

# Jesse D. Jones College of Science, Engineering and Technology



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

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

## **PROGRAMS**

#### UNDERGRADUATE

## <u>Associate</u>

Civil Engineering Technology Industrial Technology

#### <u>Baccalaureate</u>

Applied Physics

Biology

Chemistry

Civil Engineering Technology
Earth and Environmental Sciences

Electromechanical Engineering Technology

**Engineering Graphics and Design** 

Engineering Physics

Manufacturing Engineering Technology

Mathematics

Occupational Safety and Health

**Physics** 

Telecommunications Systems Management

Wildlife and Conservation Biology

#### Minor

Actuarial Science Industrial and Engineering

Anthropology Technology

Applied Statistics Mathematical Biology

Archaeology Mathematics

Astronomy Occupational Safety

Biology and Health

Cell Biology Physics
Chemistry Social Science

Earth Science Sustainability Studies

Engineering Science Telecommunications Systems
Environmental Geology Management

Environmental Geology Environmental Technology

Geographic Information

Science

## Certificate

Geographic Information Science

#### **GRADUATE**

Master's

Applied Engineering and Technology Management

Biology

Chemistry

Earth and Environmental Sciences

Mathematics

Occupational Safety and Health

Sustainability Science

Telecommunications Systems Management

Certificate

Geospatial Data Science

# Jesse D. Jones College of Science, Engineering and Technology

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

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

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

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

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

#### **Programs and Facilities**

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

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

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

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

- Mapping Applications and Resource Center. Since the late 1970s when Murray State was declared the Commonwealth's technology transfer agent for NASA's Landsat satellite, MARC has distinguished itself in the area of remote sensing and Geographic Information Systems (GIS). Students from around the world have received classroom instruction and have been mentored in research by the MARC Associates, a group of faculty and staff with expertise in a wide variety of application areas, many of which are focused on natural and cultural resource areas including land cover mapping, archaeological site analysis, mineral exploration, water quality and wildlife habitat mapping, emergency preparedness, and demographic modeling. Research projects have been conducted for local, state, and federal agencies, the private sector, and the university. MARC provides training in remote sensing and GIS and acts as a resource center for those within and beyond the university. MARC is one component of the Watershed Studies Institute and, as such, maintains a GIS for the lower reaches of the Kentucky Lake drainage basin.
- Hancock Biological Station. A year-round research and teaching facility located on beautiful Kentucky Lake, the HBS is one of the finest centers of its kind in the Midwest. HBS acts as the field research focal point for the Watershed Studies Institute and for the Ecological Consortium of Mid-America. The facilities, which include both faculty and student housing, are available year-round to all scientists interested in ecosystem research. Hancock Biological Station contains state-of-the-art laboratories for aquatic chemistry, scanning electron microscopy, ecology, wildlife and fisheries. A full-time technical staff operates the facilities. Field-oriented classes at the station attract students from around the nation. A wide variety of formal classes are offered each summer. These may include ecology, ornithology, limnology, field botany, stream ecology, reservoir ecology, scanning electron microscopy and vertebrate ecology. Independent research topics provide opportunities for individualized instruction and close interactions with researchers. Classes are open to undergraduates, graduate students, teachers and others interested in enhancing their knowledge of ecology, ecosystems and the natural environment.
- •Chemical Services Laboratory. The Chemical Services Laboratory offers analytical laboratory services for industries and institutions in the west Kentucky and greater Ohio Valley region. Services include analyses for environmental chemistry, ecotoxicology, trace element, and acid-deposition studies. In addition to serving the needs of the region, this laboratory offers an opportunity for instruction and training at both the undergraduate and graduate levels.

Note: See page 58 for graduate courses notated with L, R, or PT.

#### **Sustainability Studies Minor**

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

#### MINOR:

#### **Sustainability Studies**

Total	Mino	r Requirements 22-24 I	nrs
Requi	ired C	ourses10 l	hrs
BIO	103	Saving Planet Earth	
ENG	371	Literature and the Environment	
IDC	150	Issues in Sustainability Studies	
PHI	376	Environmental Ethics	
Restri	icted I	Electives 6 l	nrs

Choose two of the following:

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

Unrestricted Electives ...... 6-8 hrs

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

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

## Sustainability Science

Graduate Coordinator - Howard Whiteman

(270) 809-6753

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

#### **Requirements for Admission**

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

#### Unconditional

- Baccalaureate degree in science-related field.
- At least a 3.0 undergraduate GPA.
- Composite GRE score of at least 297 (148 verbal + 149 quantita-
- 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.

<b>Master of Science</b>
<b>Sustainability Science</b>

CIP 30.3301

Total Course Requirements	30-32 hours
Core Requirements	17 hrs
CET 687 Sustainable Environmental	Technology
EES 601 Understanding Scientific Co	mmunication
EES 607 Land Use Planning	
WSC 601 Seminar in Sustainability So	cience
WSC 693 Sustainability Practicum I <sup>1</sup>	
WSC 694 Sustainability Practicum II <sup>1</sup>	
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	
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 613 Environmental Chemistry

612 Remote Sensing

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** 

CHF 613 **Environmental Chemistry** 

**FFS** 612 **Remote Sensing** 

EES 621 **Geographic Information Systems** 

#### Industrial and Technical Sustainability

CET 655 Environmental Regulatory Affairs CET Pollution Assessment and Control

CET Industrial Ecology

CET 686 **Environmental Assessment and Remediation** 

CET 687 Sustainable Environmental Technology

688 Waste Minimization and Pollution Prevention CET

CHE 600 Chemistry of Fuels

CHE 604 Fundamentals of Toxicology

CHE 613 **Environmental Chemistry** 

IOE 619 Industrial Energy Management

OSH 622 Toxicology of Industrial Materials	PHY	235	Mechanics, Heat and Wave Motion	
OSH 646 Fundamentals of Risk Management	PHY	236	Mechanics, Heat and Wave Motion Labora	tory
OSH 687 Wastewater Treatment				
OSH 689 Solid and Hazardous Waste Management			ourses	41 hrs
			Transitions	
Sustainability Education			The Cellular Basis of Life	
EDU 615 Introduction to Environmental Education			Biological Inquiry and Analysis <sup>1</sup>	
EDU 664 Techniques of Teaching Environmental Education			Zoology: Animal Form and Function <sup>1</sup>	
EDU 665 Field Experiences in Environmental Education			Botany: Plant Form and Function <sup>1</sup>	
EDU 667 International Environmental Education			Introduction to Evolutionary Principles	
EDU 668 Agriculture and the Environment in the Classroom			Principles of Ecology	
			Genetics	
			Senior Biology Seminar	
Department of Biological Sciences	BIO ele	ective	es, 300-level or above (13 hrs) <sup>2</sup>	
2112 Biology Building				
270-809-2786	Co-Re	quire	ments for Biology Major	7-8 hrs
210-003-2100	Group	1:		
Interim Chair: Michael Flinn. Faculty: Arkov, Beckers, Canning, Dar-	CHE	312	Organic Chemistry I	
•	CHE	320	Organic Chemistry II	
racq, Derting, Flinn, Gagnon, He, Nakamura, Spier, Sullivan-Beckers,	or Gro	•		
Trzepacz, Weinberger, White, Whiteman, Wright, ZeRuth.			Brief Organic Chemistry <sup>1,3</sup>	
The Department of Dislocical Colonics office handlesseets	CHE	215	Chemistry Laboratory <sup>1,3</sup>	
The Department of Biological Sciences offers baccalaureate	CHE	330	Basic Biochemistry	
programs with a major in biology (pre-medicine, pre-dentistry, pre-				
optometry, pre-physical therapy, pre-physician assistant, fisheries,	Requir	red N	linor⁴	3-21 hrs
aquatic biology, secondary certification, and watershed science				
tracks are available) or an area of concentration in wildlife and	Unrest	tricte	d Electives	17-28 hrs
conservation biology. These programs are designed to prepare				
students for professional or graduate work in the life sciences, such	iotai	Curric	ulum Requirements	120 hrs
as the M.S. in biology offered by the department. Curricula provide	2 - '		sed to fulfill University Studies requirements.	40.4 400 403
students with a basic core of science courses plus advanced biology	101 ma		um of three hours total from BIO 391, 392, 483, 4 used. BIO 488 will not count here.	484, 489, 493,
courses in their particular field of interest. The department also of-	3This		se does not apply toward the chemistry minor.	
fers a two-year, pre-professional program in pharmacy and a minor			y co-requirements may apply toward the requi	irements for a
in biology.	minor i	n cnei	mistry.	
The department has offices, classrooms, laboratories, and re-				
search facilities in the Biology Building and on the second floor of	ADEA			
the newly constructed Engineering and Physics Building. The depart-				
ment also has two off-campus resources which are utilized in field-			Biomedical Sciences Track <sup>1</sup>	
oriented teaching and research programs. One of these, Murphy's		or of S	cience/Bachelor of Arts	CIP 26.0101
Pond, is a 300-acre preserve in Hickman County with one of the few				40.40.1
remaining cypress swamps in western Kentucky. The other, Han-			Studies Requirements	42-43 hrs
cock Biological Station, is a modern classroom/laboratory complex	(See A	cadei	mic Degrees and Programs.)	
located on the western shore of Kentucky Lake, 17 miles from the				
main campus. The station is ideally located in an area of diverse			itudies selections must include:	cı.:
aquatic habitats and is the focal point for the reservoir research on		-	Inquiry, Methodologies, and Quantitative	SKIIIS
Kentucky Lake and Lake Barkley.			General College Chemistry	
			Calculus and Analytic Geometry I	
			General Physics I <sup>2</sup>	
MAJOR:			General Physics I Laboratory <sup>2</sup>	
Biology			Studies Electives	
Bachelor of Science/Bachelor of Arts CIP 26.0101	CHE	202	General Chemistry and Qualitative Analysi	IS <sup>2</sup>
	D			47
University Studies Requirements <sup>1</sup> 38-44 hrs			ourses	47 nrs
(See Academic Degrees and Programs.)			Transitions	
			The Cellular Basis of Life	
University Studies selections must include:			Biological Inquiry and Analysis <sup>3</sup>	
•Scientific Inquiry, Methodologies, and Quantitative Skills			Zoology: Animal Form and Function <sup>2,3</sup>	
CHE 201 General College Chemistry		or 222	Potany Plant Form and Function3	
CHE 202 General Chemistry and Qualitative Analysis			Botany: Plant Form and Function <sup>3</sup>	
MAT 150 Algebra and Trigonometry			Biomedical Research I	
or			Introductory Microbiology	
MAT 250 Calculus and Analytic Geometry I			Cell Biology: Mechanisms <sup>4</sup>	
• University Studies Electives		or	Call Biology: Systems4	
PHY 130 General Physics I			Cell Biology: Systems <sup>4</sup>	
PHY 131 General Physics I Laboratory			Animal Physiology Genetics	

BIO 333 Genetics

or

BIO	200	Biomedical Research II	a I Ini	vorcit	y Studies Electives
BIO		Biomedical Research III	CHE	202	General Chemistry and Qualitative Analysis
BIO		Biomedical Research IV			
BIO	439	Biomedical Research V	Requ	iired C	ourses 40 hrs
BIO	499	Senior Biology Seminar	BIO	1007	Γ Transitions
BIO	533	Molecular Genetics	BIO	115	The Cellular Basis of Life
			BIO		Biological Inquiry and Analysis <sup>1</sup>
Co-R	anuira	ments for Area 18 hrs			
			BIO		Zoology: Animal Form and Function <sup>1</sup>
CHE		Organic Chemistry I	BIO		Botany: Plant Form and Function <sup>1</sup>
CHE		Organic Chemistry II	BIO	321	Cell Biology: Mechanisms
CHE		Fundamentals of Biochemistry I		or	
CHE	540	Fundamentals of Biochemistry II	BIO	323	Cell Biology: Systems
PHY	132	General Physics II <sup>2,3</sup>	BIO		Animal Physiology
PHY	133	General Physics II Laboratory <sup>2,3</sup>	BIO		Genetics
		, , , , , , , , , , , , , , , , , , , ,	_		
Postr	icted	Electives15 hrs	BIO		Senior Biology Seminar
			BIO 6	elective	es, 300-level or above (12 hrs) <sup>2</sup>
	-	n the following:			
BIO		Ethics in Biology <sup>3</sup>	Co-R	equire	ments for Biology Major12 hrs
BIO		Comparative Vertebrate Anatomy			Organic Chemistry I
BIO	321	Cell Biology: Mechanisms <sup>4</sup>	CHE		Organic Chemistry II
	or		PHY		General Physics II <sup>1</sup>
BIO	323	Cell Biology: Systems <sup>4</sup>			
BIO		Vertebrate Histology	PHY		General Physics II Laboratory <sup>1</sup>
BIO				or	
		Immunology	PHY	255	Electricity, Magnetism and Light <sup>1</sup> and
BIO		Medical Cell Biology	PHY	256	Electricity, Magnetism and Light Laboratory <sup>1</sup>
BIO		Cell Biology Laboratory			
BIO	528	Neurobiology	Regu	ired N	/linor <sup>3</sup> 3-21 hrs
BIO	534	Molecular Genetics Laboratory	cqu		
BIO	597	Topics in Advanced Molecular Biology	Hana		ed Electives <sup>4</sup> 8-21 hrs
CHE		Analytical Chemistry	Unite	Stricte	ed Electives 8-21 nrs
CHE		Organic Chemistry II Laboratory	_		
CHE		Basic Physical Chemistry			culum Requirements120 hrs
					sed to fulfill University Studies requirements.
PHY	3/0	Introduction to Modern Physics	²A r	naximu	ım of three hours total from BIO 391, 392, 483, 484, 489, 493
			494 n	nay be	used. BIO 488 will not count here.
Total	Curric	culum Requirements 120 hrs	3Ch	emistry	co-requirements may apply toward chemistry minor.
<sup>1</sup> A 1	reshm	an must have a math ACT score of 25 or higher to declare a ma-	<sup>4</sup> EN	G 204	strongly recommended. Electives other than ENG 204 must be
jor in	Biome	dical Sciences. However, any student may apply to the program	at the	300-le	evel or above.
and m	iust ha	ve completed 32 credit hours with a GPA of 3.0, and must have			
taken	BIO 11	.5, 216, CHE 201, 202 and MAT 250 with grades of <i>B</i> or better.			
Any st	udent	wishing to seek this degree (whether declared as a freshman or	MA.	JOR:	
not) n	nust ap	ply to the Biomedical Sciences committee for admission into the	Riol	ogy/l	Pre-Optometry Track
progra	am.				
2Rec	uired f	or area if not taken as a University Studies elective.	Bache	elor or :	Science/Bachelor of Arts CIP 26.0101
³Ma	y be us	ed to fulfill University Studies requirements.			
⁴Red	uired f	or area as either Core choice or as a Restricted Elective.	Univ	ersity	Studies Requirements 41-42 hrs
			(See	Acade	mic Degrees and Programs.)
MAJ	ΩD.		Univ	ersity S	Studies selections must include:
					Inquiry, Methodologies, and Quantitative Skills
Biol	ogy/F	Pre-Medical/Pre-Dental Track		-	Calculus and Analytic Geometry I
Bache	lor of S	Science/Bachelor of Arts CIP 26.0101			
			PHY		General Physics I
Univ	ersity	Studies Requirements 42-43 hrs	PHY	131	General Physics I Laboratory
		mic Degrees and Programs.)		and	
(See	4Cuuei	The Degrees and Frograms.	PHY	132	General Physics II
			PHY		General Physics II Laboratory
Unive	ersity S	Studies selections must include:		or	, , , , , , , , , , , , , , , , , , , ,
•Scie	ntific I	Inquiry, Methodologies, and Quantitative Skills	PHY		Mechanics, Heat and Wave Motion
CHE	201	General College Chemistry			
MAT		Algebra and Trigonometry	PHY	236	Mechanics, Heat and Wave Motion Laboratory
1417 (1		rugesta and rugenometry		and	
N 4 A T	or 250	Calculus and Analytic Coometry	PHY	255	Electricity, Magnetism and Light
MAT		Calculus and Analytic Geometry I	PHY	256	Electricity, Magnetism and Light Laboratory
PHY		General Physics I	•Soc		d Self-Awareness and Responsible Citizenship
PHY	131	General Physics I Laboratory	PSY		General Psychology
	or				studies Electives
PHY	235	Mechanics, Heat and Wave Motion and			
PHY		Mechanics Heat and Wave Motion Laboratory	CHE	201	General College Chemistry

•Social and Self-Awareness and Responsible Citizenship

PSY 180 General Psychology (recommended)

Required Courses ...... 41 hrs

BIO 100T Transitions

BIO BIO	115	T 0 11 1 D 1 C11C			
BIO	113	The Cellular Basis of Life	BIO	228	Human Anatomy Laboratory
	216	Biological Inquiry and Analysis <sup>1</sup>	BIO	322	Animal Physiology
BIO		Zoology: Animal Form and Function <sup>1</sup>	BIO	333	Genetics
BIO	222	Botany: Plant Form and Function <sup>1</sup>	BIO		Senior Biology Seminar
BIO	300	Introductory Microbiology	BIO e	lective	es, approved by advisor, 300-level or above (9 hrs) <sup>2</sup>
BIO	322	Animal Physiology	(If BI	O 320	is taken, only four hours of 300-level or above.)
BIO	333	Genetics			
BIO	499	Senior Biology Seminar	Co-R	equire	ments for Biology Major24-25 hrs
BIO e	elective	es, 300-level or above (12 hrs) <sup>2</sup>	BIO	450	Exercise Physiology
			CHE		Organic Chemistry I
Co-R		ments for Biology Major23 hrs	CHE	320	Organic Chemistry II
CHE	202	General Chemistry and Qualitative Analysis <sup>1</sup>	PSY	300	Principles and Methods of Statistical Analysis
CHE	312	Organic Chemistry I		or	
CHE	320	Organic Chemistry II	STA	135	Introduction to Probability and Statistics <sup>1</sup>
CHE	330	Basic Biochemistry	PHY	132	General Physics II <sup>1</sup>
	or		PHY	133	General Physics II Laboratory <sup>1</sup>
CHE	530	Fundamentals of Biochemistry I	PSY	260	Lifespan Development
ENG	204	Advanced Expository Writing <sup>1</sup>	SOC	133	Introduction to Sociology <sup>1</sup>
STA	135	Introduction to Probability and Statistics <sup>1</sup>			
			Requ	ired N	/linor <sup>3</sup> 3-21 hrs
Requ	ired N	linor <sup>3</sup> 0-21 hrs	Hana		d Electives0-12 hrs
Unre	stricte	d Electives 0-15 hrs	Unire	stricte	a Electives
			Total	Currio	culum Requirements 120 hrs
		culum Requirements 120 hrs	<sup>1</sup> Ma	y be us	sed to fulfill University Studies requirements.
		ed to fulfill University Studies requirements.			m of three hours total from BIO 391, 392, 483, 484, 489, 493,
		m of three hours total from BIO 391, 392, 483, 484, 489, 493,		-	used. BIO 488 will not count here.
	•	used. BIO 488 will not count here.	3Ch	emistry	co-requirements may apply toward chemistry minor.
CHE	emistry	co-requirements may apply toward chemistry minor.			
-			MA.	OR:	
MAJ	IOR:			_	Due Dhemisian Assistant Torolo
Biol	ngv/l	Pre-Physical Therapy Track			Pre-Physician Assistant Track
		Science/Bachelor of Arts CIP 26.0101	Bache	nor or s	Science/Bachelor of Arts CIP 26.0101
-			Hair		Chudica Daguinananta 43 has
Unive	ersity	Studies Requirements42-43 hrs		-	Studies Requirements
	-	Studies Requirements		-	Studies Requirements
	-	Studies Requirements	(See	Acade	mic Degrees and Programs.)
(See	Acade	mic Degrees and Programs.)	(See	Acade.	mic Degrees and Programs.)  Studies selections must include:
(See )	Acade.	mic Degrees and Programs.) Studies selections must include:	(See Unive	Acade ersity S <b>ntific</b>	mic Degrees and Programs.)  Studies selections must include:  Inquiry, Methodologies, and Quantitative Skills
(See Unive	Acade ersity S entific	mic Degrees and Programs.) Studies selections must include: Inquiry, Methodologies, and Quantitative Skills	Unive	Acade ersity S <b>ntific</b> 1 201	mic Degrees and Programs.) Studies selections must include: Inquiry, Methodologies, and Quantitative Skills General College Chemistry
(See / Unive • <i>Scie</i> CHE	Acade ersity S entific 201	Studies selections must include: Inquiry, Methodologies, and Quantitative Skills General College Chemistry	Unive	Acade ersity S ntific 201 150	mic Degrees and Programs.) Studies selections must include: Inquiry, Methodologies, and Quantitative Skills General College Chemistry Algebra and Trigonometry
(See / Unive • <i>Scie</i> CHE	Acade ersity S entific 201 150	mic Degrees and Programs.) Studies selections must include: Inquiry, Methodologies, and Quantitative Skills	Unive	ersity S ntific 1 201 150 or	mic Degrees and Programs.) Studies selections must include: Inquiry, Methodologies, and Quantitative Skills General College Chemistry Algebra and Trigonometry
(See / Unive • <b>Scie</b> CHE MAT	ersity Sentific 1201 150	mic Degrees and Programs.) Studies selections must include: Inquiry, Methodologies, and Quantitative Skills General College Chemistry Algebra and Trigonometry	Unive	ersity S ntific 1 201 150 or 250	Studies selections must include: Inquiry, Methodologies, and Quantitative Skills General College Chemistry Algebra and Trigonometry  Calculus and Analytic Geometry I
(See Unive • <i>Scie</i> CHE MAT MAT	ersity Sentific 1201 150 or 250	Studies selections must include: Inquiry, Methodologies, and Quantitative Skills General College Chemistry Algebra and Trigonometry  Calculus and Analytic Geometry I	Unive	ersity S ntific I 201 150 or 250 130	Studies selections must include: Inquiry, Methodologies, and Quantitative Skills General College Chemistry Algebra and Trigonometry  Calculus and Analytic Geometry I General Physics I
(See A Unive •Scie CHE MAT MAT PHY	ersity S entific a 201 150 or 250 130	Studies selections must include: Inquiry, Methodologies, and Quantitative Skills General College Chemistry Algebra and Trigonometry  Calculus and Analytic Geometry I General Physics I	Unive • Scie CHE MAT  MAT PHY PHY	Acade ersity S ntific 1 201 150 or 250 130	Studies selections must include: Inquiry, Methodologies, and Quantitative Skills General College Chemistry Algebra and Trigonometry  Calculus and Analytic Geometry I General Physics I General Physics I Laboratory
Unive	ersity S entific ( 201 150 or 250 130	Studies selections must include: Inquiry, Methodologies, and Quantitative Skills General College Chemistry Algebra and Trigonometry  Calculus and Analytic Geometry I General Physics I General Physics I Laboratory	Unive	Acade ersity S ntific ( 201 150 or 250 130 131	Studies selections must include: Inquiry, Methodologies, and Quantitative Skills General College Chemistry Algebra and Trigonometry  Calculus and Analytic Geometry I General Physics I General Physics I Laboratory I Self-Awareness and Responsible Citizenship
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BIO	499 Senior Biology Seminar	BIO	330	Principles of Ecology
BIO e	lectives, 300-level or above (10 hrs) <sup>2</sup> [BIO 488 and 489 will not	BIO	333	Genetics
count	· here.]·	BIO	499	Senior Biology Seminar
		BIO	549	Fisheries Techniques
Co-Re	equirements for Biology Major18-20 hrs	BIO	570	Ichthyology
BIO	227 Human Anatomy	BIO	578	Conservation Biology
BIO	228 Human Anatomy Laboratory		or	<b>5</b> ,
BIO	229 Human Physiology	BIO		Wildlife Policy and Administration
BIO	230 Human Physiology Laboratory	BIO		Fisheries Management
CHE	210 Brief Organic Chemistry	BIO		Limnology
	and	5.0	or	
CHE	215 Organic Chemistry Laboratory	BIO		Reservoir Ecology
	or	CHE		General Chemistry and Qualitative Analysis
CHE	312 Organic Chemistry I	CHE		·
PSY	300 Principles and Methods of Statistical Analysis			Brief Organic Chemistry
	or	CHE	215	Brief Organic Chemistry Laboratory
STA	135 Introduction to Probability and Statistics <sup>1</sup>		. ,	
PSY	260 Lifespan Development	-	-	the following not selected previously:
131	200 Eliespan Development	BIO		Introduction to Evolutionary Principles
Requi	ired Minor <sup>3</sup> 6-21 hrs	BIO		Parasitology
Requi	II EU 141111010-21 1113	BIO		Undergraduate Research III
Hana	stricted Electives0-14 hrs	BIO	542	Watershed Ecology
Unres	stricted ElectivesU-14 nrs	BIO	546	Stream Ecology
T-4-1	Control on Browlesson	BIO	561	Freshwater Invertebrates
	Curriculum Requirements 120 hrs	BIO	563	Aquatic Entomology
	y be used to fulfill University Studies requirements. naximum of three hours total from BIO 391, 392, 483, 484, 489, 493,	BIO	568	Wetland Ecology
	ay be used. BIO 488 will not count here.	BIO	572	Herpetology
_	emistry co-requirements may apply toward chemistry minor.	BIO		Ornithology
Circ	initially to requirements may apply toward enemistry minor.	BIO		Mammalogy
		BIO		Conservation Biology
ARE	<b>A</b> :	BIO		Wildlife Policy and Administration
Biolo	ogy/Fisheries and Aquatic Biology Track <sup>1</sup>	BIO		Limnology
	lor of Science/Bachelor of Arts CIP 26.0101	BIO		Freshwater Biology
	<u> </u>	BIO		Reservoir Ecology
Unive		DIO	200	Reservoir Ecology
	ersity Studies Requirements43 hrs	DΙΟ		Internation
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Unive • Scient CHE MAT  MAT PHY • Socio BIO BIO COM PHI POL • Unive STA and o COM ENG	Academic Degrees and Programs.)  Persity Studies selections must include: Intific Inquiry, Methodologies, and Quantitative Skills  201 General College Chemistry 150 Algebra and Trigonometry or 250 Calculus and Analytic Geometry I 130 General Physics I 131 General Physics I Laboratory all and Self-Awareness and Responsible Citizenship of the following: 103 Saving Planet Earth 308 Ethics in Biology 260 Communication Ethics 202 Ethics 140 American National Government versity Studies Electives 135 Introduction to Probability and Statistics one of the following: 131 Interpersonal Communication 224 Writing in the Professions	and 3 AGR AGR CHE CSC EES EES EES EES EES EES EES EES EHS EES EHS EES EE	595 3-5 cre 328 345 and 346 330 101 125 199 200 210 303 305 312 314 424 512 521 250 235 255	dits from the following: Statistics for Food and Agriculture Soil Science  Soil Science Lab Biochemistry Introduction to Problem Solving using Computers Weather and Climate Earth Science Introduction to Oceanography Hydrology Introduction to Water Science Introduction to Cartography Introduction to Remote Sensing Sediments and Soils Conservation and Environmental Geosciences Remote Sensing Geographic Information Systems Calculus and Analytic Geometry I¹ Mechanics, Heat and Wave Motion Electricity, Magnetism, and Light
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of the program.)

EES 202 Introduction to GIS

<sup>4</sup>PHY 255 and 256 will also meet this requirement.

<sup>5</sup>PRAXIS Exam required during last semester before student teaching. Certi-

#### fication requires a grade of B or better in one English composition course and MAJOR: a grade of B or better in a University Studies math course, public speaking, Biology/Secondary Certification (Grades 8-12) Track and EDU 180 or equivalent course. Additional requirements for admission Bachelor of Science/Bachelor of Arts to teacher education and student teaching must be met. See advisor and/or Office of Teacher Education Services for details. <sup>6</sup>EDU 480 and SEC 420 must be taken together two semesters before student University Studies Requirements ...... 43-44 hrs teaching. (See Academic Degrees and Programs.) <sup>7</sup>Must be taken one semester before student teaching. 8Chemistry co-requirements may apply toward chemistry minor. University Studies selections must include: •Scientific Inquiry, Methodologies, and Quantitative Skills CHE 201 General College Chemistry AREA: CHE 202 General Chemistry and Qualitative Analysis Wildlife and Conservation Biology/ MAT 150 Algebra and Trigonometry **Conservation Biology Track** University Studies Electives Bachelor of Science/Bachelor of Arts CIP 03.0601 PHY 130 General Physics I1 PHY 131 General Physics I Laboratory<sup>1</sup> University Studies Requirements ...... 42-43 hrs Note: Certification requires a grade of B or better in one English composition (See Academic Degrees and Programs.) 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 University Studies selections must include: Office of Teacher Education Services for details. · Global Awareness, Cultural Diversity, and the World's Artistic **Traditions** Required Courses ...... 38 hrs POL 250 Introduction to International Relations BIO 100T Transitions Scientific Inquiry, Methodologies, and Quantitative Skills BIO 115 The Cellular Basis of Life 135 Introduction to Probability and Statistics BIO 216 Biological Inquiry and Analysis CHE 105 Introductory Chemistry 221 Zoology: Animal Form and Function or 222 Botany: Plant Form and Function BIO 201 General College Chemistry CHE BIO 300 Introductory Microbiology MAT 150 Algebra and Trigonometry BIO 320 Comparative Vertebrate Anatomy 322 Animal Physiology BIO MAT 250 Calculus and Analytical Geometry I 330 Principles of Ecology RIO Social and Self-Awareness and Responsible Citizenship 333 Genetics BIO ECO 231 Principles of Microeconomics 499 Senior Biology Seminar University Studies Electives 216 Biological Inquiry and Analysis Co-Requirements for Biology Major...... 11-12 hrs ENG 224 Writing for the Professions Chemistry Requirement Group 1: Core Courses1 ...... 62-65 hrs CHE 312 Organic Chemistry I BIO 100T Transitions CHE 320 Organic Chemistry II 115 The Cellular Basis of Life BIO or Group 2: BIO Introduction to Wildlife and Conservation Biology CHE 210 Brief Organic Chemistry<sup>2,3</sup> BIO 221 Zoology: Animal Form and Function CHE 215 Brief Organic Chemistry Laboratory<sup>2,3</sup> BIO 222 Botany: Plant Form and Function CHE 330 Basic Biochemistry BIO 310 Vertebrate Natural History 330 Principles of Ecology BIO Physics Requirement 333 Genetics BIO PHY 132 General Physics II4 BIO 380 Wildlife Techniques PHY 133 General Physics II Laboratory<sup>4</sup> BIO 499 Senior Biology Seminar BIO 578 **Conservation Biology** Required for Secondary Certification<sup>5</sup>......33 hrs RIO 580 Principles of Wildlife Management EDU 180 Exploring the Teaching Profession RIO 584 Wildlife Policy and Administration EDU 280 Educating for Human Development BIO 554 **Dendrology and Forest Conservation** EDU 380 Inclusive Teaching of Diverse Learners and EDU 480 Effective Pedagogy BIO 350 Systematic Botany **Professional Perspectives for Teaching** EDU 485 or SEC Practicum in Secondary Schools<sup>6</sup> 420 BIO 553 Field Botany Student Teaching in the Secondary School SEC 421 and one of the following: SEC 422 Extended Practicum<sup>7</sup> 382 Scientific Communication for the Biologist ENG 324 Technical Writing Required Minor ...... 3-21 hrs8 and one of the following: 572 Herpetology BIO Total Curriculum Requirements ...... 128-148 hrs BIO 573 Ornithology <sup>1</sup>PHY 235 and 236 will also meet this requirement. BIO 574 Mammalogy <sup>2</sup>May be used to fulfill University Studies requirements. and two of the following: <sup>3</sup>This course does not apply toward the chemistry minor.

AGR 345 Soil Science

AGR 350 Soil Survey

AGR CHE		Soil Management Brief Organic Chemistry	HIS • <i>Uni</i>		American Experience since 1865  Studies Electives
	and		BIO		Biological Inquiry and Analysis
CHE EES		Organic Chemistry Laboratory Earth Science	ENG	224	Writing for the Professions
EES		Sediments and Soils	Core		es <sup>1</sup>
PHY	130	General Physics I	BIO		Transitions
	and		BIO	115	The Cellular Basis of Life
PHY	131	General Physics I Laboratory	BIO	149	Introduction to Wildlife and Conservation Biology
			BIO	221	Zoology: Animal Form and Function
Cons	ervatio	on Biology Track17 hrs	BIO	222	Botany: Plant Form and Function
EES	202	Introduction to Geographical Information Science	BIO	310	Vertebrate Natural History
and o	ne of	the following:	BIO	330	Principles of Ecology
ECO	310	Issues in the Global Economy	BIO	333	Genetics
		Environmental Economics	BIO	380	Wildlife Techniques
			BIO	499	Senior Biology Seminar
and a	minin	num of ten hours from the following: <sup>2</sup>	BIO	578	Conservation Biology
ANT		Human Ecology	BIO		Principles of Wildlife Management
BIO		Biological Applications in GIS	BIO		Wildlife Policy and Administration
BIO		Introductory Microbiology	BIO		Dendrology and Forest Conservation
BIO		Ethics in Biology		and	
BIO		Biogeography	BIO		Systematic Botany
BIO		Principles of Managing Diseases in Wildlife	2.0	or	oystematic setting
BIO		Wetland Ecology	BIO		Field Botany
BIO		Ichthyology			the following:
BIO		Herpetology	BIO	-	Scientific Communication for the Biologist
BIO		Ornithology			_
BIO		= :			Technical Writing
		Mammalogy  Panulation and Conservation Constics		-	the following:
BIO		Population and Conservation Genetics	BIO		Herpetology
BIO		Applied Wildlife Economics, Policy, and Administation	BIO		Ornithology
BIO		Disturbance Ecology	BIO		Mammalogy
EES		Introduction to Remote Sensing		-	the following:
EES		Field Techniques in Geosciences			Soil Science
EES		Remote Sensing			Soil Survey
EES		Geographic Information Systems	AGR		Soil Management
PLN		Land Use Planning	CHE	210	Brief Organic Chemistry
SOC	455	Environmental Sociology		and	
			CHE	215	Organic Chemistry Laboratory
		rulum Requirements 121-125 hrs	EES	199	Earth Science
		urse requirements for Associate Wildlife Biologist Certification	EES	314	Sediments and Soils
		dlife Society.	PHY	130	General Physics I
		course from BIO 572, 573, and 574 (if not taken as a core course)		and	
WIII CO	unt to	ward this requirement.	PHY	131	General Physics I Laboratory
ADE	۸.		Cons	ervatio	on Education and Interpretation Track 17 hrs
ARE			EDU	404	Teaching Environmental Education
		and Conservation Biology/	REC	202	Recreation Program Planning
		tion Education and Interpretation Track			
Bache	lor of S	cience/Bachelor of Arts CIP 03.0601	and c	ı minir	num of 13 hours from the following: <sup>2</sup>
			BIO	240	Biological Applications in GIS
		Studies Requirements 42-43 hrs	BIO	525	Biogeography
(See A	Acadei	mic Degrees and Programs.)	BIO	542	Watershed Ecology
			BIO	546	Stream Ecology
Unive	ersity S	Studies selections must include:	BIO	561	Freshwater Invertebrates
•Scie	ntific I	nquiry, Methodologies, and Quantitative Skills	BIO	563	Aquatic Entomology
STA	135	Introduction to Probability and Statistics	BIO	564	Entomology
CHE	105	Introductory Chemistry	BIO	568	Wetland Ecology
	or		BIO	570	Ichthyology
CHE	201	General College Chemistry	BIO		Herpetology
MAT		Algebra and Trigonometry	BIO		Ornithology
	or	- ,	BIO		Mammalogy
MAT		Calculus and Analytical Geometry I	BIO		Disturbance Ecology
		Self-Awareness and Responsible Citizenship	EES		Introduction to Geographical Information Science
EDP		Psychology of Human Development	EES		Landscapes of the National Parks
HIS		American Experience to 1865	EES		Field Techniques in Geosciences
	or		EES		Remote Sensing

EES 521 Geographic Information Systems	and two of the following:
PLN 507 Land Use Planning	AGR 345 Soil Science
REC 411 Curriculum Development in Adventure Education	AGR 350 Soil Survey
REC 450 Recreational Use of Natural Resoures	AGR 455 Soil Management
REC 465 Interpretation of Cultural and Natural Resources	CHE 210 Brief Organic Chemistry and
Total Curriculum Requirements 121-125 hrs	CHE 215 Organic Chemistry Laboratory
<sup>1</sup> Meets course requirements for Associate Wildlife Biologist Certification	EES 199 Earth Science
from The Wildlife Society.	EES 314 Sediments and Soils
<sup>2</sup> Only one course from BIO 572, 573, and 574 (if not taken as a core course)	PHY 130 General Physics I
will count toward this requirement.	and
	PHY 131 General Physics I Laboratory
AREA:	Conservation Law Enforcement Track
Wildlife and Conservation Biology/	CRJ 220 Law Enforcement
Conservation Law Enforcement Track	CRJ 300 Crime and Criminals
Bachelor of Science/Bachelor of Arts CIP 03.0601	and a minimum of eleven hours from the following: <sup>2</sup>
Bachelol of Science/Bachelol of Arts CIP 03.0001	BIO 240 Biological Applications in GIS
University Studies Requirements 42.42 hrs	BIO 548 Principles of Managing Diseases in Wildlife
University Studies Requirements	BIO 570 Ichthyology
Dee Academic Degrees and Programs.	BIO 572 Herpetology
University Ctudies colorations must include:	BIO 573 Ornithology
University Studies selections must include:	BIO 574 Mammalogy
• Scientific Inquiry, Methodologies, and Quantitative Skills	BIO 581 Applied Wildlife Economics, Policy, and Administration
STA 135 Introduction to Probability and Statistics	BIO 582 Fisheries Management
CHE 105 Introductory Chemistry	CRJ 240 Corrections
or	CRJ 346 Crime Investigation
CHE 201 General College Chemistry	CRJ 365 Interviewing and Interrogation
MAT 150 Algebra and Trigonometry	CRJ 445 Criminal Justice Diversity
or	EES 202 Introduction to Geographical Information Science
MAT 250 Calculus and Analytical Geometry I	REC 465 Interpretation of Cultural and Natural Resources
Social and Self-Awareness and Responsible Citizenship	The Tos The precation of Gallara and Hacara Resources
CRJ 140 Introduction to Criminal Justice	Total Curriculum Requirements 121-125 hrs
PSY 180 General Psychology	<sup>1</sup> Meets course requirements for Associate Wildlife Biologist Certification
University Studies Electives	from The Wildlife Society.
BIO 216 Biological Inquiry and Analysis	<sup>2</sup> Only one course from BIO 572, 573, and 574 (if not taken as a core course)
ENG 224 Writing for the Professions	will count toward this requirement.
Core Courses <sup>1</sup> 62-65 hrs	
BIO 100T Transitions	AREA:
BIO 115 The Cellular Basis of Life	Wildlife and Conservation Biology/
BIO 149 Introduction to Wildlife and Conservation Biology	• • • • • • • • • • • • • • • • • • • •
BIO 221 Zoology: Animal Form and Function	Wildlife Biology Track  Backelor of Science / Packelor of Arts  CIR 03 0601
BIO 222 Botany: Plant Form and Function	Bachelor of Science/Bachelor of Arts CIP 03.0601
BIO 310 Vertebrate Natural History	Heiraneity Christian Denvironments
BIO 330 Principles of Ecology	University Studies Requirements
BIO 333 Genetics	(See Academic Degrees and Programs.)
BIO 380 Wildlife Techniques	
BIO 499 Senior Biology Seminar	University Studies selections must include:
	<ul> <li>Scientific Inquiry, Methodologies, and Quantitative Skills</li> </ul>
BIO 578 Conservation Biology	STA 135 Introduction to Probability and Statistics
BIO 580 Principles of Wildlife Management	CHE 105 Introductory Chemistry
BIO 584 Wildlife Policy and Administration	or
BIO 554 Dendrology and Forest Conservation	CHE 201 General College Chemistry
and	MAT 150 Algebra and Trigonometry
BIO 350 Systematic Botany	or
or	MAT 250 Calculus and Analytical Geometry I
BIO 553 Field Botany	<ul> <li>Social and Self-Awareness and Responsible Citizenship</li> </ul>
and one of the following:	ECO 231 Principles of Microeconomics
BIO 382 Scientific Communication for the Biologist	University Studies Electives
ENG 324 Technical Writing	BIO 216 Biological Inquiry and Analysis
and one of the following:	ENG 224 Writing for the Professions
BIO 572 Herpetology	
BIO 573 Ornithology	Core Courses <sup>1</sup> 62-65 hrs
BIO 574 Mammalogy	BIO 100T Transitions
	BIO 115 The Cellular Basis of Life
	DIO 110 Introduction to Wildlife and Consequetion Biology

BIO

149 Introduction to Wildlife and Conservation Biology

BIO	221	Zoology: Animal Form and Function		_		
BIO		Botany: Plant Form and Function	ARE			
BIO		Vertebrate Natural History	Wilc	llife a	and Conservation Biology/	
		•	Zool	ogica	al Conservation Track	
BIO		Principles of Ecology		_	Science/Bachelor of Arts	CIP 03.0601
BIO		Genetics				
BIO	380	Wildlife Techniques	Univ	arcity	Studies Requirements	12-12 hrs
BIO	499	Senior Biology Seminar			•	42-43 1113
BIO	578	Conservation Biology	(See	Acuue	mic Degrees and Programs.)	
BIO	580	Principles of Wildlife Management				
BIO		Wildlife Policy and Administration			Studies selections must include:	
			•Scie	ntific	Inquiry, Methodologies, and Quantitative	Skills
BIO		Dendrology and Forest Conservation	STA	135	Introduction to Probability and Statistics	
	and		CHE	105	Introductory Chemistry	
BIO	350	Systematic Botany		or	, , , , , , , , , , , , , , , , , , , ,	
	or		CHE		General College Chemistry	
BIO	553	Field Botany				
		the following:	IVIAI		Algebra and Trigonometry	
BIO	-	Scientific Communication for the Biologist		or		
		_			Calculus and Analytical Geometry I	
		Technical Writing	•Uni	versity	Studies Electives	
and c	one of	the following:	BIO	216	Biological Inquiry and Analysis	
BIO	572	Herpetology	ENG	224	Writing for the Professions	
BIO	573	Ornithology			Ü	
BIO		Mammalogy	Core	Cours	es¹	62-65 hrs
		the following:				02-05 1113
	-		BIO		Transitions	
		Soil Science	BIO		The Cellular Basis of Life	
AGR	350	Soil Survey	BIO	149	Introduction to Wildlife and Conservation	Biology
AGR	455	Soil Management	BIO	221	Zoology: Animal Form and Function	
CHE	210	Brief Organic Chemistry	BIO	222	Botany: Plant Form and Function	
	and	· ·	BIO		Vertebrate Natural History	
CHE		Organic Chemistry Laboratory	BIO		Principles of Ecology	
			BIO		Genetics	
EES		Earth Science				
EES		Sediments and Soils	BIO		Wildlife Techniques	
PHY	130	General Physics I	BIO		Senior Biology Seminar	
	and		BIO		Conservation Biology	
PHY	131	General Physics I Laboratory	BIO	580	Principles of Wildlife Management	
		, , , , , , , , , , , , , , , , , , , ,	BIO	584	Wildlife Policy and Administration	
Wildi	ifo Bio	ology Track 17 hrs	BIO		Dendrology and Forest Conservation	
				and	0,	
EES		Introduction to Geographical Information Science	BIO		Systematic Botany	
and c	i minir	num of 13 hours from the following: <sup>2</sup>	ыо		Systematic Botally	
AGR	240	Crop Science	DI O	or	F: 11 D .	
BIO	240	Biological Applications in GIS	BIO		Field Botany	
BIO	320	Comparative Vertebrate Anatomy		_	the following:	
BIO		Biogeography	BIO	382	Scientific Communication for the Biologis	t
			ENG	324	Technical Writing	
BIO		Principles of Managing Diseases in Wildlife	and c	ne of	the following:	
BIO		Wetland Ecology	BIO		Herpetology	
BIO		Ichthyology	BIO		Ornithology	
BIO	572	Herpetology	BIO			
BIO	573	Ornithology			Mammalogy	
BIO	574	Mammalogy		-	the following:	
BIO		Population and Conservation Genetics			Soil Science	
			AGR	350	Soil Survey	
BIO		Applied Wildlife Economics, Policy, and Administration	AGR	455	Soil Management	
BIO		Fisheries Management	CHE	210	Brief Organic Chemistry	
EDU	404	Teaching Environmental Education		and		
EES	312	Introduction to Remote Sensing	CHE		Organic Chemistry Laboratory	
EES	512	Remote Sensing			•	
EES		Geographic Information Systems	EES	199		
MAT		Statistical Methods	EES		Sediments and Soils	
			PHY	130	General Physics I	
PLN		Urban and Regional Land Use Planning		and		
REC	465	Interpretation of Cultural and Natural Resources	PHY	131	General Physics I Laboratory	
		culum Requirements	Zoolo	ogical	Biology Track	17 hrs
		urse requirements for Associate Wildlife Biologist Certification	AGR	300	Principles of Animal Nutrition	
		Idlife Society.	AGR		Applications in Animal Technology	
		course from BIO 570, 572, 573, and 574 (if not taken as a core	AGR		Veterinary Laboratory Principles	
course	e) will c	count toward this requirement.	EDU		Teaching Environmental Education	
			LDU	404	icacining Environmental Education	

and a minimum of seven hours from the following:2 AGR 324 Veterinary Diagnostic Imaging Veterinary Hematology and Microbiology AGR 329 AGR 332 **Veterinary Nursing** BIO 240 **Biological Applications in GIS** BIO 300 Introductory Microbiology **Animal Physiology** 322 BIO **General Parasitology** BIO 467 BIO 538 **Animal Behavior** 539 BIO Animal Behavior Laboratory 548 Principles of Managing Diseases in Wildlife BIO BIO 570 Ichthyology BIO 572 Herpetology BIO 573 Ornithology BIO 574 Mammalogy BIO 577 Population and Conservation Genetics 465 Interpretation of Cultural and Natural Resources

## Total Curriculum Requirements ...... 121-125 hrs

<sup>1</sup>Meets course requirements for Associate Wildlife Biologist Certification from The Wildlife Society.

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

## Biology Minor......21 hrs

Complete BIO 115, 216, and either 221 or 222 (or both). Remaining BIO hours should be chosen with advisor's approval (BIO 330 and 333 are highly recommended). A maximum of three hours total from BIO 391, 392, 483, 484, 493, or 494 may be used. BIO 101, 488, 489, and 499 will not count toward this minor. Six hours must be upper-level (300 and greater) courses.

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

#### Pre-Pharmacy Curriculum<sup>1</sup>

132 General Physics II<sup>2</sup>

Elective hours:

PHY 133 General Physics II Laboratory<sup>2</sup>

Cross-cultural<sup>3</sup> (3) General electives (4)

Requi	Required Courses58 hrs					
BIO	221	Zoology: Animal Form and Function <sup>2</sup>				
BIO	227	Human Anatomy				
BIO	228	Human Anatomy Laboratory				
BIO	300	Introductory Microbiology				
CHE	201	General College Chemistry <sup>2</sup>				
CHE	202	General Chemistry and Qualitative Analysis <sup>2</sup>				
CHE	312	Organic Chemistry I				
CHE	320	Organic Chemistry II				
CHE	325	Organic Chemistry II Laboratory				
ECO	231	Principles of Microeconomics <sup>2</sup>				
ENG	105	Reading, Writing and Inquiry <sup>2</sup>				
ENG	204	Advanced Expository Writing <sup>2</sup>				
MAT	250	Calculus and Analytic Geometry I <sup>2</sup>				
PHY	130	General Physics I <sup>2</sup>				
PHY	131	General Physics I Laboratory <sup>2</sup>				

## Social and Self-Awareness and Responsible Citizenship (3)

135 Introduction to Probability and Statistics<sup>2</sup>

<sup>1</sup>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

Humanities⁴ (6)

B.S. degree should follow the pre-medicine track and include all the courses listed above. The pre-pharmacy advisor should be consulted.

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

<sup>3</sup>A course focusing on the study of a developing or non-Western country. <sup>4</sup>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 DECILIDEMENTS

THESIS REQUIREINENTS				
Total Course Requirements30 hours				
BIO 689 Introduction to Graduate Study				
BIO 696 Understanding Scientific Communication <sup>L</sup>				
BIO 697 Seminar				
BIO 698-699 Thesis <sup>R</sup>				
BIO 600-level and above courses (9-20 hrs)				
Graduate advisor/committee approved courses in related fields				
(0-11 hrs)				
Other Degree Peguirements				

#### 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

689 Introduction to Graduate Study

BIO 696 Understanding Scientific Communication<sup>L</sup>

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 Requirements30 hours					
Required Courses 10 hours					
BIO	642	Watershed Ecology (same as EES 642)			
BIO	689	Introduction to Graduate Study			
BIO	696	Understanding Scientific Communication <sup>L</sup>			
BIO	697	Seminar			
BIO	698-699 Thesis <sup>R</sup>				

#### Restricted Electives...... 17 hours

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

- AGR 674 Agricultural Irrigation and Water Systems
- BIO 625 Biogeography
- BIO 630 **Animal Ecology**
- BIO 631 Plant Ecology
- BIO 632 Quantitative Ecology
- BIO 646 Stream Ecology
- Freshwater Invertebrates BIO 661
- BIO 663 **Aquatic Entomology**
- BIO 668 Wetland Ecology
- BIO Biological Limnology 669
- 670 Limnological Analysis Laboratory BIO
- BIO 671 Ichthyology
- 672 Herpetology BIO
- 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
- CFT **Environmental Regulatory Affairs**
- CET 681 Pollution Assessment and Control
- CET 685 Remediation Technology
- CHE 613 **Environmental Chemistry**
- CHE 617 Advanced Organic Chemistry
- CHE 627 **Chemical Separations**
- CHE 628 Mass Spectrometry
- CHE 665 Biogeochemistry

**EES** 

- 612 Remote Sensing **FFS**
- 621 Geographic Information Systems
- 640 Advanced Remote Sensing **EES**
- **EES** 641 Digital Image Processing Research
- **EES** 662 Hydrogeology
- EES 665 Physical/Chemical Limnology
- **EES** 680 Advanced Geographic Information Systems

## **Other Degree Requirements**

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

Defense of thesis.

#### **Master of Arts in Education Secondary Teacher Leader with Biology Concentration** CIP 13.1205

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

## Department of Chemistry

1201 Jesse D. Jones Hall 270-809-2584

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

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

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

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

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

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

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

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

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

AREA:	MAJOR:
Chemistry Bachelor of Science/Bachelor of Arts CIP 40.09	Chemistry  Bachelor of Science/Bachelor of Arts CIP 40.0501
	Bachelor of Science/Bachelor of Arts CIP 40.0501
ACCREDITED BY: American Chemical Society	University Studies Requirements
University Studies Requirements43-4	(See Academic Degrees and Programs.) hrs
(See Academic Degrees and Programs.)	University Studies selections must include:
3 7	Scientific Inquiry, Methodologies, and Quantitative Skills
University Studies selections must include:	MAT 250 Calculus and Analytic Geometry I <sup>1</sup>
•Scientific Inquiry, Methodologies, and Quantitative Skills	PHY 130 General Physics I <sup>1</sup> and
MAT 250 Calculus and Analytic Geometry I <sup>1</sup>	PHY 131 General Physics I Laboratory <sup>1</sup>
PHY 235 Mechanics, Heat and Wave Motion <sup>1</sup>	PHY 132 General Physics II <sup>1</sup> and
PHY 236 Mechanics, Heat and Wave Motion Lab <sup>1</sup>	PHY 133 General Physics II Laboratory <sup>1</sup>
PHY 255 Electricity, Magnetism and Light <sup>1</sup>	
PHY 256 Electricity, Magnetism and Light Lab <sup>1</sup>	Required Courses35 hrs
	CHE 100T Transitions
Required Courses 6	
CHE 100T Transitions	CHE 202 General Chemistry and Qualitative Analysis
CHE 201 General College Chemistry	CHE 305 Analytical Chemistry
CHE 202 General Chemistry and Qualitative Analysis	CHE 312 Organic Chemistry I
CHE 305 Analytical Chemistry	CHE 320 Organic Chemistry II
CHE 312 Organic Chemistry I	CHE 352 Basic Chemical Instrumentation
CHE 320 Organic Chemistry II	CHE 403 Basic Physical Chemistry
CHE 325 Organic Chemistry II Laboratory	CSC 235 Programming in C++ <sup>2</sup>
CHE 400 Chemical Literature	a to the second
CHE 401 Ethics for the Chemist	Required Limited Electives
CHE 410 Physical Chemistry I	CHE 488 Cooperative Education/Internship
CHE 420 Physical Chemistry II	Or CUE 405 Capies Bassach
CHE 509 Advanced Inorganic Chemistry I	CHE 495 Senior Research
CHE 510 Inorganic Chemistry Laboratory	Described Address
CHE 519 Instrumental Analysis	Required Minor 21 hrs
CHE 530 Fundamentals of Biochemistry I	Electives <sup>3</sup>
CHE 576 Polymer Chemistry	Electives 17-20 nrs
CSC 235 Programming in C++ <sup>2</sup>	Total Comingulum Denoinements 120 has
MAT 308 Calculus and Analytic Geometry II	Total Curriculum Requirements
MAT 309 Calculus and Analytic Geometry III	<sup>2</sup> CSC 232 or EGR 140 may be substituted.
Descriped Limited Fleetings	<sup>3</sup> At least one three-hour free elective must be chosen from outside Chemistr
Required Limited Electives <sup>3</sup> CHE 488 Cooperative Education/Internship	and may not be counted as a University Studies requirement.
·	
or CHE 495 Senior Research	
CITE 455 Settlot Research	MAJOR:
Unrestricted Electives6-	Chemistry/Secondary Certification (Grades 8-12) Track
onestricted Liectives	Bachelor of Science/Bachelor of Arts CIP 40.0501
Total Curriculum Requirements12	hrs NOTE Beauties and for the second
<sup>1</sup> Required for area if not taken as a University Studies elective.	NOTE: Requirements for teacher certification are established by the Kentuck Education Professional Standards Board. Students are cautioned that require
<sup>2</sup> CSC 232 or EGR 140 may be substituted.	ments may change. For current information, students should check with a
$^3 \text{In conjunction}$ with this program it is possible through careful course	elec- advisor in the Department of Adolescent, Career and Special Education.
tion to obtain an M.S. degree with one additional year of study following	
awarding of the B.S. degree. Students interested in this M.S. concent	University Studies Requirements 41-50 nrs
should contact the graduate coordinator in the department no later during the junior year.	(See Academic Degrees and Programs.)
auting the junior year.	
	University Studies selections must include:
	<ul> <li>Scientific Inquiry, Methodologies, and Quantitative Skills</li> </ul>
	MAT 250 Calculus and Analytic Geometry
	PHY 130 General Physics I <sup>1</sup> and
	PHY 131 General Physics I Laboratory <sup>1</sup>
	PHY 132 General Physics II <sup>1</sup> and
	PHY 133 General Physics II Laboratory <sup>1</sup>
	<b>Note:</b> 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 t

teacher education and student teaching must be met. See advisor and/or

Office of Teacher Education Services for details.

Requ	ired C	ourses30 hrs	MA	JOR:			
CHE		Transitions			y/Pre-Medical/Pre-Dental Track		
CHE		Chemical Laboratory Safety			Science/Bachelor of Arts	CIP 40.0501	
CHE		General College Chemistry			20.01.00, 20.01.01.01.01	0 10.0301	
CHE		General Chemistry and Qualitative Analysis	Univ	ersity	Studies Requirements	41-44 hrs	
CHE		Analytical Chemistry			mic Degrees and Programs.)		
CHE		Organic Chemistry I					
CHE		Organic Chemistry II	Unive	ersity :	Studies selections must include:		
CHE	405	Basic Physical Chemistry	•Scie	ntific	Inquiry, Methodologies, and Quantitative	Skills	
Regui	ired Li	mited Electives3-4 hrs	MAT	250	Calculus and Analytic Geometry I <sup>1</sup>		
-		the following:	PHY		General Physics I <sup>1</sup>		
CHE	-	Basic Biochemistry	PHY		General Physics I Laboratory <sup>1</sup>		
CHE		Basic Chemical Instrumentation	PHY		General Physics II <sup>1</sup>		
CHE		Fundamentals of Toxicology	PHY	133	General Physics II Laboratory <sup>1</sup>		
		Environmental Chemistry					
			•		ourses	38 hrs	
Secor	ndarv	Certification Courses 33 hrs	CHE		Transitions		
EDU		Exploring the Teaching Profession <sup>2</sup>	CHE		General College Chemistry		
EDU		Educating for Human Development <sup>2</sup>	CHE		General Chemistry and Qualitative Analys	IS	
EDU	380	Inclusive Teaching of Diverse Learners <sup>2</sup>	CHE		Analytical Chemistry		
EDU		Effective Pedagogy <sup>2,3</sup>	CHE		Organic Chemistry I		
EDU	485	Professional Perspectives for Teaching <sup>2,4</sup>	CHE		Organic Chemistry II Basic Chemical Instrumentation		
SEC	420	Practicum in Secondary Schools <sup>3</sup>	CHE				
SEC	421	Student Teaching in the Secondary School	CHE CHE	403	Basic Physical Chemistry Fundamentals of Biochemistry I		
SEC	422	Extended Practicum <sup>4</sup>	CSC		Programming in C++2		
			ENG		Advanced Expository Writing		
Requ	ired N	linor 21 hrs	LING	or	Advanced Expository Writing		
			ENG		Technical Writing		
		ulum Requirements 128-138 hrs	LING	324	reclinical writing		
	•	for major if not taken as a University Studies elective. Students	Regu	ired N	linor³	21 hrs	
	-	nysics minor may substitute PHY 235/236 and 255/256 for PHY 132/133.					
_		ade of <i>B</i> or better.	Unre	stricte	d Electives	17-20 hrs	
	<sup>4</sup> EDU 480 and SEC 420 must be taken together two semesters before student						
teachi	_		Total	Curri	culum Requirements	120 hrs	
⁵Mı	ust be t	aken one semester before student teaching.			for major if not taken as a University Studies ele	ective.	
Cl		Too ahina Caradalisatian			r EGR 140 may be substituted.		
	Chemistry Teaching Specialization <sup>3</sup> Biology minor strongly recommended.						
		hing specialization in chemistry is a path to secondary					
		in chemistry, designed to accompany certification in	MA.	IOR:			
		ence content area. (All College of Education and Human			. /Dia ala assistant Tua ala		
		condary certification course requirements must be met.) g specialization in chemistry meets and exceeds Murray			y/Biochemistry Track	CID 40 0E01	
		rsity's requirements for a minor in chemistry. <b>Note:</b> Even	Bacile	2101 01 3	Science/Bachelor of Arts	CIP 40.0501	
		program exceeds Murray State University's requirements	Hniv	orcity	Studies Requirements	11-11 hrs	
		stry minor, in order for a chemistry minor to appear on a			mic Degrees and Programs.)	41-44 1113	
		minor must be declared, and all residential and graduation	(366)	Acuuc	inic Degrees and Programs.		
		its must be met.	Unive	ersity '	Studies selections must include:		
		ments for teacher certification are established by the			Inquiry, Methodologies, and Quantitative	Skills	
		ducation Professional Standards Board. Students are		-	Calculus and Analytic Geometry I <sup>1</sup>		
		nat changes in these requirements may occur. Therefore, for	PHY		General Physics I <sup>1</sup> and		
		rrent information, students should check with an advisor	PHY		General Physics I Laboratory <sup>1</sup>		
		ge of Education and Human Services.	PHY		General Physics II <sup>1</sup> and		
	•		PHY		General Physics II Laboratory <sup>1</sup>		
Chem	nistry 1	Teaching Specialization24 hrs			•		
CHE		Chemical Laboratory Safety	Requ	ired C	ourses	44 hrs	
CHE		General College Chemistry	CHE	100	Transitions		
CHE		General Chemistry and Qualitative Analysis	CHE		General College Chemistry		
CHE		Analytical Chemistry	CHE		General Chemistry and Qualitative Analys	is	
CHE	312	Organic Chemistry I	CHE	305	Analytical Chemistry		

CHE 312 Organic Chemistry I

CHE 320 Organic Chemistry II

CHE 403 Basic Physical Chemistry

CHE 530 Fundamentals of Biochemistry I

352 Basic Chemical Instrumentation

Choose one elective from the following:

330 Basic Biochemistry

CHE 403 Basic Physical Chemistry

352 Basic Chemical Instrumentation

CHE 320 Organic Chemistry II

CHE

CHE

CHE 537 Experimental Biochemistry CHE 540 Fundamentals of Biochemistry II	MAJOR: Chamistry/Balyman and Matarials Science Track
CSC 235 Programming in C++ <sup>2</sup>	Chemistry/Polymer and Materials Science Track Bachelor of Science/Bachelor of Arts CIP 40.0501
Required Minor <sup>3</sup> 21 hrs	University Studies Requirements
Electives 11-14 hrs	(See Academic Degrees and Programs.)
Total Curriculum Requirements	University Studies selections must include:
<sup>1</sup> Required for major if not taken as a University Studies elective.	<ul> <li>Scientific Inquiry, Methodologies, and Quantitative Skills</li> </ul>
<sup>2</sup> CSC 232 or EGR 140 may be substituted.	MAT 250 Calculus and Analytic Geometry I <sup>1</sup>
<sup>3</sup> Biology minor is strongly recommended.	PHY 235 Mechanics, Heat and Wave Motion <sup>1</sup>
	PHY 236 Mechanics, Heat and Wave Motion Laboratory <sup>1</sup>
	PHY 255 Electricity, Magnetism and Light Laboratory
MAJOR:	PHY 256 Electricity, Magnetism and Light Laboratory <sup>1</sup>
Chemistry/Forensics Track	Required Courses 51 hrs
Bachelor of Science/Bachelor of Arts CIP 40.0501	CHE 100T Transitions
	CHE 201 General College Chemistry
University Studies Requirements	CHE 202 General Chemistry and Qualitative Analysis
(See Academic Degrees and Programs.)	CHE 305 Analytical Chemistry
	CHE 312 Organic Chemistry I
University Studies selections must include:	CHE 320 Organic Chemistry II
Scientific Inquiry, Methodologies, and Quantitative Skills	CHE 352 Basic Chemical Instrumentation
MAT 250 Calculus and Analytic Geometry I	CHE 503 Industrial Chemistry
PHY 130 General Physics I <sup>1</sup> and	CHE 576 Polymer Chemistry
PHY 131 General Physics I Laboratory <sup>1</sup>	CSC 235 Programming in C++ <sup>2</sup>
PHY 132 General Physics II <sup>1</sup> and	EGR 240 Thermodynamics I
PHY 133 General Physics II Laboratory <sup>1</sup>	EGR 375 Materials Science
	MAT 308 Calculus and Analytic Geometry II
Required Courses34 hrs	PHY 370 Introduction to Modern Physics
CHE 100T Transitions	1111 370 Introduction to Wodern Hysics
CHE 201 General College Chemistry	Required Limited Electives 3 hrs
CHE 202 General Chemistry and Qualitative Analysis	
CHE 305 Analytical Chemistry	CHE 488 Cooperative Education/Internship
CHE 312 Organic Chemistry I	or CHE 495 Senior Research
CHE 320 Organic Chemistry II	CITE 433 Selliot Research
CHE 325 Organic Chemistry II Laboratory	Required Minor <sup>3</sup> 11-21 hrs
CHE 403 Basic Physical Chemistry I	Required Millor
CSC 235 Programming in C++ <sup>2</sup>	Unrestricted Electives 1-17 hrs
Required Limited Electives	Total Curriculum Requirements 120 hrs
ARC 335 Forensic Archaeology	<sup>1</sup> Required for major if not taken as a University Studies elective.
CHE 330 Basic Biochemistry	<sup>2</sup> CSC 232 or EGR 140 may be substituted.
CHE 352 Basic Chemical Instrumentation	<sup>3</sup> PHY 235, 236, 255, and 256 count toward a physics minor, with 11 additiona
	hours remaining; otherwise, 21 hours are required to complete a minor.
Criminal Justice Minor <sup>3</sup> 21 hrs	
CRJ 220, 333, and 346 are required selections.	·
	MAJOR:
Unrestricted Electives11-14 hrs	Chemistry/Pre-Pharmacy Track <sup>1</sup>
	Bachelor of Science/Bachelor of Arts CIP 40.0501
Total Curriculum Requirements 120 hrs	
<sup>1</sup> Required for major if not taken as a University Studies elective.	University Studies Requirements 41-44 hrs
<sup>2</sup> CSC 232 or EGR 140 may be substituted.	(See Academic Degrees and Programs.)
<sup>3</sup> A second major in Criminal Justice can substitute for the minor.	
	University Studies selections must include:
	<ul> <li>Scientific Inquiry, Methodologies, and Quantitative Skills</li> </ul>
	MAT 250 Calculus and Analytic Geometry I <sup>2</sup>
	PHY 130 General Physics I <sup>2</sup>
	PHY 131 General Physics I Laboratory <sup>2</sup>
	PHY 132 General Physics II <sup>2</sup>
	PHY 133 General Physics II Laboratory <sup>2</sup>
	Social and Self-Awareness and Responsible Citizenship
	ECO 231 Principles of Microeconomics
	200 201 Timospies of Wild Occontonies

	Required Courses 46 nrs				
	CHE	100T	Transitions		
	CHE	201	General College Chemistry		
	CHE	202	General Chemistry and Qualitative Analysis		
	CHE	305	Analytical Chemistry		
	CHE	312	Organic Chemistry I		
	CHE	320	Organic Chemistry II		
	CHE	325	Organic Chemistry II Laboratory		
	CHE	330	Basic Biochemistry		
	CHE	352	Basic Chemical Instrumentation		
	CHE	403	Basic Physical Chemistry I		
	CSC	235	Programming in C++ <sup>3</sup>		
	STA	135	Introduction to Probability and Statistics		
Required Minor <sup>4</sup> 21 hrs					
Unrestricted Electives					
<b>Total Curriculum Requirements</b>					

those listed above. The curriculum can be modified to meet the requirements of most professional programs.

<sup>2</sup>Required for major if not taken as a University Studies elective.

3CSC 232 or EGR 140 may be substituted.

<sup>4</sup>Biology minor is strongly recommended.

#### Chemistry Minor ...... 21 hrs

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

#### **Graduate Programs**

Graduate Coordinator - Rachel Allenbaugh

## **Master of Science** Chemistry

CIP 40.0501

#### **Requirements for Admission**

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

#### Unconditional

To qualify for unconditional admission, an applicant must have:

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

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

#### Conditional

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

#### THESIS REQUIREMENTS

Total Course Requirements30 hours				
CHE	601	Seminar <sup>L,1</sup>		
CHE	602	Seminar <sup>1</sup>		
CHE	609	Advanced Inorganic Chemistry I		
CHE	617	Advanced Organic Chemistry		
CHE	681	Advanced Physical Chemistry		

#### **Research and Other Requirements**

CHE 698<sup>R</sup>-699<sup>PT</sup> Thesis Research

600-level courses (13 hrs)

(Up to six hours may be selected from courses other than CHE.) 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 Requirements36 ho					
	CHE	601	Seminar <sup>L2</sup>		
	CHE	602	Seminar <sup>2</sup>		

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.) <sup>1</sup>CHE 691, 692, and 693 will not count toward completion of this degree.

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

#### **Other Degree Requirements**

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

CHE 600-level electives to total 36 hours.

## **Master of Arts in Education**

**Secondary Teacher Leader with Chemistry Concentration** CIP 13.1205

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

## **Department of Earth and Environmental Sciences**

334 Blackburn Science Building 270-809-2591

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

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

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

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

#### AREA:

# Earth and Environmental Sciences/Environmental Science Track

Bachelor of Science CIP 40.0601

(See Academic Degrees and Programs.)

-			
Requi	red Co	ourses52	2 hr
ARC	150	Introduction to Archaeology <sup>1</sup>	
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 <sup>2</sup>	

- EES 110 World Geography<sup>1</sup>
- FFS 125 Weather and Climat
- EES 125 Weather and Climate<sup>2</sup>
- 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:

	,	) 9 -
BIO	101	Biological Concepts
CHE	210	<b>Brief Organic Chemistry</b>

- 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

CSC 101<sup>3</sup> Introduction to Problem Solving Using Computers

CSC 199<sup>3</sup> Introduction to Information Technology

MAT 150<sup>2</sup> Algebra and Trigonometry (or above)

r

STA 135<sup>2</sup> Introduction to Probability and Statistics (or above)

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

## 

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

<sup>2</sup>Will count towards University Studies Scientific Inquiry, Methodologies, and Quantitative Skills requirements.

<sup>3</sup>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<sup>2</sup>
- 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. Bi	ology		ARE	Δ.	
BIO	101	Biological Concepts			d Environmental Sciences/Geology Track
BIO		Bachelor of Science			
BIO		Zoology: Animal Form and Function	51. 1010001		
BIO		Botany: Plant Form and Function	Univ	ersity	Studies Requirements 38-43 hrs
	emist	•			mic Degrees and Programs.)
CHE		Consumer Chemistry	(		3 ,
CHE		Introductory Chemistry	Requ	iired (	Courses 50 hrs
CHE		General College Chemistry	ARC		Introduction to Archaeology <sup>1</sup>
CHE		General Chemistry and Qualitative Analysis	ARC		Human Ecology
C. Ph	•		CHE	105	Introductory Chemistry
PHY		Mechanics, Heat and Wave Motion	EES		Transitions
	and		EES	101	The Earth and the Environment <sup>2</sup>
PHY		Mechanics, Heat and Wave Motion Laboratory	EES	102	Earth through Time <sup>2</sup>
PHY		Electricity, Magnetism and Light	EES	110	World Geography <sup>1</sup>
	and		EES	202	Introduction to Geographic Information Sciences
PHY	256	Electricity, Magnetism and Light Laboratory	EES	210	Hydrology
			EES	301	Understanding Scientific Communication
-		or Secondary Certification31 hrs	EES	310	Rock and Mineral Resources
EDU		Exploring the Teaching Profession <sup>1</sup>	EES	312	Introduction to Remote Sensing
EDU		Educating for Human Development <sup>1</sup>	EES	314	Sediments and Soils
EDU		Inclusive Teaching of Diverse Learners <sup>1</sup>	EES	336	Principles of Geomorphology
EDU		Effective Pedagogy <sup>1,2</sup>	EES	562	Hydrogeology
EDU		Professional Perspectives for Teaching <sup>1,3</sup>			
SEC	420	Practicum in Secondary Schools <sup>2</sup>	Requ	iired Li	imited Electives8 hrs
SEC	421	Student Teaching in the Secondary School	Choo	se froi	m the following approved electives:
SEC	422	Extended Practicum <sup>3</sup>	ARC	300	Archaeology Method and Theory
			ARC	302	Archaeological Field Work I
Total	Currio	culum Requirements 120 hrs	ARC		Archaeology Laboratory Methods
	_	ade of B or better.	ARC		Geoarchaeology
		taken together and two semesters before student teaching.	BIO		Biological Concepts
³M	ust be t	taken one semester before student teaching.	CET		Plane Surveying
			CHE		General College Chemistry
Eart	h Sci	ence Teaching Specialization	CHE		General Chemistry and Qualitative Analysis
Th	e teacl	hing specialization in earth science is a path to secondary	EES		Introduction to Oceanography
		n in earth science designed to accompany certification in	EES		Introduction to Water Science
anoth	nersci	ence content area (biology/chemistry/physics). All College	EES		Introduction to Cartography
of Ec	ducatio	on and Human Services secondary certification course	EES		Landscapes of the National Parks
requi	iremer	nts must be met. <b>Note:</b> Even though this program exceeds	EES		Economic Geography
		te University's requirements for an earth science minor,	EES		Field Geology
in ord	der for	a earth science minor to appear on a transcript, a minor	EES		Field Techniques in Geosciences
must	be de	clared, and all residential and graduation requirements	EES		International Experience in the Geosciences
	be me		EES		Conservation and Environmental Geosciences
	•	nents for teacher certification are established by the	EES		Structural Geology
	,	ducation Professional Standards Board. Students are	EES		Cooperative Education/Internship
		hat changes in these requirements may occur. Therefore, for	EES		Land Use Planning
		rrent information, students should check with an advisor	EES		Remote Sensing
in the	e Colle	ge of Education and Human Services.	EES		Geographic Information Systems
			EES		Advanced Cartography
Earth	Scien	ce Teaching Specialization30 hrs	EES		Paleoecology
AST	115	Introductory Astronomy	EES		Invertebrate Paleontology
AST	116	Introductory Astronomy Laboratory	EES		Soils and Geomorphology
EES		The Earth and the Environment	EES		Watershed Ecology
EES		Earth through Time	EES		<u>-</u> ,
EES		Weather and Climate			Terrestrial Ecosystem Modeling
EES	202	Introduction to Geographic Information Sciences	EES		Remote Sensing of Vegetation
EES	303	Introduction to Water Science	EES		Special Problems
EES	336	Principles of Geomorphology	EES		Special Problems
EES	339	Field Geology	EES		Special Problems
	or		PHY		General Physics I Laboratory
EES	350	Field Techniques in Geosciences	PHY	131	General Physics I Laboratory

CSC 199<sup>3</sup> Introduction to Information Technology

or

	or	Algebra and Trigonometry (or above)	ARC ARC		Archaeology and Political Ecology of Empires Archaeology of Religion
STA	135 <sup>2</sup>	Introduction to Probability and Statistics (or above)	ARC		Archaeological Field Work II
			ARC	425	Advanced Archaeological Laboratory Methods
Unre	stricte	ed Electives11-17	irs ARC		Cooperative Education/Internship
			ARC		Cooperative Education/Internship
		culum Requirements			Directed Studies
		t towards University Studies Global Awareness, Cultural Diver ld's Artistic Tradition requirements.	, , , , , ,		Advanced Archaeological Field Work
		ia's Artistic Tradition requirements. It towards University Studies Scientific Inquiry, Methodolog	ARC		Geophysical Surveying
		ative Skills requirements.	CET		Plane Surveying
		University Studies electives writing-intensive or technology	-in-		Introduction to Cartography
tensiv	e cour	se.	EES		Landscapes of the National Parks
			EES EES		Rock and Mineral Resources
			EES		Field Techniques in Geosciences
ARE			EES		International Experience in the Geosciences Geographic Information Systems
		d Environmental Sciences/	LLJ	321	deographic information systems
		ogy Track	Colla	teral F	Requirement7-8 hr
Bache	elor of S	Science CIP 40.060			Introduction to Problem Solving Using Computers
l late	orcia	Studios Doquiromento 30.43		or	5 -
	-	Studies Requirements	CSC		Introduction to Information Technology
(see	нсиие.	mic Degrees and Programs.)	MAT		Algebra and Trigonometry (or above)
Hnive	arcity (	Studies selection must include:		or	
		vareness, Cultural Diversity, and the World's Artistic	STA	135 <sup>2</sup>	Introduction to Probability and Statistics (or above)
	itions	a. c. cos, calcarar biversity, and the violia 3 Artistic			
	140	Introduction to Cultural Anthropology	Unre	estricte	d Electives11-17 hr
		, ,,	T-1-		Lun Barrian anta
Requ	ired C	ourses44	irs		t towards University Studies Global Awareness, Cultural Diversit
ARC	150	Introduction to Archaeology <sup>1</sup>			ld's Artistic Tradition requirements.
4 D.C	300	Archaeological Method and Theory			it towards University Studies Scientific Inquiry, Methodologie
ARC					it towards offiversity studies scientific frigury, ivietriouologie
ARC	304	Archaeological Laboratory Methods			ative Skills requirements.
		Archaeological Laboratory Methods Human Ecology	and (	Quantita nis is a	ntive Skills requirements. University Studies electives writing-intensive or technology-in
ARC	320 330	Human Ecology North American Archaeology	and (	Quantita	ative Skills requirements. University Studies electives writing-intensive or technology-ir
ARC ARC ARC ARC	320 330 390	Human Ecology North American Archaeology Geoarchaeology	and (	Quantita nis is a	ntive Skills requirements. University Studies electives writing-intensive or technology-in
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ARC ARC ARC EES EES EES EES	320 330 390 1007 101 110 202 301	Human Ecology North American Archaeology Geoarchaeology Transitions The Earth and the Environment <sup>2</sup> World Geography <sup>1</sup> Introduction to Geographic Information Sciences Understanding Scientific Communication	and G  The strength of the str	Quantitation is a live cours  A:  th and  Track	tive Skills requirements. University Studies electives writing-intensive or technology-ise.  d Environmental Sciences/Geography and
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ARC ARC ARC EES EES EES EES EES EES	320 330 390 1007 101 110 202 301 312 336	Human Ecology North American Archaeology Geoarchaeology Transitions The Earth and the Environment <sup>2</sup> World Geography <sup>1</sup> Introduction to Geographic Information Sciences Understanding Scientific Communication Introduction to Remote Sensing Principles of Geomorphology	and G  Trices  ARE Eart GIS Bach Univ	Quantita his is a ve cours  A: th and Track elor of S	tive Skills requirements. University Studies electives writing-intensive or technology-intensive or te
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ARC ARC ARC EES EES EES EES EES EARC ARC ARC	320 330 390 1007 101 110 202 301 312 336 credit (	Human Ecology North American Archaeology Geoarchaeology Transitions The Earth and the Environment <sup>2</sup> World Geography <sup>1</sup> Introduction to Geographic Information Sciences Understanding Scientific Communication Introduction to Remote Sensing Principles of Geomorphology hours chosen from the following: Archaeological Field Work I	and C 3TI tensi  ARE Eart GIS Bach Univ (See Requ ARC ARC	EA:  Carried C  Acade  Lired C  150  320	thive Skills requirements. University Studies electives writing-intensive or technology-ise.  d Environmental Sciences/Geography and Science CIP 40.0601  Studies Requirements 38-43 hr mic Degrees and Programs.)  ourses 47 hr Introduction to Archaeology <sup>1</sup> Human Ecology
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ARC ARC EES EES EES EES ARC	320 330 390 100T 101 110 202 301 312 336 credit i 302 402 510 se from 311 325 329 314 315 321 335 340 345 357 360 370	Human Ecology North American Archaeology Geoarchaeology Transitions The Earth and the Environment² World Geography¹ Introduction to Geographic Information Sciences Understanding Scientific Communication Introduction to Remote Sensing Principles of Geomorphology hours chosen from the following: Archaeological Field Work I Archaeological Field Work II Advanced Archaeological Field Work  imited Electives	and G 3TI tensi  ARE Eart GIS Bach Univ (See  Requ ARC ARC EES EES EES EES EES EES EES EES EES EE	EA: th and Track elor of S  acception  in the property of the	A Environmental Sciences/Geography and Science CIP 40.0601  Studies Requirements 38-43 hrmic Degrees and Programs.)  Ourses 47 hrmic Degrees and Programs.)  Ourses 47 hrmic Degrees and Programs.)  Ourses 47 hrmic Degrees and Programs.  Introduction to Archaeology¹ Human Ecology Transitions The Earth and the Environment² World Geography¹ Weather and Climate² Introduction to Geographic Information Sciences Understanding Scientific Communication Introduction to Cartography Introduction to Remote Sensing Economic Geography Principles of Geomorphology Remote Sensing Geographic Information Systems  Imited Electives 11 hrm the following approved electives: Hydrology Introduction to Water Science Landscapes of the National Parks
ARC ARC EES EES EES EES ARC	320 330 390 100T 101 110 202 301 312 336 credit i 302 402 510 se from 311 325 329 314 315 321 335 340 345 357 360 370	Human Ecology North American Archaeology Geoarchaeology Transitions The Earth and the Environment² World Geography¹ Introduction to Geographic Information Sciences Understanding Scientific Communication Introduction to Remote Sensing Principles of Geomorphology hours chosen from the following: Archaeological Field Work I Archaeological Field Work II Advanced Archaeological Field Work  imited Electives	and G  Titensi  ARE Eart GIS Bach Univ (See Requ ARC ARC EES EES EES EES EES EES EES EES EES EE	Quantitation is a vectours  EA: th and Track elor of S  ersity : Acade  150 320 1007 101 110 125 202 301 305 312 330 336 512 521  uired Li se from 210 303 306 310	At Environmental Sciences/Geography and Science CIP 40.0601  Studies Requirements 38-43 hrmic Degrees and Programs.)  Ourses 47 hrmic Introduction to Archaeology¹ Human Ecology Transitions The Earth and the Environment² World Geography¹ Weather and Climate² Introduction to Geographic Information Sciences Understanding Scientific Communication Introduction to Remote Sensing Economic Geography Introduction to Remote Sensing Economic Geography Principles of Geomorphology Remote Sensing Geographic Information Systems  In the following approved electives: Hydrology Introduction to Water Science

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
Collat	eral R	equirement7-8 hrs
CSC	101 <sup>3</sup>	Introduction to Problem Solving Using Computers
	or	
CSC		Introduction to Information Technology
MAT	150 <sup>2</sup> or	Algebra and Trigonometry (or above)
STA		Introduction to Probability and Statistics (or above)
Unres	tricte	d Electives
<sup>1</sup> Wil and the <sup>2</sup> Wil	l count e Worl I coun	ulum Requirements
	s is a l	University Studies electives writing-intensive or technology-in-
ANT 1 elective and 39 follow	40, AN es. Ele 95. Ele ing as	gy Minor
ARC 1	50, 30	y Minor
EES 10 the fo	)1, 102 Ilowin	<b>21 hrs</b> 2, 125, and 339 or 350. Six additional hours selected from ag: AST 115, 116; EES 202, 210, 303, 310, 312, 336, 591, x hours must be upper-level courses.
EES 10 the ac	)1, 102 Ivice a	ntal Geology Minor
EES 11 the fo	l0, 12 llowir	Information Science Minor
Open ics, his social hours discipl	only t story, studie of up lines v	o majors in earth and environmental sciences, economor political science who seek secondary certification in es. ECO 231, EES 110, HIS 221, POL 140, SOC 133; and six per level courses (300 or above) from the social science with approval of advisor. Courses required for a major counted toward the minor: substitutions must be from

a social science discipline other than the major and be approved by

the advisor; and requirements for certification for teaching second-

ary school social studies, grades 8 through 12 through the College of Education and Human Services must also be met. Six hours must be upper-level courses.

#### CERTIFICATE:

## **Geographic Information Science**

CIP 45.0702

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

Total Course I	Requirements	•••••	• • • • • • • • • • • • • • • • • • • •	15 hours

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

<sup>1</sup>A grade of *C* or better must be earned in all courses.

## **Graduate Program**

#### Graduate Coordinator - Haluk Cetin

The Department of Earth and Environmental Sciences offers a Master of Science degree in Earth and Environmental Sciences. Students choose the thesis or the non-thesis option. Four concentrations are offered for the thesis option: environmental geology, geoarchaeology, geoinformatics, and watershed science. Each student's program is developed in consultation with the graduate coordinator.

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

The **Archaeology Concentration** is an interdisciplinary master's degree program designed to prepare students for further graduate studies or careers in the public or private sector. The archaeology concentration offers students a broad range of options to develop a curriculum that matches their particular interests and needs. The archaeology concentration emphasizes the relationship between human culture and the natural environment and provides opportunities to apply the principles and methods of archaeology to reconstruct the past to better understand our cultural heritage.

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

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

Earth and Environmental Sciences is closely associated with the Mapping Applications and Resources Center (MARC) where hardware and software related to remote sensing and geographic information science are located. Students also have the opportunity to conduct research through activities of the department's Archaeology Laboratory.

#### **Requirements for Admission**

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

#### Unconditional

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

#### Conditional

Students admitted conditionally are admitted to full standing after completing (1) any remedial courses required by the graduate faculty and (2) one semester of graduate work with an overall grade point average of 3.0 or above.

## **Master of Science Earth and Environmental Sciences**

CIP 40.0699

### NON-THESIS REQUIREMENTS

Total	Cours	e Requirements30 hours
EES	612	Remote Sensing
EES	619	Seminar in Research Techniques <sup>PT</sup>

EES 621 Geographic Information Systems

EES 680 Advanced Geographic Information Systems

EES 696 Understanding Scientific Communication

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 Requirements30 hour				
EES	619	Seminar in Research Techniques <sup>PT</sup>		
FFC	C24	Communication Contains		

EES 621 Geographic Information Systems

EES 696 Understanding Scientific Communication

EES 698 Thesis Research<sup>L, R</sup> EES 699 Thesis Research<sup>L, R</sup>

## Environmental Geology Restricted Electives ...... 15 hours

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

BIO 686 Limnology

CHE 665 Biogeochemistry

EES 616 Isotope Geochemistry

EES 633 Paleoecology

EES 642 Watershed Ecology

EES 680 Advanced Geographic Information Systems

#### *Eight to nine hours from the following:*

ARC 615 Environmental Archaeology

BIO 623 Physiological Ecology

BIO 625 Biogeography

BIO 632 Quantitative Ecology

BIO 646 Stream Ecology

BIO 678 Conservation Biology

BIO 690 Disturbance Ecology

CET 655 Environmental Regulatory Affairs

CET 681 Pollution Assessment and Control

CHE 613 Environmental Chemistry

EES 636 Soils and Geomorphology

EES 662 Hydrogeology

EES 665 Physical/Chemical Limnology

EES 691 Special Problems

EES 692 Special Problems EES 693 Special Problems

MAT 665 Applied Statistics I

WSC 601 Seminar in Sustainability Studies

### **Other Degree Requirements**

Defense of thesis.

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

# 

ARC 600 Graduate Seminar in Archaeology

EES 619 Seminar in Research Techniques<sup>PT</sup>

EES 621 Geographic Information Systems

EES 696 Understanding Scientific Communication

EES 698 Thesis Research<sup>L, R</sup>

EES 699 Thesis Research<sup>L, R</sup>

## Geoarchaeology Restricted Electives ...... 12 hours

Choose one course from the following:

ARC 602 Graduate Archaeological Field Work

EES 636 Soils and Geomorphology

ES 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	BIO	646	Stream Ecology
EES	680	Advanced Geographic Information Systems	BIO	661	Freshwater Invertebrates
EES	691	Special Problems	BIO	663	Aquatic Entomology
EES	692	Special Problems	BIO	668	Wetland Ecology
EES	693	Special Problems	BIO	669	Biological Limnology
MAT	665	Applied Statistics I	BIO	670	Limnological Analysis Laboratory
WSC	601	Seminar in Sustainability Studies	BIO	671	Ichthyology
			BIO	672	Herpetology
Othe	r Degr	ee Requirements	BIO	678	Conservation Biology
D	efense	of thesis.	BIO	682	Waterfowl Management
			BIO	683	Fisheries Management
		fortune realization and fortune delications of	BIO		Limnology
		f Science Earth and Environmental Sciences/	BIO	687	Freshwater Biology
Geo	infor	matics Concentration CIP 40.0699	BIO	688	Reservoir Ecology
			BIO	690	Disturbance Ecology
Total	Cours	e Requirements30 hours	CET	655	Environmental Regulatory Affairs
EES	619	Seminar in Research Techniques <sup>PT</sup>	CET		Pollution Assessment and Control
EES	621	Geographic Information Systems	CET	685	Remediation Technology
EES	696	Understanding Scientific Communication	CHE		Environmental Chemistry
EES	698	Thesis Research <sup>L, R</sup>	CHE		Advanced Organic Chemistry
EES	699	Thesis Research <sup>L, R</sup>	CHE	627	Chemical Separations
			CHE	628	Mass Spectrometry
Requ	ired C	oncentration Courses 10 hours	CHE	665	Biogeochemistry
EES	612	Remote Sensing	EES		Isotope Geochemistry
EES	640	Advanced Remote Sensing	EES	636	Soils and Geomorphology
EES	680	Advanced Geographic Information Systems	EES		Advanced Remote Sensing
			EES		Digital Image Processing Research
Geoi	nform	atics Restricted Electives 5 hours	EES		Soil Micromorphology
Choo	se froi	m the following:	EES		Hydrogeology
CIS	609	Data Warehouses and Business Intelligence	EES		Physical/Chemical Limnology
CIS	615	Information System Security	EES		Terrestrial Ecosystem Modeling
EES	622	Advanced Cartography	EES		Remote Sensing of Vegetation
EES	641	Digital Image Processing Research	EES		Advanced Geographic Information Systems
EES	656	Geophysical Surveying			, , , , , , , , , , , , , , , , , , ,
EES	660	Spatial Analysis Techniques	Othe	r Degr	ee Requirements
EES		Precision GIS/GPS Applications		_	ful completion of MAT 665 Applied Statistics Lif substituted
EES		Terrestrial Ecosystem Modeling		ES 619	
EES		Remote Sensing of Vegetation			and oral comprehensive examinations as specified by the
EES		Special Problems			mmittee in broad aspects of watershed science and area
EES		Special Problems			ration (usually taken in third semester of residence).
EES		Special Problems			e of thesis.

### **Other Degree Requirements**

MAT 665 Applied Statistics I

Defense of thesis.

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

## 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

Thesis Research<sup>L, R</sup>

BIO 625 Biogeography

**EES** 

699

BIO 630 Animal Ecology

BIO 631 Plant Ecology

BIO 632 Quantitative Ecology

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

#### Total Course Requirements......14 hours

- EES 612 Remote Sensing
- EES 621 Geographic Information Systems
- EES 693 Special Problems

#### Required Limited Electives......3 hours

Choose from the following approved electives:

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

#### Institute of Engineering

263A Collins Center 270-809-3392

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

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

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

Murray State's Engineering Physics degree is an engineering program accredited by the Engineering Accreditation Commission of ABET (EAC/ABET). This accreditation will place a student on the pathway to become a licensed engineer in Kentucky and through-

out the country. Recognition by this organization has been earned by 22 Engineering Physics programs nationwide.

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

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

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

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

#### **Engineering Accreditation**

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

#### **Engineering Technology Accreditation**

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

## AREA:

#### Engineering Physics<sup>1</sup>

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<sup>2</sup>

MAT 250 Calculus and Analytic Geometry I<sup>2</sup>

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<sup>2</sup> 236 Mechanics, Heat and Wave Motion Laboratory Core Courses ...... 50 hrs 100T Transitions **FGR** 101 Introduction to Engineering Introduction to Computing Applications in Science **EGR** and Engineering EGR 240 Thermodynamics I EGR 259 **Statics** EGR 264 Linear Circuits I EGR 330 **Dynamics** EGR 363 Signals and Systems EGR 375 Materials Science EGR 390 **Engineering Measurements** EGR 460 Electricity and Magnetism I 498 Senior Engineering Design I **EGR** 499 Senior Engineering Design II **EGR** 309 Calculus and Analytic Geometry III<sup>2</sup> MAT 338 Ordinary Differential Equations<sup>2</sup> MAT

## Technical Electives<sup>3</sup>......24 hrs

Electricity, Magnetism and Light Laboratory

Electricity, Magnetism and Light

370 Introduction to Modern Physics

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

PHY

PHY

PHY

PHY

255

256

470 Optics

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

TD 102 CAD Applications

Any aerospace engineering track course

Completion of at least 24 hours is required in this track (18 hours must be EGR prefix courses). Remaining nine hours of electives must be advisor approved.

## Mathematics Depth Elective<sup>4</sup>......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

<sup>1</sup>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.

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

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

<sup>4</sup>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	MAJOR: Physics/Secondary Certification (Grades 8-12) Bachelor of Science/Bachelor of Arts CIP 40.0801				
EGR 140 Introduction to Computing Applications in Science and Engineering	NOTE: Requirements for teacher certification are established by the Kentucky				
MAT 250 Calculus and Analytic Geometry I			ofessional Standards Board. Students are cautioned that change.		
MAT 308 Calculus and Analytic Geometry II			uirements may occur. For current information, student should		
MAT 309 Calculus and Analytic Geometry III			n advisor in the Department of Adolescent, Career and Specia nd with Teacher Education Services.		
MAT 338 Ordinary Differential Equations	Euucu	tion ar	id with reacher Education Services.		
PHY 235 Mechanics, Heat and Wave Motion	Unive	ersity	Studies Requirements38-44 hrs		
PHY 236 Mechanics, Heat and Wave Motion Laboratory			mic Degrees and Programs.)		
PHY 255 Electricity, Magnetism and Light	(300)	TCUUC	mie Degrees and Programs.		
PHY 256 Electricity, Magnetism and Light Laboratory	Unive	rsity	Studies selections must include:		
University Studies courses			I Self-Awareness and Responsible Citizenship		
Discipline-specific courses			Psychology of Human Development		
•			cation requires a grade of B or better in one English composition		
			B or better in a University Studies math course, public speaking		
MAJOR:			or equivalent course. Additional requirements for admission to		
Physics	teach	er edu	cation and student teaching must be met. See advisor and/or		
Bachelor of Science/Bachelor of Arts CIP 40.0801	Office	of Tea	cher Education Services for details.		
University Studies Requirements38-44 hrs	Reau	ired C	ourses32 hrs		
(See Academic Degrees and Programs.)			Introduction to Computing Applications in Science		
Note: See required courses below before selecting Scientific Inquiry, Meth-			and Engineering		
odologies, and Quantitative Skills University Studies electives.	EGR	240	Thermodynamics I		
	EGR		Engineering Measurements		
Required Courses 32 hrs	PHY		Transitions		
EGR 140 Introduction to Computing Applications in Science	PHY		Mechanics, Heat and Wave Motion		
and Engineering	PHY		Mechanics, Heat and Wave Motion Laboratory		
EGR 240 Thermodynamics I	PHY		Electricity, Magnetism and Light		
EGR 390 Engineering Measurements	PHY		Electricity, Magnetism and Light Laboratory		
PHY 100T Transitions	PHY		Electricity and Magnetism I		
PHY 235 Mechanics, Heat and Wave Motion	PHY		Optics		
PHY 236 Mechanics, Heat and Wave Motion Laboratory	PHY		Mechanics I		
PHY 255 Electricity, Magnetism and Light	PHY		Modern Physics I		
PHY 256 Electricity, Magnetism and Light Laboratory	FIII	360	Widdefff Fffysics i		
PHY 460 Electricity and Magnetism I	Co-re	auiro	ments for Major 6 hrs		
PHY 470 Optics			General College Chemistry <sup>1, 2</sup>		
PHY 530 Mechanics I			General Chemistry and Qualitative Analysis <sup>1, 2</sup>		
PHY 580 Modern Physics I	CSC		Numerical Analysis I		
, , , , , , , , , , , , , , , , , , ,	CSC	or	Numerical Analysis i		
Co-requirements for Major 6 hrs	MAT		Introduction to Numerical Analysis <sup>2</sup>		
CHE 201 General College Chemistry <sup>1, 2</sup>	MAT		Calculus and Analytic Geometry I <sup>1, 2</sup>		
CHE 202 General Chemistry and Qualitative Analysis <sup>1, 2</sup>	MAT		Calculus and Analytic Geometry II <sup>1, 2</sup>		
CSC 420 Numerical Analysis I	MAT		Calculus and Analytic Geometry III <sup>1, 2</sup>		
or	MAT		Ordinary Differential Equations <sup>2</sup>		
MAT 442 Introduction to Numerical Analysis <sup>2</sup>		-	,		
MAT 250 Calculus and Analytic Geometry I <sup>1, 2</sup>	Requ	ired L	imited Electives 3 hrs		
MAT 308 Calculus and Analytic Geometry II <sup>1, 2</sup>			purses numbered 300-level or above.		
MAT 309 Calculus and Analytic Geometry III <sup>1, 2</sup>	, -				
MAT 338 Ordinary Differential Equations <sup>2</sup>	Requ	ired f	or Secondary Certification35 hrs		
	EDU	103	Issues and Practices of American Education <sup>3</sup>		
Required Limited Electives 3 hrs	EDU	303	Strategies of Teaching		
PHY/EGR courses numbered 300 or above.	EDU	403	Structures and Foundations of Education		
	EDU	405	Evaluation and Measurement in Education <sup>4</sup>		
Required Minor3-21 hrs <sup>2</sup>	REA	427	Teaching Content Area Literacy in the		
			Secondary School		
Unrestricted Electives 14-20 hrs	SEC	420	Practicum in Secondary Schools <sup>4</sup>		
	SEC	421			
Total Curriculum Requirements 120 hrs	SEC	422	Extended Practicum <sup>5</sup>		
<sup>1</sup> Fulfill University Studies requirements. Required for major if not taken as	SED	300	Educating Students with Disabilities		
a University Studies requirement.			-		
<sup>2</sup> 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.	Requ	ired N	/linor 3-21 hrs		

308, 309, 338, and 442 fulfill requirements for a minor in math.

#### Total Curriculum Requirements ...... 120-123 hrs

<sup>1</sup>Fulfill University Studies requirements. Required for major if not taken as a University Studies requirement.

<sup>2</sup>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.

<sup>3</sup>With a grade of *B* or better.

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

5Must be taken one semester before student teaching.

#### **Physics Teaching Specialization**

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

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

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

AST	115	Introductory Astronomy
AST	116	Introductory Astronomy Laboratory
MAT	250	Calculus and Analytic Geometry I <sup>1</sup>
MAT	308	Calculus and Analytic Geometry II <sup>2</sup>
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

<sup>1</sup>Corequisite of PHY 235. <sup>2</sup>Corequisite of PHY 255.

#### AREA:

#### **Applied Physics**

Bachelor of Science/Bachelor of Arts

#### 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
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EGR	140	introduction to Computing Applications in Science	
		and Engineering	
EGR	240	Thermodynamics I	
ECD.	264	Lincon Cinquita I	

EGR 264 Linear Circuits I

PHY 100T Transitions

PHY 235 Mechanics, Heat and Wave Motion

236 Mechanics, Heat and Wave Motion Laboratory PHY

PHY 255 Electricity, Magnetism and Light

Electricity, Magnetism and Light Laboratory PHY 256

370 Introduction to Modern Physics PHY

or

PHY 580 Modern Physics I

Electricity and Magnetism I 460 PHY

PHY 470 **Optics** 

PHY 530 Mechanics I

Co-requirements for Area 6 hrs					
	-	General College Chemistry <sup>1, 2</sup>			
CHE	202	General Chemistry and Qualitative Analysis <sup>1, 2</sup>			
CSC	420	Numerical Analysis I			

420 Numerical Analysis I

or

MAT 442 Introduction to Numerical Analysis<sup>2</sup> Calculus and Analytic Geometry I1,2 MAT 250

Calculus and Analytic Geometry II1,2 MAT 308 Calculus and Analytic Geometry III1, 2 MAT 309

338 Ordinary Differential Equations<sup>2</sup>

Technical Electives<sup>3</sup> .......24 hrs

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

### Total Curriculum Requirements ...... 120 hrs

<sup>1</sup>Fulfill University Studies requirements. Required for area if not taken as a University Studies requirement.

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

<sup>3</sup>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 admis-

# sion 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** 

330 Principles of Finance FIN

MGT 350 Fundamentals of Management

MKT 360 Principles of Marketing

Unrestricted Electives ...... 6 hrs

#### Astronomy Minor ...... 21 hrs

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

## Physics Minor ...... 22 hrs

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

#### **Engineering Technology Accreditation**

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

#### **Professional Licensure**

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

#### **Engineering Technology**

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

#### **Civil Engineering Technology**

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

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

#### **Architectural Engineering Technology**

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

## **Construction Engineering Technology**

A baccalaureate degree in construction engineering technology provides students with experience in construction, estimating, project management, scheduling, surveying, building structures, construction materials, and engineering mechanics. The curriculum stresses the

application of technical knowledge, construction methods, problemsolving ability, and communication skills toward the completion of large-scale construction projects. Career opportunities for the construction-engineering technologist are as diverse as the industry. Potential employers include construction companies, general contractors, subcontractors, construction equipment and materials suppliers, testing laboratories, governments, industrial companies, and utilities.

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

#### **Environmental Engineering Technology**

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

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

#### **Electromechanical Engineering Technology**

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

The electromechanical engineering technologist is a blend of mechanical and electrical engineering technology, computer science, information technology, and control systems. Graduates have broad application backgrounds in automation, electronics, data acquisition, controls, programming, and mechanical and electrical science principles. This allows students to understand the design and operation of systems found in the plant environment.

#### **Manufacturing Engineering Technology**

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

	_	neering Technology Science	CIP 15.0201	IOE IOE		Professional Development Seminar I Cooperative Education/Internship	
				ITD		Introduction to Technical Drawing and	
		Studies Requirements mic Degrees and Programs.)	23 hrs			Computer-Aided Drafting	
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Unive	ersity S	Studies selections must include:		CET		Strength of Materials	
		Inquiry, Methodologies, and Quantitativ	e Skills	CET		Route Surveying	
		General Physics I		CET	410	Transportation Systems and Design	
PHY	131	General Physics I Laboratory		CET		Structural Steel Design	
Reau	ired C	ourses	32 hrs	CET		Reinforced Concrete Design	
CET		Plane Surveying	32 1113	CET		Construction Materials	
CET		Sustainable Design and Construction		CET		Soil Mechanics and Foundations	
CET		Construction Estimating I		ENT	286	Introduction to Environmental Engineering Techn	lolog
		Technical Writing		Emnh	acic	9-1	I1 hr
ENT		Transitions				area of emphasis below:	
ENT ENT		Statics for Technology Mechanical and Electrical Systems		Civil	0	area of emphasis serom	
ITD		Introduction to Technical Drawing and		EES	202	Introduction to Geographic Information Science	
		Computer-Aided Drafting		EES		Land Use Planning	
		,		ITD	301	Architectural Design Studio I	
		ourses	13 hrs				
EES		The Earth and the Environment		Const			
		Technical Math I General Physics II		CET		Construction Estimating II	
		General Physics II Laboratory		CET ITD		Construction Scheduling and Methods Architectural Design Studio I	
	133	General mysics in Euspiratory		ווט	301	Architectural Design Studio i	
Total	Curri	culum Requirements	62 hrs	Enviro	onme	ntal	
				CET		Water Quality Technology I	
				CET		Water Quality Technology II	
ARE	Α:			CET	585	Remediation Technology	
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IOE 125 Analytical Methods in Engineering Technology IOE 399 Professional Development Seminar I IOE 488 Cooperative Education/Internship ITD 107 Introduction to Technical Drawing and Computer-Aided Drafting  Track Courses	CET 386 Construction Estimating II CET 481 Structural Steel Design CET 482 Reinforced Concrete Design CET 483 Construction Materials CET 484 Soil Mechanics and Foundations CET 490 Construction Scheduling and Methods MGT 350 Fundamentals of Management OSH 384 Construction Safety  Total Curriculum Requirements
Total Curriculum Requirements	(See Academic Degrees and Programs.)
AREA: Civil Engineering Technology/ Construction Engineering Technology Track Bachelor of Science CIP 15.0201  This track is ACCREDITED BY: Engineering Technology Accreditation Commission of ABET, http://www.abet.org	University Studies 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
University Studies Requirements44 hrs	ECO 230 Principles of Macroeconomics • University Studies Electives
(See Academic Degrees and Programs.)	EES 101 The Earth and the Environment
University Studies selections must include:	MAT 230 Technical Math II
•Scientific Inquiry, Methodologies, and Quantitative Skills	Core Courses41 hrs
MAT 130 Technical Math I PHY 130 General Physics I	CET 280 Plane Surveying
PHY 131 General Physics I Laboratory	CET 284 Sustainable Design and Construction
PHY 132 General Physics II	CET 385 Construction Estimating I
PHY 133 General Physics II Laboratory	CET 480 Construction Planning and Management
<ul> <li>Social and Self-Awareness and Responsible Citizenship</li> </ul>	ENG 324 Technical Writing
ECO 230 Principles of Macroeconomics	ENT 100T Transitions
• University Studies Electives	ENT 287 Statics for Technology ENT 358 Mechanical and Electrical Systems
EES 101 The Earth and the Environment	ENT 382 Hydraulics
MAT 230 Technical Math II	ENT 393 Engineering Economy
Core Courses	ENT 419 Senior Project
CET 280 Plane Surveying	IOE 125 Analytical Methods in Engineering Technology
CET 284 Sustainable Design and Construction	IOE 399 Professional Development Seminar I
CET 385 Construction Estimating I	IOE 488 Cooperative Education/Internship
CET 480 Construction Planning and Management	ITD 107 Introduction to Technical Drawing and
ENG 324 Technical Writing ENT 100T Transitions	Computer-Aided Drafting
ENT 287 Statics for Technology	Track Courses
ENT 358 Mechanical and Electrical Systems	CET 330 Water Quality Technology I
ENT 382 Hydraulics	CET 331 Water Quality Technology II
ENT 393 Engineering Economy	CET 342 Air Quality Technology
ENT 419 Senior Project	CET 353 Solid and Hazardous Waste Management
IOE 125 Analytical Methods in Engineering Technology	CET 555 Environmental Regulatory Affairs
IOE 399 Professional Development Seminar I	CET 585 Remediation Technology
IOE 488 Cooperative Education/Internship ITD 107 Introduction to Technical Drawing and	CHE 111 Essentials of Chemistry and Biochemistry
ITD 107 Introduction to Technical Drawing and Computer-Aided Drafting	ENT 286 Introduction to Environmental Engineering Technology
Computer-Alucu Draiting	ENT 400 Energy Management EES 202 Introduction to Geographic Information Science
Track Courses	STA 135 Probability and Statistics
	SIA TOO FIONANIILY AIIU SLALISLICS
ACC 200 Principles of Financial Accounting	'
ACC 200 Principles of Financial Accounting CET 298 Strength of Materials	Total Curriculum Requirements 122 hrs

AREA: Civil Engineering Technology/	PHY 131 General Physics I Laboratory
	STA 135 Introduction to Probability and Statistics
Surveying Engineering Technology Track Bachelor of Science CIP 15.0201	<ul> <li>Social and Self-Awareness and Responsible Citizenship</li> </ul>
Bacheloi di Science Cir 13.0201	ECO 230 Principles of Macroeconomics
University Studies Requirements	or
(See Academic Degrees and Programs.)	ECO 231 Principles of Microeconomics
(See reductine Begrees and trog, arms.)	<ul> <li>University Studies Electives</li> </ul>
University Studies selections must include:	MAT 230 Technical Math II
•Scientific Inquiry, Methodologies, and Quantitative Skills	PHY 132 General Physics II
MAT 130 Technical Math I	and
PHY 130 General Physics I	PHY 133 General Physics II Laboratory
PHY 131 General Physics I Laboratory	Comp Common
PHY 132 General Physics II	Core Courses
PHY 133 General Physics II Laboratory	EMT 110 Electrical Systems I
Social and Self-Awareness and Responsible Citizenship	EMT 210 Electrical Systems II
ECO 230 Principles of Macroeconomics	EMT 201 Engineering Technology Simulation EMT 202 Engineering Technology Analysis
University Studies Electives	EMT 261 Introduction to Fluid Power Systems
EES 101 The Earth and the Environment	EMT 262 Introduction to Fluid Power Systems  EMT 262 Introduction to Fluid Power Systems Laboratory
MAT 230 Technical Math II	EMT 305 Electrical Machinery and Controls
	EMT 310 Programmable Logic Controllers
Core Courses41 hrs	EMT 312 Industrial Instrumentation
CET 280 Plane Surveying	EMT 320 Mechatronics
CET 284 Sustainable Design and Construction	EMT 351 Industrial and Commercial Power Distribution
CET 385 Construction Estimating I	EMT 365 Dynamics for Technology
CET 480 Construction Planning and Management	EMT 455 Manufacturing Control Systems
ENG 324 Technical Writing	EMT 461 Motion Controls
ENT 100T Transitions	ENG 324 Technical Writing
ENT 287 Statics for Technology	ENT 100T Transitions
ENT 358 Mechanical and Electrical Systems	ENT 287 Statics for Technology
ENT 382 Hydraulics	ENT 393 Engineering Economy
ENT 393 Engineering Economy	ENT 419 Senior Project I
ENT 419 Senior Project	IOE 399 Professional Develop Seminar I
IOE 125 Analytical Methods in Engineering Technology	IOE 488 Cooperative Education/Internship
IOE 399 Professional Development Seminar I	ITD 102 CAD Applications
IOE 488 Cooperative Education/Internship	TSM 301 Physical Network Theory
ITD 107 Introduction to Technical Drawing and	
Computer-Aided Drafting	Technical Electives7 hrs
Track Courses	
CET 370 Route Surveying	Total Curriculum Requirements 120 hrs
CET 381 Boundary Surveying I	<sup>1</sup> A minimum grade of <i>C</i> is required in all EMT, ENT, and TSM prefix
CET 410 Transportation Systems and Design	courses.
CET 460 Geodesy	
CET 486 Boundary Surveying II	AREA:
CSC 202 Introduction to Geographic Information Science	Manufacturing Engineering Technology
EES 521 Geographic Information Systems	Bachelor of Science CIP 15.0613
PHI 202 Ethics	
Technical Electives (5 hrs)	University Studies Requirements
. ,	(See Academic Degrees and Programs.)
Total Curriculum Requirements 120 hrs	
	University Studies selections must include:
	<ul> <li>Scientific Inquiry, Methodologies, and Quantitative Skills</li> </ul>
AREA:	MAT 130 Technical Math I
Electromechanical Engineering Technology	PHY 130 General Physics I
Bachelor of Science CIP 15.0403	PHY 131 General Physics I Laboratory
	STA 135 Introduction to Probability and Statistics
University Studies Requirements 43-47 hrs	Social and Self-Awareness and Responsible Citizenship
(See Academic Degrees and Programs.)	ECO 230 Principles of Macroeconomics
	or
University Studies selections must include:	ECO 231 Principles of Microeconomics
• Scientific Inquiry, Methodologies, and Quantitative Skills	University Studies Electives     CSC 199 Introduction to Information Technology
MAT 130 Technical Math I or	CSC 199 Introduction to Information Technology MAT 230 Technical Math II
O1	=55 (COMMON WINGTON

PHY 130 General Physics I

and

	Courses 64 hrs	Core Co	urses 78 hrs
EMT	110 Electrical Systems I	CET 2	98 Strength of Materials
	261 Introduction to Fluid Power Systems	ENG 3	24 Technical Writing
EMT	262 Introduction to Fluid Power Systems Laboratory		87 Statics for Technology
EMT	310 Programmable Logic Controllers		50 Technology Management
EMT	312 Industrial Instrumentation		99 Professional Development Seminar I
EMT	351 Power Distribution		88 Cooperative Education/Internship
ENG	324 Technical Writing		87 Quality Control
ENT	100T Transitions		00T Transitions
ENT	393 Engineering Economy		01 Introduction to Design and Graphic Communications
IOE	350 Technology Management		04 Computer Aided Design
IOE	399 Professional Development Seminar I		30 Manufacturing Processes and Materials
IOE	488 Cooperative Education/Internship		04 Parametric Modeling and Rendering
ITD	102 CAD Applications		02 Applied Technical Drawing
ITD	130 Manufacturing Processes and Materials		03 Advanced Parametric Modeling
ITD	204 Parametric Modeling and Rendering		06 Engineering Graphics 30 Machine Tool Processes
ITD	330 Machine Tool Processes		33 ANSI Fundamentals for Mechanical Product Design
MET	310 Manufacturing Analysis		03 Product and Tooling Design
MET	320 Control Systems		04 Computer-Aided Engineering Design Graphics
MET	400 Lean Manufacturing Systems		98 Senior Design
	410 Sustainable Management		30 Technical Math I
MET	. , 6	1417.11	50 Teamical Water F
MET	450 Systems Project Management	Technic	al Electives 8 hrs
Techr	nical Electives	Total Cu	rriculum Requirements 120 hrs
Total	Curriculum Requirements		
	and the Constitution of Bartan		rial Technology
	neering Graphics and Design	Associate	e of Science CIP 15.0612
	baccalaureate degree in engineering graphics and design pro-		
	students with the fundamentals of design principles, computer	Univers	ity Studies Requirements22 hrs
	design, and commercial/industrial design standards. Graduates	(See Acc	ademic Degrees and Programs.)
	e prepared to work with engineers and architects in designing,		
	ructing and manufacturing in modern industrial and architec- corporations.		ity Studies selections must also include:
	corporations.		
110	is broad based program emphasizes computer sided design		fic Inquiry, Methodologies, and Quantitative Skills
	is broad based program emphasizes computer aided design,	MAT 1	fic Inquiry, Methodologies, and Quantitative Skills 30 Technical Math I
and c	design graphics including: mechanical engineering drawings,	MAT 1 PHY 1	fic Inquiry, Methodologies, and Quantitative Skills 30 Technical Math I 30 General Physics I
and c	design graphics including: mechanical engineering drawings, erings, technical animations and 3D parametric design. Applied	MAT 1 PHY 1 PHY 1	Fic Inquiry, Methodologies, and Quantitative Skills  Technical Math I  General Physics I  General Physics I Laboratory
and or render engin	design graphics including: mechanical engineering drawings, erings, technical animations and 3D parametric design. Applied eering and engineering design/CAD are typical job descriptors	MAT 1 PHY 1 PHY 1 •Social	ific Inquiry, Methodologies, and Quantitative Skills Technical Math I General Physics I General Physics I Laboratory and Self-Awareness and Responsible Citizenship
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courses at 300-level or above.

#### **Graduate Program**

#### Graduate Coordinator - Michael Kemp

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

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

#### **Requirements for Admission**

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

#### Unconditional

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

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

## Conditional

Students denied unconditional admission to the M.S. in Applied Engineering and Technology Management, but who meet University requirements for conditional admission, may petition for conditional admission. Conditional admission is usually reserved for applicants whose previous education and/or experience is evaluated by the department chair to indicate a likelihood of success. Students applying for conditional admission must have a GPA of 2.25 to 2.74. A student accepted conditionally will be expected to complete nine hours of prescribed work with a minimum 3.0/4.0 GPA. These initial nine hours are assigned by the advisor and may be in addition to the student's program of study. After completion of these nine hours the Departmental Graduate Committee will evaluate the student's progress. The first nine hours may include undergraduate or graduate courses as directed by the department. Depending on the student's undergraduate preparation, undergraduate courses may be required before enrolling in any graduate courses. Graduate courses may be allowed concurrently with these undergraduate courses in special situations.

#### **Language Proficiency**

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

# Master of Science Applied Engineering and Technology Management

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

#### Total Course Requirements......30 hours1

CET 682 Industrial Environmental Management

IOE 684 Engineering Economic Analysis

IOE 691 Industrial Operations<sup>L</sup>

IOE 693 Systems Management Technology

IOE 695 Industrial SupervisionPT

IOE 697 Research in Industrial and Engineering Technology<sup>R,1</sup>

#### Electives ...... 12 hrs

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

#### **Other Degree Requirements**

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

<sup>1</sup>A basic statistics course or equivalent is required prior to enrolling in IOE 697.

#### **Telecommunications Systems Management**

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

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

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

#### **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 135 Introduction to Probability and Statistics Social and Self-Awareness and Responsible Citizenship ECO 231 Principles of Microeconomics •University Studies Electives 101 Introduction to Problem Solving Using Computers 199 Introduction to Information Technology Required Courses ...... 58 hrs 200 Principles of Financial Accounting CIS **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** IOF 399 Professional Development Seminar I MKT 360 Principles of Marketing TSM 100T Transitions 134 Introduction to Telecommunications Systems Management TSM 232 Operating Systems TSM 233 Network Services TSM 241 Networking Fundamentals TSM 301 Physical Network Theory Introduction to Wireless Technology TSM 320 TSM 343 Protocol Analysis **Principles of Information Security** TSM 351 Network Design, Operations and Management TSM 411 TSM 443 Telephone Technology Cooperative Education/Internship<sup>1</sup> TSM 488 Choose **one** of the methods of completion below: 1) Select 21 hours from any of the classes listed below or 2) Select two emphasis areas and complete at least 21 hours Note: When selecting courses for an area of emphasis or as an elective, a maximum of nine hours may be selected from courses with a business prefix including: MGT or MKT. Adherence to course prerequisites is critical. **Wireless Communications Electronics** TSM 321 Wireless Communications Wireless Communications II 322 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**

310 Database Administration Scripting Languages

Telecommunications Policy and Management TSM 450

TSM 517 Systems Planning

#### **Approved Electives**

370 Introduction to Artificial Intelligence

**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

<sup>1</sup>Maximum of three hours Internship or Cooperative Education counts toward a degree.

#### Telecommunications Systems Management Minor ...... 22 hrs

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

#### **Graduate Program**

Graduate Coordinator - Michael Bowman 270-809-6218

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

#### **Requirements for Admission**

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

#### Unconditional

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

**GMAT Users:**  $(200 \times UGPA) + GMAT \ge 1,000$ 

**GRE Users:** GRE  $\geq$  321 - (11.66 x GPA - (Combined quantita-

tive 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.

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

1) The applicant takes TSM 601, TSM 610, and one other core

course (ACC 604, TSM 602, TSM 603, TSM 607, TSM 610, or TSM 630) as their first nine hours of the program and earns a GPA not less than 3.33 from the three core courses; or

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

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

#### **International Admission**

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

- 1) 79
- 2) Minimum of 16 in each band

or International English Language Testing System (IELTS) exam and score 6.5 on the academic test (with no band <6.0) to be fully admitted into the program.

#### Master of Science

**Telecommunications Systems Management** CIP 11.0401

#### **NON-THESIS REQUIREMENTS ONLY**

Total	Cours	e Requirements30 hours		
ACC	604	Quantitative Financial Controls		
TSM	601	Telecommunications Principles		
TSM	602	Telecommunications Systems		
TSM	603	Telecommunications Project Management		
TSM	607	Advanced Telecommunications Project Management		
TSM	610	Telecommunication Networks Management		
TSM	630	Telecommunications Legal Environment: Law, Policy		
		and Regulations		
TSM	680	Telecommunications Solution Development		
Electives (6 hrs)				

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

# Department of Mathematics and Statistics

6C9 Faculty Hall 270-809-2311

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

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

The department offers a major in mathematics, an area in mathematics with secondary certification, a major in mathematics with

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

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

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

## MAJOR:

#### **Mathematics**

Bachelor of Science/Bachelor of Arts CIP 27.0101

University Studies Requirements ...... 38-44 hrs

(See Academic Degrees and Programs.)

MAT 100T Transitions

MAT 250 Calculus and Analytic Geometry I<sup>1</sup>

MAT 308 Calculus and Analytic Geometry II<sup>1</sup>

MAT 309 Calculus and Analytic Geometry III<sup>1</sup>

MAT 312 Mathematical Reasoning<sup>2</sup>

MAT 335 Matrix Theory and Linear Algebra

STA 540 Mathematical Statistics I<sup>3</sup>

## 

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

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- <sup>1</sup>May be taken as a University Studies elective.
- <sup>2</sup>This is a University Studies writing intensive course.
- <sup>3</sup>This is a University Studies technology intensive course.

ADEA	Unrestricted Electives0-3 hrs
AREA: Mathematics/Secondary Certification (Grades 8-12) Track	
Bachelor of Science/Bachelor of Arts  CIP 27.0101	Total Curriculum Requirements
	<sup>1</sup> With a grade of <i>B</i> or better. <sup>2</sup> Must be taken together and two semesters before student teaching.
University Studies Requirements43-44 hrs	<sup>3</sup> Must be taken one semester before student teaching.
(See Academic Degrees and Programs.)	
University Studies selections must include:	MAJOR:
Scientific Inquiry, Methodologies, and Quantitative Skills	Mathematics/Secondary Certification (Grades 8-12) Track
MAT 250 Calculus and Analytic Geometry I	Bachelor of Science/Bachelor of Arts CIP 27.0101
MAT 308 Calculus and Analytic Geometry II	
Social and Self-Awareness and Responsible Citizenship      Convert Responsible Citizenship	University Studies Requirements
PSY 180 General Psychology • University Studies Electives	(See Academic Degrees and Programs.)
MAT 309 Calculus and Analytic Geometry III	University Studies selections must include:
<b>Note:</b> Certification requires a grade of <i>B</i> or better in one English composition	•Scientific Inquiry, Methodologies, and Quantitative Skills
course and a B or better in a University Studies math course, public speaking,	MAT 250 Calculus and Analytic Geometry I
and EDU 180 or equivalent course. Additional requirements for admission to	MAT 308 Calculus and Analytic Geometry II
teacher education and student teaching must be met. See advisor and/or	<ul> <li>Social and Self-Awareness and Responsible Citizenship</li> </ul>
Office of Teacher Education Services for details.	PSY 180 General Psychology
Required Courses20 hrs	University Studies Electives
MAT 100T Transitions	MAT 309 Calculus and Analytic Geometry III
MAT 312 Mathematical Reasoning	<b>Note:</b> Certification requires a grade of <i>B</i> or better in one English composition course and a <i>B</i> or better in a University Studies math course, public speaking,
MAT 335 Matrix Theory and Linear Algebra	and EDU 180 or equivalent course. Additional requirements for admission to
MAT 517 Foundations of Geometry	teacher education and student teaching must be met. See advisor and/or
MAT 550 Teaching Mathematics	Office of Teacher Education Services for details.
MAT 551 Mathematics for Teachers	
STA 540 Mathematical Statistics I	Required Courses
	MAT 100T Transitions
Required Limited Electives18-20 hrs	MAT 312 Mathematical Reasoning <sup>2</sup>
Three MAT courses (3- or 4-credit hour) selected from MAT 338 and	MAT 335 Matrix Theory and Linear Algebra MAT 517 Foundations of Geometry
MAT or STA courses numbered 400 or above including:	MAT 550 Teaching Mathematics
at least one of the following:	STA 540 Mathematical Statistics I <sup>3</sup>
MAT 513 Modern Algebra I	
MAT 516 Introduction to Topology MAT 525 Advanced Calculus I	Required Limited Electives9 hrs
and at least one of the following:	Three MAT courses (3- or 4-credit hour) selected from MAT 338 and
MAT 442 Introduction to Numerical Analysis	MAT or STA courses numbered 400 or above including:
MAT 506 Mathematical Modeling I	at least one of the following:
MAT 524 Boundary Value Problems	MAT 513 Modern Algebra I MAT 516 Introduction to Topology
STA 541 Mathematical Statistics II	MAT 525 Advanced Calculus I
An additional course (at least 3 credit hours) selected from MAT 338	and at least one of the following:
and MAT or STA courses numbered 400 or above.	MAT 442 Introduction to Numerical Analysis
and	MAT 506 Mathematical Modeling I
At least three (3- or 4-credit hour) courses selected from courses numbered 400 or above or from courses related to the application	MAT 524 Boundary Value Problems
of mathematics selected from a list approved by the Department of	STA 541 Mathematical Statistics II
Mathematics and Statistics.	
Widthermatics and Statistics.	Co-Requirement
Co-Requirement 3 hrs	One course in computer programming selected from: CSC 145, 232,
One course in computer programming selected from: CSC 145, 232,	235, or EGR 140.
235, or EGR 140.	Required Minor21 hrs
Required for Secondary Certification	Required for Secondary Certification
EDU 180 Exploring the Teaching Profession <sup>1</sup>	EDU 303 Strategies of Teaching
EDU 280 Educating for Human Development <sup>1</sup>	EDU 403 Structures and Foundations of Education
EDU 380 Inclusive Teaching of Diverse Learners <sup>1</sup>	EDU 405 Evaluation and Measurement in Education <sup>4</sup>
EDU 480 Effective Pedagogy <sup>1,2</sup>	REA 427 Teaching Content Area Literacy in the
EDU 485 Professional Perspectives for Teaching <sup>1,3</sup>	Secondary School
SEC 420 Practicum in Secondary Schools <sup>2</sup>	SEC 420 Practicum in Secondary Schools <sup>4</sup>
SEC 421 Student Teaching in the Secondary School	SEC 421 Student Teaching in the Secondary School
SEC 422 Extended Practicum <sup>3</sup>	SEC 422 Extended Practicum <sup>5</sup>
	SED 300 Educating Students with Disabilities

Total Curriculum Requirements 126-130 hrs	Required Courses39 hrs
<sup>1</sup> With a grade of <i>B</i> or better.	ACC 200 Principles of Financial Accounting
<sup>2</sup> This is a University Studies writing intensive course.	ACC 201 Principles of Managerial Accounting
<sup>3</sup> This is a University Studies technology intensive course.	BUS 355 Information Systems and Decision Making
<sup>4</sup> EDU 405 and SEC 420 must be taken together and two semesters before	CSC 199 Introduction to Information Technology <sup>1</sup>
student teaching. <sup>5</sup> Must be taken one semester before student teaching.	FIN 330 Principles of Finance
wast be taken one semester before student teaching.	LSC 343 Fundamentals of Operations and Technology
	MAT 100T Transitions
AREA:	MAT 312 Mathematical Reasoning <sup>2</sup>
Mathematics/Applied Mathematics Track	MAT 335 Matrix Theory and Linear Algebra
Bachelor of Science/Bachelor of Arts CIP 27.0101	MGT 350 Fundamentals of Management
	MKT 360 Principles of Marketing
University Studies Requirements	STA 540 Mathematical Statistics I <sup>3</sup>
(See Academic Degrees and Programs.)	STA 565 Applied Statistics I
Required Courses 31 hrs	Required Limited Electives
MAT 100T Transitions	Four (3- or 4-credit hour) courses selected from MAT 338 and MAT
MAT 250 Calculus and Analytic Geometry I <sup>1</sup>	courses numbered 400 or above.
MAT 308 Calculus and Analytic Geometry II <sup>1</sup>	
MAT 309 Calculus and Analytic Geometry III <sup>1</sup>	Co-Requirements3 hrs
MAT 312 Mathematical Reasoning <sup>2</sup>	One course in computer programming selected from: CSC 145, 232,
MAT 335 Matrix Theory and Linear Algebra	235, or EGR 140.
MAT 338 Ordinary Differential Equations	, -
MAT 442 Introduction to Numerical Analysis STA 540 Mathematical Statistics I <sup>3</sup>	Unrestricted Electives
STA 540 Mathematical Statistics I <sup>3</sup>	Total Curriculum Requirements
Required Limited Electives	<sup>1</sup> This is a University Studies technology intensive course.
A. Three (3- or 4-credit hour) courses selected from MAT courses numbered 400 or above.	<sup>2</sup> This is a University Studies writing intensive course. <sup>3</sup> Will be a University Studies technology intensive course.
B. Five or six courses related to the application of mathematics.	
Must total at least 18 hours and be approved by the advisory	Actuarial Science Minor21-22 hrs
committee. <sup>4</sup>	MAT 250, 308, 309, 543, STA 540. Students already taking MAT 250,
	308, 309, and STA 540 for another program may substitute these
Co-Requirements 6 hrs	courses with: ECO 230, 231, FIN 330, MAT 555, STA 565, 567. Six
Two courses in computer programming selected from a list approved	hours must be upper-level courses.
by the Department of Mathematics and Statistics.	
	Applied Statistics Minor
Unrestricted Electives11-18 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
Total Curriculum Requirements 120 hrs	taking MAT 250, 308, STA 540 for another program, the recommended
<sup>1</sup> May be taken as a University Studies elective.	coursework is: STA 135, 235, 541, 565, 567, 568, and one of MAT 555,
<sup>2</sup> This is a University Studies writing intensive course.	STA 566, 569. Six hours must be upper-level courses.
<sup>3</sup> This is a University Studies technology intensive course.	
<sup>4</sup> The program is very flexible. For example, an emphasis in either biology,	Mathematical Biology Minor21 hrs
chemistry, computer science, earth and environmental science, engineering	Students not in a mathematics program take one or two of STA 135,
physics, statistics and finance, or actuarial science.	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,
AREA:	330, 333, 532, 557 so that the total number of hours in the minor is
Mathematics/Pre-MBA Track	at least 21. Six hours must be upper-level courses.
Bachelor of Science/Bachelor of Arts CIP 27.0101	
Cit 27.0101	Mathematics Minor
University Studies Requirements	MAT 250, 308, 309 and nine hours of selected mathematics courses
(See Academic Degrees and Programs.)	numbered above 309 (except for MAT 330, 399 or STA 554). Depart-
(	mental approval required. Six hours must be upper-level courses.
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

#### **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

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

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

## Master of Arts **Mathematics**

CIP 27.0101

#### THESIS REQUIREMENTS

Total Course Requirements......30 hours1

MAT 725 Integration Theory

MAT or STA courses, 600- or 700-level (21 hrs) MAT 798-799 Research and Thesis (6 hrs)

#### Other Degree Requirements

Oral defense and examination of thesis.

#### **NON-THESIS REQUIREMENTS**

Total Degree Requirements ......30 hours1

MAT 725 Integration Theory and six hours chosen from MAT 716, 721, 722, 723 or 726 MAT or STA courses, 600- or 700-level (21 hrs)

#### **Other Degree Requirements**

Program of study must include MAT 614 or 721 and MAT 616 or 716.

Comprehensive examinations over coursework.

<sup>1</sup>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 hours1

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

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

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

MAT 798-799 Research and Thesis (6 hrs)

#### **Other Degree Requirements**

An advanced course in real analysis (MAT 725<sup>L, R</sup>). Oral defense and examination of thesis.

#### **NON-THESIS REQUIREMENTS**

Total Course Requirements......33 hours1

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

MAT or STA courses, 600 or 700-level (15-24 hrs) Allied field, 600 or 700-level (0-9 hrs)

#### **Other Degree Requirements**

An advanced course in real analysis (MAT 725<sup>L, R</sup>).

Comprehensive examinations over coursework.

<sup>1</sup>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**

#### **Education Courses**

EDU	600	Introduction	to	Teacher	Leadership
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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<sup>L, R</sup>

EDU 640 Exit Seminar in Teacher Leadership

#### **Other Degree Requirements**

Students must complete EDU 600 before enrolling in EDU 639.

## Master of Arts in Education

Secondary Teacher Leader with Mathematics Concentration CIP 13.1205

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

# Department of Occupational Safety and Health

157 Collins Center 270-809-2488

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

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

#### **Occupational Safety and Health Track**

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

#### **Environmental Health and Safety Track**

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

#### **Requirements for Admission**

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

#### **Degree Requirements**

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

#### AREA:

## Occupational Safety and Health/ **Occupational Safety and Health Track**

Bachelor of Science

CIP 15.0701

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

## University Studies Requirements ...... 42 hrs

(See Academic Degrees and Programs.)

University Studies selections must include:

## •Scientific Inquiry, Methodologies, and Quantitative Skills

BIO 101 Biological Concepts

CHE 105 Introductory Chemistry<sup>1</sup>

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<sup>2</sup>

135 Introduction to Probability and Statistics

## Required Core Courses ...... 51 hrs

טו	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

**Physical Agents** OSH 425

OSH 450 **Practical Application Lab** 

OSH 452 Systems Approach to Hazard Control

OSH 488 Cooperative Education/Internship

550 Safety and Health Program Management and Training OSH

OSH 591 **Engineering and Technical Aspects of Safety** 

PHY 125 **Brief Introductory Physics** 

PHY 126 Brief Introductory Physics Lab

## Safety Courses ...... 30 hrs

OSH 101 Emergency Medical Training

OSH 384 **Construction Safety** 

OSH 445 Loss Control Management and Measurement

OSH 546 Fundamentals of Risk Management

Technical electives (15 hrs)

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

#### **Technical Electives**

Choose from the following:

CET 310 Anatomy of Buildings

CET 342 Air Quality Technology

CET 353 Solid Hazardous Waste Management

CET 385 Construction Estimating I

Construction Planning and Management CFT 480

CET 555 **Environmental Regulatory Affairs** 

585 Remediation Technology CFT

120 **Chemical Laboratory Safety** CHF

CHF 210 **Brief Organic Chemistry** 

**Organic Chemistry Laboratory** CHE 215

**Communication Skills for Professionals** COM 384

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** 

Global Issues in OSH<sup>3</sup> OSH

OSH 371 Professional Internship II

OSH 412 **Emergency Management** 

OSH 453 **Human Factors in Safety Engineering** 

OSH 488 Cooperative Education/Internship<sup>4</sup>

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

<sup>1</sup>Course must contain lab component.

<sup>2</sup>CSC 199 can be substituted by another computer related course with advisor's approval.

## 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<sup>1</sup>

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<sup>2</sup>

STA 135 Introduction to Probability and Statistics

<sup>&</sup>lt;sup>3</sup>May be repeated for additional credit.

<sup>&</sup>lt;sup>4</sup>May be repeated for a second experience.

Requ	ired Co	ore Courses51 hrs	Total Curriculum Requirements 123 hrs
ITD	120	Processes and Materials	<sup>1</sup> Course must contain lab component.
MGT	350	Fundamentals of Management	<sup>2</sup> CSC 199 can be substituted by another computer related course with
OSH	100T	Transitions	advisor's approval. <sup>3</sup> May be repeated for additional credit.
OSH	192	Introduction to Occupational Safety and Health	<sup>4</sup> May be repeated for a second experience.
OSH	299	Professional Development Seminar I	iviay be repeated for a second experience.
OSH	310	Fire and Emergency Preparedness Preplanning	Occupational Safety and Health Minor21 hrs
OSH	311	Hazardous Materials and Emergency Planning	OSH 192, 353, 387, 420, and nine hours from OSH 101, 320, 384,
OSH	320	Environmental and Occupational Health Engineering	425, 452. Six hours must be upper-level courses. Courses may require
		Technology	prerequisites.
OSH	353	Prevention of Musculoskeletal Disorders	prerequisites.
		in the Workplace	
OSH	387	OSH Standards	Graduate Program
OSH	420	Fundamentals of Industrial Hygiene	
OSH	425	Physical Agents	The graduate program in occupational safety and health is
OSH		Practical Application Lab	unique in this region. In light of an increased sensitivity to the safety
OSH		Systems Approach to Hazard Control	of the work environment and to the overall health of all Americans,
OSH		Cooperative Education/Internship	the program is a timely response to business and industry needs.
OSH		Safety and Health Program Management and Training	Few programs of this type are found in higher education.
OSH		Engineering and Technical Aspects of Safety	
PHY		Brief Introductory Physics	Requirements for Admission
PHY		Brief Introductory Physics Lab	Applicants must meet the Murray State University requirements
		5.16. ma oa a ca ca y 1.11/0.00 2 a 2	(see Graduate Admissions). Additional requirements for uncondi-
Envir	onmei	ntal Health and Safety Courses 30 hrs	tional and conditional admission are as follows.
CET		Water Quality Technology I	
CET		Water Quality Technology II	Unconditional
OSH		Hazardous Waste Site Operations	Unconditional Admission status is granted only to students who
		Occupational Diseases	graduate from Murray State University with a baccalaureate degree
		Air Contaminants and Industrial Ventilation	in occupational safety and health with an overall GPA of 3.00 or
		ectives (15 hrs)	higher.
		pproved by advisor and chosen from the Technical Elec-	
		low and/or the Occupational Safety and Health Track.)	<b>Conditional</b> Conditional Admission status is granted to students with an
Tochr	sical El	lectives	undergraduate GPA of 2.75 or higher, regardless of undergraduate
			baccalaureate degree field or major. To change to Unconditional sta-
	-	n the following:	tus, the student must meet the university requirement of obtaining
CET		Anatomy of Buildings	a 3.00 in the first nine hours of graduate work and additional criteria
CET		Air Quality Technology	set forth by the Department of Occupational Safety and Health.
CET		Solid Hazardous Waste Management	Students admitted from a different undergraduate field/disci-
CET		Construction Estimating I	pline must complete the following course work in addition to the
CET		Construction Planning and Management	above GPA requirements. Undergraduate coursework is required in
CET		Environmental Regulatory Affairs	biology, chemistry, mathematics, and physics. The following courses
CET		Remediation Technology	are the minimum accepted requirements for pursuing a master's
CHE		Chemical Laboratory Safety	degree in occupational safety and health.
CHE		Brief Organic Chemistry	• BIO 101 • PHY 125 and 126
CHE		Organic Chemistry Laboratory	• CHE 105 • PSY 300 or STA 135
		Communication Skills for Professionals	<ul> <li>MAT 130 or MAT 140 and 145 or 150</li> </ul>
		Conflict and Communication	Students must also complete 15 prerequisite credit hours in oc-
CRJ		Introduction to Criminal Justice	cupational safety and health and pass these courses with a grade
CRJ		Security in Business and Industry	of C or higher.
CRJ		Terrorism	
		Human Resource Management	Prerequisite Undergraduate Requirements15 hours
		Labor-Management Relations	OSH 192 Introduction to Occupational Safety and Health
OSH		Global Issues in OSH <sup>3</sup>	OSH 353 Prevention of Musculoskeletal Disorders
OSH		Professional Internship II	in the Workplace
OSH	412	Emergency Management	or
OSH		Human Factors in Safety Engineering	OSH 453 Human Factors in Safety Engineering
OSH		Cooperative Education/Internship <sup>4</sup>	OSH 387 OSH Standards
OSH	499	Professional Development Seminar II	OSH 420 Fundamentals of Industrial Hygiene
OSH	536	Motor Fleet Safety	and
OSH	571	Problems in Safety and Health	one of the following concentration-specific courses:
OSH	578	Workshop in Safety and Health	Safety Management
PSY	405	Industrial and Organizational Psychology	OSH 384 Construction Safety
SDΔ		Rasic Spanish and Culture for Occupational Safety	

and Health

**Industrial Hygiene** 

OSH 425 Physical Agents

## 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<sup>1</sup>......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<sup>PT</sup> (or approved elective with prior safety internship or equivalent) 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<sup>PT</sup> (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<sup>L</sup> (Safety Management) OSH 697 Research in Environmental Health and Safety<sup>R</sup>

(Industrial Hygiene or Environmental)

Additional coursework may be required.

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.

**Environmental** 

**Master of Science** 

**Occupational Safety and Health** 

OSH 320 Environmental and Occupational Health Engineering Technology

CIP 15.0701

Safety	/ Man	agement 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
Indus	trial H	ygiene 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
Enviro	onmer	ntal 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