Jesse D. Jones College of Science, Engineering and Technology

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

DEPARTMENTS

PROGRAMS

UNDERGRADUATE

Associate
Civil Engineering Technology
Industrial Technology

Baccalaureate
Applied Physics
Biology
Chemistry
Construction Management and Architecture
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
Wildlife and Conservation Bio

Certificate
Geographic Information Science
Emergency Management
Wildlife Technician

GRADUATE

Master's
Biology
Chemistry
Earth and Environmental Sciences
Engineering Management
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].

Department of Biological Sciences

2112 Biology Building
270-809-2786

Interim Chair: Sterling Wright. **Faculty:** Arkov, Beckers, Canning, Darracq, Derting, Flinn, He,Jog, Nakamura, Spier, Sullivan-Beckers, Trzepacz, Weinberger, 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 310 Organic Chemistry I
and
CHE 311 Organic Chemistry I Laboratory
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 310 Organic Chemistry I
and

CHE 311 Organic Chemistry I Laboratory
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 310 Organic Chemistry I
and
CHE 311 Organic Chemistry I Laboratory
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 310 Organic Chemistry I
and
CHE 311 Organic Chemistry I Laboratory
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 310 Organic Chemistry I
and
CHE 311 Organic Chemistry I Laboratory
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 310 Organic Chemistry I
and
CHE 311 Organic Chemistry I Laboratory
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 310 Organic Chemistry I
and
CHE 311 Organic Chemistry I Laboratory
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. Certification requires a grade of *B* or better in one English composition course and a grade of *B* or better in a University Studies math course, public speaking, and EDU 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
and one of the following:
CHE 105 Introductory Chemistry
CHE 201 General College Chemistry
and one of the following:
MAT 150 Algebra and Trigonometry
MAT 250 Calculus and Analytical Geometry I
•Social and Self-Awareness and Responsible Citizenship
Choose one of the following:
ECO 230 Principles of Macroeconomics
ECO 231 Principles of Microeconomics
•University Studies Electives
BIO 216 Biological Inquiry and Analysis
ENG 224 Writing for the Professions

Core Courses[1] ..... 58-64 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
and one of the following:
BIO 333 Genetics
BIO 377 Conservation Genetics
and
BIO 380 Wildlife Techniques
BIO 499 Senior Biology Seminar
BIO 554 Dendrology and Forest Conservation
BIO 578 Conservation Biology
BIO 580 Principles of Wildlife Management
BIO 584 Wildlife Policy and Administration
and one of the following:
BIO 350 Systematic Botany
BIO 352 Native Plants for Wildlife
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..... 10 hrs
PLN 507 Land Use Planning
and one of the following:
BIO 240 Biological Applications in GIS
EES 202 Introduction to Geographical Information Science
and one of the following:
ECO 310 Issues in the Global Economy
ECO 345 Environmental Economics
HIS 381 Environmental History of the Americas
HIS 382 Ecological History

Career-Focused Electives[2] ..... 1-10 hrs

Total Curriculum Requirements ..... 120-129 hrs

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

[2]These must be selected in consultation with an academic advisor and provide knowledge and skills directly related to a student's future career objectives.

AREA:
Wildlife and Conservation Biology/ Conservation Education and Interpretation Track

Bachelor of Science/Bachelor of Arts CIP 03.0601

University Studies Requirements..... 42-45 hrs
(See *Academic Degrees and Programs.*)

University Studies selections must include:
•Scientific Inquiry, Methodologies, and Quantitative Skills
STA 135 Introduction to Probability and Statistics
and one of the following:
CHE 105 Introductory Chemistry
CHE 201 General College Chemistry
and one of the following:
MAT 150 Algebra and Trigonometry
MAT 250 Calculus and Analytical Geometry I
•Social and Self-Awareness and Responsible Citizenship
EDP 260 Psychology of Human Development
and one of the following:
HIS 221 American Experience to 1865
HIS 222 American Experience since 1865
•University Studies Electives
BIO 216 Biological Inquiry and Analysis
ENG 224 Writing for the Professions

Core Courses[1] ..... 58-64 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
and one of the following:
BIO 333 Genetics
BIO 377 Conservation Genetics
and
BIO 380 Wildlife Techniques
BIO 499 Senior Biology Seminar
BIO 554 Dendrology and Forest Conservation
BIO 578 Conservation Biology
BIO 580 Principles of Wildlife Management
BIO 584 Wildlife Policy and Administration
and one of the following:
BIO 350 Systematic Botany
BIO 552 Native Plans for Wildlife
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 ..... 9 hrs
JMC 391 Public Relations Principles
and one of the following:
NLS 420 Field Studies in Environmental Education
NLS 460 Natural Resources and Society
NLS 470 Interpretation of Cultural and Natural Resources
and one of the following:
HIS 381 Environmental History of the Americas
HIS 382 Ecological History

Career-Focused Electives[2] ..... 2-11 hrs

Total Curriculum Requirements ..... 120-129 hrs

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

[2]These must be selected in consultation with an academic advisor and provide knowledge and skills directly related to a student's future career objectives

AREA:
Wildlife and Conservation Biology/ Conservation Law Enforcement Track

Bachelor of Science/Bachelor of Arts CIP 03.0601

University Studies Requirements ..... 42-45 hrs
(See *Academic Degrees and Programs.*)

University Studies selections must include:
•Scientific Inquiry, Methodologies, and Quantitative Skills
STA 135 Introduction to Probability and Statistics
and one of the following:
CHE 105 Introductory Chemistry
CHE 201 General College Chemistry
and one of the following:
MAT 150 Algebra and Trigonometry
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] ..... 58-64 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
and one of the following:
BIO 333 Genetics
BIO 377 Conservation Genetics
and
BIO 380 Wildlife Techniques
BIO 499 Senior Biology Seminar
BIO 554 Dendrology and Forest Conservation
BIO 578 Conservation Biology
BIO 580 Principles of Wildlife Management
BIO 584 Wildlife Policy and Administration
and one of the following:
BIO 350 Systematic Botany
BIO 552 Native Plants for Wildlife
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 ..... 12 hrs
CRJ 220 Law Enforcement
CRJ 300 Crime and Criminals
and one of the following:
CRJ 346 Criminal Investigation
CRJ 365 Interviewing and Interrogation
and one of the following:
BIO 308 Ethics in Biology
CRJ 325 Criminal Justice Ethics

Career-Focused Electives[2] ..... 0-8 hrs

Total Curriculum Requirements ..... 121-129 hrs

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

[2]These must be selected in consultation with an academic advisor and provide knowledge and skills directly related to a student's future career objectives

AREA:
Wildlife and Conservation Biology/ Wildlife Biology Track

Bachelor of Science/Bachelor of Arts CIP 03.0601

University Studies Requirements ..... 42-45 hrs
(See *Academic Degrees and Programs.*)

University Studies selections must include:
•Scientific Inquiry, Methodologies, and Quantitative Skills
STA 135 Introduction to Probability and Statistics
and one of the following:
CHE 105 Introductory Chemistry
CHE 201 General College Chemistry
and one of the following:
MAT 150 Algebra and Trigonometry
MAT 250 Calculus and Analytical Geometry I
•Social and Self-Awareness and Responsible Citizenship
Choose one of the following:
ECO 231 Principles of Microeconomics
AGR 199 Contemporary Issues in Agriculture
•University Studies Electives
BIO 216 Biological Inquiry and Analysis
ENG 224 Writing for the Professions

Core Courses[1] ..... 58-64 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
and one of the following:
BIO 333 Genetics
BIO 377 Conservation Genetics
and
BIO 380 Wildlife Techniques
BIO 499 Senior Biology Seminar
BIO 554 Dendrology and Forest Conservation
BIO 578 Conservation Biology
BIO 580 Principles of Wildlife Management
BIO 584 Wildlife Policy and Administration
and one of the following:

BIO 350 Systematic Botany
BIO 552 Native Plants for Wildlife
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 ..... 7 hrs
Choose one of the following:
BIO 240 Biological Applications in GIS
EES 202 Introduction to Geographical Information Science
and one of the following:
HIS 381 Environmental History of the Americas
HIS 382 Ecological History

Career-Focused Electives[2] ..... 4-13 hrs

Total Curriculum Requirements ..... 120-129 hrs
[1]Meets course requirements for Associate Wildlife Biologist Certification from The Wildlife Society.
[2]These must be selected in consultation with an academic advisor and provide knowledge and skills directly related to a student's future career objectives

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
and one of the following:
CHE 105 Introductory Chemistry
CHE 201 General College Chemistry
and one of the following:
MAT 150 Algebra and Trigonometry
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] ..... 58-64 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
and one of the following:
BIO 333 Genetics
BIO 377 Conservation Genetics
and
BIO 380 Wildlife Techniques
BIO 499 Senior Biology Seminar
BIO 554 Dendrology and Forest Conservation
BIO 578 Conservation Biology
BIO 580 Principles of Wildlife Management
BIO 584 Wildlife Policy and Administration
and one of the following:
BIO 350 Systematic Botany
BIO 552 Native Plants for Wildlife
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 Conservation Track..... 10 hrs
BIO 538 Animal Behavior
BIO 539 Animal Behavior Laboratory
BIO 579 Zoological Conservation
and one of the following:
AGR 300 Principles of Animal Nutrition
AGR 310 Applications in Animal Technology

Career-Focused Electives[2] ..... 1-10 hrs

Total Curriculum Requirements ..... 121-125 hrs
[1]Meets course requirements for Associate Wildlife Biologist Certification from The Wildlife Society.
[2]These must be selected in consultation with an academic advisor and provide knowledge and skills directly related to a student's future career objectives

CERTIFICATE:
Wildlife Technician

CIP 03.0601

The Wildlife Technician Certification program is designed to provide students not majoring in Wildlife and Conservation Biology (WCB) with the knowledge and skills to successfully act as a wildlife technician with private and governmental organizations. The program will provide students with experience in field identification of various flora, fauna, and soils and field data collection methods. After certification, students will be qualified to apply for wildlife technician positions, which help wildlife biologists and conservation

scientists gather data and carry out management and conservation plans.

This certificate is intended for non-WCB majors within the biology department that are interested in pursuing field technician positions in the future. Candidates outside of the biology department can also pursue the certificate but, in addition to the requirements below, will need to complete BIO 221 and 222 to meet pre-requisites associated with course requirements. Depending on which elective courses are chosen, BIO 216 and 330 may also be required. Elective courses with these additional requirements are marked with an asterisk (*).

Total Course Requirements..... 17-19 hours
A minimum grade of C must be earned in all courses.

Required Courses ..... 3 hours
BIO 310 Vertebrate Natural History
BIO 380 Wildlife Techniques
BIO 553 Field Botany

Limited Electives..... 5-7 hours
Choose one from the following:
AGR 345 Soil Science
AGR 350 Soil Survey
Choose one from the following:
AGR 170 Introduction to Agricultural Systems Technology
BIO 506 Advanced Field Biology
BIO 530 Advanced Ecology*
BIO 552 Native Plants for Wildlife
BIO 554 Dendrology and Forest Conservation*
BIO 570 Ichthyology*
BIO 572 Herpetology*
BIO 573 Ornithology*
BIO 574 Mammalogy*

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, 333, 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.

Wildlife and Conservation Biology Minor..... 21 hrs
BIO 149, 221, 310, 330, 380; and 578 or 580.

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 310 Organic Chemistry I
and
CHE 311 Organic Chemistry I Laboratory
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 Advanced 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
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
ENT 655 Environmental Regulatory Affairs
ENT 681 Pollution Assessment and Control
ENT 685 Remediation Technology

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.

Department of Chemistry

1201 Jesse D. Jones Hall
270-809-2584

Chair: Kevin Revell. **Faculty:** Allenbaugh, 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 310 Organic Chemistry I
and
CHE 311 Organic Chemistry I Laboratory
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 310 Organic Chemistry I
and
CHE 311 Organic Chemistry I Laboratory
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 310 Organic Chemistry I
and
CHE 311 Organic Chemistry I Laboratory
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 310 Organic Chemistry I
and
CHE 311 Organic Chemistry I Laboratory
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 310 Organic Chemistry I
and
CHE 311 Organic Chemistry I Laboratory
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 310 Organic Chemistry I
and

CHE 311 Organic Chemistry I Laboratory
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 310 Organic Chemistry I
and
CHE 311 Organic Chemistry I Laboratory
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 ..... 50 hrs
CHE 100T Transitions
CHE 201 General College Chemistry
CHE 202 General Chemistry and Qualitative Analysis
CHE 305 Analytical Chemistry
CHE 310 Organic Chemistry I
and
CHE 311 Organic Chemistry I Laboratory
CHE 320 Organic Chemistry II
CHE 352 Basic Chemical Instrumentation
CHE 576 Polymer Chemistry
CHE 580 Principles of Chemical Engineering for Chemists
CHE 586 Polymer and Materials Science Laboratory
CSC 235 Programming in C++[2]
EGR 240 Thermodynamics I
MAT 308 Calculus and Analytic Geometry II
MAT 338 Ordinary Differential Equations

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

Required Physics Minor[3] ..... 11-21 hrs
EGR 375 and PHY 370 are required selections

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 fulfil ten of the required 22 hours for a physics minor. EGR 375, PHY 370, and six additional hours of upper-level coursework will complete the 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 310 Organic Chemistry I
and
CHE 311 Organic Chemistry I Laboratory
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, 513, 565, and 330 or 530, but not both. A maximum of three hours may be counted from CHE 488.

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.

Department of Earth and Environmental Sciences

334 Blackburn Science Building
270-809-2591

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

An area in earth and environmental sciences with tracks in archaeology, 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/ 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
CMA 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/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 an 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/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/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.

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
CHE 201 General College Chemistry
CHE 202 General Chemistry and Qualitative Analysis
CMA 280 Plane Surveying
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.

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.

Globalization and Development Minor ..... 21 hrs
ANT 140, 390: EES 110, 330: one ANT/ARC course selected from ANT/ARC 320, ARC 302 (when offered abroad), 345, 360, 389; one EES course selected from EES 125, 202, 388, 424, 507; one elective selected from ECO 310; HIS 120, 331; NLS 104; POL 250; SOC 465; SPA 325.

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 secondary 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.

Sustainability Studies Minor..... 22-24 hrs
BIO 103; ENG 371; IDC 150; PHI 376; two of the following: AGR 353, CMA 284, REC 450; and 6-8 hours 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. 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 of remote sensing. Student will gain experience using industry standard hardware and software to develop a variety of projects and 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: archaeology, environmental geology, geoinformatics, and watershed science. Each student's program is developed in consultation with the graduate coordinator.

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 **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 **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). It 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.

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 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.

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

Required Courses ..... 16 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

Required Courses ..... 15 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 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
ENT 655 Environmental Regulatory Affairs
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

Required Courses ..... 18 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
Required Courses ..... 25 hours
EES 612 Remote Sensing
EES 619 Seminar in Research Techniques[PT]
EES 621 Geographic Information Systems
EES 640 Advanced Remote Sensing
EES 680 Advanced Geographic Information Systems
EES 696 Understanding Scientific Communication
EES 698 Thesis Research[L, R]
EES 699 Thesis Research[L, R]

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
Required Courses ..... 18 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 Advanced 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
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
ENT 655 Environmental Regulatory Affairs
ENT 681 Pollution Assessment and Control
ENT 685 Remediation Technology

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.

Master of Science Sustainability Science CIP 30.3301

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 Techni-

cal 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.

Total Course Requirements..... 30-32 hours

Core Requirements..... 17 hrs

EES 601 Understanding Scientific Communication
EES 607 Land Use Planning
ENT 687 Sustainable Environmental Technology
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 686 Environmental Assessment and Remediation
CET 688 Waste Minimization and Pollution Prevention
CHE 600 Chemistry of Fuels
CHE 604 Fundamentals of Toxicology
CHE 613 Environmental Chemistry
ENT 655 Environmental Regulatory Affairs
ENT 681 Pollution Assessment and Control
ENT 682 Industrial Ecology
ENT 687 Sustainable Environmental Technology
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

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
Required Courses ..... 11 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 607 Manager's Guide to Database
CIS 609 Data Warehouses and Business Intelligence
CIS 643 Advanced Business Analytics
CIS 695 Comprehensive Project in Computer Information Systems
CYS 615 Information System Security
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

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 engineering management.

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

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

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

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

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

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

Engineering Accreditation

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

Engineering Technology Accreditation

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

AREA:
Engineering 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 363 Signals and Systems
EGR 375 Materials Science
EGR 390 Engineering Measurements
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
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 310, 311, 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*.)

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 180 Exploring the Teaching Profession[3]
EDU 280 Educating for Human Development[3]
EDU 380 Inclusive Teaching of Diverse Learners[3]
EDU 480 Effective Pedagogy[3, 4]
EDU 485 Professional Perspectives for Teaching[3,5]
SEC 420 Practicum in Secondary Schools[4]
SEC 421 Student Teaching in the Secondary School
SEC 422 Extended Practicum[5]

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 480 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

Construction Management and Architecture

A baccalaureate degree in construction management and architecture 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.

This 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.

Architectural Design Track

The architectural design track 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 Management Track

The construction management track 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.

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

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

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 and Sustainability Engineering

Bachelor of Science in Engineering — CIP 14.0801

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 250 Calculus and Analytic Geometry I
PHY 235 Mechanics, Heat and Wave Motion
•Social and Self-Awareness and Responsible Citizenship
ECO 230 Principles of Macroeconomics
•University Studies Electives
MAT 308 Calculus and Analytic Geometry II
PHY 236 Mechanics, Heat and Wave Motion Laboratory

Core Courses ..... 41 hrs
EGR 100T Transitions
CSE 284 Sustainable Design
CSE 330 Water Quality I
CSE 331 Water Quality II
CSE 382 Hydraulics
CSE 410 Transportation Systems and Design
CSE 481 Structural Analysis
CSE 482 Steel and Concrete Design
CSE 483 Construction Materials
CSE 484 Soil Mechanics and Foundations
CSE 498 Senior Design I
CSE 585 Remediation Engineering
EGR 259 Statics
EGR 359 Mechanics of Materials
EGR 488 Cooperative Education/Internship
MAT 338 Ordinary Differential Equations
PHY 255 Electricity, Magnetism and Light

PHY 256 Electricity, Magnetism and Light Laboratory
STA 135 Introduction to Probability and Statistics

Required Courses ..... 26 hrs
CMA 107 Introduction to Technical Drawing and Computer-..... Aided Drafting
CMA 280 Plane Surveying
CMA 385 Construction Estimating I
CMA 480 Construction Planning and Management
EES 101 The Earth and the Environment
ENG 324 Technical Writing
ENT 393 Engineering Economy

Total Curriculum Requirements ..... 121 hrs

AREA: Construction Management and Architecture/ Architectural Design 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 ..... 44 hrs
CMA 107 Introduction to Technical Drawing and Computer-Aided Drafting
CMA 210 Construction Documents
CMA 280 Plane Surveying
CMA 284 Sustainable Design and Construction
CMA 310 Anatomy of Buildings
CMA 385 Construction Estimating I
CMA 480 Construction Planning and Management
ENG 324 Technical Writing
ENT 100T Transitions
ENT 265 Statics and Strengths of Materials
ENT 358 Mechanical and Electrical Systems
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

Track Courses ..... 32 hrs
CMA 108 Applied Computer-Aided Design
CMA 301 Architectural Design I
CMA 401 Architectural Design II
CMA 470 Steel and Concrete in Construction
CMA 483 Construction Materials
CMA 490 Construction Scheduling and Methods
CMA 503 Architectural Design III
IOE 350 Technology Management
Technical elective (3 hrs)

Total Curriculum Requirements ..... 120 hrs

AREA: Construction Management and Architecture/ Construction Management 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 ..... 44 hrs
CMA 107 Introduction to Technical Drawing and Computer-Aided Drafting
CMA 210 Construction Documents
CMA 280 Plane Surveying
CMA 284 Sustainable Design and Construction
CMA 310 Anatomy of Buildings
CMA 385 Construction Estimating I
CMA 480 Construction Planning and Management
ENG 324 Technical Writing
ENT 100T Transitions
ENT 265 Statics and Strengths of Materials
ENT 358 Mechanical and Electrical Systems
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

Track Courses ..... 32 hrs
ACC 200 Principles of Financial Accounting
CMA 386 Construction Estimating II
CMA 470 Steel and Concrete in Construction
CMA 483 Construction Materials
CMA 490 Construction Scheduling and Methods
IOE 350 Technology Management
OSH 384 Construction Safety
Technical Electives (10 hrs)

Total Curriculum Requirements ..... 120 hrs

AREA: Electromechanical Engineering Technology

Bachelor of Science CIP 15.0403

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
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 ..... 61 hrs[1]

EMT 110 Electrical Systems I
EMT 201 Engineering Technology Simulation
EMT 202 Engineering Technology Analysis
EMT 210 Electrical Systems II
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
ENT 265 Statics and Strengths of Materials
ENT 393 Engineering Economy
ENT 419 Senior Project I
TSM 301 Physical Network Theory

Support Courses ..... 15 hrs[1]

EGD 102 CAD Applications
ENG 324 Technical Writing
ENT 100T Transitions
IOE 399 Professional Develop Seminar I
IOE 488 Cooperative Education/Internship

Technical Electives ..... 6 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

EGD 102 CAD Applications
EGD 130 Manufacturing Processes and Materials
EGD 204 Parametric Modeling and Rendering
EGD 330 Machine Tool Processes
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
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 ..... 76 hrs

EGD	100T	Transitions
EGD	101	Introduction to Design and Graphic Communications
EGD	104	Computer Aided Design
EGD	130	Manufacturing Processes and Materials
EGD	204	Parametric Modeling and Rendering
EGD	302	Applied Technical Drawing
EGD	303	Advanced Parametric Modeling
EGD	306	Engineering Graphics
EGD	330	Machine Tool Processes
EGD	333	ANSI Fundamentals for Mechanical Product Design
EGD	403	Product and Tooling Design
EGD	404	Computer-Aided Engineering Design Graphics
EGD	498	Senior Design
ENG	324	Technical Writing
ENT	265	Statics and Strengths of Materials
IOE	350	Technology Management
IOE	399	Professional Development Seminar I
IOE	488	Cooperative Education/Internship
IOE	587	Quality Control
MAT	130	Technical Math I

Technical Electives ..... 10 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

EGD	100T	Transitions
EGD	101	Introduction to Design and Graphic Communications
EGD	104	Computer Aided Design
EGD	130	Manufacturing Processes and Materials
EGD	204	Parametric Modeling and Rendering
EGD	330	Machine Tool Processes
EMT	261	Introduction to Fluid Power Systems
EMT	262	Introduction to Fluid Power Systems Laboratory
IOE	399	Professional Development Seminar I
TSM	110	Electrical Systems I

Technical Electives ..... 14 hrs

Total Curriculum Requirements ..... 64 hrs

Environmental Technology Minor ..... 21 hrs
CMA 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 Engineering 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 engineering 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 Engineering 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 3.0 grade point average (GPA based on an *A* equals 4.0).

Conditional

The GPA of 3.0 for unconditional admission may be lowered if an applicant has substantial industrial experience. In such a case, applicants will be required to submit a statement about industrial experience.

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. The TOEFL score must be a 71 or higher with no section below 16. For the IELTS, 6.0 of higher with no section below 5.0. Language proficiency scores below these will not be admitted to the Engineering Management program.

Master of Science
Engineering Management

CIP 15.0000

The Engineering 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]

IOE 682 Production Systems and Computer Integrated Manufacturing
IOE 684 Engineering Economic Analysis
IOE 687 Quality Control
IOE 690 Industrial Environmental Management
IOE 691 Industrial Operations
IOE 692 Plant Layout and Material Handling
IOE 695 Industrial Supervision[PT]

Electives ..... 9 hrs

IOE 601 Manufacturing Processes
IOE 610 Operations Research
IOE 644 Graduate Cooperative Education
IOE 681 Sustainable Energy
IOE 696 Teamwork and the Management of Technology
HDL 660 Developing Human Potential
HDL 670 Multicultural and Diversity Issues in Leadership
HDL 675 Assessment of Human Potential
HDL 682 Leadership Organization: Process of Critical Thinking and Problem Solving
HDL 392 Individual, Group and Team Dynamics

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 135 Introduction to Network Technology
TSM 232 Operating Systems
TSM 233 Network Services
TSM 241 Networking Fundamentals
TSM 302 Internet of Things Networking
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

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 x UGPA) + GMAT $\geq$ 1,000
GRE Users: GRE $\geq$ 321 - (11.66 x GPA - (Combined quantitative and verbal sections only.)

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

In addition, 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 CYS 601, TSM 610, and one other core course (ACC 604, TSM 602, CYS 603, TSM 607, TSM 610, or CYS 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
CYS	601	Data Communications and Networking
CYS	603	Project Management
CYS	630	Telecommunications Legal Environment: Law, Policy and Regulations
CYS	680	Information Security Solutions Development
TSM	602	Telecommunications Systems
TSM	607	Advanced Telecommunications Project Management
TSM	610	Telecommunication Networks Management
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, 233, 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, 233, 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, 233, 235, or EGR 140.

Required Minor ..... 21 hrs

Required for Secondary Certification ..... 33 hrs
EDU 180 Exploring the Teaching Profession[1]
EDU 280 Educating for Human Development[1]
EDU 380 Teaching Diverse Learners[1]
EDU 480 Effective Pedagogy[1]
EDU 485 Professional Perspectives for Teaching[1]
SEC 420 Practicum in Secondary Schools[4]
SEC 421 Student Teaching in the Secondary School
SEC 422 Extended Practicum[4]

Total Curriculum Requirements ..... 126-130 hrs
[1]With a grade of *B* or better.
[2]This is a University Studies writing intensive course.
[3]This is a University Studies technology intensive course.
[4]Must be taken one semester before student teaching.

AREA:
Mathematics/Applied Mathematics Track
Bachelor of Science/Bachelor of Arts CIP 27.0101

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

Required Courses ..... 31 hrs
MAT 100T Transitions
MAT 250 Calculus and Analytic Geometry 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, 233, 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.

Mathematics/Pre-MS in Biostatistics Track

This program is designed for students majoring in Mathematics or Statistics at Murray State University to earn an MS degree in Biostatistics from the University of Louisville in a manner similar to a five year BS-MS program. The program requires completion of a minimum of 32 semester credit hours at the University of Louisville, 12 of which will complete a BA/BS degree in Mathematics/Applied Mathematics at Murray State University.

Enrollment at the University of Louisville

The applicant enrolls in the Spring semester at the University of Louisville as a visiting student during the last semester of their undergraduate study, taking 9 graduate hours and 3 undergraduate hours. Tuition and fees for all these courses will be charged at an undergraduate level. The Applicant will then transfer these 12 credit hours to MSU as undergraduate credit and earn the BA/BS degree at the end of the Spring semester.

During the Spring semester, upon review of the complete application, which, among other materials, includes a satisfactory GRE score, the Applicant may be admitted to the MS degree in Biostatistics at the University of Louisville, conditional upon completion of the bachelor's degree from MSU. The 9 graduate credit hours applied toward the bachelor's degree will also be counted towards the MS degree in Biostatistics.

AREA:
Mathematics/Pre-MS in Biostatistics Track

Bachelor of Science/Bachelor of Arts CIP 27.0101

University Studies Requirements..... 40-43 hrs
(See *Academic Degrees and Programs*.)
•Scientific Inquiry, Methodologies, and Quantitative Skills
MAT 250 Calculus and Analytic Geometry I
BIO 216 Biological Inquiry and Analysis

Required Courses ..... 39 hrs
BIO 115 The Cellular Basis of Life
MAT 100T Transitions
MAT 308 Calculus and Analytic Geometry II
MAT 309 Calculus and Analytic Geometry III
MAT 312 Mathematical Reasoning
MAT 335 Matrix Theory and Linear Algebra
MAT 338 Ordinary Differential Equations
MAT 442 Introduction to Numerical Analysis
MAT 525 Advanced Calculus I
STA 540 Mathematical Statistics I
STA 541 Mathematical Statistics II
STA 565 Applied Statistics I

Computer Programming Electives..... 6 hrs
CSC 145 Introduction to Programming
CSC 232 Introduction to Programming in C#
CSC 235 Programming in C++
CSC 325 Advanced Object-Oriented Programming
CSC 332 Advanced Programming in C#
EGR 140 Introduction to Computing Applications in Science & Engineering

Unrestricted Electives..... 20-23 hrs

Final sem. coursework from the University of Louisville..... 12 hrs
Advanced Calculus II and 9 hours of coursework in Biostatistics

Total Curriculum Requirements ..... 120 hrs

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.

Department of Occupational Safety and Health

157 Collins Center
270-809-2488

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

EGD 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:

CMA 310 Anatomy of Buildings
CMA 342 Air Quality Technology
CMA 353 Solid Hazardous Waste Management
CMA 385 Construction Estimating I
CMA 480 Construction Planning and Management
CMA 555 Environmental Regulatory Affairs
CMA 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

EGD 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

CMA 330 Water Quality Technology I
CMA 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:

CMA 310 Anatomy of Buildings
CMA 342 Air Quality Technology
CMA 353 Solid Hazardous Waste Management
CMA 385 Construction Estimating I
CMA 480 Construction Planning and Management
CMA 555 Environmental Regulatory Affairs
CMA 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.

CERTIFICATE: Emergency Management

CIP 45.0702

The undergraduate certificate in Emergency Management is designed to complement the undergraduate degree in Occupational Safety and Health. The certificate program's objectives are to provide students with an enhanced knowledge base in the area of emergency management, gain an understanding of regulations and guidelines, and to acquaint students with current trends and best practices in emergency management.

A grade of C or higher must be achieved in all Occupational Safety and Health courses in the Emergency Management certificate for successful completion of the certificate program.

Requirements for Admission

Students enrolled in an undergraduate degree program at Murray State University may be enrolled in the certificate program upon permission of the program coordinator. Post-baccalaureate degree students are also eligible for this program upon permission of the program coordinator.

Total Course Requirements ..... 18 hours[1]

OSH 101 Emergency Medical Training
OSH 310 Fire and Emergency Preparedness Preplanning
OSH 311 Hazardous Materials and Emergency Planning
OSH 412 Emergency Management

One elective course from the following:

CRJ 355 Security in Business and Industry
CRJ 425 Terrorism

Graduate Program

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

Requirements for Admission

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

Unconditional

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

Conditional

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

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

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

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

Prerequisite Undergraduate Requirements ..... 15 hours

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

or

OSH 453 Human Factors in Safety Engineering
OSH 387 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

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

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

THESIS REQUIREMENTS

Total Course Requirements ..... 30 hours

Technical 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 (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