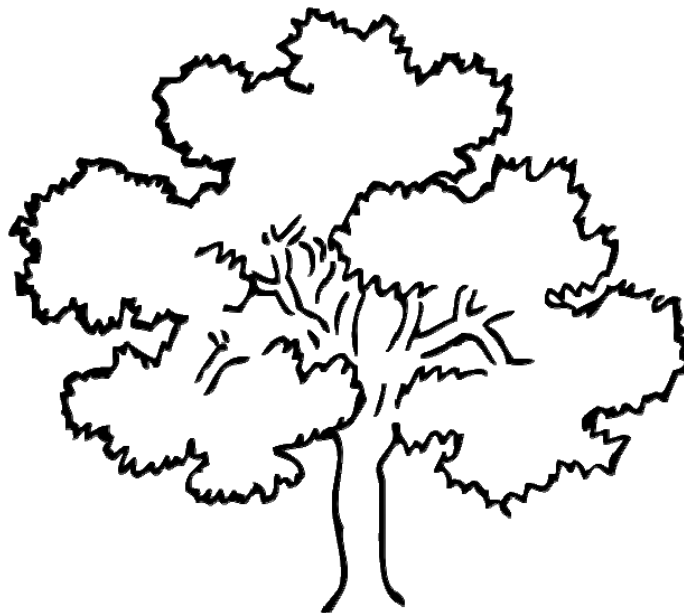


# Forest Ecosystem Management

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2016-17 Student Handbook

Ecosystem Science and Management  
College of Agricultural Sciences  
The Pennsylvania State University



<http://ecosystems.psu.edu/>

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## **Ecosystem Science and Management Department**

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The Ecosystem Science and Management Department is an academic unit in the College of Agricultural Sciences at Penn State. Our mission is to provide educational opportunities and science-based information to protect, manage, and use natural resources for sustained benefits. This is accomplished through educational, research, and service programs in forestry, wildlife and fisheries, soils, water, and related areas.

The Ecosystem Science and Management Department offers two associate in science (A.S.) degree programs: Forest Technology (at Penn State Mont Alto) and Wildlife Technology (at Penn State DuBois); and two bachelor of science (B.S.) degree programs: Forest Ecosystem Management and Wildlife and Fisheries Science. A minor in each of these areas is also offered as is a minor in Environmental Soil Science. In addition, we offer graduate programs at both the master's and doctoral levels. We are committed to quality teaching.

Information about our academic programs, scholarships, student activities and professional societies, faculty, and facilities is available on our website, <http://ecosystems.psu.edu>.

Follow us on Facebook ([facebook.com/PSUecosystems](https://www.facebook.com/PSUecosystems)) and Twitter ([twitter.com/PSUecosystems](https://twitter.com/PSUecosystems)).

## **Undergraduate Programs Office**

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The Ecosystem Science and Management Undergraduate Programs Office is housed in 113 Forest Resources Building at Penn State University Park; phone (814) 865-4237. Ms. Ellen Manno is the undergraduate program coordinator, Ms. Dana Grove is the staff assistant, and Dr. Paola Ferreri is our department's representative on the College of Agricultural Sciences Instruction and Curricular Affairs committee.

Each student in the Ecosystem Science and Management Department is assigned an academic adviser. For students at the University Park campus, advising assignments are made by the Ecosystem Science and Management Undergraduate Programs Office.

Any student enrolled in or thinking about enrolling in a major in the Ecosystem Science and Management Department, regardless of campus location, is encouraged to contact the Ecosystem Science and Management Undergraduate Programs Office.

Undergraduate Programs Office  
Ecosystem Science and Management  
The Pennsylvania State University  
113 Forest Resources Building  
University Park, PA 16802-4301  
*phone* (814) 865-4237  
*fax* (814) 865-3725

## Forest Ecosystem Management Undergraduate Program

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### Introduction

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Degrees in forestry have been awarded at Penn State since 1907 and our program was among the first group of forestry programs accredited by the Society of American Foresters (SAF) in 1935. The SAF is a professional organization that strives, among other things, to advance the science, education, technology, and practice of forestry and is the only organization that may accredit forestry curricula in the United States.

SAF grants accreditation only to specific educational curricula that lead to a first professional degree in forestry, which can be either the bachelor's or master's level at any particular institution (e.g., at Penn State it is the B.S. level). The SAF maintains a list of accredited institutions on their website, <http://www.eforester.org>; click on the "Accreditation" tab. These institutions offer curricula that have been found to meet minimum standards for objectives, curriculum, faculty, students, administration, parent-institution support, and physical resources and facilities. The SAF accreditation process is recognized by the Commission on Recognition of Postsecondary Accreditation.

Penn State's Forest Management, Forest Biology, and Community and Urban Forest Management options are accredited by the SAF and also fulfill the educational qualification requirements for the federal occupational series in forestry. The Watershed Management option is not accredited by the SAF but fulfills the educational qualification requirements for the federal occupational series in hydrology, and with certain course selections may also fulfill the educational requirements for the federal occupational series in forestry. In addition, it is possible through elective coursework in all four options to satisfy several federal Wildland Firefighter basic trainings (Basic Firefighting PA130 and Introduction to Fire Behavior S190) and Wildfire Power Saws S212.

As with many professions, the scope and complexity of the forestry profession has increased since its inception in the United States more than a century ago. Not only do foresters now manage for a wide range of ecosystem services requiring specialized knowledge, but technological advances have expanded the range of necessary technical skills while societal shifts have expanded the range of necessary professional skills. The Forest Ecosystem Management curriculum satisfies these three areas by 1) ensuring professional skills through general education requirements and across-the-board skill development in upper-division courses, 2) providing technical skills through the core requirements of the major, and 3) offering four separate options for specialization.

Professional foresters are challenged with restoration, habitat creation and maintenance, and the sustainable provision of a wide range of ecosystem services, which may include clean water, construction timber, carbon sequestration, pulpwood, wildlife habitat, nontimber forest products, recreational opportunities, and trees to beautify rural and urban landscapes. For a successful forestry career, several personal qualities are desirable:

- a love of the woods and the outdoors
- an ethical concern for natural resources and an appreciation of nature
- an interest in the complexity of forest ecosystems and a desire to work where people and nature meet (at the interface of biology, ecology, economics, and social issues)
- an analytical mind and creative abilities for problem solving
- the ability to communicate with the public and to supervise employees.

Forest Ecosystem Management graduates may become forest managers who are responsible for managing the flora and fauna on thousands of acres of forests and watersheds, including valuable timberland, national and state parks, game lands, and recreation areas. Others may work as ecologists, studying environmental factors that affect forests, or as consultants, surveying timberlands and recommending harvest and reforestation practices. Graduates also find employment as community foresters managing street trees and urban green spaces; as

biometricians working with databases to assess forest conditions and trends; as industrial foresters ensuring a company's need for raw materials; as park superintendents overseeing the operation of parks and recreation facilities; as resource economists determining levels of supply and demand for forest resources; as hydrologists measuring stream flow and managing municipal watersheds; or in forest policy, addressing issues raised by the interaction of people and forests.

Employment opportunities for graduates of the Forest Management and Forest Biology options include forest management positions with public agencies such as the Pennsylvania Bureau of Forestry and the U.S. Forest Service, nonprofit organizations such as The Nature Conservancy, industries such as sawmills and bioenergy facilities, and private environmental consulting firms. The Community and Urban Forest Management option prepares students to manage community trees and green spaces. Employment opportunities include municipalities, arboricultural companies, utilities, and government agencies. The Watershed Management option focuses on the integrated management of natural resources, with emphasis on water. Graduates can find federal employment as hydrologists or pursue careers in municipal watershed management; in local, state, and federal government; and in environmental/engineering consulting.

## Mission

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The mission of the bachelor of science program in Forest Ecosystem Management is to help students develop the knowledge, skills, and professional ethics for understanding and managing forest ecosystems and living as responsible members of society.

## Forest Ecosystem Management Curriculum Requirements

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*(Last revised Fall 2013)*

120 - 123 credits are required for a Bachelor of Science degree in Forest Ecosystem Management:

- Forest Biology Option (FBIO) - 120 credits
- Forest Management Option (FMGT) - 120 credits
- Community and Urban Forest Management Option (CURFM) - 123 credits
- Watershed Management Option (WMGT) - 120 credits

### **Courses Required for ALL Options:**

(Individual course credits are given in parentheses.)

#### COMMUNICATIONS

- ENGL 015 GWS - Rhetoric and Composition (3)
- ENGL 202C GWS - Technical Writing (3); or ENGL 202D GWS – Business Writing (3)
- CAS 100 GWS - Effective Speech (3)

#### QUANTIFICATION

- STAT 200 GQ\* – Elementary Statistics (4); or STAT 240 GQ\* - Introduction to Biometry (3); or STAT 250 GQ\* – Introduction to Biostatistics (3)

#### NATURAL SCIENCES and OTHER PRESCRIBED COURSES

- CHEM 110 GN - Chemical Principles (3)
- CHEM 111 GN - Experimental Chemistry (1)
- ECON 102 GS – Microeconomics (3)
- FOR 200\* - The Profession of Forestry (1)
- FOR 203\* - Field Dendrology (3)

- FOR 255\* - GPS and GIS Applications for Natural Resources Professionals (3)
- FOR 266\* - Forest Resources Measurements (4)
- FOR 308\* - Forest Ecology (3)
- FOR 400\* - Senior Forest Practicum (2)
- FOR 421\* - Silviculture (3)
- SOILS 101 - Introduction to Soils (3)

\*Courses requiring at least a C grade.

#### ARTS [GA]

- Select from the University-approved Arts list (6)  
(Note: the CURFM option requires that 3 GA credits be selected from LARCH 060, LARCH 065, or ARCH 316)

#### HUMANITIES [GH]

- Select from the University-approved Humanities list (6)

#### SOCIAL AND BEHAVIORAL SCIENCES [GS]

- ECON 102 GS - Introductory Microeconomic Analysis and Policy (3)
- Select from the University-approved Social and Behavioral Sciences list (3)  
(Note: The WMGT option has a specific list of GS courses from which to choose.)

#### HEALTH SCIENCES and PHYSICAL EDUCATION [GHA, GPE, or GHS]

- Select from the University-approved Health Sciences and Physical Education course list (3)

#### ELECTIVES

- Open selection (excludes remedial courses) (0-9)

#### UNITED STATES CULTURES and INTERNATIONAL CULTURES

- Select 3 credits of University-approved United States Cultures (US) and 3 credits of University-approved International Cultures (IL) (6)
- Courses that are listed as both US or IL and GA, GH, or GS can count for both requirements (i.e., a course listed for both GA and IL will satisfy both Arts and International Cultures).

#### FIRST-YEAR SEMINAR

- Select a course designated as a First-Year Seminar (1+)

#### WRITING-INTENSIVE COURSE WORK [W]

- Select a writing-intensive course within your major or college of enrollment. (3)  
This is satisfied by completion of FOR 466W in the FMGT option, and by FOR 450W in the CURFM, FBIO, and WMGT options.

## Required Field Equipment

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One of the hallmarks of the professional forester is familiarity and competency with commonly used field equipment. Several of the core courses in the Forest Ecosystem Management major require you to provide your own field equipment. Most of this equipment will be required by more than one course and, if properly maintained, will serve you for many years. It is your responsibility to obtain the required equipment in advance of each course. Student discounts from Ben Meadows and Forestry Suppliers are detailed on the following two pages, but you are not required to purchase equipment from any particular dealer; and you may also choose to purchase used equipment.

<b>Equipment</b>	<b>Courses</b>
Mirrored compass (in azimuths, with adjustable declination)	FOR 266, 308, 421, 439
Clinometer* (with topo 1:66 and percent scales)	FOR 266, 308, 421, 439
75-foot Loggers tape (with DBH in tenths on backside)	FOR 266, 308, 421, 439
Horseshoe nail hook	FOR 266, 421
10 BAF prism and case	FOR 266, 421, 439
Tree and log scale stick (in International scale)	FOR 266
Hard hat (ANSI Z98.1 standard, fluorescent orange)**	FOR 266, 320, 439
Hard hat ear muffs & visor***	FOR 228
Cruising vest (fluorescent orange)	FOR 266, 439

\*Protective cases, although optional, are highly recommended to prolong the life of your equipment.

\*\*Hard hats (helmets) are available in a wide range of cost, comfort, and level of protection. You may wish to invest in a “better” product, which, with proper care, will provide good service for many years.

\*\*\*If you plan to take FOR 228, Chainsaw Safety, Maintenance, and Operation in Forest Management (which counts only for Elective credit), purchase ear muffs and visor at the same time as your hard hat to make sure they are compatible. The FOR 228 instructor recommends a Peltor Complete Lumberjack System, available locally from Milheim Small Engine or through mail order online. You may also contact Best Line Equipment in State College to check availability.

## Ben Meadows

Ben Meadows (1-800-241-6401; benmeadows.com) offers the following discounts to Penn State students. You must use **keycode TS6PPSU** when placing your order with Ben Meadows. *The keycode will only give you discounts on the items identified below.* You will need to provide your name, billing and shipping address, and payment information. These Ben Meadows discounts are available through January 31, 2017.

Item #	Description	Catalog Price	Student Cost
101924	Silva® Ranger™ Azimuth Compass	\$46.00	\$39.99
102204	SUUNTO® Clinometer PM-5/66PC, Percent and Topographic	\$145.00	\$135.00
121571	Spencer® Combination Logger's/Diameter Tape, 75'L/120"-dia., Graduations of Feet, 10ths and 100ths on one side and Dia. Equivalent in Inches and 10ths on other side	\$77.40	\$65.80
122210	Spencer® Tape End Nail, Horseshoe Style, Steel ( <b>get 3</b> )	\$0.85	\$0.70
102221	Exact-Factor Cruising Prism, 10 BAF	\$21.10	\$19.00
121614	Tree and Log Scale Stick – International	\$15.00	\$13.00
	Vest (make sure your cruising vest is large enough to fit <b>over</b> your winter coat)		
227237	BEN MEADOWS™ Cotton Duck 10-Pocket Field Vest, Orange	\$74.65	\$67.60
or 227240	BEN MEADOWS™ Nylon 10-Pocket Field Vest, Blaze Orange	\$76.65	\$68.95

### HARD HATS available from Ben Meadows

Item #	Description	Catalog Price	Student Cost
	MSA		
18988OR	V-Gard ratchet	\$14.80	\$12.58
22609OR	V-Gard pinlock	\$10.35	\$8.80
	North		
54712OR	Standard, pinlock	\$8.70	\$7.40
54713OR	Standard, ratchet	\$13.25	\$11.25
	Allsafe		
15112ORH	Sentry III, ratchet	\$16.80	\$14.30
	Aluminum - Allhorn		
221341ORG	Full-Brim aluminum	\$54.95	\$46.70



## Forestry Suppliers

Forestry Suppliers (1-800-647-5368; forestry-suppliers.com) offers the following discounts to Penn State students. You must use Forestry Summer Camp program **keycode K43** when placing your order with Forestry Suppliers. *This keycode will give you a 10% discount on anything you order, even items not listed below, and you will also get a free Forestry Suppliers Field Cap.* You will need to provide your name, billing and shipping address and payment information with your order. These Forestry Suppliers discounts are available through December 30, 2016.

Item #	Description	Catalog Price	Student Cost
37136 or 37036	Silva® Ranger® CL15 Compass with Built-In Clinometer, Azimuth	\$41.95	\$37.76
43895	SUUNTO® PM5/66PC Clinometer with Percent and Topo Scales	\$144.50	\$130.05
39436	Spencer® Logger's Tape Model 975DC. Measures in feet, 10ths, 100ths on one side and 120" diameter inches, 10ths, other side	\$68.95	\$62.06
39341	Spencer Horseshoe Nail ( <b>get 3</b> )	\$0.75	\$0.68
59026	JIM-GEM® Rectangular Shape Prism, 10 BAF, Clear	\$28.25	\$26.06
59770	Tree and Log Scale Stick, International 1/4" Scale	\$14.50	\$13.05
96010 or 96013	JIM-GEM® "Pro" 10-Pocket Cruiser Vest (Make sure your cruising vest is large enough to fit <b>over</b> your winter coat)	\$64.95 or \$66.95	\$58.46 or \$60.26

A 10% discount will also be applied to any hard hat or field vest you order from Forestry Suppliers; remember to use the designated keycode noted above.

## Forest Biology (FBIO) Option

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### Prescribed Courses for the Forest Biology option:

- BIOL 110 GN – Biology: Basic Concepts and Biodiversity (4)
- BIOL 220W GN – Biology: Populations and Communities (4)
- CHEM 202 – Fundamentals of Organic Chemistry I (3)
- FOR 204\* – Dendrology (2)
- FOR 350\* – Forest Ecosystem Monitoring and Data Analysis (3)
- FOR 409\* – Tree Physiology (2)
- FOR 410\* – Elements of Forest Ecosystem Management (3)
- FOR 430\* – Conservation Biology (3)
- FOR 450W\* – Human Dimensions of Natural Resources (3)
- HORT 445 – Plant Ecology (3)
- SOILS 102 – Introductory Soil Science Laboratory (1)
- WFS 209 – Wildlife and Fisheries Conservation (3)

\*Courses requiring at least a C grade.

### Additional Courses for the Forest Biology option:

- MATH 110 GQ\* (4) or MATH 140 GQ\* (4)
- Select 4-5 credits from ENT 313 (2) or FOR 403 (3) or PPEM 318 (2)
- Supporting Courses selected in consultation with a Forest Ecosystem Management Adviser (15)

### Supporting Course selections for the Forest Biology option:

Select required courses for a MINOR in Biology or Chemistry or Mathematics or Statistics  
or

Select 15 credits from department list in consultation with an adviser.

A maximum of 3 credits may be selected from this list:

BIOL 120	GEOG 111
BIOL 222	HORT 202
ERM 330	METEO 122

Select 12-15 credits from this list:

AGECO 438	BIOL 436	ERM 412	GEOG 475W
AGECO 457	BIOL 438	FOR 303	HORT 402W
BIOL 407	BIOL 441	FOR 418	HORT 407
BIOL 414	BIOL 444	FOR 475	SOILS 412W
BIOL 419	BIOL 446	FOR 494	WFS 407
BIOL 420	BIOL 448	GEOG 311	WFS 408
BIOL 427	BIOL 450W	GEOG 411	WFS 447W
BIOL 428	BIOL 463	GEOG 412W	WFS/ERM 450

**Recommended Academic Plan for Forest Ecosystem Management - Forest Biology  
Commonwealth Campuses and University Park, Effective Fall 2013**

Semester 1 (fall)	Credits	Semester 2 (spring)	Credits
First-Year Seminar	1-3	<i>BIOL 220W (GN)</i> Populations and Comm	4
<i>BIOL 110 (GN)</i> Basic Concepts and Biodiversity	4	<i>CHEM 110 (GN)</i> Chemical Principles	3
<b>MATH 110 or 140 (GQ)</b>	4	<i>CHEM 111 (GN)</i> Experimental Chem.	1
<i>ENGL 015 or 030 (GWS)</i> Rhetoric & Comp	3	<b>STAT 200, 240, or 250 (GQ) Statistics</b>	3-4
Humanities (GH)	3	<i>CAS 100 (GWS)</i> Effective Speech	3
	credits: 15-17		credits: 14 -15
Semester 3	Credits	Semester 4	Credits
<b>FOR 200 Profession of Forestry</b>	1	<b>FOR 204 Dendrology</b>	2
<b>FOR 203 Field Dendrology</b>	3	<b>FOR 266 Forest Resource Measurements</b>	4
<b>FOR 255 GPS/GIS for Natural Resources</b>	3	<i>CHEM 202</i> Organic Chemistry I	3
<i>SOILS 101 (GN)</i> Introduction to Soils	3	<i>ECON 102 (GS)</i> Microeconomics	3
<i>SOILS 102 (GN)</i>	1	<i>ENGL 202C or 202D (GWS)</i>	3
Arts (GA)	3	Humanities (GH)	3
	credits: 14		credits: 18
Semester 5	Credits	Semester 6	Credits
<b>FOR 308 Forest Ecology</b>	3	ENT 313, FOR 403, or PPEM 318 (need 2)	2-3
<i>WFS 209 (GN)</i> Wildlife and Fisheries Cons.	3	<b>FOR 350 Ecosystem Monitoring &amp; Data Analysis</b>	3
Supporting Course selection from list	3	<b>FOR 409 Tree Physiology</b>	2
Social Sciences (GS)	3	<b>FOR 410 Forest Ecosystem Management</b>	3
<b>FOR/WFS 430 Conservation Biology</b>	3	Supporting Course selection from list	3
Health and Physical Activity (GHA)	1.5	Health and Physical Activity (GHA)	1.5
	credits: 16.5		credits: 14.5-15.5
Semester 7	Credits	Semester 8	Credits
<b>FOR 421 Silviculture</b>	3	ENT 313, FOR 403, or PPEM 318 (need 2)	2-3
Arts (GA)	3	<b>FOR 400 Senior Forest Practicum</b>	2
<b>HORT 445 Plant Ecology</b>	3	<b>FOR 450W Human Dimensions Nat Res</b>	3
Supporting Course selection from list	3	Supporting Course selection from list	3
Free Electives	2-4	Supporting Course selection from list	3
	credits: 14-16		credits: 13-14

- **Bold** type indicates courses requiring a quality grade of C or better.
- *Italics* indicates courses that satisfy both major and General Education requirements.
- ***Bold Italics*** indicates courses requiring a quality grade of C or better and that satisfy both major and General Education requirements.
- GWS, GHA, GQ, GN, GA, GH, and GS are codes used to identify General Education requirements.
- US and IL are codes used to designate courses that satisfy University United States/International Cultures requirements.
- W is the code used to designate courses that satisfy University Writing Across the Curriculum requirements.

**Scheduling patterns for courses not taught each semester:** FOR 409 is only taught spring of odd years, please plan to take FOR 409 in spring of your junior or senior year. Many FOR classes are only taught once per year, in the fall OR the spring; please plan your schedule accordingly.

**Academic Advising Notes:**

US and IL may “double count” with GA, GH, or GS course.

Students should monitor their academic progress by checking their degree audits on LionPATH. Questions about degree audits should be directed to academic advisers or to the Undergraduate Programs Office.

Student				<b>FOREST ECOSYSTEM MANAGEMENT – FBIO OPTION</b> <i>Effective Fall 2013      120 Credits Required</i> The Pennsylvania State University College of Agricultural Sciences Department of Ecosystem Science and Management				Adviser				
Student Number								Gen. Ed. Year		Program Year		
E-mail Address								Date				
<b>REQUIREMENTS FOR THE MAJOR</b>								<b>REQUIREMENTS FOR GENERAL EDUCATION</b>				
SEM	COURSE	CR	GRADE	SEM	COURSE	CR	GRADE	SEM	COURSE	CR	GRADE	
<b>PRESCRIBED COURSES FOR THE MAJOR (29 CR.)</b>				<b>PRESCRIBED COURSES FOR THE OPTION (34 CR.)</b>				<b>COMMUNICATION (9 CR. GWS)</b>				
	CHEM 110 GN	3			BIOL 110 GN	4			ENGL 015 or 030	3		
	CHEM 111 GN	1			BIOL 220W GN	4			CAS 100A, B, or C	3		
	ECON 102 GS	3			CHEM 202	3		<i>and ENGL 202C or 202D (3)</i>				
	FOR 200 *	1			FOR 204 *	2		<b>QUANTIFICATION (6 CR. GQ)</b>				
	FOR 203 *	3			FOR 350 *	3		<i>MATH GQ and STAT GQ</i>				
	FOR 255 *	3			FOR 409 *	2		<b>NATURAL SCIENCES (9 CR. GN)</b>				
	FOR 266 *	4			FOR 410 *	3		<i>BIOL GN, CHEM GN, and SOILS GN</i>				
	FOR 308 *	3			FOR/WFS 430 *	3		<b>ARTS (6 CR. ♦GA)</b>				
	FOR 400 *	2			FOR 450W *	3				3		
	FOR 421 *	3			HORT 445	3				3		
	SOILS 101 GN	3			SOILS 102 GN	1		<b>HUMANITIES (6 CR. ♦GH)</b>				
					WFS 209	3				3		
<b>ADDITIONAL COURSES FOR THE MAJOR (6 - 7 CR.)</b>				<b>ADDITIONAL COURSES FOR THE OPTION (8 - 9 CR.)</b>								
	ENGL 202C or ENGL 202D GWS	3						<b>SOCIAL AND BEHAVIORAL SCIENCES (6 CR. ♦GS)</b>				
	STAT 200 *, 240 *, or 250 GQ *	3-4			MATH 110 GQ * or MATH 140 GQ *	4				3		
					Forest Health Theme: Select 4 - 5 credits from ENT 313 (2), FOR 403 (3), and PPEM 318 (2)	4-5		<i>and ECON 102 GS</i>				
								<b>UNITED STATES CULTURES (3 CR. US) ▲</b>				
<b>ELECTIVES (2 - 4 CR.)</b>				<b>SUPPORTING COURSES FOR THE OPTION (15 CR.)</b> Select from department list in consultation with adviser								
								<b>INTERNATIONAL CULTURES (3 CR. IL) ▲</b>				
										3		
								<b>FIRST-YEAR SEMINAR (1-3 CR.) ▲</b>				
								<b>HEALTH AND PHYSICAL EDUCATION (3 CR. GHA)</b>				
<b>LEGEND</b>												
* COURSES REQUIRING AT LEAST A C GRADE.												
▲ CAN DOUBLE COUNT WITH ANOTHER GEN ED COURSE OR ELECTIVE												
♦GA/GH/GS CREDITS REQUIREMENTS CAN BE ADJUSTED TO ANY 3/6/9 ARRANGEMENT OF CREDITS (EX. 6 GA, 3 GH, 9 GS)												
<b>A MINIMUM CUMULATIVE GPA OF 2.00 IS REQUIRED FOR GRADUATION.</b>												
DECEMBER 2013												



## Forest Management (FMGT) Option

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### Prescribed Courses for the Forest Management option:

- ENT 313 – Introduction to Entomology (2)
- FOR 204\* – Dendrology (2)
- FOR 320\* – Forest Fire Management (2)
- FOR 350\* – Forest Ecosystem Monitoring and Data Analysis (3)
- FOR/WFS 430\* – Conservation Biology (3)
- FOR 440\* – Forest and Conservation Economics (3)
- FOR 455\* – Remote Sensing and Spatial Data Handling (3)
- FOR 466W\* – Forest Management and Planning (3)
- FOR 470\* – Watershed Management (3)
- FOR 480\* – Policy and Administration (3)
- PPEM 318 – Diseases of Forest and Shade Trees (2)
- WFS 209 GN – Wildlife and Fisheries Conservation (3)

### Additional Courses for the Forest Management option:

- BIOL 110 GN (4) or BIOL 127 GN (3)
- MATH 022 GQ\* (3) **and** MATH 026 GQ\* (3); or MATH 040 GQ\* (5); or MATH 041 GQ\* (3); or MATH 110 GQ\* (4); or MATH 140 GQ\* (4)
- Supporting Courses and related areas selected in consultation with a Forest Ecosystem Management adviser (12)

\*Courses requiring at least a C grade.

### Supporting Courses for the Forest Management option must be selected from the list below.

- Select 12 credits from department list in consultation with adviser.
- Courses that count toward a designated minor will count as Supporting Courses.
- Six of the 12 credits must be at the 300- or 400-level

ASM 217	ERM 430	FOR 497	GEOG 436	SOILS 102	WFS 310	WILDL 106S
ASM 327	ERM 435	FOR 499	GEOG 463	SOILS 401	WFS 406	WILDL 204
AGBM 101	ERM 436	FORT 130	GEOG 464	SOILS 402	WFS 407	WILDL 208M
BA 250	ERM 447	FORT 140	GEOG 467	SOILS 403	WFS 408	WILDL 211
CAS 211	ERM 450	FORT 170	GEOG 468	SOILS 404	WFS 409	WILDL 213
CAS 212	EARTH 103	FORT 230	GEOG 483	SOILS 405	WFS 410	WP 203
CAS 213	ECON 302	FORT 250	GEOG 484	SOILS 412W	WFS 422	
CAS 252	ECON 428	GEOG 110	GEOG 485	SOILS 416	WFS 430	
CAS 404	FOR 201	GEOG 111	GEOG 486	SOILS 418	WFS 435	
CED 201	FOR 242	GEOG 130	GEOG 487	SOILS 419	WFS 436	
CED 309	FOR 303	GEOG 160	GEOG 488	SOILS 420	WFS 440	
CED 409	FOR 297	GEOG 161	GEOG 489	SOILS 422	WFS 446	
CED 417	FOR 401	GEOG 310W	MATH 111	SOILS 450	WFS 447W	
CED 427W	FOR 403	GEOG 311	MATH 141	SOILS 499	WFS 450	
CED 429	FOR 409	GEOG 361	MATH 318	STAT 301	WFS 452	
CED 431W	FOR 410	GEOG 362	MATH 319	STAT 318	WFS 453	
CMPS 101	FOR 418	GEOG 363	PHYS 150	STAT 319	WFS 454	
CMPS 203	FOR 439	GEOG 364	PHYS 211	STAT 401	WFS 460	
ERM 300	FOR 450W	GEOG 411W	PLSC 135	STAT 402	WFS 462	
ERM 411	FOR 471	GEOG 412W	PLSC 403	SUST 200	WFS 463W	
ERM 412	FOR 475	GEOG 430	PLSC 444	WFS 300	WFS 499	
ERM 413W	FOR 488Y	GEOG 434	PPATH 405	WFS 301	WILDL103	

**Recommended Academic Plan for Forest Ecosystem Management - Forest Management,  
Commonwealth Campuses and University Park, Effective Fall 2013**

Semester 1 (fall)	Credits	Semester 2 (spring)	Credits
First-Year Seminar	1-3	CHEM 110 (GN) Chemical Principles	3
<b>MATH 22 and 26, or 40, or 41, 110 or 140 (GQ)</b>	3-6	CHEM 111 (GN) Experimental Chem.	1
BIOL 110 or 127 (GN) Introductory Biology	3-4	ECON 102 (GS) Microeconomics	3
ENGL 015 or 030 (GWS) Rhetoric & Comp	3	<b>STAT 200, 240, or 250 (GQ) Statistics</b>	3-4
Humanities (GH)	3	CAS 100 (GWS) Effective Speech	3
		Arts (GA)	3
	credits: 13-19		credits: 16-17
Semester 3	Credits	Semester 4	Credits
<b>FOR 200 Profession of Forestry</b>	1	<b>FOR 204 Dendrology</b>	2
<b>FOR 203 Field Dendrology</b>	3	<b>FOR 266 Forest Resources Measurements</b>	4
<b>FOR 255 GPS/GIS for Natural Resources</b>	3	PPEM 318 Forest Pest Management	2
SOILS 101 (GN) Introduction to Soils	3	ENT 313 Intro to Entomology	2
Arts (GA)	3	ENGL 202C or 202D (GWS)	3
Health and Physical Activity (GHA)	1.5	Humanities (GH)	3
	credits: 14.5		credits: 16
Semester 5	Credits	Semester 6	Credits
<b>FOR 308 Forest Ecology</b>	3	<b>FOR 320 Forest Fire Management</b>	2
<b>FOR 440 Forest and Conservation Economics</b>	3	<b>FOR 350 Ecosystem Monitoring &amp; Data Analysis</b>	3
Social Sciences (GS)	3	WFS 209 (GN) Wildlife and Fisheries Cons.	3
<b>FOR 401 Urban Forest Management</b> or Supporting Course, from list	3	<b>FOR 450W Human Dimensions Nat Res</b> or Supporting Course, from list	3
Free Electives	0-5	<b>FOR 455 Remote Sensing &amp; Spatial Data</b>	3
		Health and Physical Activity (GHA)	1.5
	credits: 12-17		credits: 15.5
Semester 7	Credits	Semester 8	Credits
<b>FOR 421 Silviculture</b>	3	<b>FOR 400 Senior Forest Practicum</b>	2
Supporting Course, from list	3	<b>FOR 466W Forest Management &amp; Planning</b>	3
<b>FOR/WFS 430 Conservation Biology</b>	3	<b>FOR 480 Policy &amp; Administration</b>	3
<b>FOR 475</b> or Supporting Course, from list	3	<b>FOR 409 Tree Physiology</b> and SOILS 102, or Supporting Course, from list	3
Supporting Course, from list	3	<b>FOR 470 Watershed Hydrology</b>	3
	credits: 15		credits: 14



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- W is the code used to designate courses that satisfy University Writing Across the Curriculum requirements.

**Scheduling patterns for courses not taught each semester:**

Many FOR classes are only taught once per year, in the fall OR the spring; please plan your schedule accordingly.

**Academic Advising Notes:**

US and IL may “double count” with GA, GH, or GS course.

Students should monitor their academic progress by checking their degree audits on LionPATH. Questions about degree audits should be directed to academic advisers or to the Undergraduate Programs Office.





## Community and Urban Forest Management (CURFM) Option

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### Prescribed Courses for the Urban Forestry option:

- ASM 217 – Landscape Soil and Water Management (3)
- ENT 313 – Introduction to Entomology (2)
- ENT 314 – Management of Insect and Pests of Ornamentals (1)
- FOR 204\* – Dendrology (2)
- FOR 401\* – Urban Forest Management(3)
- FOR 450W\* – Human Dimensions of Natural Resources (3)
- FOR 480\* – Policy and Administration (3)
- GEOG 430 – Human Use of Environment (3)
- HORT 138 – Ornamental Plant Materials (3)
- HORT 301 – Principles of Arboriculture (3)
- HORT 408 – Landscape Plant Establishment and Maintenance (4)
- PPEM 318 – Diseases of Forest and Shade Trees (2)

### Additional Courses for the Urban Forestry option:

- BIOL 110 GN (4) or BIOL 127 GN (3)
- MATH 022 GQ\* (3) **and** MATH 026 GQ\* (3); or MATH 040 GQ\* (5); or MATH 041 GQ\* (3); or MATH 110 GQ\* (4); or MATH 140 GQ\* (4)
- 3 credits from LARCH 060 GA (3) or LARCH 065 GA (3), or ARCH 316 GA (3)
- 3 credits from FOR 475\* (3), or FOR 409\* (2) **and** SOILS 102 (1)
- 3 credits from FOR 495\*<sup>▲</sup> (3) or FOR 496\* (3)
- 3 credits from RPTM 320 (3) or RPTM 325 (3) or RPTM 435 (3) or RPTM 470 (3)
- 3 credits from FOR 455 (3) or GEOG 363 (3) or SOILS 450 (3)
- 8-9 credits from Supporting Courses and related areas from one grouping.

#### **Municipal Forestry –**

AGECO 457	CAS 404	CED 309	CED 417	ERM 411
FOR 466W	HORT 201	LARCH 241		

#### **Commercial Arboriculture –**

ACCTG 211	AGECO 457	BA 250	BLAW 243	FIN 100
HORT 201	MGMT 100	MKTG 221		

#### **Env. Outreach & Planning -**

CAS 404	CED 309	CED 409	CED 417	CED 427W
ERM 411	FOR 410	FOR 430	FOR 470	LARCH 241
LARCH 341	WFS 209			

\*Courses requiring at least a C grade.

<sup>▲</sup> Please see the Internship Handbook at:

<http://ecosystems.psu.edu/students/handbooks/internship-handbook/view>

**Recommended Academic Plan for  
Forest Ecosystem Management – Community and Urban Forest Management Option  
Commonwealth Campuses and University Park, Effective Fall 2013**

Semester 1 (fall)	Credits	Semester 2 (spring)	Credits
First-Year Seminar	1-3	CHEM 110 (GN) Chemical Principles	3
<b>MATH 22 and 26, or 40, or 41, 110 or 140 (GQ)</b>	3-6	CHEM 111 (GN) Experimental Chem.	1
BIOL 110 or 127 (GN) Introductory Biology	3-4	ECON 102 (GS) Microeconomics	3
ENGL 015 or 030 (GWS) Rhetoric & Comp	3	<b>STAT 200, 240, or 250 (GQ) Statistics</b>	3-4
Humanities (GH)	3	CAS 100 (GWS) Effective Speech	3
		Arts (GA)	3
	credits: 13-19		credits: 16-17
Semester 3	Credits	Semester 4	Credits
<b>FOR 200 Profession of Forestry</b>	1	<b>FOR 204 Dendrology</b>	2
<b>FOR 203 Field Dendrology</b>	3	<b>FOR 266 Forest Res. Measurements</b>	4
<b>FOR 255 GPS/GIS for Natural Resources</b>	3	HORT 301 Principles of Arboriculture	3
SOILS 101 (GN) Introduction to Soils	3	ENT 313 Intro to Entomology	2
LARCH 060, 065 or ARCH 316 (GA)	3	ENT 314 Insect Pests of Ornamentals	1
Health and Physical Activity (GHA)	1.5	ENGL 202C or 202D (GWS)	3
	credits: 14.5		credits: 15
Semester 5	Credits	Semester 6	Credits
<b>FOR 308 Forest Ecology</b>	3	PPEM 318 Forest Pest Management	2
HORT 138 Ornamental Plant Materials - Shrubs	3	ASM 217 Landscape Soil & Water Mgmt	3
Supporting Course	3	FOR 455, GEOG 363, or SOILS 450	3
<b>FOR 475 Forest Soils, or Supporting Course</b>	3	<b>FOR 409 Tree Physiology and SOILS 102, or Supporting Course</b>	3
RPTM 320, 325, 435, or 470	3	Social Science (GS)	3
		Elective(s)	0-3
	credits: 15		credits: 14-17
Semester 7	Credits	Semester 8	Credits
<b>FOR 421 Silviculture</b>	3	HORT 408 Landscape Plant Estab & Mainten	4
<b>FOR 495 or 496</b>	3	<b>FOR 480 Policy &amp; Administration</b>	3
Supporting Course	2-3	GEOG 430 Human Use of Environment	3
<b>FOR 401 Urban Forest Management</b>	3	<b>FOR 400 Senior Forest Practicum</b>	2
Humanities (GH)	3	<b>FOR 450W Human Dimensions Nat Res</b>	3
Electives	0-3	Health and Physical Activity (GHA)	1.5
	credits: 14-18		credits: 16.5

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- US and IL are codes used to designate courses that satisfy University United States/International Cultures requirements.
- W is the code used to designate courses that satisfy University Writing Across the Curriculum requirements.

**Scheduling patterns for courses not taught each semester:**

Many FOR classes are only taught once per year, in the fall OR the spring, please plan your schedule accordingly.

**Academic Advising Notes:**

US and IL may “double count” with GA, GH, or GS course.

Students should monitor their academic progress by checking their degree audits on LionPATH. Questions about degree audits should be directed to academic advisers or to the Undergraduate Programs Office.

The requirements for the Arboriculture Minor can be completed within the 123 credits required in the CURFM option.







## Watershed Management (WMGT) Option

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### Prescribed Courses for the Watershed Management option:

- FOR 450W\* - Human Dimensions of Natural Resources (3)
- FOR 470\* - Watershed Management (3)
- FOR 471\* - Watershed Management Laboratory (1)

### Additional Courses for the Watershed Management option:

- MATH 110 GQ\* (4); or MATH 140 GQ\* (4)
- MATH 111 GQ (2); or MATH 141 GQ (4)
- 3 credits from FOR 409\* (2) and SOILS 102 (1); or FOR 475 (3)

### Supporting Courses for the Watershed Management option:

- 6 credits of GS social sciences from EBF 200 GS (3), ECON 302 GS (3), EGEE 211 GS (3), ENVST 100 GS (3), GEOG 020 GS (3), GEOG 030 GS (3), GEOG 130 GS (3), GEOG 160 GS (3), PLSC 001 GS (3), PLSC 135 GS (3)
- 6 credits of physical sciences from EARTH 100 GN (3), EARTH 103 GN (3), EARTH 111 GN (3), GEOG 010 GN (3), GEOG 110 GN (3), GEOSC 001 (3), GEOSC 010 GN (3), GEOSC 040 GN (3), METEO 003 GN (3), METEO 122 GN (3), MICRB 106 GN (3), MICRB 201 (3)
- 6-8 credits of GN from PHYS 001 GN (3), PHYS 150 GN (3), PHYS 151 GN (3), PHYS 211 GN (4), PHYS 213 GN (2), PHYS 250 GN (4), PHYS 251 GN (4)
- 3 credits of geospatial analysis from FOR 455 (3), GEOG 362 (3), GEOG 363 (3), GEOG 364 (3) or SOILS 450 (3)
- 6 credits of resources management from ASM 327 (3), CED 201 (3), CED 427W (3), CED 429 (3), CED 431W (3), CED 450 IL (3), ERM 411 (3), ERM 412 (3), ERM 413W (3), FOR 410 (3), FOR 440 (3), GEOG 411W (3), GEOG 430 (3), GEOG 431 (3), SOILS 422 (3)
- 9 credits of water sciences from ASM 309 (3), CE 360 (3), CE 370 (3), CE 371 (3), ERM 435 (3), ERM 447 (3), ERM 450 (3), ENVE 411 (3), ENVE 415 (3), ENVSE 408 (3), GEOG 310W (3), GEOG 311 (3), GEOG 412W (3), GEOSC 412 (3), GEOSC 413W (3), GEOSC 440 (3), GEOSC 452 (3), METEO 451 (3), METEO 454 (3), SOILS 405 (3), WFS 422 (3). **Three credits must be at the 400-level.**
- 3 additional credits at the 300- or 400-level from the lists above.

\* Courses requiring at least a C grade.

**Recommended Academic Plan for Forest Ecosystem Management - Watershed Management,  
Commonwealth Campuses and University Park, Effective Fall 2013**

Semester 1 (fall)	Credits	Semester 2 (spring)	Credits
First-Year Seminar	1-3	<i>MATH 111 or 141</i> (GQ)	2-4
<b><i>MATH 110 or 140</i></b> (GQ)	4	<i>CHEM 110</i> (GN) Chemical Principles	3
<i>ENGL 015 or 030</i> (GWS) Rhetoric & Comp	3	<i>CHEM 111</i> (GN) Experimental Chem.	1
Humanities (GH)	3	<b><i>STAT 200, 240, or 250</i></b> (GQ) Statistics	3-4
<i>ECON 102</i> (GS) Microeconomics	3	<i>CAS 100</i> (GWS) Effective Speech	3
	credits:		credits:
	14-16		12 -15
Semester 3	Credits	Semester 4	Credits
<b>FOR 200</b> Profession of Forestry	1	<b>FOR 266</b> Forest Resource Measurements	4
<b>FOR 203</b> Field Dendrology	3	<i>PHYS GN</i> selection from list	3-4
<b>FOR 255</b> GIS for Natural Resources	3	Social Sciences GS selection from list	3
<i>SOILS 101</i> (GN) Introduction to Soils	3	<i>ENGL 202C or 202D</i> (GWS)	3
Arts (GA)	3	Humanities (GH)	3
Health and Physical Activity (GHA)	1.5		
	credits:		credits:
	14.5		16-17
Semester 5	Credits	Semester 6	Credits
FOR 308 Forest Ecology	3	<b>FOR 470</b> Watershed Hydrology	3
<i>PHYS GN</i> selection from list	3-4	<b>FOR 471</b> Watershed Measur em Techniques	1
Resources Management selection from list	3	Physical Sciences selection from list	3
FOR 475 Forest Soils, or Geospatial Analysis selection from list	3	FOR 409 Tree Physiology <u>and</u> <i>SOILS 102</i> , or Geospatial Analysis selection from list	3
Water Sciences selection from list	3	Social Sciences GS selection from list	3
		Health and Physical Activity (GHA)	1.5
	credits:		credits:
	15-16		14.5
Semester 7	Credits	Semester 8	Credits
<b>FOR 421</b> Silviculture	3	<b>FOR 400</b> Senior Forest Practicum	2
Physical Sciences selection from list	3	Resources Management selection from list	3
Water Sciences selection from list	3	<b>FOR 450W</b> Human Dimensions Nat Res	3
Arts (GA)	3	Water Sciences selection from list	3
Free Electives	2-4	Three additional credits at the 300- or 400-level from selection lists	3
		Free Electives	2-5
	credits:		credits:
	14-16		16-19

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**Academic Advising Notes:**

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## Internships, Independent Study, and Work Experience

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Practical work or research experience that supplements a student's course work is a valuable asset when seeking employment after graduation. All Forest Ecosystem Management students are encouraged to get related work experience through either summer jobs or internships. Academic credit can be awarded for internship work experiences; however, it is not required (with the exception of the CURFM option). A handbook of guidelines for FOR/WFS 495 internships is available in the Ecosystem Science and Management Undergraduate Programs Office, 113 Forest Resources Building. These guidelines must be followed before a student registers for internship credits. Students must have a minimum cumulative 2.0 GPA in order to register for internship credits.

The Ecosystem Science and Management Internship Handbook is also available online at: <http://ecosystems.psu.edu/students/handbooks/internship-handbook/view>

The Ecosystem Science and Management Department maintains an employment webpage to assist students in their search for related experience. This page includes job, internship, and graduate assistantship openings, as well as links to natural resources employers. It is important to remember that this is only one resource and that an effective job search may utilize a variety of sources.

The Ecosystem Science and Management employment webpage is: <http://ecosystems.psu.edu/students/employment/openings>.

## Study Abroad

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### Office of International Programs

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Staff in the College of Agricultural Sciences Office of International Programs are available to help students find the right program and identify financial support. Learn more at <http://agsci.psu.edu/international>.

### Office of Global Programs

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The Penn State University Office of Global Programs also offers help in planning an international experience. Penn State has more than 180 summer, semester and full-year programs in more than 45 countries! More than 60 of these programs are either specially designed, semester-length programs or are reciprocal exchange programs with an international university. The Office of Global Programs also offers numerous other short-term, faculty-led programs. With all these options, it is possible for students in nearly any discipline to study abroad. A listing of these programs may be found at <http://global.psu.edu/>. In addition, Penn State accepts transfer credits from many other programs.

## Course Descriptions

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ASM 217 LANDSCAPE SOIL AND WATER MANAGEMENT (3) Landscape soil and water management and practices including irrigation, hydrology, erosion, open channel, drainage, and impoundments.

ASM 309/ERM 309 MEASUREMENT & MONITORING OF HYDROLOGIC SYSTEMS (3) Introduction to measurement and monitoring equipment/techniques commonly used in analyses and design of hydrologic systems. Prerequisite: PHYS 211 or PHYS 250, CHEM 110.

ASM 327 SOIL AND WATER RESOURCE MANAGEMENT (3) Soil and water management systems and practices including hydrology, surface drainage, open channels, and erosion, subsurface drainage, impoundments and irrigation. Prerequisite: PHYS 250

ACCTG 211 FINANCIAL AND MANAGERIAL ACCOUNTING FOR DECISION MAKING (4) Introduction to the role of accounting numbers in the process of managing a business and in investor decision making. Prerequisite: MATH 021 or 1.5 units of high school algebra.

AGECO 457 (ENT 457) PRINCIPLES OF INTEGRATED PEST MANAGEMENT (3) Integrated study of pest complexes and their management, emphasizing ecological principles drawing on examples from a range of agricultural, forestry and urban systems. This course is designed for sixth, seventh, and eight semester students and graduate students. Prerequisite: Must take two or more of the following: ENT 313, PPEM 405, PPEM 318, or HORT 238

ARCH 316 GA ANALYSIS OF HUMAN SETTLEMENTS: CITIES (3) Analysis of the interrelated factors which determined and shaped the various types of early cities through the nineteenth century.

BIOL 110 GN BIOLOGY: BASIC CONCEPTS AND BIODIVERSITY (4) A study of the evolution of the major groups or organisms including the fundamental concepts of biology.

BIOL 127 GN INTRODUCTION TO PLANT BIOLOGY (3) Cellular structure and organization; physiological processes; classification; reproduction and development; relationship of plant groups. Students who have passed BIOL 240W may not schedule this course.

BIOL 220W BIOLOGY: POPULATIONS AND COMMUNITIES (4) A study of the structures and functions of organismic interactions from simple populations to complex ecosystems. (BIOL 220W, 230W, and 240W each carry only 1 credit of "writing"; all three courses must be taken to meet the writing requirement.) Prerequisite: BIOL 110

BA 250 SMALL BUSINESS MANAGEMENT (3) Analysis of problems of the small firm, particularly for the student who wishes to venture into business. Prerequisite: 3 credits in economics.

BLAW 243 LEGAL ENVIRONMENT OF BUSINESS (3) Social control through law: courts, basic policies underlying individual and contractual rights in everyday society. May not be used to satisfy Smeal College baccalaureate degree requirements. Not available to students who have taken BA 243. Prerequisite: third-semester standing.

CAS 100 GWS EFFECTIVE SPEECH (3) Introduction to speech communication, formal speaking, group discussion, analysis and evaluation of messages. FOREM students may take CAS 100A, 100B or 100C.

CAS 404 CONFLICT RESOLUTION AND NEGOTIATION (3) Theories and strategies important for conceptualizing, developing, and managing conflict negotiation, meditation, and third-party intervention. Prerequisite: CAS 100

CE 360 FLUID MECHANIS (3) Mechanics of fluids; flow in conduits and around bodies, friction and energy loss, fluid measurements. Prerequisite: EMCH 212

CE 370 INTRODUCTION TO ENVIRONMENTAL ENGINEERING (3) Nature and scope of environmental issues; air, water, land impacts; fundamentals and processes of pollution control. Prerequisite: CHEM 110; MATH 111 or MATH 141

CE 371 WATER AND WASTEWATER TREATMENT (3) Water treatment; water storage; design of water distribution and wastewater systems; pumping stations. Prerequisite: CE 360, CE 370

CED 201 INTRODUCTORY ENVIRONMENTAL AND RESOURCE ECONOMICS (3) Apply principles of economics to analyze environmental protection policies and natural resource use decision. Examine contemporary policy issues. Prerequisite: AGBM 101 or ECON 102

CED 309 LAND USE DYNAMICS (3) Theory of land use and land use decision-making. Prerequisite: ECON 102 or equivalent; GEOG 160

CED 409 LAND USE PLANNING AND PROCEDURE (3) General land use planning laws and procedures. Prerequisite: 6 credits of B LAW, CED, ECON, ERM, ERRE, PLSC, REST, SOC, STS (any combination)

CED 417 POWER, CONFLICT, AND COMMUNITY DECISION MAKING (3) Impact of institutions on human interdependence and behavior, the structure of power, and community decision making and public policy. Prerequisite: RSOC 011 or SOC 001

CED 427W SOCIETY AND NATURAL RESOURCE (3) Analysis of the relationships between societal development and enhancement and natural resources. Prerequisite: RSOC 011 or SOC 001 and ENGL 202.

CED 429 NATURAL RESOURCE ECONOMICS (3) Optimal management of resources; roles of markets and other institutions; resources and economic development; public policy. Prerequisite: ECON 302 and MATH 110 or MATH 140.

CED 431 ECONOMIC ANALYSIS OF ENVIRONMENTAL AND RESOURCE POLICIES (3) Economic analysis of environmental and natural resource policies, benefit-cost analysis, non-market valuation techniques; resource damage assessment. Prerequisite: ECON 302.

CED 450 IL INTERNATIONAL DEVELOPMENT, RENEWABLE RESOURCES, AND THE ENVIRONMENT (3) Theories of agricultural and economic development, with particular attention to interactions between development, renewable resources, and the environment. Prerequisite: 6 credits in environmental economics, resource economics, or economics.

CHEM 110 GN CHEMICAL PRINCIPLES (3) Basic concepts and quantitative relations. Students may take only one course for General Education credit from CHEM 110 or CHEM 101. Prerequisite: Satisfactory performance on the Math placement tests – i.e., placement beyond the level of MATH 022; or CHEM 101 and MATH 022 or MATH 041.



CHEM 111 GN EXPERIMENTAL CHEMISTRY (1) Introduction to quantitative experimentation in chemistry. Prerequisite: or concurrent: CHEM 110 or CHEM 106

CHEM 202 FUNDAMENTALS OF ORGANIC CHEMISTRY I (3) Introduction to organic chemistry, with emphasis on the properties of organic compounds of biochemical importance. Because of duplication of subject matter, students may not receive credit for both CHEM 202 and 210. Prerequisite: CHEM 101, 110, or 106.

EARTH 100 GN ENVIRONMENT EARTH (3) Natural processes and their relationship to anthropogenic influences. General principles of global cycles and the role they play in natural hazards, global warming, ozone depletion, etc.

EARTH 103 GN EARTH IN THE FUTURE: PREDICTING CLIMATE CHANGE AND ITS IMPACTS OVER THE NEXT CENTURY (3) Climate predictions for the coming century are utilized to examine potential impacts on regions, sectors of society, and natural ecosystems.

EARTH 111 GN;US WATER: SCIENCE AND SOCIETY (3) Investigation of water behavior and occurrence, its relevance to life, human activities, politics, and society.

EBF 200 GS INTRODUCTION TO ENERGY AND EARTH SCIENCES ECONOMICS (3) Resource use decisions and their effect on local, national, and global development. Prerequisite: ECON 102 and MATH 022 or equivalent.

ECON 102 GS, INTRODUCTORY MICROECONOMIC ANALYSIS AND POLICY (3) Methods of economic analysis and their use; economic aggregates; price determination; theory of the firm; distribution.

ECON 302 GS INTERMEDIATE MICROECONOMIC ANALYSIS (3) Allocation of resources and distribution of income within various market structures with emphasis on analytical tools. Prerequisite ECON 102.

EGEE 211 GS;US SOCIAL LEGACY OF PENNSYLVANIA COAL (3) Survey of coal technologies with economic, social, and political impacts discussed with historical, cultural, and international perspectives.

ENGL 015 GWS RHETORIC AND COMPOSITION (3). Instruction and practice in writing expository prose that shows sensitivity to audience and purpose. Prerequisite: ENGL 004 or satisfactory performance on the English proficiency examination.

ENGL 030 GWS HONORS FRESHMAN COMPOSITION (3) Writing practice for specially qualified and screened students. Students who have passed a special writing test will qualify for this course.

ENGL 202C GWS. EFFECTIVE WRITING: TECHNICAL WRITING (3) Writing for students in scientific and technical disciplines. Prerequisite: ENGL 015 or ENGL 030; fourth-semester standing.

ENGL 202D GWS. EFFECTIVE WRITING: BUSINESS WRITING (3) Writing reports and other common forms of business communication. (A student may take only one course for credit from ENGL 202A, 202B, 202c, and 202D.) Prerequisite: ENGL 015 or ENGL 030; fourth-semester standing.

ENT 313 INTRODUCTION TO APPLIED ENTOMOLOGY (2) Introduction to basic entomology, covering insect diversity, identification, structure and function, and principles of management. Prerequisite: 3 credits of natural science.

ENT 314 MANAGEMENT OF INSECT PESTS OF ORNAMENTALS (2) Diagnosis and management of insect pests on shrubs and trees in the landscape or production nursery. Prerequisite: ENT 313

ENVE 411 WATER SUPPLY AND POLLUTION CONTROL (3) Water supply, wastewater characteristics, design of unit processes for water and wastewater treatment, sludge processing, and related new technologies. Prerequisite: CE 370 or graduate standing.

ENVE 415 HYDROLOGY (3) Watershed response to rainfall events; hydrologic systems; ground water flow. Prerequisite: ENVE 417; and STAT 301 or STAT 401

ENVSE 408 CONTAMINANT HYDROLOGY (3) Mobility of contaminants in aquifers; multiphase flow, transport, retardation and attenuation, vapor mobility, aquifer characterization, mathematical models and aquifer remediation. Prerequisite: GEOSC 452

ENVST 100 GS VISIONS OF NATURE (3) An interdisciplinary introduction to environmental studies, including perspectives from ethics, economics, public policy, art, literature, history, geology, biology, and ecology.

ERM 411 LEGAL ASPECTS OF RESOURCE MANAGEMENT (3) Legal systems and lawmaking processes; property rights in land, water, and wildlife resources; jurisdictional problems in planning resource use. Prerequisite: ECON 102 or AG BM 101; and prerequisite or concurrent ERM 151, CED 152, or EBF 200.

ERM 412 RESOURCE SYSTEMS ANALYSIS (3) The concept of systems; techniques of analysis, including input/output, mathematical programming, and simulation; application to resource systems. Prerequisite: BIOL 220W, ERM 151, ERM 300 and STAT 240; MATH 111 or MATH 141.

ERM 413W CASE STUDIES IN ECOSYSTEM MANAGEMENT (3) Application of biological, physical, and social science principles to ecosystem management problems; introduction to environmental impact analysis and review. Prerequisite: BIOL 220W, SOILS 101. Prerequisite or concurrent: ERM 412

ERM 435 (WFS 435) LIMNOLOGY (3) Biogeochemistry and natural history of freshwater ecosystems. Prerequisite: BIOL 110, BIOL 220W, CHEM 110

ERM 447 STREAM RESTORATION (3) Stream restoration including fluvial geomorphology, stream classification, impairment, sediment transport, stable stream design, and watershed assessment. Prerequisite: ASM 327 or ABE 307 or CE 362

ERM 450 (WFS 450) WETLAND CONSERVATION (3) Wetland types, classification, functions and values; hydrology, soils, and plants; introduction to wetland identification and delineation; wetland regulations. Prerequisite: ERM 300 or WFS 209.

FIN 100 INTRODUCTION TO FINANCE (3) The nature, scope, and interdependence of the institution and individual participants in the financial system. May not be used to satisfy Penn State Business baccalaureate degree requirements. Not available to students who have taken BA 301 or FIN 301. Prerequisite: Third-semester standing.

FOR 200 The Profession of Forestry (1) Introduction to the profession of forestry and related career opportunities. Concurrent: FOR 203

FOR 201 GN GLOBAL CHANGE AND ECOSYSTEMS (3) This course will provide students with an understanding of the climate system, ecosystems, and feedbacks between the two. Prerequisite: 3 credits of science.

FOR 203 FIELD DENDROLOGY (3) Field identification of native and introduced trees and shrubs by leaf, fruit, twig, and bark.

FOR 204 DENDROLOGY (2) Taxonomic and silvical characteristics, ranges, genetic relationships, and uses of important forest tree species. Prerequisite: FOR 203

FOR 228 CHAINSAW SAFETY, MAINTENANCE, AND OPERATION IN FOREST MANAGEMENT (2) Safety, maintenance, skills, and techniques for effective chainsaw operation in forest management. Prerequisite: FOR 203 and WP 203

FOR 242 ELEMENTS OF PROJECT SUPERVISION IN FORESTRY (3) Supervisory techniques developed through an understanding of the behavioral sciences applied to field forestry personnel management. Offered only at the DuBois and Mont Alto campuses.

FOR 255 GPS AND GIS APPLICATIONS FOR NATURAL RESOURCES PROFESSIONALS (3) Using Global Positioning Systems (GPS) and Geographic Information Systems (GIS) for mapping and analysis of natural resources data. Prerequisite: MATH 022 and MATH 026; or MATH 040; or MATH 041; or MATH 110; or MATH 140

FOR 266 FOREST RESOURCES MEASUREMENTS (4) Measurement systems used in forest and wildlife management and urban forestry. Prerequisite: FOR 203; FOR 255; MATH 022 AND MATH 026, MATH 040; or MATH 041; or MATH 110; or MATH 140; STAT 200, STAT 240 or STAT 250

FOR 295 FOREST TECHNOLOGY INTERNSHIP (1-4) Supervised field experience related to the student's major. This course is offered only at the Mont Alto Campus as part of the two-year Forest Technology major. Prerequisite: approval of proposed assignment by instructor prior to registration.

FOR 296 INDEPENDENT STUDIES (1-18)

FOR 297 SPECIAL TOPICS (1-9)

FOR 299 IL FOREIGN STUDIES (1-12)

FOR 303 HERBACEOUS FOREST PLANT IDENTIFICATION AND ECOLOGY (3) Survey of common herbaceous plant taxa occurring within forested habitats in Pennsylvania and eastern North America. Botanical characteristics, ecological interrelations, commercial importance, and field specimen collection methods are covered. Prerequisite: 3 credits in plant or biological sciences.

FOR 308 FOREST ECOLOGY (3) Effect of environment, spacing, and age in trees; forest influences; origin and development of forest communities. Prerequisite or concurrent: FOR 203.

FOR 320 FOREST FIRE MANAGEMENT (2) Principles and concepts involved in managing the forest ecosystem in regard to fire. Prerequisite: FOR 308.

FOR 350 FOREST ECOSYSTEM MONITORING AND DATA ANALYSIS (3) Quantitative approaches for characterization, monitoring, and comparison of forest ecosystems. Prerequisite: STAT 200, STAT 240, STAT 250 or equivalent with a C or higher

FOR 400 SENIOR FOREST PRACTICUM (2) Application of forest management concepts and principles. Students will collect, analyze, and interpret forest management data and present project solutions.

Prerequisite: FOR 203, FOR 255, FOR 266, FOR 308, FOR 421, ECON 102, SOILS 101 and STAT 200, STAT 240 or STAT 250.

FOR 401 URBAN FOREST MANAGEMENT (3) Nature's role in community development, landscapes, arboriculture, administering urban forestry programs, land-use planning and regulatory policy, open-space conservation, civic environmentalism. Prerequisite: Fifth-semester standing.

FOR 403 INVASIVE FOREST PLANTS: Identification, Ecology, and Management (3) Survey of common nonnative ("exotic") herbs, forbs, shrubs, trees, and vines that invade forested habitats in Pennsylvania and the region. Field identification, life history traits, ecosystem-related challenges and problems, and management options and considerations are reviewed. Prerequisite: 6 credits in plant or biological sciences.

FOR 409 TREE PHYSIOLOGY (2) Fundamentals of the relationship of the basic physiological functions of forest trees to form. Prerequisite: BIOL 110 or BIOL 127

FOR 410 ELEMENTS OF FOREST ECOSYSTEM MANAGEMENT (3) Fundamentals of forest ecosystem management for goods and services. Prerequisite: 3 credits in both ecology and biology.

FOR 418 US/IL AGROFORESTRY: SCIENCE, DESIGN, AND PRACTICE (3) Agroforestry integrates trees in agricultural landscapes, and/or agriculture products into forested areas for multiple benefits.

FOR 421 SILVICULTURE (3) The application of the principles of forest ecology to control of establishment, composition, and growth of forest stands. Prerequisite: FOR 308, FOR 266

FOR 430 (W F S) CONSERVATION BIOLOGY (3) The application of biological principles to issues in the conservation of biodiversity. Prerequisite: BIOL 220W or FOR 308 or WFS 209.

FOR 439 TIMBER SALE ADMINISTRATION (3) Practical aspects of the logistical, environmental, managerial, and regulatory oversight of active and retired timber sales. Prerequisite: FOR 203 and FOR 266; and prerequisite or concurrent FOR 421

FOR 440 FOREST AND CONSERVATION ECONOMICS (3) The role and application of economics and finance to forest resource conservation and management. Prerequisite: ECON 102 or ECON 104.

FOR 450W HUMAN DIMENSIONS OF NATURAL RESOURCES (3) Addresses human needs and desires, from individuals to nations, for social, ecological, and economic benefits derived from natural resource decisions. Prerequisite: 6 credits of social and behavioral sciences.

FOR 455 REMOTE SENSING AND SPATIAL DATA HANDLING (3) Remote sensing systems, with emphasis on application to forest ecosystem analysis. Includes introduction to computer systems for spatial data handling. Prerequisite: MATH 110, 3 credits in computer science, 6 credits in ecological and/or geological sciences.

FOR 466W FOREST RESOURCE MANAGEMENT (3) Rationale, process, and tools for forest management decision-making and planning. Developing and communicating forest plans for forested properties. Prerequisite: FOR 255, FOR 421, and FOR 440.

FOR 470 WATERSHED MANAGEMENT (3) Management of wild land watersheds for control of the amount and timing of water yield, water quality, erosion, and sedimentation. Prerequisite: 3 credits in Soils.

FOR 471 WATERSHED MANAGEMENT LABORATORY (1) Introduction to hydrologic and climatic measurements and computations useful in watershed management. Prerequisite or concurrent: FOR 470.

FOR 475 PRINCIPLES OF FOREST SOILS MANAGEMENT (3) Effect of current forest management practices on the properties and productive capacity of forest soils. Prerequisite: FOR 308 and 3 credits in soils.

FOR 480 POLICY AND ADMINISTRATION (3) Forest resources policy objectives; criteria and goals of society; policy implementation by ownership classes; planning, administration, and evaluation of programs. Prerequisite: 3 credits of social or behavioral science.

FOR 488Y IL GLOBAL FOREST CONSERVATION (3) Ecological, economic, technological, and political aspects of forested ecosystems in a global context, emphasizing tropical and developing countries. Prerequisite: 3 credits in natural sciences and 3 credits in social and behavioral sciences.

FOR 494 UNDERGRADUATE RESEARCH (3) Supervised student activities on research projects identified on an individual or small group basis. Prerequisite: Permission of the Forest Ecosystem Management Program.

FOR 495 FORESTRY INTERNSHIP (1-6) Supervised field experience related to the student's major. Prerequisite: approval of proposed assignment by instructor prior to registration.

FOR 496 INDEPENDENT STUDIES (1-18)

FOR 497 SPECIAL TOPICS (1-9)

FOR 499 IL FOREIGN STUDIES (1-12)

GEOG 010 GN PHYSICAL GEOGRAPHY: AN INTRODUCTION (3) Survey and synthesis of processes creating geographical patterns of natural resources, with application of basic environmental processes in resource management.

GEOG 020 GS;US;IL HUMAN GEOGRAPHY: AN INTRODUCTION (3) Spatial perspective on human societies in a modernizing world; regional examples; use of space and environmental resources; elements of geographic planning.

GEOG 030 GS;IL GEOGRAPHIC PERSPECTIVES ON SUSTAINABILITY AND HUMAN-ENVIRONMENTAL SYSTEMS (3) Introduction to theory, methods, history and contemporary issues in global and regional relationships between human activity and the physical environment.

GEOG 110 GN CLIMATES OF THE WORLD (3) Introduction to climatology, including principal processes of the global climatic system and their variation over space and time.

GEOG 130 GS ENVIRONMENT, POWER, AND JUSTICE (3) This course explores contemporary themes in human-environment relations through the lens of political ecology.

GEOG 160 GS MAPPING OUR CHANGING WORLD (3) Fundamental concepts of GIS, cartography, remote sensing, and GPS in the context of environmental and social problems.

GEOG 310W INTRODUCTION TO GLOBAL CLIMATIC SYSTEMS (3) Introduction to global atmospheric circulation, including tropical, midlatitude and polar substations; ocean, land, cryospheric and urban climatic systems and interactions. Prerequisite: GEOG 010 or METEO 003

GEOG 311 LANDSCAPE ECOLOGY (3) This course examines the ways in which spatial patterns and spatial processes operate in an ecological context. Prerequisite: GEOG 314, BIOL 110, FOR 308, or WFS 209 or by permission.

GEOG 362 IMAGE ANALYSIS (3) Introduction to the basic principles of remote sensing and the analysis of aerial and satellite data. Prerequisite: GEOG 160.

GEOG 363 GEOGRAPHIC INFORMATION SYSTEMS (3) Principles and use of geographic information; emphasis is on data acquisition and techniques for computer-aided analysis. Prerequisite: GEOG 160

GEOG 364 SPATIAL ANALYSIS 1 (3) Geographic measurement, scaling, and classification; analysis of spatial pattern and structure; geographic covariation and autocorrelation. Prerequisite: STAT 200 and 6 credits in social science.

GEOG 411W FOREST GEOGRAPHY (3) This course studies processes that control spatial and temporal change in forests. Prerequisite: GEOG 010, GEOG 111; or BIOL 220W

GEOG 412W CLIMATIC CHANGE AND VARIABILITY (3) Theories and observations of past, present, and future climatic change and variability; introduction to techniques used in climatic change research. Prerequisite: GEOG 110 or METEO 003

GEOG 430 HUMAN USE OF ENVIRONMENT (3) The human use of resources and ecosystems and social causes and consequences of environmental degradation in different parts of the world; development of environmental policy and management strategies. Prerequisite: GEOG 010 or GEOG 020 or GEOG 030 or GEOG 040 or GEOG 130 or permission of the program.

GEOG 431 GEOGRAPHY OF WATER RESOURCES (3) Perspectives on water as a resource and hazard for human society; water resource issues in environmental and regional planning. Prerequisite: 6 credits in geography or natural sciences.

GEOSC 001 PHYSICAL GEOLOGY (3) Earth processes and their effects on the materials, structure, and morphology of the earth's crust. Practicum includes field work, study of rocks, minerals, dynamic models, and topographic maps. (This course includes from one to several field trips for which an additional charge will be made to cover transportation.)

GEOSC 010 GN GEOLOGY OF THE NATIONAL PARKS (3) Introduction to geology, geological change, and environmental hazards, as seen in the National Parks.

GEOSC 040 GN THE SEA AROUND US (3) Introduction to marine sciences and the world ocean, including physical, chemical, biological, and geological aspects of oceanography.

GEOSC 412 WATER RESOURCES GEOCHEMISTRY (3) Aqueous geochemistry of silica, alumina, carbonate minerals, and selected metals; organic species in water; isotope geochemistry applied to water. Prerequisite: CHEM 110, CHEM 112

GEOSC 413W TECHNIQUES IN ENVIRONMENTAL GEOCHEMISTRY (3) This course teaches techniques needed for the collection, chemical analysis, and data analysis of environmental geochemical measurements. This course has one or more required field trips for which a fee is charge to the student. Prerequisite: One of the following: CE 475, CHEM 402, GEOSC 202, GEOSC 412, SOILS 419

GEOSC 440 MARINE GEOLOGY (3) Chemical and physical processes affecting the topography and sediments of the sea floor. Prerequisite: fourth-semester standing

GEOSC 452 HYDROGEOLOGY (3). Hydrologic cycle: occurrence, movement, quality, and quantity of groundwater; quantitative geologic and hydrologic methods; role of water in geologic processes. Prerequisite: CHEM 112; GEOSC 001, GEOSC 020 or GEOSC 071; MATH 140 or MATH 110.

HORT 138 ORNAMENTAL PLANT MATERIALS (3) Identification and description under spring conditions; discussion of cultural and aesthetic aspects of shrubs of value in ornamental plantings.

HORT 201 APPLIED ARBORICULTURE (2) Overview of methods used to diagnose problems and provide for the long term care of large trees. Prerequisite: Students must be physically capable of safely handling a running chainsaw and pulling their weight up a rope.

HORT 301 PRINCIPLES OF ARBORICULTURE (3) Overview of the concepts and methods prescribed for the evaluation and care of large trees in urban settings. Prerequisite: BIOL 110 and SOILS 101

HORT 408 LANDSCAPE PLANT ESTABLISHMENT AND MAINTENANCE (4) The principles and practices involved in the establishment of plants in the landscape, and their subsequent maintenance. Prerequisite: HORT 137 or HORT 138; SOILS 101

HORT 445 PLANT ECOLOGY (3) Advanced lectures on plant ecology which stress integration of physiological, population-level and community-level phenomena, and ecology in agriculture. Prerequisite: BIOL 220W, FOR 308, or HORT 315.

LARCH 060 GA US;IL HISTORY OF LANDSCAPE ARCHITECTURE (3) A survey of the historical development of outdoor space in relationship to allied arts from early beginnings to this century.

LARCH 065 GA US;IL BUILT ENVIRONMENT AND CULTURE (3) Investigates the relationship between socio-cultural practices and the development and organization of contemporary built environments.

LARCH 241 ECOLOGICAL PRINCIPLES FOR LANDSCAPE DESIGN (3) The development of basic ecological knowledge that becomes the basis for sensitive ecological design. Prerequisite: LARCH majors only or permission of the program.

LARCH 341 PLANTS, PEOPLE, AND PLACE: PLANTS IN LANDSCAPE ARCHITECTURAL DESIGN (3) The ecological, historic, and aesthetic values of native and ornamental herbaceous and woody plants and their use in landscape design. Prerequisite: LARCH 241

MATH 022 GQ COLLEGE ALGEBRA II AND ANALYTIC GEOMETRY (3) Relations, functions, graphs; polynomial, rational functions, graphs; word problems; nonlinear inequalities; inverse functions; exponential, logarithmic functions; conic sections; simultaneous equations. Prerequisite: MATH 021 or satisfactory performance on the mathematics placement examination.

MATH 026 GQ PLANE TRIGONOMETRY (3) Trigonometric functions; solutions of triangles; trigonometric equations; identities. Prerequisite: MATH 021 or satisfactory performance on the mathematics placement examination.

MATH 040 GQ ALGEBRA, TRIGONOMETRY, AND ANALYTIC GEOMETRY (5) Concepts of algebra; equations; inequalities; functions; graphs; polynomial and rational geometry; complex numbers. Prerequisite: satisfactory performance on the mathematics placement examination.

MATH 041 GQ TRIGONOMETRY AND ANALYTIC GEOMETRY (3-4) Straight lines; circles; functions and graphs; graphs of polynomial and rational functions; exponential and logarithmic functions; trigonometry; conic sections. Prerequisite: MATH 021 or satisfactory performance on the mathematics placement examination.

MATH 110 GQ TECHNIQUES OF CALCULUS I (4) Functions, graphs, derivatives, integrals, techniques of differentiation and integration, exponentials, improper integrals, applications. Students may only take one course for credit from MATH 110, 140, 140A, and 140B. Prerequisite: MATH 022; MATH 040; MATH 041; or satisfactory performance on proficiency examination.

MATH 140 GQ CALCULUS WITH ANALYTIC GEOMETRY I (4) Functions, limits; analytic geometry; derivatives, differentials, applications; integrals, applications. Students may only take one course for credit from MATH 110, 140, 140A, and 140B and 140H. Prerequisite: MATH 022, MATH 026; MATH 026 and satisfactory performance on the mathematics placement examination; MATH 040 or MATH 041; satisfactory performance on the mathematics placement.

MATH 141 GQ CALCULUS WITH ANALYTIC GEOMETRY II (4) Derivatives, integrals, applications; sequences and series; analytic geometry; polar coordinates. Students may take only one course for credit from MATH 141, 141B, and 141H. Prerequisite: MATH 140; MATH 140A; MATH 140B; MATH 140E; MATH 140G; MATH 140H.

METEO 003 GN INTRODUCTORY METEOROLOGY (3) Nontechnical treatment of fundamentals of modern meteorology; effect of water and climate on man and his activities. A student who took METEO 002 may take the laboratory part of this course for 1 credit only.

METEO 122 (AGECO 122) GN ATMOSPHERIC ENVIRONMENT: GROWING IN THE WIND (3) Students will learn about the effect of weather on plants, animals, and humans.

METEO 451 INTRODUCTION TO PHYSICAL OCEANOGRAPHY (3) Air-sea interaction, wind-driven and thermohaline circulations, upswelling, El Nino, waves, and tides. Prerequisite: METEO 421

METEO 454 INTRODUCTION TO MICROMETEOROLOGY (3) Physical processes and their measurement in the lowest layers of the atmosphere; application to hydrology, plant systems, and air pollution. Prerequisite: METEO 421 and METEO 431 or EME 301.

MICRB 106 GN ELEMENTARY MICROBIOLOGY (3) Importance of microorganisms in health and disease, agriculture, and industry; descriptive course for students not planning advanced study in microbiology. The combination of MICRB 106 GN and 107 GN must be taken to receive General Education credit in biology.

MICRB 201 INTRODUCTORY MICROBIOLOGY (2) Elementary ecological relationships of microorganisms in the biosphere; role of bacteria in water pollution and purification. This course should not be scheduled by students who have taken MICRB 201 or 202. Prerequisite: CHEM 202.

MGMT 100 SURVEY OF MANAGEMENT (3) Introduction to organizational factors relevant to management processes, including leadership, motivation, job design, technology, organizational design and environments, systems, change. May not be used to satisfy Smeal College baccalaureate degree requirements. Not available to students who have taken BA 304 or MGMT 301.



MKTG 221 CONTEMPORARY AMERICAN MARKETING (3) Social and economic aspects, movement of goods and services from producers to consumers; analysis of marketing functions, systems, and institutions. May not be used to satisfy Penn State Business baccalaureate degree requirements. Not available to students who have taken BA 303 or MKTG 301. Prerequisite: 3 credits in economics.

PHYS 001 GN THE SCIENCE OF PHYSICS (3) Historical development and significance of major concepts, with emphasis on the nature of physics and its role in modern life.

PHYS 150 GN TECHNICAL PHYSICS I (3) Elementary treatment of topics in mechanics, heat, wave motion, and sound leading toward an understanding of technical applications. Prerequisite: 1 ½ units of algebra. Prerequisite or concurrent: MATH 021 or MATH 081.

PHYS 151 GN TECHNICAL PHYSICS II (3) Elementary treatment of topics in electricity, light, and modern physics leading toward an understanding of technical applications. Prerequisite: PHYS 150

PHYS 211 GN GENERAL PHYSICS: MECHANICS (4) Calculus-based study of the basic concepts of mechanics: motion, force, Newton's laws, energy, collisions, and rotation. Concurrent: MATH 140

PHYS 213 GN GENERAL PHYSICS: FLUIDS AND THERMAL PHYSICS (2) Calculus-based study of the basic concepts of fluids and sound, heat, kinetic theory, and entropy. Prerequisite: MATH 140, PHYS 211. Concurrent: MATH 141

PHYS 250 GN INTRODUCTORY PHYSICS I (4) Selected topics in mechanics, heat, and sound. Prerequisite: MATH 022, MATH 026; or MATH 040; or MATH 041 or satisfactory performance on math proficiency exam.

PHYS 251 GN INTRODUCTORY PHYSICS II (4) Selected topics in light, electricity, magnetism. Prerequisite or concurrent: PHYS 250 GN.

PL SC 001 GS INTRODUCTION TO AMERICAN NATIONAL GOVERNMENT (3) Introduction to development and nature of American political culture, constitution/structural arrangements, electoral/policy processes; sources of conflict and consensus.

PLSC 135/STS 135 GS THE POLITICS OF THE ECOLOGICAL CRISIS (3) The political implications of the increasing scarcity of many of the world's resources.

PPEM 318 DISEASES OF FOREST AND SHADE TREES (2) Introduction to diagnosis and management of forest and shade tree diseases.

RPTM 320 RECREATION RESOURCE PLANNING AND MANAGEMENT (3) Relationship between leisure behavior and natural environment. Exploration of natural resources which enhance leisure.

RPTM 325 PRINCIPLES OF ENVIRONMENTAL INTERPRETATION (3) Introduction, history, practice, and principles of contemporary interpretive activities common to natural and cultural history program sites.

RPTM 435 RECREATION FACILITIES PLANNING AND MANAGEMENT (3) Planning and management of selected facilities with emphasis upon maintenance, activity, and support provisions. Prerequisite: fifth-semester standing or above.

RPTM 470 RECREATION AND PARK MANAGEMENT (3) Management of recreation and park services in public/non-profit settings; planning, budgeting fiscal development, resources allocation, decision-making, computer applications. Prerequisite: RPTM 320

SOILS 101 GN INTRODUCTORY SOIL SCIENCE (3) A study of soil properties and processes and relationships to land use, plant growth, environmental quality, and society.

SOILS 102 INTRODUCTORY SOIL SCIENCE LABORATORY (1) Laboratory exercise and field trips designed to develop student competency in soil description, analysis, and assessment. Prerequisite: SOILS 101  
Concurrent: SOILS 101

SOILS 405 (GEO SC 405) HYDROPEDOLOGY (3) Soil and water interactions across scales, integrated studies of landscape-soil-water relationships, fundamental processes of water flow and chemical transport. Prerequisite: SOILS 101

SOILS 422 NATURAL RESOURCES CONSERVATION AND COMMUNITY SUSTAINABILITY (4) Conservation, land-use, and community (soil, water, air, plants, animals, and humans) impacting quality of life and sense of place. Prerequisite: SOILS 101

SOILS 450 ENVIRONMENTAL GEOGRAPHIC INFORMATION SYSTEMS (3) Use of geographic information systems (GIS) and digital spatial databases to characterize landscapes for environmental assessment and management. Prerequisite: SOILS 101

STAT 200 GQ ELEMENTARY STATISTICS (4) Descriptive statistics, frequency distributions, probability, binomial and normal distributions, statistical inference, linear regression, and correlation. Prerequisite: Placement into MATH 021 or higher.

STAT 240 GQ INTRODUCTION TO BIOMETRY (3) Statistical analysis, sampling, and experimentation in the agricultural sciences; data collection, descriptive statistics, statistical inference, regression, one factor AOV, probability. Students may take only one course from STAT 200, 220, 240, 250 for credit. Prerequisite: Placement into MATH 021 or higher.

STAT 250 GQ INTRODUCTION TO BIOSTATISTICS (3) Statistical analysis and interpretation of data in the biological sciences; probability; distributions; statistical inference for one- and two-sample problems. Prerequisite: Placement into MATH 021 or higher.

WFS 209 GN WILDLIFE AND FISHERIES CONSERVATION (3) Survey of current and historical issues in wildlife and fisheries conservation; emphasis on vertebrate biodiversity, habitat management and protection, and populations. Prerequisite: BIOL 110

WFS 422 ECOLOGY OF FISHES (3) Role of fishes in aquatic communities and general ecosystems. Environmental factors influencing fish as individuals, populations, and communities. Prerequisite: BIOL 220W or WFS 209.

WFS/ERM 435 LIMNOLOGY (3) Biogeochemistry and natural history of freshwater ecosystems. Prerequisite: BIOL 110 , BIOL 220W , CHEM 110.

## Ecosystem Science and Management Undergraduate Course Offerings by Semester at University Park

*These offerings are subject to change as circumstances require*

Course	Title (cr.)	Fall 2016	Spring 2017	Fall 2017	Spring 2018	Fall 2018	Spring 2019	Fall 2019	Spring 2020
FOR 200	Forest Profession (1)	X		X		X		X	
FOR 203	Field Dendrology (3)	X		X		X		X	
FOR 204	Dendrology (2)		X		X		X		X
FOR 228	Chnsaw in For Mgmt (1)		X		X		X		X
FOR 255	GPS/GIS Nat Res (3)	X	X	X	X	X	X	X	X
FOR 266	For Res Measurements (4)		X		X		X		X
FOR 303	Forest Herbs (3)		X		X		X		X
FOR 308	Forest Ecology (3)	X		X		X		X	
FOR 320	Forest Fire Mgmt (2)		X		X		X		
FOR 350	For Monit & Analy (3)		X		X		X		X
FOR 400	Senior Practicum (2)		X		X		X		X
FOR 401	Urban Forest Mgmt (3)	X		X		X		X	
FOR 403	Invasive Plants (3)	X		X		X		X	
FOR 409	Tree Physiology (2)		X				X		
FOR 410	Forest Ecosys Mgmt (3)		X		X		X		X
FOR 418	Agroforestry (3)				X				X
FOR 421	Silviculture (3)	X		X		X		X	
FOR 430	Conservation Biol (3)	X		X		X		X	
FOR 439	Timber Sale Admin (3)	X		X		X		X	
FOR 440	For & Consv Econ (3)	X		X		X		X	
FOR 450W	Hum Dimen Nat Res (3)		X		X		X		X
FOR 455	Rem Sens & Spa Dat (3)		X		X		X		X
FOR 466W	For Mgmt & Plan (3)		X		X		X		X
FOR 470	Watershed Mgmt (3)		X		X		X		X
FOR 471	Watershed Mgmt Lab (1)		X		X				X
FOR 475	Forest Soils Mgmt (3)	X		X		X		X	
FOR 480	Policy & Adm (3)		X		X		X		X
FOR 488Y	Global Forest Cons (3)		X				X		
SOILS 071	Env Sustainability (3)		X		X		X		X
SOILS 101	Intro Soil Science (3)	X	X	X	X	X	X	X	X
SOILS 102	Intro Soil Science Lab (3)	X	X	X	X	X	X	X	X
SOILS 401	Soil Comp/Phy Prop (3)		X		X		X		X
SOILS 402	Soil Nutr Behav (3)		X		X		X		X
SOILS 403	Soil Morph Prac (2)	X		X		X		X	
SOILS 404	Urban Soils (3)		X		X		X		X
SOILS 405	Hydropedology (3)	X		X		X		X	
SOILS 412W	Soil Ecol (3)	X		X		X		X	
SOILS 416	Soil Gen Class Map (4)	X		X		X		X	
SOILS 418	Nutr Mgmt Ag Sys (3)	X		X		X		X	
SOILS 420	Soil Remediation (3)	X		X		X		X	
SOILS 422	Natural Res Cons (4)		X		X		X		X
SOILS 450	Environmental GIS (3)	X		X		X		X	
SOILS 489	Supv Exp Col Tchg (1-3)	X	X	X	X	X	X	X	X
WFS 209	Wild/Fish Conservation (3)	X	X	X	X	X	X	X	X
WFS 300	The Vertebrates (2)								
WFS 301	Vertebrate Laboratory (2)	X		X		X		X	
WFS 310	W F S Measurements (3)	X		X		X		X	

Course	Title (cr.)	Fall 2016	Spring 2017	Fall 2017	Spring 2018	Fall 2018	Spring 2019	Fall 2019	Spring 2020
WFS 406	Ornithology Lab (2)		X		X		X		X
WFS 407	Ornithology (3)		X		X		X		X
WFS 408	Mammalogy (3)		X		X		X		X
WFS 409	Mammalogy Lab (2)		X		X		X		X
WFS 410	Fisheries Science (3)	X		X		X		X	
WFS 422	Ecology of Fish (3)	X				X			
WFS 430	Conservation Biology (3)								
WFS 435	Limnology (3)	X		X		X		X	
WFS 446	Wildl Fish Pop Dyn (3)		X		X		X		X
WFS 447W	Wildl Management (3)	X		X		X		X	
WFS 450	Wetland Conservation (3)	X		X		X		X	
WFS 452	Ichthyology (2)	X		X		X		X	
WFS 453	Ichthyology Lab (2)	X		X		X		X	
WFS 460	Wildlife Behavior (3)	X		X		X		X	
WFS 462	Amphibians and Reptiles (3)		X		X		X		X
WFS 463W	Fishery Management (3)		X		X		X		X



*The University is committed to equal access to programs, facilities, admission and employment for all persons. It is the policy of the University to maintain an environment free of harassment and free of discrimination against any person because of age, race, color, ancestry, national origin, religion, creed, service in the uniformed services (as defined in state and federal law), veteran status, sex, sexual orientation, marital or family status, pregnancy, pregnancy-related conditions, physical or mental disability, gender, perceived gender, gender identity, genetic information or political ideas. Discriminatory conduct and harassment, as well as sexual misconduct and relationship violence, violates the dignity of individuals, impedes the realization of the University's educational mission, and will not be tolerated. Direct all inquiries regarding the nondiscrimination policy to Dr. Kenneth Lehrman III, Vice Provost for Affirmative Action, Affirmative Action Office, The Pennsylvania State University, 328 Boucke Building, University Park, PA 16802-5901, Email: [kfl2@psu.edu](mailto:kfl2@psu.edu), Tel (814) 863-0471.*