# ENVIRONMENTAL ENGINEERING SCIENCES

## Program Information

Graduate study is offered leading to the degrees Master of Engineering, Master of Science, and Doctor of Philosophy in the field of environmental engineering sciences. Our graduate research and education areas are

### Air Resources

- Monitoring of air pollutants: indoor, ambient, industrial, and occupational
- Monitoring methodology and instrumentation development
- Formation and fate of air pollutants
- Air quality modeling
- Air pollution control: system, process and materials
- Sustainability of air quality
- Health effects and environmental impact of air pollutant

### Environmental Nanotechnology

- Manufacturing and tailoring of nanomaterials and nanodevices for application in environmental and human health research
- Environmental fate and transport of nanomaterials
- Environmental implications of nanomaterials

### Engineering Education Collaborative

- Student-centered learning and design based apprenticeship
- Problem solving and critical thinking
- Diversity and cultures of inclusion
- Role of informal learning environments
- Universal design for STEM students with (learning) disabilities

### GeoSystem Engineering/Waste Management

- Bioreactor Landfills
- Combustion and Thermal Treatment Residuals
- Contaminated Soil Characterization and Treatment
- Construction and Demolition Debris
- Electronic Waste
- Hazardous Waste
- Landfill Design and Operations
- Landfill Gas and Leachate
- Recycling and Beneficial Use of Wastes
- Treated Wood
- Waste Characterization and Leaching
- Solid Waste Management in Developing Countries

### Stormwater, Water Supply and Wastewater

- Fundamental characterization of aqueous and particulate-phase contaminants including emerging contaminants: representative ambient monitoring, methodology and load quantification.
- Sourcing and generation of aqueous and particulate phase contaminants, physics and chemistry of contaminant transport and fate.
- Water contaminant control: systems, unit operation and processes, and materials development, in particular innovative mass transfer materials and low impact development materials.
- Water reuse as part of the urban water cycle: volumetric and contaminant load impacts
- Unit operation and process modeling: scalable physical models and computational fluid dynamics (CFD).
- Integrated physical, chemical, biological and thermal treatment phenomena for water cycle components.
- Coupling fundamental monitoring and material balance testing with urban water modeling.
- Fundamental and applied studies of physical-chemical water treatment processes, such as adsorption, coagulation, ion exchange, and oxidation, for a wide range of water qualities including surface water, groundwater, membrane concentrate, landfill leachate, and human urine.
- Innovative applications of ion exchange for water treatment.
- Fundamental studies in aquatic chemistry with a focus on the role of natural organic matter.
- Fundamental and applied studies of adsorption and photocatalysis, including surface optimization
- Bottom up integrated urban water system simulation and optimization

### Sustainability Science & Engineering

- Rational design of nanomaterial through acute and full-life-cycle toxicity assessment
- Life cycle assessment calculations and comparisons of alternative energy and materials options
- Industrial ecology
- Corporate water resources sustainability
- Campus green building codes
- Green laboratory techniques
- Operation of buildings to meet green energy requirements

### Systems Ecology and Ecological Engineering

- Ecological Engineering
- Emergy Analysis and Environmental Economics
- Wetlands and Watershed Ecology
- Ecological Modeling
- Community and Conservation Ecology
- Environmental Policy
- Microbiology of Natural and Engineered Systems
- Biological and Chemical Remediation of Contaminated Systems
- Effects of Climate and Land Use Changes on Biogeochemical Cycles

### Water Systems

- Contaminant transport and fate
- Decision support systems
- Ecohydrology and hydrologic restoration
- Hydrology
- Stormwater control
- Water resources planning and management
- Water conservation

- Fundamental characterization of aqueous and particulate-phase contaminants including emerging contaminants: representative ambient monitoring, methodology and load quantification.
- Sourcing and generation of aqueous and particulate phase contaminants, physics and chemistry of contaminant transport and fate.
- Water contaminant control: systems, unit operation and processes, and materials development, in particular innovative mass transfer materials and low impact development materials.
- Water reuse as part of the urban water cycle: volumetric and contaminant load impacts
- Unit operation and process modeling: scalable physical models and computational fluid dynamics (CFD).
- Integrated physical, chemical, biological and thermal treatment phenomena for water cycle components.
- Coupling fundamental monitoring and material balance testing with urban water modeling.
- Fundamental and applied studies of physical-chemical water treatment processes, such as adsorption, coagulation, ion exchange, and oxidation, for a wide range of water qualities including surface water, groundwater, membrane concentrate, landfill leachate, and human urine.
- Innovative applications of ion exchange for water treatment.
- Fundamental studies in aquatic chemistry with a focus on the role of natural organic matter.
- Fundamental and applied studies of adsorption and photo catalysis, including surface optimization
- Bottom up integrated urban water system simulation and optimization
- Aqueous Geochemistry and Water Treatment

Graduate students can also combine one or more of the above areas with specialties in other departments at the University of Florida.

The department participates in the hydrologic sciences interdisciplinary concentration that is offered through 9 departments in 3 colleges. This concentration is described under Interdisciplinary Graduate Studies.

Direct admission into the Master of Science and Doctor of Philosophy programs requires a bachelor's degree in engineering or in a basic science such as chemistry, geology, physics, biology, or mathematics. Persons with a degree in a nontechnical field may also be admitted into this program after completing appropriate technical courses. Direct admission into the Master of Engineering program requires a bachelor's degree in engineering from an ABET-accredited institution.

Requirements for a master's degree normally take 12 to 24 months to complete. The length of time required for the Doctor of Philosophy degree depends partly on the research topic, and may be completed in 3 years, but often takes longer, depending on prior academic experience.

**Combination degree program:** The department offers a combination bachelor's/master's degree program. This program allows qualified students to earn both a bachelor's degree and a master's degree, with a savings of 12 credits.

**Joint program:** The Environmental Engineering Sciences Department, in partnership with the Levin College of Law, offers a joint program leading to the M.S. or M.E. degree in environmental engineering sciences and the Juris Doctor degree. Twelve credits of appropriate course work are counted toward both degrees.

For more information, please see our website: http://www.essie.ufl.edu.

## Degrees Offered

# Degrees Offered with a Major in Environmental Engineering Sciences

- Doctor of Philosophy
  - without a concentration
  - concentration in Geographic Information Systems
  - concentration in Hydrologic Sciences
  - concentration in Wetland Sciences
- Master of Engineering
  - without a concentration
  - concentration in Geographic Information Systems
  - concentration in Hydrologic Sciences
  - concentration in Wetland Sciences
- Master of Science
  - without a concentration
  - concentration in Geographic Information Systems
  - concentration in Hydrologic Sciences
  - concentration in Wetland Sciences

Requirements for these degrees are given in the Graduate Degrees (http://gradcatalog.ufl.edu/graduate/degrees/) section of this catalog.

## Courses

# Environmental Engineering Sciences Program Courses

| Code | Title | Credits |
|---|---|---|
| CWR 6116 | Advanced Surface Hydrology | 3 |
| CWR 6252 | Environmental Biochemistry of Trace Metals | 3 |
| CWR 6537 | Contaminant Subsurface Hydrology | 3 |
| EES 5245 | | 3 |
| EES 5305C | | 3 |
| EES 5306 | | 3 |
| EES 6307 | Advanced Ecological Engineering | 3 |
| EES 5415 | | 3 |
| EES 6007 | Advanced Energy and Environment | 3 |
| EES 6051 | Advanced Environmental Planning and Design | 3 |
| EES 6208 | Principles of Water Chemistry I | 3 |
| EES 6225 | Atmospheric Chemistry | 3 |
| EES 6308C | | 3 |
| EES 6309 | Wetland Design and Restoration | 3 |
| EES 6318 | | 3 |
| EES 6425 | | 3 |
| EES 6932 | Modeling the Fate of Air Pollutants | 3 |
| ENV 6439 | Activated Carbon: Environmental Design and Application | 3 |
| ENV 5075 | | 3 |
| ENV 5105 | Foundations of Air Pollution | 3 |
| ENV 5306 | Municipal Refuse Disposal | 3 |
| ENV 5518 | Field Methods in Environmental Hydrology | 3 |
| ENV 6052 | | 3 |
| ENV 6126 | Air Pollution Control Design | 3 |

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| ENV 6130 | Aerosol Mechanics | 3 |
| ENV 6301 | Advanced Solid Waste Containment Design | 3 |
| ENV 6435 | Advanced Water Treatment Process Design | 3 |
| ENV 6437 | Advanced Wastewater System Design | 3 |
| ENV 6438 | Advanced Potable Water Systems Design | 3 |
| ENV 6441 | Water Resources Planning and Management | 3 |
| ENV 6416 | Advanced Stormwater Control Systems | 3 |
| ENV 6508 | Wetland Hydrology | 3 |
| ENV 6511 | Biological Wastewater Treatment | 3 |
| ENV 6556 | | 3 |
| ENV 6617 | | 3 |
| ENV 6905 | Individual Work | 1-4 |
| ENV 6910 | Supervised Research | 1-5 |
| ENV 6916 | Nonthesis Project | 1-3 |
| ENV 6932 | Special Problems in Environmental Engineering | 1-4 |
| ENV 6935 | Graduate Environmental Engineering Seminar | 1 |
| ENV 6971 | Research for Master's Thesis | 1-15 |
| ENV 7979 | Advanced Research | 1-12 |
| ENV 7980 | Research for Doctoral Dissertation | 1-15 |

## Hydrology / Water Resources Shared Courses

| Code | Title | Credits |
|---|---|---|
| CGN 6905 | Special Problems in Civil Engineering | 1-6 |
| CWR 5125 | Groundwater Flow I | 3 |
| CWR 5127 | Evaluation of Groundwater Quality | 3 |
| CWR 5235 | Open Channel Hydraulics | 3 |
| CWR 6537 | Contaminant Subsurface Hydrology | 3 |
| EGM 5816 | Intermediate Fluid Dynamics | 3 |
| ENV 5518 | Field Methods in Environmental Hydrology | 3 |
| ENV 6052 | | 3 |
| ENV 6441 | Water Resources Planning and Management | 3 |
| ENV 6508 | Wetland Hydrology | 3 |
| ENV 6932 | Special Problems in Environmental Engineering | 1-4 |

## Environmental Engineering Sciences Departmental Courses

| Code | Title | Credits |
|---|---|---|
| CWR 5125 | Groundwater Flow I | 3 |
| CWR 6116 | Advanced Surface Hydrology | 3 |
| CWR 6252 | Environmental Biochemistry of Trace Metals | 3 |
| CWR 6537 | Contaminant Subsurface Hydrology | 3 |
| EES 6007 | Advanced Energy and Environment | 3 |
| EES 6051 | Advanced Environmental Planning and Design | 3 |
| EES 6208 | Principles of Water Chemistry I | 3 |
| EES 6225 | Atmospheric Chemistry | 3 |
| EES 6307 | Advanced Ecological Engineering | 3 |
| EES 6309 | Wetland Design and Restoration | 3 |
| EES 6344 | Coastal Policy Lab | 3 |
| EES 6345 | Florida Marine and Coastal Law and Policy | 3 |
| EES 6346 | Engineering Nature-Based Coastal Solutions | 3 |
| EES 6932 | Modeling the Fate of Air Pollutants | 3 |
| EGN 5949 | Practicum/Internship/Cooperative Work Experience | 1-6 |
| EGN 6640 | Entrepreneurship for Engineers | 3 |
| EGN 6913 | Engineering Graduate Research | 0-3 |
| ENV 5105 | Foundations of Air Pollution | 3 |
| ENV 5306 | Municipal Refuse Disposal | 3 |
| ENV 5518 | Field Methods in Environmental Hydrology | 3 |
| ENV 5619 | Principles of Sustainable Engineering Design | 3 |
| ENV 6043 | Life Cycle Assessment | 3 |
| ENV 6126 | Air Pollution Control Design | 3 |
| ENV 6130 | Aerosol Mechanics | 3 |
| ENV 6301 | Advanced Solid Waste Containment Design | 3 |
| ENV 6416 | Advanced Stormwater Control Systems | 3 |
| ENV 6435 | Advanced Water Treatment Process Design | 3 |
| ENV 6437 | Advanced Wastewater System Design | 3 |
| ENV 6438 | Advanced Potable Water Systems Design | 3 |
| ENV 6439 | Activated Carbon: Environmental Design and Application | 3 |
| ENV 6441 | Water Resources Planning and Management | 3 |
| ENV 6455 | Microbiology of Environmental Engineering Systems | 3 |
| ENV 6508 | Wetland Hydrology | 3 |
| ENV 6511 | Biological Wastewater Treatment | 3 |
| ENV 6905 | Individual Work | 1-4 |
| ENV 6910 | Supervised Research | 1-5 |
| ENV 6916 | Nonthesis Project | 1-3 |
| ENV 6932 | Special Problems in Environmental Engineering | 1-4 |
| ENV 6935 | Graduate Environmental Engineering Seminar | 1 |
| ENV 6940 | Supervised Teaching | 1-5 |
| ENV 6971 | Research for Master's Thesis | 1-15 |
| ENV 7979 | Advanced Research | 1-12 |
| ENV 7980 | Research for Doctoral Dissertation | 1-15 |
| LAW 6472 | Natural Resources Law | 3-4 |

## College of Engineering Courses

| Code | Title | Credits |
|---|---|---|
| EEE 5354L | Semiconductor Device Fabrication Laboratory | 3 |
| EEE 5776 | Applied Machine Learning | 3 |
| EEE 6778 | Applied Machine Learning II | 3 |
| EGN 5215 | Machine Learning Applications in Civil Engineering | 3 |
| EGN 5216 | Machine Learning for Artificial Intelligence Systems | 3 |
| EGN 5442 | Programming for Applied Data Science | 3 |
| EGN 6216 | Artificial Intelligence Systems | 3 |
| EGN 6217 | Applied Deep Learning | 3 |
| EGN 6446 | Mathematical Foundations for Applied Data Science | 3 |
| EGN 6640 | Entrepreneurship for Engineers | 3 |
| EGN 6642 | Engineering Innovation | 3 |
| EGN 6913 | Engineering Graduate Research | 0-3 |
| EGN 6933 | Special Topics | 1-3 |
| EGN 6937 | Engineering Fellowship Preparation | 0-1 |
| EGS 6012 | Research Methods in Engineering Education | 3 |
| EGS 6020 | Research Design in Engineering Education | 3 |
| EGS 6039 | Engineering Leadership | 3 |
| EGS 6050 | Foundations in Engineering Education | 3 |
| EGS 6051 | Instructional Design in Engineering Education | 3 |
| EGS 6054 | Cognition, Learning, and Pedagogy in Engineering Education | 3 |
| EGS 6056 | Learning and Teaching in Engineering | 1 |
| EGS 6085 | Advanced Engineering Educational Technology | 3 |
| EGS 6101 | Divergent Thinking | 3 |

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|---|---|---|
| EGS 6626 | Fundamentals of Engineering Project Management | 3 |
| EGS 6628 | Advanced Practices in Engineering Project Management | 3 |
| EGS 6629 | Agile Project Management for Engineers and Scientists | 3 |
| EGS 6681 | Advanced Engineering Leadership | 3 |
| EGS 6930 | Engineering Education Seminar | 1 |
| EGS 6940 | Preparation for Engineering Education Practicum | 1 |
| EGS 6949 | Research to Practice Experience in Engineering Education | 1-3 |
| EGS 6971 | Research for Master's Thesis | 1-12 |
| EGS 7979 | Advanced Research | 1-12 |
| EGS 7980 | Research for Doctoral Dissertation | 1-12 |
| ESI 6900 | Principles of Engineering Practice | 1-4 |

## Student Learning Outcomes

# environmental engineering sciences (PHD)

SLO 1 Knowledge
Knowledge an ability to identify, formulate, and solve environmental problems using scientific and engineering methods and tools

SLO 2 Skills
An ability to critically read and evaluate engineering or science literature.
An ability to use the techniques, methods, and appropriate professional tools necessary for professional practice at an advanced level
An ability to communicate effectively

SLO 3 Professional Behavior
An understanding of professional and ethical responsibility

# Environmental Engineering Sciences (ME & MS)

SLO 1 Knowledge
An ability to identify, formulate, and solve environmental problems using scientific and engineering methods and tools

SLO 2 Skills
An ability to critically read and evaluate engineering or science literature

An ability to use the techniques, methods, and appropriate professional tools necessary for professional practice at an advanced level
An ability to communicate effectively

SLO 3 Professional Behavior
An understanding of professional and ethical responsibility