

### 3.4. Degree Requirements

All graduate students in the Environmental Engineering Program must meet all *Standards and Degree Requirements* as set forth by the Graduate School in the current University of Connecticut Graduate Catalog (<http://catalog.grad.uconn.edu>). Additional Program requirements that must be met for students pursuing the four Environmental Engineering Program degrees (MS Plan A, MS Plan B, Professional Practice MS, and PhD) are outlined in detail below.

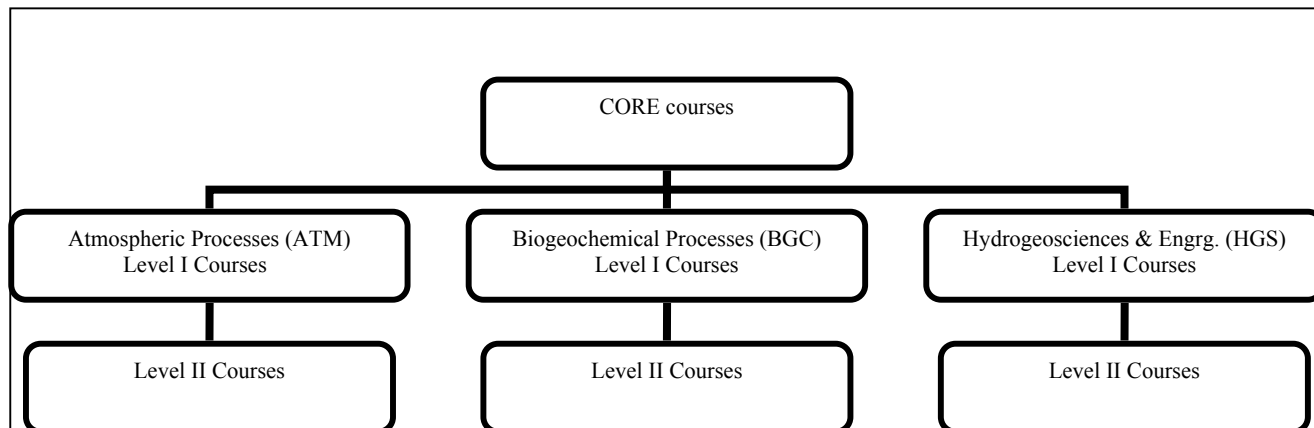
Beginning in August 2003, incoming graduate students must follow the new curriculum outlined below that the Environmental Engineering Program faculty approved in Spring 2003. A set of required **CORE** courses must be taken by all EEP graduate students. Students also select degree requirement courses from the **Level I and Level II** course lists (see below) for the three EEP subdiscipline “**Tracks**” depending on their specific interests. The three EEP Tracks are:

**Atmospheric Processes (ATM):** Students completing this track will gain knowledge in meteorology and atmospheric science, will be able to quantify how species move in the atmosphere, understand climate and its forcings; be able to make atmospheric measurements (meteorological and sampling for gaseous and aerosol pollutants); and obtain knowledge of atmospheric chemical processes. Entering students should have basic quantitative skills (math and statistics) and completed courses in introductory hydrology (large-scale fluid motion) and chemistry.

**Biogeochemistry (BGC):** Students completing this track will gain knowledge and skills that will allow them to identify, quantify, and ultimately control, the biological, geological and chemical reactive processes of natural and engineered systems affecting contaminant transport in the environment in order to restore/maintain soil and water quality. Entering students should have basic quantitative skills (physics, math and statistics) and completed courses in introductory microbiology, geology and chemistry.

**Hydrogeosciences & Engineering (HGS):** Students completing this track will gain knowledge and skills in measurement and modeling of primary hydrologic processes taking place at the atmosphere-surface interface (precipitation, energy balance), related to overland flows and sediment transport, and to vadose zone and groundwater flow and contaminant transport. Students will acquire experience in hydrologic site characterization and monitoring methods. Entering students should have basic quantitative skills (physics, math and statistics) and completed courses in introductory hydrology, geology and chemistry.

The following figure diagrams the relationship between courses for all three EEP subdiscipline tracks.



### 3.4.A. IMPLEMENTATION OF TRACK COURSES IN EEP GRADUATE STUDENT PLAN OF STUDY

**M.S. Degrees.** Level I and Level II courses outlined below for each of the three Environmental Engineering Program subdiscipline “tracks” are the only courses that M.S. plan A and plan B graduate students may use to meet the course requirements beyond the **core** course requirements. Only with explicit approval of the EEP program can other courses be substituted for the Level I and Level II courses.

Degree	Course Credit Requirements	After Core	Credits Required From Level I/II Track Lists
M.S. Plan A	21	21-9=12	4
M.S. Plan B	27	27-9=18	6

**Ph.D. Degrees.** A Ph.D student is required to take 24 credits of advanced coursework (= 8 courses) beyond the MS degree. A minimum of 9 credits of this advanced coursework must be taken from Level I/II courses listed below, with the remainder (15 credits) taken from any other field, with the approval of the student’s advisory committee. EEP core courses are not required courses for the PhD degree; however these courses reflect a level of knowledge that the PhD candidate will be expected to demonstrate at the point of the general exam.

**CORE courses of the EEP curriculum.** EEP students are required to take three of the four courses and the first two courses are required for students in all three EEP tracks.

Course Title	Existing Course #	Course Content
Environmental Transport Phenomena <REQUIRED>	ENVE 310 CE 389 Fall	Movement and fate of chemicals: interfacial processes and exchange rates in environmental matrices.
Quantitative Methods for the Environment <REQUIRED>	ENVE 3XX CE 320-01 Fall	Basic uni- and multi-variate statistics & probability. Simple and multiple regression. Uncertainty estimation and propagation. Optimization, parameter estimation and curve fitting. Time series analysis. Basic numerical methods for ODEs and PDEs and fundamentals of off-the-shelf programs.
Hydrometeorology	ENVE 385 CE 383 Fall - even	Global dynamics of water distribution and circulation. Hydrologic cycle, atmospheric circulation, precipitation, interception, storage, infiltration, overland flow, distributed hydrologic modeling, and stream routing.
Biogeochemical Processes	ENVE 3XX CE 320-02 Fall - odd	An introduction to physical, chemical and biological processes related to chemical fate and transport in environmental systems. Material balances, equilibrium chemistry, chemical partitioning, and reaction kinetics are used to analyze and solve practical environmental problems in aqueous, soil and gaseous systems.

The above courses with XX are temporary until a number is assigned to them.

**ENVIRONMENTAL ENGINEERING PROGRAM  
ATMOSPHERIC PROCESSES (ATM) TRACK COURSES**

**Level I ATM courses**

Course Title	Existing Course #	Course Content	
Air Pollution	CHEG 385 Spring	JJH	Not open to students who have taken CHEG 285. Sources and properties of air pollutants, atmospheric chemistry, dynamics of atmospheric pollution, analytical and sampling techniques, control and abatement processes and air pollutants.
Hydrologic Remote Sensing	ENVE 3XX CE 320 Spring - even	ENA	Principles of remote sensing of hydrologic processes. Active and passive microwave, propagation, scattering and absorption of EM radiation, space-borne and ground-based techniques. Emphasis on precipitation, evaporation and soil moisture.
Transportation and Air Quality	ENVE 305 CE 305 Fall - even	BAH	Mobile source emissions models in theory and practice. Regulatory framework. Emissions control technology. Field and laboratory measurement techniques. Roadway dispersion modeling. Current topics in mobile source emissions.
Geophysical Fluid Dynamics	ENVE 3XX CE 320  On demand beginning Fall 2006	GW	Motion of fluid in Earth's atmosphere and ocean.
Combustion and Air Pollution Engineering	ENVE 340 ME 346	BC	Review of thermodynamics and chemical equilibrium. Introduction to chemical kinetics. Studies of combustion processes, including diffusion and premixed flames. Combustion of gases, liquid, and solid phases, with emphasis on pollution minimization from stationary and mobile systems. Air pollution measurement and instrumentation.
Micrometeorology I	NRME 420 Fall - even	DM	Study of basic processes of the atmospheric boundary layer including turbulent flow and the exchanges of heat, water vapor and pollutants.
Micrometeorology II	NRME 421 Fall - odd	DM	Study of current literature on processes in the atmospheric boundary layer.
Introductory Remote Sensing	NRME 237 Fall	DC	UG COURSE
Meteorology	NRME 241	XY	UG COURSE
Global Change Sciences	ENVE 2XX Spring	GW	UG COURSE

## Level II ATM courses

Course Title	Existing Course #		Course Content
Environmental Biophysics	NRME 328 Spring - even	XY	Gas laws and transport processes. Radiation environment. Momentum, heat and mass transfer. Steady-state and transient energy balance. Microclimate of plant and animals. Physical and physiological interactions between plants/animals and their environment.
Advanced Combustion	ENVE 341 ME 351	BC	Review of thermodynamic properties, transport properties, conservation equations of multicomponent reacting gas. Introduction to chemical kinetics. Classification of combustion waves. Deflagrations, detonations and diffusion flames. Ignition phenomena, droplet and spray combustion and some aspects of turbulent combustion.
Seminar in Combustion Generated Pollution	ENVE 342 ME 352	BC	A study of the mechanism of production of pollutants such as nitrogen oxides, carbon monoxide, sulphur dioxide, soot and unburned hydrocarbons from power plants such as stationary gas turbines, internal combustion engines, and jet engines. Emphasis will be placed on current research problems and recent advances in combustor designs.
Environmental Measurements & Instrumentation	NRME 325 Fall	DM	Principles that govern the selection and use of both field sensors and recording data systems for field research and environmental monitoring.
Transport and Transformation of Air Pollutants	ENVE 343 CE 408 Fall – odd	BAH	Transport and deposition of gaseous and aerosol pollutants; chemical formation and reactions of oxidants and acidic compounds. Interfacial chemistry.
Aerosol Science	CHEG 387 On demand	JJH	The physics and chemistry governing aerosols, with an emphasis on environmental aerosols. Focus on particle formation and growth, techniques for predicting particle motion, methods of aerosol characterization.
Advanced Remote Sensing	NRME 238V Spring	DC	UG COURSE
Environmental Meteorology	NRME 271 Spring - even	XY	UG COURSE
Pollution from Combustion	ME 239	BC	UG COURSE

**ENVIRONMENTAL ENGINEERING PROGRAM  
BIOGEOCHEMISTRY (BGC) TRACK COURSES**

**Level I BGC courses**

Course Title	Existing Course #	Course Content	
Environmental Transformations	ENVE 3XX Spring - odd	AAM	Processes affecting the transformation of chemical species in environmental systems with focus on mechanisms of abiotic and biotic transformation of organic and inorganic compounds. Topics include: rate expressions, hydrolysis, photochemistry, redox, key enzymes and biochemical pathways, cometabolism, bioavailability
Environmental Microbiology	ENVE 3XX CE 320 Spring - odd	BFS	Diversity of microbial metabolism, quantitative treatment of energy conservation, growth stoichiometry and kinetics, microbial ecology principles and applications to aquatic and terrestrial environments, public health microbiology
Environmental Engineering Chemistry I	ENVE 300 Fall	AAM BAH GEH	Quantitative treatment of chemical processes using equilibrium calculations as a tool to understand the behavior of chemical species in aquatic systems. Topics include: chemical thermodynamics, acid-base, solution and surface complexation, dissolution/precipitation, and redox reactions and phase transfer processes.
Environmental Systems Modeling	ENVE 311 CE 405 Spring	BFS TT DO	Modeling pollutants in natural surface waters. Advective, dispersive, and advective-dispersive systems. Modeling water quality, toxic organic and heavy metals pollution.
Groundwater Flow Modeling	ENVE 388 CE 406 Spring - odd	ACB	Multiphase, two- and three-dimensional flow in saturated and unsaturated zones. Finite difference methods. Application to field sites.
Vadose Zone Hydrology	ENVE 3XX Spring - even	DO GSW	Theoretical and experimental tools for characterization and description of physical and hydrological properties and processes that control mass and energy transport in partially-saturated porous media. Measurement and interpretation of hydrological information and methods of analysis required for addressing vadose-zone related environmental engineering problems.
Open Channel Hydraulics	ENVE 384 CE 338 Spring - even	FLO	Unsteady, uniform flow; energy and momentum concepts, flow control, St. Venant equations, unsteady flow modeling of channels and natural rivers.
Coastal Pollution and Bioremediation	ENVE 3XX MARN 382	PV	Overview of processes and compounds leading to pollution in the nearshore marine environment. The impact of pollution on the marine foodweb and its response is emphasized. Alleviation of pollution through metabolism of organisms, including bacteria, seagrasses and salt marshes.

<p>Environmental Measurements in Natural Systems</p>	<p>ENVE 3XX CE 320  Fall - odd</p>	<p>DO GEH LL</p>	<p>Methods for observation, quantification and continuous monitoring of environmental processes related to risk assessment, remediation and treatment of land, water and air resources. Hands-on experience in using modern in-situ measurement and monitoring methods for hydrological processes and for assessment of soil, water and air quality. Elements of measurement science, basic electronics, environmental characterization (subsurface geophysics, direct sampling, remote sensing); spatial and temporal sampling network design and sensor deployment; sensor pairing and flux estimation; data logging, data management and quality control. (Team taught)</p>
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## Level II BGC courses

Course Title	Existing Course #		Course Content
Environmental PhysicoChemical Processes	ENVE 321. CE 387  Spring - odd	GEH AAM	Reactor dynamics, applications of interfacial phenomena and surface chemistry, processes for separation and destruction of dissolved and particulate contaminants, scholarly reviews
Environmental BioChemical Processes	ENVE 322 CE 388  Spring - odd	BFS	Major biochemical reactions, stoichiometric and kinetic description, suspended and attached growth modeling, engineered biotreatment systems for contaminant removal from aqueous, gaseous, and solid wastestreams, process design
Advanced Soil Chemistry	ENVE 303 PLS 378  Spring - odd	CPS	Mineral surface/interface instrumental analysis, solid-liquid interface properties, & solid-liquid interface modeling.
Transport and Transformation of Air Pollutants	ENVE 343  Spring	BH	Transport and deposition of gaseous and aerosol pollutants; chemical formation and reactions of oxidants and acidic compounds. Interfacial chemistry.
Environmental Engineering Chemistry II	ENVE 301 CE 490  Spring - even	AAM	Formulation of simple fate models to describe concentrations of organic or inorganic compounds in natural or engineered systems. Estimation of equilibrium phase distribution constants and transformation rate constants from linear free energy relationships and semi-empirical models.
Bioremediation	ENVE 3XX CHEG 374  Spring	TKW	Application of engineering and biological principles toward remediation of hazardous wastes, degradation of toxic chemicals using genetically-engineered microorganisms, biological contacting devices for waste remediation.
Biofilm Engineering	ENVE 3XX	JB	Quantitative treatment of biofilms, integration of concepts of microbiology, biochemistry, and genetics with principles of stoichiometry, kinetics, and transport phenomena in order to critically analyze, interpret, design, and optimize biofilm processes.
Radiotracer Applications in Natural Systems	ENVE 3XX MARN 325  Fall - odd	TT	Applications of radiotracers in the environment. Use of radionuclides in the interpretation and quantification of aqueous transport processes. The interaction of geochemistry, mass transport and flux balances in Earth, ocean and environmental systems.
Contaminant Source Remediation	ENVE 323 CE 411  Fall – even	GEH	Regulatory framework. Soil clean-up criteria. Treatment technologies: soil vapor extraction, solidification-stabilization, soil washing – chemical extraction, hydrolysis – dehalogenation, thermal processes, bioremediation. Risk analysis.

**ENVIRONMENTAL ENGINEERING PROGRAM  
HYDROGEOSCIENCES & ENGINEERING (HGS) TRACK COURSES**

**Level I HGS courses**

Course Title	Existing Course		Course Content
Groundwater Flow Modeling	ENVE 388 CE 406  Spring - odd	ACB	Multi-phase, two- and three-dimensional flow in saturated and unsaturated zones. Finite difference methods. Application to field sites.
Hydroclimatology	ENVE 3XX  Spring - odd	GW	This course provides understanding of the climate system as the framework for the physical principles underlying the spatial and temporal hydrological variability, and will focus on regional and global-scale processes and phenomena. Topics include atmospheric physics and dynamics controlling the water/energy budgets at the earth's surface as well as in the atmosphere; global water cycle, its dynamics, and causes of variability/changes; occurrence of drought and flood; climate teleconnections and their application in medium- to long-range hydrologic forecast; hydrological impact of global changes; quantitative methods in hydroclimatic analysis.
Numerical Methods in Civil Engineering	CE 327	MLA FLO ACB	Solution of linear and nonlinear systems of equations and algebraic eigenvalue problems. Interpolation, numerical integration, and regression. Ordinary and partial differential equations by finite difference method. Computer programming.
Open Channel Hydraulics	ENVE 384 CE 338  On demand	FLO	Unsteady, nonuniform flow; energy and momentum concepts; flow control; de St. Venant equations; unsteady flow modeling of channels and natural rivers.
River Mechanics	CE 381  Spring - odd	FLO	Erosion and sedimentation, physical properties of sediment, dimensional analysis, mechanics of sediment laden flows, particle motion, incipient motion, bedforms, bed load, suspended load.
Vadose Zone Hydrology	ENVE 3XX  Spring - even	DO GSW	Theoretical and experimental tools for characterization and description of physical and hydrological properties and processes that control mass and energy transport in partially-saturated porous media. Measurement and interpretation of hydrological information and methods of analysis required for addressing vadose-zone related environmental engineering problems.
Applied and Environmental Geophysics	ENVE 3XX/ GEOL 378  Spring	LL GR DO GEH	Potential theory (gravity, static electricity and magnetic fields), electromagnetic coupling, Maxwell's equations; electromagnetic wave propagation; principles of detection of subsurface interface and structures by geophysical methods.

Environmental Measurements in Natural Systems	ENVE 3XX CE 320  Fall - odd	DO GEH LL	Methods for observation, quantification and continuous monitoring of environmental processes related to risk assessment, remediation and treatment of land, water and air resources. Hands-on experience in using modern in-situ measurement and monitoring methods for hydrological processes and for assessment of soil, water and air quality. Elements of measurement science, basic electronics, environmental characterization (subsurface geophysics, direct sampling, remote sensing); spatial and temporal sampling network design and sensor deployment; sensor pairing and flux estimation; data logging, data management and quality control. (Team taught)
Advanced Hydrogeology	GEOL 355  Fall	GR	Transport processes in groundwater systems. Mathematical methods in groundwater hydrology. Water quality and resource evaluation.
Ecohydrology	ENVE 3XX CE 320  Spring – even	GW	Interactions between ecological processes and the water cycle. This course focuses on the terrestrial aspect of Ecohydrology, emphasizing the hydrological mechanisms underlying various terrestrial ecological patterns and the ecological quantities controlling the hydrologic and climatic regimes. It also includes introduction to numerical models and satellite observational datasets used for ecohydrological research.
Environmental Systems Modeling	ENVE 311 CE 405  Spring	BFS TT DO	Modeling pollutants in natural surface waters. Advective, dispersive, and advective-dispersive systems. Modeling water quality, toxic organic and heavy metals pollution.

## Level II HGS courses

Course Title	Existing Course #		Comments
Subsurface Contaminant Transport Modeling	CE 407/ ENVE 3XX/  Spring -even	ACB	Fate and transport of contaminants in groundwater. Convection, dispersion and adsorption, and biological and radioactive decay. Field scale modeling. Galerkin finite elements. Application to field sites.
Hydrological Remote Sensing	ENVE 3XX CE 320  Spring - even	ENA	Principles of remote sensing of hydrologic processes. Active and passive microwave, propagation, scattering and absorption of EM radiation, space-borne and ground-based techniques. Emphasis on precipitation, evaporation and soil moisture.
Laminar Viscous Flows	ME 312		Derivation of the Navier Stokes Equation. Exact solutions of the Navier Stokes Equation. Derivation of laminar boundary layer equations for plan and axially symmetric flow. Methods of solution of the laminar boundary layer equations including Blasius solution, momentum integral method and Falkner-Skan similarity solutions. Application to the flow over plates and bodies of various shapes. Jets and wakes.
Computational Methods of Viscous Fluid Dynamics	ME 318		An advanced course on integral and finite-difference methods of solution of the parabolic and elliptic equations of viscous fluid flow. Method of weighted residuals; Crank-Nicolson; Dufort-Frankel; Peaceman-Rachford alternating direction method; truncation error analysis; stability. Applications to boundary layer and heat transfer problems. A background of FORTRAN programming and numerical analysis is necessary.
Micrometeorology I	NRME 420	XY	Study of basic processes of the atmospheric boundary layer including turbulent flow and the exchanges of heat, water vapor, and pollutants.
The Flood Problem	CE 386  On demand	FLO	Flood Hazards. Preventing or alleviating damages. Flood frequency analysis. Effect of land-use/land-cover and soil moisture on flooding. Remote sensing in flood prediction. Flood and dam-break modeling. Multiple purpose projects.
Unsaturated Flow & Transport	ENVE 3XX  On demand	DO ACB	TBA
Groundwater Assessment & Remediation	ENVE 320/ CE 410/  Fall - even	ACB GEH	Quantitative evaluation of field data in assessing nature and extent of groundwater contamination. Subsurface control and remediation. Case studies.
Field Problems in Hydrogeology	GEOL 357  Spring	GR	Field methods associated with ground water and contamination assessments.
Geophysical Inverse Theory	GEOL 375  Fall	LL	The problem of fitting geophysical model parameters to data. Topics include model uniqueness, model and data, after data resolution, resolution and error estimation.
Probabilistic Methods in Engineering Systems	ENVE 304 CE 389  Spring - odd	ENA XY	Common probabilistic models used in engineering and physical science design, prediction, and operation problems; derived distributions, multivariate stochastic models, and estimation of model parameters; analysis of

			date, model building and hypothesis testing; uncertainty analysis.
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The degree requirements for each of the four EEP degrees are summarized in Table 2 (next page) and described in more detail in the indicated section of this document:

### **Master of Science in Environmental Engineering**

The primary objective of the two-year M.S. in Environmental Engineering is the development of a student's understanding of the subject matter. This understanding is achieved either through an emphasis on research (Plan A), or comprehensive study of a more general nature (Plan B). The M.S. can lead to a professional career in environmental engineering and can be considered a prerequisite for application to Ph.D. programs.

- 1. Plan A (Thesis Option) – Section 3.4.a**
- 2. Plan B (Non-thesis Option) – Section 3.4.b**
- 3. Professional Practice Master of Science in Environmental Engineering – Section 3.4.c**

### **Doctor of Philosophy in Environmental Engineering – Section 3.4.d**

The primary objective of the three-to-five year Ph.D. in Environmental Engineering is the development of a student's knowledge base and independent research skills. The Ph.D. leads to a professional career in research or research-related activities in academia, industry or government.

**Table 2. Degree Requirements**

Coursework	Plan A M.S. (Thesis)	Plan B M.S. (Non-thesis)	Prof. Practice M.S. *	Ph.D.
Minimum number of advance coursework credits including:	21 (or 18 if prior prof. background)	30	30	44-48**
ENVE 3XX/CE 320 <CORE>	3	3	3	3
ENVE 310 / CE 389 <CORE>	3	3	3	3
CORE Course Electives	3	3	6	3
UG Courses – Up to 6 credits 200 Level (not open to sophomores)	6	6		6
Graduate level ENVE courses	12 (4 Level I/II)	18 (6 Level I/II)		
Advanced Math or Statistics		3	STAT 301 or STAT 320/321	
ENVE 400	every semester	every semester		every semester
Foreign Language / Related Area				✓
Independent Project	Thesis (GRAD 395 credit ≥9)	3-6	3 (CE 300)	Dissertation (GRAD 495)
General Exam – written Oral				✓ ✓
Research Prospectus/Proposal				6 month before degree completion
Final Examination	Thesis Defense	Project Presentation		Public Defense

\* Must have B.S. Engineering Degree

\*\* Or 20-24 beyond MS in related field (≥24 coursework; remainder GRAD 495)

**Seminar Series** – The seminar series, Environmental Scholars Colloquium (ENVE 400/CE 400) is offered every semester as a one-credit class. As part of the Environmental Engineering Program, students are required to participate in this class each semester.

### **3.4.B. MASTER OF SCIENCE – PLAN A (THESIS OPTION)**

Students must complete a minimum of **21 credits** of advanced coursework including:

1. ENVE3XX/CE320 *Quantitative Methods for the Environment* (3 credits)
2. ENVE310/CE389 *Environmental Transport Phenomena* (3 credits)
3. ENVE Core Course outside student's Track. (3 credits)
4. At least 12 credits from graduate level environmental engineering courses of which 4 must be selected from the student's Track Level I and Level II course lists below.
5. Environmental Engineering Seminar series (ENVE 400) each semester in residence. Participation in ENVE 400 may be satisfied either by attending the seminar weekly throughout the semester or making one seminar presentation during the semester.
6. Successfully defend an original thesis.

### **3.4.C. MASTER OF SCIENCE – PLAN B (NON-THESIS OPTION)**

Students must complete a minimum of **30 credits** of advanced coursework including:

1. ENVE3XX/CE320 *Quantitative Methods for the Environment* (3 credits)
2. ENVE 310/CE 389 *Environmental Transport Phenomena* (3 credits)
3. ENVE Core Course outside student's Track. (3 credits)
4. At least **18** credits from graduate level environmental engineering courses of which **6** must be selected from the student's Track Level I and Level II course lists below.
5. Environmental Engineering Seminar series (ENVE 400) each semester in residence. Participation in ENVE 400 may be satisfied either by attending the seminar weekly throughout the semester or making one seminar presentation during the semester.
6. At least one course emphasizing advanced mathematics or statistics (3 credits)
7. Successfully complete a final independent project (3 – 6 credits)
8. Complete a final oral or written examination. The final examination administered to candidates for a Plan B M.S. degree in Environmental Engineering shall consist of either or both of the following options:
  - a) An oral defense of a three to six credit project. The student will conduct the project work after his or her Plan of Study is approved. The oral defense is scheduled by the student in consultation with his or her advisor and in accordance with guidelines set by the Graduate School.
  - b) A four-hour written examination on the contents of four courses identified in the student's Plan of Study.

### 3.4.D. PROFESSIONAL PRACTICE MASTER OF SCIENCE IN ENVIRONMENTAL ENGINEERING

Following the Association of Environmental Engineering and Science Professors' (AEESP) resolution that the Master of Science Degree is the first professional degree level for environmental engineers, this 9-month degree has been designed for recent B.S. engineering graduates, enabling them to rapidly enter the profession with appropriate credentials. The Professional Practice M.S. is a broad-based program offering a terminal graduate degree.

Students are required to complete 30 credits of coursework, including a 3-credit practice-oriented project. Coursework consists of the following (exceptions to this schedule must be approved by the Director of the Program):

#### Fall Semester

1. ENVE 300 Environmental Engineering Chemistry I
2. ENVE 310 Environmental Transport Phenomena –OR- CHEG 315 Transfer Operations I
3. MCB 229 Fundamentals of Microbiology –OR – ENVE 3xx Environmental Microbiology (1<sup>st</sup> offering Fall '04)
4. STAT 301 Introduction to Applied Statistics -OR- STAT 320/321 Applied Statistics
5. GEOL 234C Introduction to Groundwater Hydrology

#### Spring Semester

1. ENVE 321 Environmental Physicochemical Processes –OR- ENVE 301 Environmental Engineering Chemistry II
2. ENVE 322 Environmental Biochemical Processes -OR – CHEG 383 Biochemical Engineering
3. ENVE 385 Introduction to Air Pollution
4. ENVE 311 Environmental Systems Analysis –OR- ENVE 388 Groundwater Flow Modeling
5. CE 300 Independent Design Project

#### **Master of Science –Checklist for M.S. Degree Requirements**

(For details of the Graduate School requirements, see the Graduate Catalog at <http://catalog.grad.uconn.edu/>)

\_\_\_\_\_ Advisor should be chosen by the end of the first semester. You and your advisor will choose the other members of your advisory committee (at least two other members).

\_\_\_\_\_ The Plan of Study should be filed with the Graduate School before **12 credits** are completed (usually before the end of the first year). All members of your advisory committee must sign this document. Plan A requirements =  $\geq 15$  course credits;  $\geq 9$  GRAD 395 credits. Plan B requirements =  $\geq 24$  course credits.

\_\_\_\_\_ (Plan A only) A working copy of the thesis must be submitted to the Graduate Records office. The thesis must be dated as of the calendar year in which all requirements for the degree are completed. Two high quality copies of the thesis must be deposited in the Graduate Records Office by the conferral period deadlines of August 31, December 31, or at least thirteen days before commencement. Guidelines for preparation of the thesis are available from the Graduate School and should be adhered to strictly (<http://www.grad.uconn.edu/policies.html>).

- \_\_\_\_\_ Oral defense of the thesis must be conducted with all members of the advisory committee present. All faculty and students are invited to attend.
  
- \_\_\_\_\_ Following successful defense of the thesis, two revised final copies of the thesis are filed with the Graduate Records Office along with final approval pages signed by all advisory committee members.
  
- \_\_\_\_\_ Complete all degree requirements within six years.

### **3.4.E. DOCTOR OF PHILOSOPHY IN ENVIRONMENTAL ENGINEERING**

Doctoral study provides the highest level of formal preparation before entering the engineering profession. It is both competitive and challenging and offers special opportunities for learning, research and application. Together with their professors and mentors, doctoral students comprise a true community of scholars. The student's advisory committee, which is responsible for overseeing the student's final achievement, is an integral part of such a community.

Doctoral study in Environmental Engineering is normally completed in three to five years, depending on individual circumstances. In addition to the general requirements of the Graduate School as outlined in the Graduate School Catalog, each student must meet the minimum requirements of the program as well as complete and successfully defend a dissertation.

#### **General Requirements of the Graduate School**

The requirements for the Ph.D. in Environmental Engineering conform to the requirements of the Graduate School. These requirements include approximately 44 to 48 academic credits, a general examination, and a final examination based on the dissertation (dissertation defense). A plan of study listing courses to be completed for the degree must be filed with the Graduate School before twelve credits are completed. A dissertation prospectus describing the research to be performed for the dissertation must also be submitted to the Graduate School prior to completing the dissertation. These and other requirements of the Doctor of Philosophy degree are described in detail in the Graduate Catalog.

Residence Requirements – The graduate student can fulfill the special demands of a doctoral program only by devoting a continuous period of time to concentrated study and patient research with a minimum of outside distraction or employment. During the second or subsequent years of graduate work in the field, at least two consecutive semesters must be completed in residence. The residence period must be completed at the Storrs campus or, if more appropriate, at one of the other sites of instruction and research within the University system.

Time Limits – All work for the doctoral degree must be completed within eight years of the beginning of the doctoral study, or if the student entered with a Master's degree in the same or a closely related field, the doctorate must be completed within seven years. The beginning of doctoral study is defined as the beginning date of the earliest course, wherever taken, listed on the approved doctoral plan of study.

#### **The Ph.D. Curriculum**

Each graduate student and the members of his/her faculty advisory committee are primarily responsible for shaping the student's course curriculum depending upon their background and interests. An advisory committee is composed of the student's major advisor and two associate advisors chosen by the student after consultation with his/her major advisor. To maintain the interdisciplinary nature of the Environmental

Engineering degree, students are encouraged to choose faculty from multiple departments as advisory committee members.

The students and their advisors determine the number of courses and research credits that comprise the required 44-48 credits. Typically about one-half of these credits are from coursework. The remaining credits are for thesis/dissertation research. Courses in Chemistry, Civil & Environmental Engineering, Mechanical Engineering, Chemical Engineering, Molecular & Cell Biology, Geology & Geophysics, Plant Science, Statistics, Marine Sciences and Natural Resources Management and Engineering are used to fulfill this requirement. Appropriate courses outside these core departments can also be used. All Environmental Engineering Program graduate students attend "ENVE 400", a weekly discussion of current Environmental Engineering topics attended by graduate students and faculty from around campus. Each student is expected to make presentations at these discussions periodically. Meetings of individual laboratory groups as well as departmental meetings provide students with opportunities to present their own research findings.

A series of examinations must also be passed to fulfill the requirements for the Ph.D. The **general examination** required by the Graduate School consists of two parts in the Environmental Engineering Program: an examination of general knowledge of Environmental Engineering, (the "preliminary examination," given in written and oral portions) and an examination based upon thesis-related research (the "related examination"). The preliminary exam is offered after students have been in the program for 1½ years. The preliminary examination is given in two parts, a written portion followed by an oral portion. The oral examination provides an opportunity to follow-up on questions from the written portion and to explore other areas raised in that examination. The oral examination will take place approximately two to three weeks after the written portion. A faculty examination committee will administer both portions. Upon successful completion of the preliminary examination, the student will be eligible to complete the related examination.

The related examination must be taken before the completion of three years in the program. At least one month prior to the examination, the student will submit a research prospectus to the advisory committee and two external examiners. Proposals are reviewed for their written and organizational competence, scope, familiarity with the subject and related research, and potential for making a relevant and original contribution to existing knowledge. The successful prospectus is filed with the Graduate School. The related examination concludes with an oral presentation of the prospectus work to this committee followed by questions about the work addressed to the student. Questions may cover the general area of investigation, approaches and methods. The related examination will be chaired by one of the associate advisors. Upon successful completion of the related examination, the Graduate School will be notified that the student has completed the general examination. Finally, students must defend their dissertation (the oral defense) at the end of their research program.

If a student enters the program with a master's degree, both the preliminary and related examinations are required, the master's degree may be accepted by his/her committee in partial fulfillment of the course requirements for the Ph.D. Note that in this situation, the student's doctoral study begins at the time any courses listed on the plan of study are taken. From that date, the student must complete the general examination within four years.

### **Checklist for Degree Requirements for the Ph.D. in Environmental Engineering**

(For details of the Graduate School requirements, see the Graduate Catalog.)

\_\_\_\_\_ Advisor should be chosen by the end of the first year. You and your advisor will choose the other members of your advisory committee (at least two other members).

\_\_\_\_\_ Plan of study should be filed with the Graduate School before 12 credits are completed (usually before the end of the first year). All members of your advisory committee must sign this document. The Plan of Study must include reading competency in a foreign language or six credits of

coursework in a related area (or three credits of a mathematics or statistics course). Speak with your advisor about how best to fulfill this requirement. Typically, domestic students take an advanced statistics course to fulfill this requirement and international students take a writing or English course.

\_\_\_\_\_ The preliminary examination should be taken before the end of the second year. It is typically offered in January and June.

\_\_\_\_\_ A dissertation prospectus must be approved by the advisory committee and the Graduate Program Director. It is then filed with the Graduate School. The related proposal should serve as the basis for this prospectus.

\_\_\_\_\_ The related proposal should be presented before the end of the third year. All members of the advisory committee and two other faculty examiners must be present.

\_\_\_\_\_ A working copy of the dissertation must be submitted to the Graduate Records office at least seven days before the oral defense. This must be accompanied by a tentative-approval form signed by all advisory committee members who should be given sufficient time to review the dissertation. Guidelines for preparation of the dissertation are available from the Graduate School and should be adhered to strictly.

\_\_\_\_\_ Notify the Graduate Records Office & UConn Advance office three weeks prior to the date of the oral defense by filling out the following form located at: <http://www.grad.uconn.edu/pdf/phdannounce.pdf>. Delayed submission may result in postponement.

\_\_\_\_\_ Oral defense of the dissertation (“final examination”) must be presented with all members of the advisory committee present. All faculty and students are invited to attend. Not fewer than five members of the faculty must participate in the final examination unless written Graduate School Dean approval is secured in advance.

\_\_\_\_\_ Following the defense, two final, revised copies of the dissertation are filed with the Graduate Records Office along with final approval pages signed by the advisory committee members.

\_\_\_\_\_ Complete all degree requirements within five years of beginning date of first course on Plan of Study (four years if entering with Master’s degree).

\_\_\_\_\_ Clearance notice must be filled out by any Engineering student completing a graduate degree. This form can be found at: <http://www.grad.uconn.edu/pdf/engclear.pdf>.

## Information Resources for Graduate Students

Some web sites to visit are:

Registration Information: <http://www.grad.uconn.edu/registration.html>

Office of International Affairs: <http://www.ia.uconn.edu>

Graduate School: <http://www.grad.uconn.edu>

Library Services: <http://www.lib.uconn.edu>

Recreational Services: <http://www.recreation.uconn.edu>

Student Activities and Union Programs: <http://www.ca.uconn.edu>

Student Health Services: <http://www.shs.uconn.edu>