least 24 hours is required in this track (12 hours must be EGR prefix courses).

Aerospace Engineering Emphasis
EGR 320 Fundamentals of Flight
EGR 330 Dynamics
EGR 359 Mechanics of Materials
EGR 420 Aerodynamics
  or
EGR 422 Propulsion
and one of the following:
EGR 440 Thermal and Fluid Systems Laboratory
PHY 316 Introductory Astrophysics and Space Physics
  or
any mechanical engineering track course
Completion of at least 24 hours is required in this track (18 hours must be EGR prefix courses). Remaining nine hours of electives must be advisor approved.

Electrical Engineering Emphasis
EGR 460 Electricity and Magnetism I
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 24 hours is required in this track (18 hours must be EGR prefix courses). Remaining eight to nine hours of electives must be advisor approved.

Mechanical Engineering Emphasis
EGR 330 Dynamics
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 24 hours is required in this track (18 hours must be EGR prefix courses). Remaining nine hours of electives must be advisor approved.

Mathematics Depth Elective[4] .... **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**
 [1]This 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.
 [2]This course is considered a program corequisite and may be shared with a minor or second major.
 [3]Students 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.
 [4]Technical 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 hrs[2]

Unrestricted Electives................................... 14-20 hrs

Total Curriculum Requirements .... 120 hrs
    [1]Fulfill University Studies requirements. Required for major if not taken as a University Studies requirement.
    [2]CHE 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 180 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 hrs[2]

Total Curriculum Requirements .... 120-123 hrs
[1]Fulfill University Studies requirements. Required for major if not taken as a University Studies requirement.
[2]CHE 201 and 202 fulfill requirements for a minor in chemistry; MAT 250, 308, 309, 338 and 442 fulfill requirements for a minor in math.
[3]With a grade of *B* or better.
[4]EDU 405 and SEC 420 must be taken together and two semesters before student teaching.
[5]Must 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 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
[1]Corequisite of PHY 235.
[2]Corequisite of PHY 255.

AREA:
Applied Physics
Bachelor of Science/Bachelor of Arts   CIP 40.0801

University Studies Requirements................................. 38-44 hrs
(See *Academic Degrees and Programs*.)
Note: See required courses below before selecting Scientific Inquiry, Methodologies, and Quantitative Skills University Studies electives.

Required Courses .... 33 hrs
EGR	140	Introduction to Computing Applications in Science and Engineering
EGR	240	Thermodynamics I
EGR	264	Linear Circuits I
PHY	100T	Transitions
PHY	235	Mechanics, Heat and Wave Motion
PHY	236	Mechanics, Heat and Wave Motion Laboratory
PHY	255	Electricity, Magnetism and Light
PHY	256	Electricity, Magnetism and Light Laboratory
PHY	370	Introduction to Modern Physics
	or	
PHY	580	Modern Physics I
PHY	460	Electricity and Magnetism I
PHY	470	Optics
PHY	530	Mechanics I

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

Technical Electives[3] .... 24 hrs

Unrestricted Electives..................................... 13-19 hrs

Total Curriculum Requirements .... 120 hrs
[1]Fulfill University Studies requirements. Required for area if not taken as a University Studies requirement.
[2]This course is considered a program corequisite and may be shared with a minor or second major.
[3]The 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 EES 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 principles. 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
EES   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*
EES   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
EES   202   Introduction to Geographic Information Science
EES   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*
EES   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 Analytical 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

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
Technical elective (3 hrs)

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*
EES 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
IOE 125 Analytical 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

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*
EES 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
IOE 125 Analytical 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

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
EES 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*
EES   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
IOE   125   Analytical 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

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

Total Curriculum Requirements .... 120 hrs

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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 hrs[1]
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
IOE   399   Professional Develop Seminar I
IOE   488   Cooperative Education/Internship
ITD   102   CAD Applications
TSM   301   Physical Network Theory

Technical Electives .... 7 hrs

Total Curriculum Requirements .... 120 hrs
[1]A 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
IOE	350	Technology Management
IOE	399	Professional Development Seminar I
IOE	488	Cooperative Education/Internship
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
IOE	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 the M.S. in Applied Engineering and Technology Management, 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 hours[1]
CET	682	Industrial Environmental Management
IOE	684	Engineering Economic Analysis
IOE	691	Industrial Operations[L]
IOE	693	Systems Management Technology
IOE	695	Industrial Supervision[PT]
IOE	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.

[1]A basic statistics course or equivalent is required prior to enrolling in IOE 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
IOE 350 Technology Management
IOE 399 Professional Development Seminar I
MKT 360 Principles of Marketing
TSM 100T Transitions
TSM 134 Introduction to Telecommunications Systems
              Management
TSM 232 Operating Systems
TSM 233 Network Services
TSM 241 Networking Fundamentals
TSM 301 Physical Network Theory
TSM 320 Introduction to Wireless Technology
TSM 343 Protocol Analysis
TSM 351 Principles of Information Security
TSM 411 Network Design, Operations and Management
TSM 443 Telephone Technology
TSM 488 Cooperative Education/Internship[1]

Selected Emphasis .... 21 hrs
    *Choose **one** of the methods of completion below:*
    1) Select 21 hours from any of the classes listed below or
    2) Select two emphasis areas and complete at least 21 hours
Note: When selecting courses for an area of emphasis or as an elective, a maximum of nine hours may be selected from courses with a business prefix including: MGT or MKT. Adherence to course prerequisites is critical.

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

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

Network and Systems 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
    [1]Maximum of three hours Internship or Cooperative Education counts toward a degree.

Telecommunications Systems Management Minor .... 22 hrs
TSM 134, 135, 232, 233, and 241. Nine hours of advisor approved electives. Six hours must be 300- or 400-level courses.

Graduate Program

Graduate Coordinator - Michael Bowman
270-809-6218

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

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

Unconditional
    For a TSM applicant to be unconditionally admitted to the program, an applicant must satisfy one of two formulas:
    GMAT Users: $(200 \times UGPA) + GMAT \geq 1,000$
    GRE Users: $GRE \geq 321 - (11.66 \times GPA -$ (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, international candidates must take the TOEFL and score 79 overall with no band less than 16, or the IELTS and score 6.5 with no band less than 6.0, 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, TSM 602, TSM 603, TSM 607, TSM 610, 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) 79

2) Minimum of 16 in each band

or International English Language Testing System (IELTS) exam and score 6.5 on the academic test (with no band <6.0) 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, IOE, 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, Porter, Pritchett, Roach, Schroeder, Taylor, Thome, Williams, 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 I[1]
MAT	308	Calculus and Analytic Geometry II[1]
MAT	309	Calculus and Analytic Geometry III[1]
MAT	312	Mathematical Reasoning[2]
MAT	335	Matrix Theory and Linear Algebra
STA	540	Mathematical Statistics I[3]

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**

[1]May be taken as a University Studies elective.
[2]This is a University Studies writing intensive course.
[3]This 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 ....43-44 hrs
(See *Academic Degrees and Programs*.)

University Studies selections must include:
•*Scientific Inquiry, Methodologies, and Quantitative Skills*
MAT   250   Calculus and Analytic Geometry I
MAT   308   Calculus and Analytic Geometry II
•*Social and Self-Awareness and Responsible Citizenship*
PSY   180   General Psychology
•*University Studies Electives*
MAT   309   Calculus and Analytic Geometry III
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 180 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 .... 20 hrs
MAT   100T Transitions
MAT   312   Mathematical Reasoning
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 I

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   180   Exploring the Teaching Profession[1]
EDU   280   Educating for Human Development[1]
EDU   380   Inclusive Teaching of Diverse Learners[1]
EDU   480   Effective Pedagogy[1,2]
EDU   485   Professional Perspectives for Teaching[1,3]
SEC   420   Practicum in Secondary Schools[2]
SEC   421   Student Teaching in the Secondary School
SEC   422   Extended Practicum[3]

Unrestricted Electives...0-3 hrs

Total Curriculum Requirements .... 120-123 hrs
[1]With a grade of *B* or better.
[2]Must be taken together and two semesters before student teaching.
[3]Must 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 .... 43-44 hrs
(See *Academic Degrees and Programs*.)

University Studies selections must include:
•*Scientific Inquiry, Methodologies, and Quantitative Skills*
MAT   250   Calculus and Analytic Geometry I
MAT   308   Calculus and Analytic Geometry II
•*Social and Self-Awareness and Responsible Citizenship*
PSY   180   General Psychology
•*University Studies Electives*
MAT   309   Calculus and Analytic Geometry III
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 180 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 .... 17 hrs
MAT   100T Transitions
MAT   312   Mathematical Reasoning[2]
MAT   335   Matrix Theory and Linear Algebra
MAT   517   Foundations of Geometry
MAT   550   Teaching Mathematics
STA   540   Mathematical Statistics I[3]

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

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 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

Total Curriculum Requirements .... 126-130 hrs

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 I[1]
MAT   308   Calculus and Analytic Geometry II[1]
MAT   309   Calculus and Analytic Geometry III[1]
MAT   312   Mathematical Reasoning[2]
MAT   335   Matrix Theory and Linear Algebra
MAT   338   Ordinary Differential Equations
MAT   442   Introduction to Numerical Analysis
STA   540   Mathematical Statistics I[3]

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
[1]May be taken as a University Studies elective.
[2]This is a University Studies writing intensive course.
[3]This is a University Studies technology intensive course.
[4]The program is very flexible. For example, an emphasis in either biology, chemistry, computer science, earth and environmental science, engineering physics, 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 Technology[1]
FIN   330   Principles of Finance
LSC   343   Fundamentals of Operations and Technology
MAT   100T   Transitions
MAT   312   Mathematical Reasoning[2]
MAT   335   Matrix Theory and Linear Algebra
MGT   350   Fundamentals of Management
MKT   360   Principles of Marketing
STA   540   Mathematical Statistics I[3]
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
[1]This is a University Studies technology intensive course.
[2]This is a University Studies writing intensive course.
[3]Will 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 multivariable 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 hours[1]
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 hours[1]
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.

[1]All 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 hours[1]
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 hours[1]
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.
[1]All 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, Wilbanks.

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 and Natural Science Accreditation Commission of ABET (ANSAC/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[1]
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[2]
STA   135   Introduction to Probability and Statistics

Required Core Courses .... 51 hrs
ITD   120   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   OSH Standards
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   Loss Control Management and Measurement
OSH   546   Fundamentals of Risk Management

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 Management
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
COM   384   Communication Skills for Professionals
COM   439   Conflict and Communication
CRJ   140   Introduction to Criminal Justice
CRJ   355   Security in Business and Industry
CRJ   425   Terrorism
MGT   550   Human Resource Management
MGT   575   Labor-Management Relations
OSH   330   Global Issues in OSH[3]
OSH   371   Professional Internship II
OSH   412   Emergency Management
OSH   453   Human Factors in Safety Engineering
OSH   488   Cooperative Education/Internship[4]
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   107   Basic Spanish and Culture for Occupational Safety
             and Health

Total Curriculum Requirements .... 123 hrs
   [1]Course must contain lab component.
   [2]CSC 199 can be substituted by another computer related course with advisor's approval.
   [3]May be repeated for additional credit.
   [4]May 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 and Natural Science Accreditation Commission of ABET (ANSAC/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[1]
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[2]
STA   135   Introduction to Probability and Statistics

Required Core Courses .... 51 hrs

ITD	120	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	OSH Standards
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 Management
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
COM	384	Communication Skills for Professionals
COM	439	Conflict and Communication
CRJ	140	Introduction to Criminal Justice
CRJ	355	Security in Business and Industry
CRJ	425	Terrorism
MGT	550	Human Resource Management
MGT	575	Labor-Management Relations
OSH	330	Global Issues in OSH[3]
OSH	371	Professional Internship II
OSH	412	Emergency Management
OSH	453	Human Factors in Safety Engineering
OSH	488	Cooperative Education/Internship[4]
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	107	Basic Spanish and Culture for Occupational Safety and Health

Total Curriculum Requirements .... 123 hrs
[1]Course must contain lab component.
[2]CSC 199 can be substituted by another computer related course with advisor's approval.
[3]May be repeated for additional credit.
[4]May be repeated for a second experience.

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

Graduate Program

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

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

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

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

Students admitted from a different undergraduate field/discipline must complete the following course work in addition to the above GPA requirements. Undergraduate coursework is required in biology, chemistry, mathematics, and physics. The following courses are the minimum accepted requirements for pursuing a master's degree in occupational safety and health.
- BIO 101
- PHY 125 and 126
- CHE 105
- PSY 300 or STA 135
- MAT 130 or MAT 140 and 145 or 150

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

Prerequisite Undergraduate Requirements..................... 15 hours

OSH	192	Introduction to Occupational Safety and Health
OSH	353	Prevention of Musculoskeletal Disorders in the Workplace
		or
OSH	453	Human Factors in Safety Engineering
OSH	387	OSH Standards
OSH	420	Fundamentals of Industrial Hygiene
		and

one of the following concentration-specific courses:
Safety Management

OSH	384	Construction Safety

Industrial Hygiene

OSH	425	Physical Agents

Environmental

OSH   320   Environmental and Occupational Health
                     Engineering Technology

Master of Science
Occupational Safety and Health

CIP 15.0701

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

THESIS REQUIREMENTS

Total Course Requirements.............................30 hours

Technical Requirements[1]...............................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 Management and Measurement
OSH   646   Fundamentals of Risk Management
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

Other Degree Requirement
   Oral defense of thesis.

   [1]Technical 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 courses chosen 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 Management

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