GEOGRAPHY AND ENVIRONMENTAL ENGINEERING, MASTER OF SCIENCE IN ENGINEERING

The Geography and Environmental Engineering, Master of Science in Engineering (MSE) is designed to prepare students with an ABET-accredited undergraduate engineering degree, or equivalent, to enter the workforce as leaders in the field. Students have five tracks to choose from, each with unique curricular requirements.

M.S.E. Tracks

ENVIRONMENTAL ENGINEERING AND SCIENCE
Focuses on the analysis and design of processes that affect the quality of both the natural and built environment. Specific topics include: physical, chemical and biological phenomena relevant to drinking water treatment, waste and wastewater treatment, environmental remediation, air pollution and air quality, and transport and transformation of pollutants in the environment.

HYDROLOGY AND WATER RESOURCES ENGINEERING
Focuses on the role of hydrologic processes in various earth and environmental contexts, including extreme events such as: floods and droughts, climate change impacts, transport within aquatic systems, geomorphology and landscape development, and the analysis, design, and operation of water resources systems.

DATA SCIENCE AND ANALYTICS FOR ENVIRONMENTAL HEALTH AND ENGINEERING
Emphasizes innovative computational, statistical, and "big data" tools with applications to environmental problems in air pollution, energy systems, hydrology, and climate change.

ENVIRONMENTAL MANAGEMENT AND ECONOMICS
Focuses on the use of models of physical and economic systems to analyze and improve the design and operations of public policies, environmental control systems, and infrastructure for energy, transportation, water, and other critical services.

Program Requirements

The following general requirements apply to all M.S.E. students:

- a minimum of 30 graduate credits including no more than 1 credit of seminar, 1 credit of intersession course work or 1.5 credits from CLE (with advisor approval), and 6 credits of independent research counting toward the 30 credits.
- at least 50% of the required 30 credits must come from courses within the department. The Department of Environmental Health and Engineering's course codes are 570, 180-5, and 187-8.
- students are permitted to apply up to two classes with a grade of "C" toward their degree.
- 5-6 required courses and 4-5 recommended elective courses depending on concentration. In order to substitute an alternate course for a recommended elective, students must receive written approval from their advisor prior to registering.
- prerequisites (required) for the M.S.E. program include mathematics: differential equations and computing skills.

- up to two courses from AAP or EP may be taken and counted to receive a master's degree as long as there is sufficient rigor and prior approval as deemed by the advisor. Students must have written consent from advisor (an email will suffice) prior to signing up for the course.
- students will earn credits for BSPH courses according to this BSPH-WSE credit conversion:
    - 3 WSE credits for a 4 or 5-credit BSPH course
    - 2 WSE credits for a 2 or 3-credit BSPH course
    - 1 WSE credit for a 1-credit BSPH course

The M.S.E. program is typically a two semester program based on course work alone. However, M.S.E. students have the option to complete an independent research project, submitted as a formal essay or group project report. An M.S.E. degree with significant research components will usually require three to four semesters for completion and is generally intended for those students planning to work in engineering practice. Each individual's program of study is planned by the student in consultation with department faculty and must be approved by the faculty advisor. M.S.E. students select from the concentrations below.

Tracks for the M.S.E. Degree
ENVIRONMENTAL ENGINEERING AND SCIENCE
This track focuses on the analysis and design of processes that affect the quality of both the natural and built environment.

Code	Title	Credits
Core courses:		
EN.575.645	Environmental Microbiology	3
EN.570.615	Current Trends in Environmental Microbiology	3
EN.570.641	Environmental Inorganic Chemistry	3
EN.570.642	Environmental and Analytical Organic Chemistry	4
EN.570.643	Aquatic and Biofluid Chemistry	3
EN.570.644	Physical and Chemical Processes	3
EN.575.706	Biological Processes for Water & Wastewater Treatment	3
EN.570.657	Air Pollution	3
AS.270.679	Atmospheric Science	3
One course in engineering mathematics or statistical analysis, such as:		
EN.570.616	Data Analytics in Environmental Health and Engineering	3
EN.570.654	Geostatistics: Understanding Spatial Data	3
EN.570.695	Environmental Health and Engineering Systems Design	3
EN.570.697	Risk and Decision Analysis	3
Recommended electives include:		
EN.570.619	Methods in Microbial Community Analysis	3
EN.570.626	Groundwater, Porous Media, and Hydrogeology	3
EN.570.651	Environmental Transport and Dispersion	3
EN.570.652	Experimental Methods in Environmental Engineering and Chemistry	4
EN.570.690	Solid Waste Engineering and Management	3
EN.570.691	Hazardous Waste Engineering and Management	3
AS.270.618	Remote Sensing of the Environment	3
AS.270.641	Present and Future Climate	3

HYDROLOGY AND Water resources engineering

This track focuses on the role of hydrologic processes in various earth and environmental contexts, including extreme events.

Code	Title	Credits
Core courses:		
EN.570.412	Landscape Hydrology and Watershed Analysis	3
EN.570.653	Hydrology	3
EN.570.651	Environmental Transport and Dispersion	3
One course in applied mathematics, numerical analysis, or engineering mathematics, such as:		
EN.570.695	Environmental Health and Engineering Systems Design	3
EN.570.697	Risk and Decision Analysis	3
EN.530.766	Numerical Methods	3
One course in Data Analytics and Statistical Methods, such as:		
EN.570.616	Data Analytics in Environmental Health and Engineering	3
EN.570.654	Geostatistics: Understanding Spatial Data	3
Recommended electives include:		
EN.570.615	Current Trends in Environmental Microbiology	3
EN.570.626	Groundwater, Porous Media, and Hydrogeology	3
EN.570.641	Environmental Inorganic Chemistry	3
EN.570.642	Environmental and Analytical Organic Chemistry	3
EN.570.643	Aquatic and Biofluid Chemistry	3
EN.570.644	Physical and Chemical Processes	3
EN.570.652	Experimental Methods in Environmental Engineering and Chemistry	4
EN.570.690	Solid Waste Engineering and Management	3
EN.575.626	Hydrogeology	3
EN.575.629	Modeling Contaminant Migration through Multimedia Systems	3
EN.575.708	Open Channel Hydraulics	3
EN.575.716	Principles of Estuarine Environment: The Chesapeake Bay Science and Management	3
EN.575.728	Sediment Transport and River Mechanics	3
EN.575.730	Geomorphic and Ecologic Foundations of Stream Restoration	3

Data science aNd analytics for ehe

This track emphasizes innovative computational, statistical, and "big data" tools with applications to environmental problems in air pollution, energy systems, hydrology, and climate change.

Code	Title	Credits
Data Science Foundations (2 courses)		
The following two courses are recommended:		
EN.570.616	Data Analytics in Environmental Health and Engineering	3
EN.570.654	Geostatistics: Understanding Spatial Data	3
Students can also take the following courses to fulfill this requirement:		
EN.553.620	Probability	4
EN.553.626	Introduction to Stochastic Processes	4
EN.553.630	Mathematical Statistics	4
AS.180.334	Econometrics	3
Environmental Foundations (3 courses)		

Code	Title	Credits
Students interested in air pollution and climate should consider the following courses:		
EN.570.657	Air Pollution	3
PH.182.615	Airborne Particles	4
PH.180.607	Climate Change and Public Health	3
AS.270.679	Atmospheric Science	3
AS.270.641	Present and Future Climate	3
AS.270.618	Remote Sensing of the Environment	3
Students interested in hydrology and water resources should consider the following courses:		
EN.570.351	Introduction to Fluid Mechanics	3
EN.570.626	Groundwater, Porous Media, and Hydrogeology	3
EN.570.653	Hydrology	3
EN.570.651	Environmental Transport and Dispersion	3
EN.570.643	Aquatic and Biofluid Chemistry	3
AS.270.618	Remote Sensing of the Environment	3
Students interested in energy systems should consider the following courses:		
EN.570.607	Energy Policy and Planning Models	3
EN.570.616	Data Analytics in Environmental Health and Engineering	3
EN.570.654	Geostatistics: Understanding Spatial Data	3
EN.570.697	Risk and Decision Analysis	3
Students interested in health applications should consider the following courses:		
PH.182.613	Exposure Assessment Techniques for Health Risk Management	3
Advanced Data Science (2 courses)		

Students should take two additional courses in statistics, applied match, or computing. Graduate-level courses in the following department will fulfill this requirement: EHE (only Geostatistics fulfills this requirement if not used to fulfill requirements in the Data Science Foundations category), Applied Math and Statistics (e.g., Data Mining, Bayesian Statistics, Seminar in Data Analysis, and other courses), Computer Science (e.g., Parallel Programming, Causal Inference, and other courses), Biostatistics, and Earth & Planetary Sciences (only Inversion Modeling & Data Assimilation or Geoscience Modeling fulfills this requirement).

Data Science Project (3 credits)

This requirement is waived if students are conducting master's thesis research for credit.

ENVIRONMENTAL MANAGEMENT AND ECONOMICS

This track focuses on the use of models of physical and economic systems to analyze and improve the design and operations of public policies, environmental control systems, and infrastructure for energy, transportation, water, and other critical services.

Code	Title	Credits
Core courses		
EN.570.873	Environmental Science & Management Seminar	1
Take 6 courses from the following focus areas:		
Fundamental Decision Frameworks		
EN.570.697	Risk and Decision Analysis	3
PH.318.603 or BU.220.620	Applied Microeconomics for Policymaking Business Microeconomics	3

Fundamental Tools

EN.570.695	Environmental Health and Engineering Systems Design	3
EN.570.616	Data Analytics in Environmental Health and Engineering	3
or EN.570.654	Geostatistics: Understanding Spatial Data	

Fundamentals of Environmental Systems

EN.570.643	Aquatic and Biofluid Chemistry	3
EN.570.644	Physical and Chemical Processes	3
EN.570.653	Hydrology	3
EN.570.657	Air Pollution	3
AS.270.679	Atmospheric Science	3

Applications

EN.570.607	Energy Policy and Planning Models	3
EN.560.653	An Introduction to Network Modeling	3

Electives

Environmental History and Politics (recommend SAIS courses)

EN.570.406	Environmental History	3
SA.500.104	Climate Change: Science, Economics and Politics	4

Methods

EN.553.613	Applied Statistics and Data Analysis	4
EN.553.642	Investment Science	4
EN.553.661	Optimization in Finance	4
EN.560.618	Probabilistic Methods in Civil Engineering and Mechanics	3

Economics

BU.450.630	Designing Experiments	2
PH.318.603	Applied Microeconomics for Policymaking	3

Energy Systems

EN.520.627	Photovoltaics and Energy Devices	3
EN.520.629	Networked Dynamical Systems	3
EN.530.629	Simulation and Analysis of Ocean Wave Energy Systems	3
EN.530.664	Energy Systems Analysis (graduate)	3
EN.540.630	Thermodynamics & Statistical Mechanics	3
AS.030.404	Electrochemical Systems for Energy Conversion and Storage	3
AS.271.402	Water, Energy, and Food Nexus	3
AS.410.777	Next Generation Alternative Energies	4
AS.425.604	Energy & Climate Finance	3
AS.425.601	Principles and Applications of Energy Technology	3
AS.425.625	Solar Energy:Science, Technology & Policy	3
SA.500.122	Life Cycle Assessment	4
SA.500.130	The Water, Energy and Food Nexus	4
SA.500.122	Life Cycle Assessment	4

Environmental Health Risk

PH.317.600	Introduction to the Risk Sciences and Public Policy	4
PH.317.605	Methods in Quantitative Risk Assessment	4
PH.317.610	Risk Policy, Management and Communication	3