

**Division of
University
Interdisciplinary
Programs (DUIP)**

Division of University Interdisciplinary Programs (DUIP)

Officers of the Faculty

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Ahmad Dallal	Provost, ex-officio
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Moueen Salameh	Registrar, ex-officio
Salim Kanaan	Director of Admissions, ex-officio
Rabih Talhouk	Chair of the Graduate Council, ex-officio
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Background

The Division of University Interdisciplinary Programs, established in 2012, is a degree-granting unit at the American University of Beirut. It supports University interdisciplinary programs involving multiple departments or disciplines in two or more faculties.

Mission

The Division of University Interdisciplinary Programs promotes interdisciplinary engagement in teaching and research as a shared enterprise involving AUB faculties and research units. These collaborative engagements permit faculty members and graduate students to cross traditional disciplinary boundaries in order to advance research and scholarship, acquire knowledge, and generate new insights.

The DUIP provides a responsive environment for graduate education and research by focusing on scholarship in areas not addressed through existing departmental structures, and by connecting graduate students from a variety of backgrounds with the resources which they need to achieve diverse career goals.

Objectives

- To create an environment that fosters interdisciplinary approaches to graduate education and research.
- To improve administrative and financial support for interdisciplinary programs.
- To strengthen existing interdisciplinary programs and to support the creation of new interdisciplinary curricular offerings.
- To support the involvement of University centers, institutes, and museums in research and outreach activities.
- To support individual faculty members who participate in interdisciplinary engagements.

Master of Science Degree Program in Energy Studies

Chairperson:	Ghaddar, Nesreen
Professors:	Karaki, Sami (EECE); Tabbal, Malek (PHYS); Yassine, Ali (ENMG)
Associate Professor:	Ruble, Isabella (ECON)
Assistant Professor:	Khodr, Hiba (PSPA)

Educational Goals and Program Learning Outcomes

The Master of Science in Energy Studies program is planned to consolidate and build on AUB's excellent research and professional profile addressing current and future energy research needs of the region in areas such as energy science and technology, economics, public policy, and energy management. The program's educational goals are:

- To promote an interdisciplinary approach to understand and evaluate various modes of energy supply and end-use efficiency of energy systems within the context of sustainability and development in the region.
- To develop effective collaboration skills among students from different disciplines including energy science and technology, economics, and public policy.

On successful completion of this interdisciplinary course of study, students will:

- Be able to evaluate different sources of energy related to energy extraction, conversion, and utilization for both traditional systems and sustainable/renewable energy alternatives.
- Apply methods of economic analysis, risk and decision analysis, environmental impact assessment, and policy techniques for performing energy planning and reaching, and decision making while addressing sustainability in supply and demand.
- Understand advances in selected energy technologies, products and energy end-use efficiency and their impact on market economy, and development activities.

Admission Requirements

Admission requirements to the program will follow AUB Graduate Studies Policies. Bachelor degree holders from relevant fields of study are eligible to apply for admission into the Energy Studies Master's program. Remedial courses may be needed for students as would be recommended by the Program.

Native English speakers and graduates of universities in which the language of instruction is English may be exempt from TOEFL. Students should have a GPA of at least 80 or 3.0 and good recommendations to be considered for regular admission into the Energy Studies Master's program. Students with GPA above 75 and below 80 are considered for admission on probation.

Degree Requirements

The program permits full-time or part-time enrollments. To obtain a Master's degree in energy studies, the student must complete a minimum of 24 credits of graduate course work, 6 credits of interdisciplinary thesis work on energy-related fields, and a zero-credit seminar. The course work is distributed as follows:

- 9 credits of required core courses.
- 3 to 6 credits of elective course from List A on energy resources, economics and policy.
- 6 to 9 credits elective course from List B on energy science and technology.
- 3 credits elective course as approved by thesis advisor/s if the elective is not from List A or B.
- 0 credit seminar. Credit Summary

Credit Summary

Course	Credits
Required core courses	9 cr.
Elective courses from List A	6 or 3 cr.
Elective courses from List B	6 or 9 cr.
Elective graduate course	3 cr.
Thesis	6 cr.
Seminar	0 cr.
Total number of credits required for graduation	30 cr.

Required Core Courses (9 cr.)		
ECON 333	Energy Economics and Policy	3
PSPA 352	Foundations of Public Policy	3
ENST 300	The Science and Technology of Energy (FAS/FEA)	3
List A	Energy Resources, Economics and Policy Courses	Credits
ENST 310	Advanced Energy Economics	3
ENST 320	Energy Law and Case Studies	3
ECON 337	Economic Development (with focus on energy and development)	3
ECON 338	Economics of Natural Resources and the Environment	3
ECON 305	Econometrics I	3
ECON 347 or ENMG 621	Economic Forecasting Forecasting Methods and Application	3
FINA 3xx	Energy Finance	3
ENMG 603E	Risk and Decision Analysis	3
ENMG 604E	Deterministic Optimization Models	3
ENMG 656	Management of Technological Innovations	3
PSPA 316	International Environmental Policy	3
PSPA 362	Policy Research and Analysis	3
PSPA 381	Special Topics in Energy and Public Policy	3
ENST 398	Special Projects in Energy Studies in Cooperation with Industry and/or NGO and Legislative Bodies	3
List B	Energy Science and Technology Courses	Credits
CHEM 324E	Electrochemistry	3
CHEM 352C	Renewable Energy	3
CIVE 656	Air Pollution Control I	3
CIVE 659	Environmental Impact Assessment	3
ENST 330	Energy Science and Technology Lab	3
EECE 670	Power System Planning	3
EECE 671	Environmental Aspects of Energy Systems	3
EECE 672	Energy Planning and Policy	3
EECE 675	Renewable Energy Systems	3
ENMG 651	Decision Support Systems	3
ENST 398	Special Projects in Energy Studies in Cooperation with Industry and/or NGO and Legislative Bodies.	3
GEOL 300	Elements of Petroleum Geology	3
MECH 671	Renewable Energy Potential, Technology, and Utilization in Buildings	3
MECH 673	Energy Efficient Buildings With Good Air Quality	3
PHYS 340	Atmospheric Physics and Energy	3
Seminar	Must be registered once per year	0
ENST 395A/395B	Comprehensive Exam	0
Thesis*	Interdisciplinary Thesis in Energy-related Field	6

*Although thesis can be focused on a primary discipline, the culminating thesis should include sufficient elements of at least one other discipline to permit an expert in the field to recognize its contribution.

Comprehensive Exam

See Graduate Catalogue General Academic Policies.

Prerequisite Courses

Students who join the program may have to complete prerequisites for courses offered in the program or obtain the consent of the course instructor and program chair approval. The core courses are designed to include remedial preparation in social science. This will enable the waiver of social science prerequisites for students who join from sciences, math, business, or engineering majors. BA holders from economics major may not need remedial courses beyond the core energy science course. Students from other social science majors or arts may be required to take one or remedial courses over and above program requirements, as would be recommended by the chair of the program upon admissions. Suggested remedial courses for BA holders are PHSY 210, MATH 201 or Math 204, and STAT 201 or their equivalents. These remedial courses are part of general education requirements at most universities. The prerequisites by topic include:

- Preliminary concepts of fluid dynamics, heat; first and second law of thermodynamics
- Methods of differentiation and integration
- Partial derivatives and multivariable functions
- Vector functions
- Probability and elementary statistics

The minimum passing grade for a prerequisite course taking after admission to the graduate program is 70. If a student fails to obtain a grade of 70 in any of the undergraduate prerequisites, the student is allowed to repeat the course only once.

Sample Program

Sample Program schedule is given in the following table

Fall (Term I)		Spring (Term II)	
Course Title	Cr	Course Title	Cr
Core Course I	3	Core Course II	3
List A Elective	3	List B Elective	3
List B Elective	3	Graduate Elective	3
Seminar	0		
Total Credits	9	Total Credits	9

Fall (Term III)		Spring (Term IV)	
Course Title	Cr	Course Title	Cr
Core Course III	3	Thesis	6
List A or B Elective	3	Seminar	0
Comprehensive	0		
Total Credits	6	Total Credits	6

Graduation Requirements

To be eligible for graduation with the Master's degree in energy studies, a graduate student:

- must have attained a cumulative course average of 80 or above
- is not placed on probation by the time the course work is completed
- must have completed the minimum credit hours of course work designated by the program
- must have passed comprehensive exam
- must have completed thesis requirements for thesis option degree
- must have completed project requirements for the non-thesis option degree
- must have met the residence requirements specified for the Master's degree

Course Descriptions

Core Courses

ECON 333 **Energy Economics and Policy** **3.0; 3 cr.**

A study of the theories related to energy economics, such as economics of natural resources, and the interrelationship between energy, economics and the environment, as well as some important issues in energy policy. *Students cannot receive credits for both ECON 333 and MECH 674 Energy Economics and Policy.*

ENST 300 **The Science and Technology of Energy (FAS/FEA)** **3.0; 3 cr.**

This course examines the fundamental principles of energy conversion processes as well as their impact on the environment and provides a clear physical explanation of these principles. It also offers a survey of current energy conversion technologies. Topics are selected based on their future promise energy sources. The course starts on introductory topics providing a minimum base on thermodynamics, kinetic theory of gases, heat transfer and fluid flow and the concept of energy efficiency. Topics include: Applications in heat engines, solar thermal, photovoltaic energy conversion, wind, biomass and fuel cells. *Prerequisite: PHYS 210 or equivalent.*

PSPA 352 **Foundations of Public Policy** **3.0:3 cr.**

This seminar covers topics related to the substance, methods and frameworks of public policy in a variety of disciplines including: welfare economics, political science, political economy, and organization theory. Emphasizing the role of theory in empirical policy research, the course illuminates the various policies and policy challenges in the following substantive areas: economics; education; the environment; national security; and immigration. *Core course. Annually.*

List A: Energy Resources, Economics and Policy Courses

ENST 310 **Advanced Energy Economics** **3.0; 3 cr.**

This course covers advanced topics in energy economics such as an in depth analysis of energy demand issues, forecasting energy demand and supply, the economics of electricity supply, a broad variety of topics pertaining to energy investment analysis, integrated analysis of energy systems, as well as energy and the transport sector. In addition, the course covers advanced topics in both oil and natural gas economics with a clear distinction between these two energy sources. *Prerequisite: ECON 333.*

ENST 320 Energy Law and Case Studies 3.0; 3 cr.

This course is concerned with regulation of energy, energy resources, and energy facilities. Among the topics examined are the regulation of rates and services; the state public utility commissions; and the interaction with environmental law. Attention is given to energy resources (such as oil, natural gas and coal reserves, and hydropower resources) and to generating, transmission, and distribution facilities. Special emphasis is put on the current and future roles of renewable energy, energy efficiency, and nuclear energy, as well as the regulation and deregulation of electricity. *Prerequisite: PSPA 352.*

ECON 337 Economic Development (with focus on energy and development) 3.0; 3 cr.

An examination of the major economic and non-economic determinants of development in developing countries, theories and models of development. *Occasionally.*

ECON 338 Economics of Natural Resources and the Environment 3.0; 3 cr.

An analysis of economic issues regarding the efficient use of natural resources and the management of environmental quality. *Occasionally.*

ECON 305 Econometrics I 3.0; 3 cr.

Parameter estimation and hypothesis testing within the framework of the classical linear regression model. Subjects covered include general least squares and its application (e.g. heteroscedasticity, autocorrelation, multivariate regression), GMM estimation, simultaneous equation models and panel data models. *Annually.*

ECON 347 Economic Forecasting 3.0; 3 cr.

A course that provides training methods of forecasting used in commercial enterprises. This course also introduces the methods of macroeconomic forecasting. *Occasionally.*

FINA 3xx Energy Finance 3.0; 3 cr.

Energy Finance: This course aims to provide an in-depth understanding of energy finance by addressing three areas of finance in an energy context: pricing, asset valuation, and risk management. The first section develops students' understanding of the energy markets, and how to model and forecast energy and forward/futures prices. The second part covers valuation and the application of option theory to energy related assets. In the third part of the course we will then focus on giving students an understanding of energy-related derivatives. Students will be taught the different derivative products and learn how to apply them in the energy markets to develop hedging and risk management strategies.

PSPA 316 International Environmental Policy 3.0; 3 cr.

This course provides a critical examination of the politics of international economic relations, global economic development, and transnational economic activity with a special emphasis on the position and experiences of the Middle East states in the global political economy. The course offers a survey of theoretical approaches to international political economy and addresses themes critical to the experience of the Middle East such as state-led industrialization, trade and regionalism, finance, oil, labor migration, MNCs, transnational movements, globalization, neo liberalism, and the politics of development and global governance. *Offered occasionally.*

PSPA 362 Policy Research and Analysis 3.0; 3 cr.

This course addresses both the various theoretical and practical aspects of performing policy analysis. It covers the production and use of analysis to support public policy. The course provides introduction to policy research tools and techniques as it engages methods for collecting data, structuring problems, evaluating policy alternatives and outcomes, monitoring policies and communicating policy options to decision-makers.

PSPA 381E Special Topics in Energy and Public Policy 3.0; 3 cr.

This course provides an overview of the public policies related to energy resources and technologies that are designed to ensure clean, stable supplies of energy for the future. The course studies how public policies can be formulated and implemented to influence the development of fossil fuel, renewable energy, and hydrogen technologies. The development of energy policy in the MENA and GCC regions is of particular concern, although a global perspective will be integrated throughout the course.

List B: Energy Science and Technology Courses**CHEM 324 Electrochemistry 3.0; 3 cr.**

Fundamentals and applications of electrochemistry. Overview of electrode processes, potentials and thermodynamics of cells; kinetics of electrode reactions; Marcus microscopic theory for charge transfer; treatment of mass transfer by migration and diffusion; electrochemical techniques including potential step methods, potential sweep methods, and hydrodynamic methods; electrode reactions with coupled homogeneous chemical reactions; instrumentation. *Alternate years.*

CHEM 352 C Renewable Energy 3.0; 3 cr.

This course is designed to introduce students of different backgrounds to the latest innovations in clean energy research. The students will learn through a series of interactive and modern techniques the fundamentals and hurdles in clean energy technologies such as hydrogen fuel cells, water splitting, CO₂ reduction, solar cells, thermoelectric devices, microbial fuel cell, biofuel, and recent cutting edge research in energy storage. The course also touches on the international climate change policies and reflects on the future of these technologies.

CIVE 656 Air Pollution and Control I 3.0; 3 cr.

An introductory course on air pollutants, sources, and effects; emission estimates, regulations, and monitoring techniques; particulate matter characterization; meteorology and atmospheric dispersion; and air pollution control processes. *Prerequisite: CHEM 202 or equivalent.*

CIVE 659 Environmental Impact Assessment 3.0; 3 cr.

A course that outlines theories and procedures of assessing environmental impact; analysis of the impact of development on various measures of environmental quality; and benefit-cost considerations in environmental impact assessment. *Prerequisites: CIVE 450, CIVE 654, and CIVE 656; or consent of instructor.*

EECE 670 Power Systems Planning 3.0; 3 cr.

A course that investigates energy and peak load forecasts, weather-sensitive forecasts, generation reliability, load duration curves, loss-of-load expectation, capacity reserve evaluation, generation and transmission expansion, power flow analysis, reliability of bulk supply, and cost-benefit analysis. *Prerequisite: EECE 471.*

EECE 671 Environmental Aspects of Energy Systems 3.0; 3 cr.

A course that examines world energy resources and classification; sources and effects of air pollution; air quality modeling, Gaussian dispersion models for pollution estimation; motor vehicle emissions and noise pollution; environmental impacts of electricity generation, pollution control systems, electromagnetic radiation, production and impacts in high-voltage applications; environmental impact assessment; basic concepts.

EECE 672 Energy Planning and Policy 3.0; 3 cr.

A course that focuses on features of modern energy planning and policy. Topics covered include the interaction among the technological, economic, environmental, and sociopolitical aspects of energy supply and use; electricity, oil, and gas industries, and their market structures; elements of energy planning on the sector and national levels; energy decision-making under conditions of uncertainty, risk management in energy planning; liberalization of energy markets; case studies.

EECE 675 Renewable Energy Systems 3.0; 3 cr.

A course that covers the principles of renewable energy, solar radiation, solar water heating, building and other thermal applications, photovoltaic generation, wind power, fuel cells and the hydrogen cycle, biomass, and institutional and economic factors. *Students cannot receive credit for both MECH 671 and EECE 675.*

MECH 671 Renewable Energy Potential, Technology, and Utilization in Buildings 3.0; 3 cr.

A course that covers the principles and utilization of solar (thermal and photovoltaic), wind, and geothermal energy, as well as energy from biomass. Issues relevant to energy efficiency and energy storage are discussed (heat and power store and bio-tanks). The potential of using renewable energy technologies as a complement to and, to the extent possible, replacement for conventional technologies, and the possibility of combining renewable and non-renewable energy technologies in hybrid systems are analyzed. Design aspects of active, passive, wind, bio-energy, and photovoltaic energy conversion systems for buildings; and strategies for enhancing the future use of renewable energy resources are presented. *Prerequisite: MECH 310 or PHYS 210. Students cannot receive credit for both MECH671 and MECH 675.*

MECH 673 Energy Efficient Buildings with Good Air Quality 3 credit.

Energy consumption standards and codes in buildings. Energy conservation measures in built in environment to enhance the building's energy efficiency while maintaining space thermal comfort and indoor air quality requirement. Fundamental ventilation, indoor-air-quality, infiltration natural and mechanical ventilation, importance and impact of indoor air quality on human health and energy performance of the building air conditioning system. An overview of the different heating, ventilation and air conditioning system designs are covered. Performance and energy consumption of the conventional air conditioning system (constant and variable air volume) as well as the alternative hybrid integrated air conditioning systems will be discussed and compared. The course will include several demonstrations of concept experiments. *Pre-requisite: MECH 310 or PHYS 210 or equivalent*

ENMG 603E Risk and Decision Analysis 3.0; 3 cr.

Framing of decision problems. Influence diagrams. Review of probability (random events and variables, probability distribution functions, etc.). Decision Trees. Inverting Decision Trees (Baye's Law). Traditional approach to assessment of error (confidences level). Decision Analysis view of assessment (value of information, sensitivity). Multiple attribute decision objective. Mathematical treatment of risk, tolerance and avoidance.

ENMG 604E Deterministic Optimization Models 3.0; 3 cr.

Mathematical modeling and the operation research approach. Formulation and classification of optimization models. Improving search. Formulation of linear programs (LPs). Simplex algorithms for solving LPs. Duality and sensitivity in linear programming. Multi-objective optimization and goal programming. Introduction to network flow models. Formulation of integer programs. Solution methods for integer programs. Unconstrained nonlinear programming. Introduction to constrained nonlinear programming and quadratic programming.

ENMG 621	Forecasting Methods and Applications	3.0; 3 cr.
Principles and applications of forecasting methods in planning and managing activities in organizations. Introduction to business forecasting. Forecasting and data considerations. Simple regression analysis. Multiple regression analysis. Time series regression (decomposition methods). Moving averages and exponential smoothing. Forecasting with Box-Jenkins methodology. Artificial neural networks as forecasting tools. Combining forecasts. Implementing forecasts in organizations.		
ENMG 651	Decision Support Systems	3.0; 3 cr.
Major components of decision support systems. Database management system. User interface. Model-based management system. Benefits in relation to improving the decision-making process for managers. Hardware and software limitations of alternative approaches. Anticipated technological improvements. Effective implementation.		
ENMG 656	Management of Technological Innovations	3.0; 3 cr.
Strategic management of technology-based innovation within the firm. Assessing the innovative capabilities of the firm. Managing the corporate R&D function. Managing the interfaces between functional groups in the development process. Managing the new business development function in the firm. Building distinctive technology-based competencies and competitive advantages. Technological leadership versus followership in competitive strategy. Institutionalizing innovation. Attracting and keeping corporate entrepreneurs.		
ENST 330	Energy Science and Technology Lab	3.0; 3 cr.
This course is designed to give the students “hands-on” experience on selected energy science and technology topics in solar energy; electrochemical energy storage; thermoelectric technologies; fuel cells; thermo-hydraulics of power systems; energy efficiency in a wide range of systems; hybrid engines; thermal management of electronics; and energy efficient buildings. The selected topics vary from semester to semester.		
GEOL 300	Elements of Petroleum Geology	3.0; 3 cr.
The course is designed for non-geologists who require a pretty good knowledge of geology associated with petroleum exploration and exploitation. The aim is to introduce sufficient knowledge and terminology to give the students the ability to interact knowledgeably with the global energy industry. It is to focus on the origins of oil and gas, the accumulation conditions and the techniques to find and exploit hydrocarbons, the various estimates of petroleum proven reserves and undiscovered reserves, and the distribution of the world’s major oil and gas provinces.		
PHYS 340	Atmospheric Physics and Energy	3.0; 3 cr.
The course exposes the students to the various physical principles governing energy conversion and transformation. Understanding the composition and structure of the atmosphere; transport laws, radiation, momentum transfer, heat transfer, mass transfer, steady state heat balance, microclimatology of radiation, crop meteorology and wind system, wind energy, mapping the atmosphere for the study of global warming and Ozone depletion. The basic of light matter interaction and nuclear energy.		
ENST 398	Special Projects in Energy Studies in Cooperation with Industry and/or NGO and Legislative Bodies	3.0; 3 cr.
Seminar: Must be registered once per year		0 cr.
ENST 395A/395B	Comprehensive Exam	0 cr.
ENST 699	Thesis	6 cr.

Master Degree Programs in Environmental Sciences

Chairperson:	Zurayk, Rami
Professors:	El-Fadel, Mutasem (CEE); Zaatari, Ghazi (Pathology and Laboratory Medicine); Zurayk, Rami (LDEM)
Associate Professors:	Farajalla, Nadim (LDEM); Makdisi, Karim (PSPA); Massoud; May (ENHL)

General Information

The degree of Master of Science (MS) in Environmental Sciences is offered with four possible specializations

- Ecosystem Management in the Faculty of Agricultural and Food Sciences (FAFS)
- Environmental Health in the Faculty of Health Sciences (FHS)
- Environmental Technology in the Faculty of Engineering and Architecture (FEA)
- Environmental Policy Planning in the Faculty of Arts and Sciences (FAS)

The program draws on the resources of various departments of the faculties of Agricultural and Food Sciences (FAFS), Arts and Sciences (FAS), Engineering and Architecture (FEA), Health Sciences (FHS), and Medicine (FM), and provides opportunities for study and research in the general field of the environment.

The program provides graduates with the necessary tools for professional practice and/or the pursuit of higher education. It is administered by an interfaculty committee that coordinates with the graduate committees of the faculties concerned.

Criteria for Admission

To be accepted into the program, an applicant must

- meet general university requirements for admission to graduate study
- be recommended by the appropriate faculty graduate committee and accepted by the Interfaculty Coordinating Committee of the program.

Applicants to the program may be admitted under the following categories:

- graduate - if the average in the last 60 credits or the last two years is greater than 80
- graduate on probation - if the average in the last 60 credits or the last two years is less than 80 and greater than 75.

Adequate preparation to take any graduate course is decided by the academic adviser and the Interfaculty Graduate Environmental Sciences Program Committee (IGESPC).

Comprehensive Examination

The student must register and pass a zero-credit comprehensive examination course in accordance with University general requirements. Timing of the examination is set by the department/program. The Pass (P) or Fail (F) is entered online or is reported to the Registrar immediately on the date the comprehensive examination is passed any time during the semester.

In general, a comprehensive examination is a test that covers a broad base of material. The purpose of the examination is to assess the student's knowledge and capacities to earn a given graduate degree in the field of specialization. Depending on the degree program, it may test course knowledge, knowledge of the student's proposed research area, and/or the general knowledge in the field. The student's thesis committee or the department administers the comprehensive exam.

Degree Requirements

Requirements for the degree of Master of Science in Environmental Sciences (any specialization), both thesis and non-thesis options, are tabulated below. The Master's degree with thesis option will normally require between 20 and 24 months to complete. In both options, the student is required to complete 30 credits of which 9 credits are core courses. All students are required to register in zero credit seminar ENSC 690 whenever it is offered.

Course	Group	Thesis Option Credits	Non-Thesis Option Credits
Core	A	9	9
Electives	B	15	18
Seminar		0	0
Thesis		6	
Project			3
Total number of credits required for graduation			30

Core courses, as well as basic and broad electives, are listed below. These courses are structured to provide students with a diversified and multi-disciplinary background in environmental sciences. Students have to register the core course offered by their faculty of concentration. Students are also required to select two other supplementary courses from the list of core courses approved by the program. Student can take other elective courses from the other faculties after securing the approval of the advisor. Specific Faculty/Department requirements are defined under each respective Faculty/Department.

Group A	Core Courses in Environmental Sciences	Credits
ENSC 630/LDEM 630	Natural Resources Management	3
ENSC 640/ENHL 310	Toxicology and Environmental Health Hazards	3
ENSC 650/PSPA 316	International Environmental Policy	3
ENSC 690	Seminar in Environmental Engineering and Sciences ¹	0
One of the following offered courses		
ENSC 600/CIVE 655	Air Pollution and Control	3
CIVE 552	Waste Management and Treatment	3
CIVE 550	Water Treatment and Laboratory	3
CIVE 551	Wastewater Treatment and Laboratory	3
CIVE 553	Environmental Biotechnology	3
CIVE 654	Environmental Bioremediation	3
Group B	Examples of Concentration Electives	Credits
1.Ecosystem Management		
ENSC 600/CIVE 655	Air Pollution and Control I	3
CIVE 552	Waste Management and Treatment	3
ENSC 631/LDEM 631	Agricultural Pollution and Control	3
ENSC 633/LDEM 633	Ecological Landscape Design and Planning	3
ENSC 622/CIVE 653	Environmental Chemistry and Microbiology	3
ENSC 641/ENHL 312	Occupational Health	3
ENSC 642/ENHL 314	Environmental Management Systems	3
ENSC 652/CIVE 656	Environmental Impact Assessment	3
ENSC 654	Physical and Biological Resources in Terrestrial Ecosystems	3
ENSC 655/AGSC 301	Statistical Methods in Agriculture	3
ECON 333	Energy Economics and Policy	3
ENSC 662/ECON 338	Economics of Natural Resources and the Environment	3
LDEM 300	Directed Study in Ecosystem Management	3
LDEM 301	Urban Greening	3
BIOL 362	Advanced Ecology	3
BIOL 363	Population and Community Ecology	3
AGSC 376	Resource and Environmental Economics	3
AGSC 384	Rural Social Changes Development and Environment	3
CIVE 649	Climate Change and Water Resources	3
CIVE 552	Waste Management and Treatment	3
CIVE 633	Soil and Site Improvement	3
CIVE 654	Environmental Bioremediation	3
CIVE 655	Air Pollution and Control	3
CIVE 756	Environmental and Water Conflict Management	3
URPL 664	Urban Land Use Planning	3
URPL 665	Development and Planning Policies	3

2.Environmental Health

ENSC 600/CIVE 655	Air Pollution and Control I	3
ENSC 641/ENHL 312	Occupational Health	3
ENSC 642/ENHL 314	Environmental Management Systems	3
ENHL 300	Introduction to Environmental Health	2
ENHL 307	Food Safety	3
ENHL 308	Tutorial	1-3
ENHL 320	Special Topics in Environmental Risk Analysis	3
ENSC 652/CIVE 656	Environmental Impact Assessment	3
ENSC 658/PSPA 343	Environmental Conflict Resolution	3
ENSC 661/BIOL 363	Population and Community Ecology	3
ENSC 662/ECON 338	Economics of Natural Resources and the Environment	3
CIVE 756	Environmental and Water Conflict Management	3

3.Environmental Technology

CIVE 550	Water Treatment and Laboratory	3
CIVE 551	Wastewater Treatment and Laboratory	3
CIVE 552	Waste Management and Treatment	3
CIVE 553	Environmental Biotechnology	3
CIVE 555	Air Quality Management	3
CIVE 602	Experimental Design and Statistical Methods	3
CIVE 650	Water and Sewage Works Design	3
CIVE 651	Processes in Water and Wastewater Treatment	3
CIVE 652	Landfill Engineering Design	3
CIVE 653	Environmental Chemistry and Microbiology	3
CIVE 654	Environmental Bioremediation	3
ENSC 600/CIVE 655	Air Pollution and Control I	3
CIVE 656	Environmental Impact Assessment	3
ENSC 651/CIVE 657	Methods of Environmental Sampling and Analysis	3
CIVE 751	Wastewater Reclamation and Reuse	3
CIVE 752	Industrial Waste Management	3
ENSC 602/CIVE 755	Air Pollution Modeling	3
ENSC 642/ENHL 314	Environmental Management Systems	3
ENSC 662/ECON 338	Economics of Natural Resources and the Environment	3
CIVE 648	GIS for Water Resources and Environmental Engineering	3
CIVE 756	Environmental and Water Conflict Management	3

4.Environmental Policy

PSPA 300	Methodology and Research Design	3
ENSC 655/ PSPA 306	Research Methods and Techniques	3
PSPA 310	International Politics	3
PSPA 311	International Politics in the ME	3
PSPA 312	Public International Law	3

PSPA 314	The UN and International Politics	3
PSPA 317	International Political Economy	3
PSPA 324	Government and Politics of Lebanon	3
ENSC 657/PSPA 341	Environmental Regulation and Legislation	
PSPA 345	Special Topics in Environmental Policy and Politics	
PSPA 346	Special Topics in Natural Resource Policy and Politics	
PSPA 351	Foundation of Public Administration	3
PSPA 352	Foundations of Public Policy	3
PSPA 360	Public Policy Research and Analysis	3
ENSC 659/PSPA 362	Public Policy and Administration	3
PSPA 373	The Ethics of Public Administration	3
AGSC 376	Resource and Environmental Economics	3
AGSC 384	Rural Social Change, Development the Environment	3
ECON 333	Energy Economics and Policy	3
ECON 338	Economics of Natural Resources and the Environment	3
URPL 664	Urban Land Use Planning	3
URPL 665	Development and Planning Policies	2

A student can take other elective courses from the other faculties after securing the approval of his/her advisor.

Graduation Requirements

To be eligible for graduation with the Master's degree in environmental sciences, a graduate student:

- must have attained a cumulative course average of 80 or above
- is not placed on probation by the time the course work is completed
- must have completed the minimum credit hours of course work designated by the program
- must have passed comprehensive exam
- must have completed thesis requirements for thesis option degree
- must have completed project requirements for the non-thesis option degree
- must have met the residence requirements specified for the Master's degree

Master of Science in Environmental Sciences—Suggested Curriculum

Thesis Option		
Term I	Fall	Credits
ENSC 640	Toxicology and Environmental Health Hazards	3
ENSC 690	Seminar in Environmental Engineering and Sciences	0
Any one of the following offered courses		
ENSC 600/CIVE 655	Air Pollution and Control	3
CIVE 552	Waste Management and Treatment	3
CIVE 550	Water Treatment and Laboratory	3
CIVE 551	Wastewater Treatment and Laboratory	3
CIVE 553	Environmental Biotechnology	3
CIVE 654	Environmental Bioremediation	3
ENSC 69_	Elective	3
Term II	Spring	Credits
ENSC 630	Natural Resources Management	3
ENSC 650	International Environmental Policy	3
Any one of the following offered courses		
ENSC 600/CIVE 655	Air Pollution and Control I	3
CIVE 552	Waste Management and Treatment	3
CIVE 550	Water Treatment and Laboratory	3
CIVE 551	Wastewater Treatment and Laboratory	3
CIVE 553	Environmental Biotechnology	3
CIVE 654	Environmental Bioremediation	3
ENSC 69_	Elective	3
Term III	Summer	Credits
ENSC 699	Thesis	6
Term IV	Fall	Credits
ENSC 69_	Elective	3
ENSC 690	Seminar in Environmental Engineering and Sciences	0
ENSC 699	Thesis (continued)	
Term V	Spring	Credits
ENSC 69_	Elective	3
ENSC 699	Thesis (continued)	–
Term VI	Summer	Credits
ENSC 699	Thesis (continued)	-
Total		30

Non-Thesis Option		
Term I	Fall	Credits
ENSC 640	Toxicology and Environmental Health Hazards	3
ENSC 69_	Elective	3
Any one of the following offered courses		3
ENSC 600/CIVE 655	Air Pollution and Control I	3
CIVE 552	Waste Management and Treatment	3
CIVE 550	Water Treatment and Laboratory	
CIVE 551	Wastewater Treatment and Laboratory	3
CIVE 553	Environmental Biotechnology	3
CIVE 654	Environmental Bioremediation	3
ENSC 690	Seminar in Environmental Engineering and Sciences	0
Term II	Spring	Credits
ENSC 630	Natural Resources Management	3
ENSC 650	International Environmental Policy	3
Any one of the following offered courses		3
ENSC 600/CIVE 655	Air Pollution and Control I	3
CIVE 552	Waste Management and Treatment	3
CIVE 550	Water Treatment and Laboratory	3
CIVE 551	Wastewater Treatment and Laboratory	3
CIVE 553	Environmental Biotechnology	3
CIVE 654	Environmental Bioremediation	3
ENSC 69_	Elective	3
Term III	Summer	Credits
ENSC 697	Project	3
ENSC 69_	Elective	3
Term IV	Fall	Credits
ENSC 69_	Elective	3
ENSC 690	Seminar in Environmental Engineering and Sciences	0
Term V	Spring	Credits
ENSC 697	Project	3
Total		30

Course Descriptions

CIVE 550 Water Treatment and Laboratory 3 cr.

A course that examines the quality and principles of municipal and industrial water treatment processes and methods of testing for physical, chemical and biological parameters. *Prerequisite: CIVE 251 or equivalent, or consent of instructor.*

CIVE 551 Wastewater Treatment and Laboratory 3 cr.

A course that examines the quality and principles of municipal wastewater treatment processes and methods of testing for physical, chemical, and biological parameters. *Prerequisite: CIVE 252 or equivalent, or consent of instructor.*

- CIVE 552 Waste Management and Treatment 3 cr.**
A course on engineering principles, practices, and techniques for the management of solid wastes: sources, composition, properties, impacts, generation, storage, collection and transport, processing, resource recovery, and disposal.
- CIVE 553 Environmental Biotechnology 3 cr.**
A course designed to teach students the scientific and engineering principles of microbiological treatment technologies to clean contaminated environments and formulate effective solutions to problems in biochemical engineering. *Prerequisites: CIVE 251, CIVE 252, or equivalent or consent of instructor.*
- CIVE 555 Air Quality Management 3 cr.**
A course on the principles, practices, and techniques for the management of air pollution: Types, sources, properties, impacts, standards, control technologies, atmospheric dispersion, emissions, and indoor air quality.
- CIVE 602 Experimental Design and Statistical Methods 3 cr.**
A course that covers the main steps required to efficiently plan, conduct, analyze, and interpret the results from experiment and observational studies. The course focuses on statistical inference and modeling. Topics covered include ANOVA, t-tests, regression models, and nonparametric tests. The course involves working within a statistical modeling environment.
- CIVE 633 Soil and Site Improvement 3 cr.**
A course that covers compaction, admixture stabilization, foundation soil treatment, reinforced soil and composite materials, and material sites reclamation.
- CIVE 648 GIS for Water Resources and Environmental Engineering 3 cr.**
A course that introduces the concepts and principles of Geographic Information Systems (GIS) from the perspective of water resources and environmental engineering and sciences. It provides coverage of state-of-the-art GIS methods and tools: spatial and terrain analysis, geostatistical analysis, watershed delineation, time series analysis, and development of GIS integrated models.
- CIVE 649 Climate Change and Water Resources 3 cr.**
An introductory course on global climate change and its potential impacts on water resources and related sectors. It explores drivers of climate change, greenhouse gases emissions and mitigation efforts, and adaptation options with emphasis on Integrated Water Resources Management.
- CIVE 650 Water and Sewage Works Design 3 cr.**
A course that examines the design of water and wastewater schemes, including design reports and a literature search on the development of conventional treatment processes. *Prerequisites: CIVE 550 and CIVE 551 or consent of instructor.*
- CIVE 651 Processes in Water and Wastewater Treatment 3 cr.**
A course on sedimentation, filterability, permeability and fluidization, ion exchange, aeration, flotation, membrane filtration, and aerobic digestion. Experimental applications of processes. *Prerequisites: CIVE 251, CIVE 252, or equivalent or consent of instructor.*
- CIVE 652 Landfill Engineering Design 3 cr.**
A course on solid waste disposal with emphasis on design development of landfill elements: site selection and characterization, gas extraction and management, leachate collection and management, liners, covers, closure and post-closure monitoring. *Prerequisite: consent of instructor.*

CIVE 653 Environmental Chemistry and Microbiology 3 cr.

A course that deals with organic, inorganic, and physical chemistry; chemical equilibrium; reaction kinetics; acidity, alkalinity; composition, morphology, and classification of microorganisms; energy, metabolism, and synthesis; growth, decay, and kinetics; and biological water quality indicators. *Prerequisites: CIVE 251, CIVE 252, or equivalent or consent of instructor.*

CIVE 654 Environmental Bioremediation 3 cr.

A course that discusses the application of biological treatment for the remediation of contaminated environments, and highlights current engineering methods/design used to enhance biodegradation.

**ENSC 600/
CIVE 655 Air Pollution and Control 3 cr.**

A course that examines processes and design equipment for the control of particulates and gaseous emissions. *Prerequisite: consent of instructor.*

CIVE 656 Environmental Impact Assessment 3 cr.

A course on procedures of assessing/preparing/reviewing/presenting environmental impacts of developmental projects/facilities: industrial facilities, waste management/disposal, wastewater treatment, transportation, dams and reservoirs, irrigation/drainage schemes, coastal zone developments, natural resource management, and so on. *Prerequisite: E4 status or consent of instructor.*

**ENSC 651/
CIVE 657 Methods of Environmental Sampling and Analysis 3 cr.**

A course on sampling techniques and instrumental methods in environmental sciences; determination of pollutants in water, air, and soil; analytical techniques; adaptation of procedures to specific matrices; case studies. *Prerequisites: CIVE 251, CIVE 252, or equivalent or consent of instructor.*

CIVE 751 Wastewater Reclamation and Reuse 3 cr.

A course that examines environmental issues in water reuse, risk assessment, water reclamation technologies, storage of reclaimed water, usage of reclaimed water, and planning of wastewater reclamation and reuse. *Prerequisite: CIVE 551.*

CIVE 752 Industrial Waste Management 3 cr.

A course on engineering principles, practices, and techniques for the management of industrial hazardous wastes: sources, generation, properties. Impacts and auditing of industrial facilities. Basic treatment processes and disposal methods. Site remediation. *Prerequisite: consent of instructor.*

**ENSC 602/
CIVE 755 Air Pollution Modeling 3 cr.**

A course that deals with mathematical models, air pollution meteorology, plume rise, dispersion and atmospheric chemistry, meteorological models, as well as Gaussian, statistical, and other special application models. *Prerequisite: CIVE 555 or consent of instructor.*

CIVE 756 Environmental and Water Conflict Management 3 cr.

A course on the development of case studies in environmental and water conflict management taught under a framework of role play of opponents perspective and decision making thereof.

LDEM 300	Directed Study in Ecosystem Management	1-3 cr.
LDEM 301	Urban Greening	3 cr.
This course focuses on the literal green aspect of urban greening that is plants and how they contribute to improve urban living. Topics covered in the course include urban agriculture, green roofs, walls, facades and corridors, parks and open spaces, urban forestry, and horticulture therapy.		
ENSC 630/ LDEM 630	Natural Resource Management	3 cr.
Ecosystem approach to NRM. Data sources and interpretation for NRM. Physical, socio-economic, cultural, political, and geographic specificity of NRM. Principles and processes of NRM. Case studies and practical examples in contrasting situations.		
ENSC 631/ LDEM 631	Agricultural Pollution and Control	3 cr.
Fate of agrochemicals in the environment. Effect on terrestrial and aquatic systems. Contamination, monitoring residues, methodologies, and risk assessment models and research. <i>Annually.</i>		
ENSC 633/ LDEM 633	Ecological Landscape Design and Planning	3 cr.
Introduction to the theory and methodology of ecological landscape design and planning, aims to introduce the holistic approach of landscape ecology and its application in sustainable management of natural and cultural landscape systems. <i>Alternate years.</i>		
ENHL 300	Introduction to Environmental Health	2 cr.
A course that introduces students to the physical life support system and interactions with the socio-economic context. Emphasis is placed on assessing, preventing, and controlling environmental hazards affecting human health and ecological wellbeing. The role of local and global regulatory systems in impacting change and sustaining a healthy environment is highlighted. Enabling communities through this process of sustainable development is critically assessed.		
ENHL 307	Food Safety and Health	3 cr.
The course will focus on the safety and management of processed food products. It will address the advantages and limitations of food processing techniques and in specific the application of food additives. Areas covered will relate mainly to food safety and quality control, health impacts, types and limitations of food processing methods, use of food additives, exposure estimation, toxicological implications, risks and benefits governing use and quality control measures and applications both at the national and international levels.		
ENHL 308	Tutorial	3cr.
A tutorial on Special Environmental Health projects of interest to the students. A written report is required.		
ENSC 640/ ENHL 310	Toxicology and Environmental Health Hazards	3 cr.
A course that reviews the essentials of toxicology: dose response, toxicokinetics (absorption, distribution, metabolic conversion, elimination), and the molecular basis for toxic action, target organ toxicity, mutagenesis, teratogenesis, and carcinogenesis. Selected chemical and biological agents that adversely affect man and environmental quality are introduced as case studies.		

ENSC 641/ Occupational Health 3 cr.
ENHL 312

An introduction to the general principles relating to occupational health. Issues related to work, work environment and organization, and their impact on the physical and mental wellbeing of employees. Principles of recognizing, evaluating, and controlling work hazards with an emphasis on the multidisciplinary nature of the field of occupational health. Various disciplines involved in occupational health and used by occupational health professionals to safeguard the health of employees, including toxicology, safety, hygiene, epidemiology, ergonomics, occupational medicine, psychology, and sociology. This course is designed for students of multiple educational and training backgrounds and does not require prerequisite knowledge.

ENSC 642/ Environmental Management Systems 3 cr.
ENHL 314

This course provides an overview of the most common international standards for environmental management systems, primarily the International Standards Organization (ISO) harmonized management systems, and its implications for different firms. It provides students with the skills to design, implement and assess such management systems. Though the first part of the course is mainly lecture based, student participation in the form of questions and discussion is always welcomed and encouraged. Critical thinking will be promoted throughout the course. Students will be expected to prepare a technical report on a firm or industry of their choice and to communicate project findings to their colleagues through verbal presentation. Emphasis is placed on solving environmental problems using an integrated approach in order to achieve an optimized management performance. Alternate years.

ENHL 320 Special Topics in Environmental Health 3 cr.

A course that covers selected topics such as risk analysis, environmental ethics and justice, or environmental policy and allows focused examination of special topics of interest to trainees in Environmental Health.

PSPA 300 Methodology and Research Design 3 cr.

An introduction to the philosophy of science and how it influences the choice of research design. The emphasis is on developing skills that are useful for any method (survey, research, comparative historical analysis, game theory). The objective is to provide students with the practical tools they need to successfully complete original research. *Core course. Annually.*

ENSC 653/ Research Methods and Techniques 3 cr.
PSPA 306

A course that deals with various methods of data collection and analysis. Specific research methods include both quantitative and qualitative techniques such as experimental, survey, field observation, content analysis, historical/comparative, and evaluation. *Occasionally.*

PSPA 310 International Politics 3 cr.

This seminar provides a survey of the discipline of international politics and contemporary research in the field. In addition to covering central theoretical perspectives in international relations theory, the course will introduce students to contemporary debates in international politics and policy with an emphasis on topics and themes relating to the Middle East. Students will develop critical thinking and analytical writing skills through close reading of key texts and writing exercises. *Core course. Annually.*

PSPA 311 International Politics and the Middle East 3 cr.

This seminar deals with issues and themes relevant to contemporary Middle East politics within the context of international relations. It explores how the politics of the Middle East, US policy in the Middle East, and the Middle East as a regional system have been understood and represented through the lens of international relations theory and scholarship. Topics include: the evolution of the Middle East state system, Arab Nationalism and the Cold War, the Arab-Israeli conflict and US policy towards Israel and the Palestinians, the geopolitics of oil and the Gulf, the Iraq War and its regional consequences, Iran's role in the Arab world, the question of empire and the future of US grand strategy, and Lebanon's position in regional politics. *Annually.*

PSPA 312 Public International Law 3 cr.

A course that aims to provide an understanding of the principles underlying public international law that facilitates relations among states, resolves disputes, protects human rights, allocates resources, and restricts conduct during wartime. Emphasis is placed on subfields of international law most closely connected to international politics such as the legal consequences of very serious violations of international law, the role played by the United Nations or the legal regulation of the use of force. Reflecting upon the kind of role international law plays in the conduct of international relations, this course includes many recent case studies and tackles some of the major debates in the field. *Annually.*

PSPA 314 The UN and International Politics 3cr.

This seminar examines the role of the United Nations (UN) within the context of international politics, security, and development. It focuses on the UN role in the Global South, particularly the Arab region. The course explores theoretical perspectives on the role of the UN in world politics and traces the evolution of UN institutions, and in particular UN peacekeeping, from the Cold War to post-Cold War period including the war on terror. It then considers a series of case studies in depth. The course will include, when possible, guest presentations from UN officials and a field trip to better appreciate the conditions within which UN operations work. *Occasionally.*

ENSC 650/ PSPA 316 International Environmental Policy 3 cr.

A course that seeks to provide a broad overview of the key concepts, actors, and issues related to global environmental policy. This course outlines the evolution of environmental policy in facing global environmental challenges and how such policies have become inherently intertwined with government policy, business practice, and international trade. *Annually.*

PSPA 317 International Political Economy 3cr.

This course provides a critical examination of the politics of international economic relations, global economic development, and transnational economic activity with a special emphasis on the position and experiences of the Middle East states in the global political economy. The course offers a survey of theoretical approaches to international political economy and addresses themes critical to the experience of the Middle East such as state-led industrialization, trade and regionalism, finance, oil, labor migration, MNCs, transnational movements, globalization, neo liberalism, and the politics of development and global governance. *Occasionally.*

PSPA 324 Government and Politics in Lebanon 3 cr.

A course that examines the evolution of the political system and the different approaches to the study of government institutions in Lebanon. This course focuses on patterns of change involving state and society from the founding of the state in the early 1920s to the present. *Occasionally.*

- ENSC 657/
PSPA 341** **Environmental Regulation and Legislation** **3 cr.**
An introduction to contemporary legislative approaches to environmental protection, the rationales for their embodiment in policies, and their effectiveness in achieving prescribed goals and alleviating environmental degradation. This course also examines the emergence of environmental initiatives in developing countries with a focus on the latest developments in Lebanon. *Occasionally.*
- PSPA 345** **Special Topics in Environmental Policy and Politics** **3 cr.**
May be repeated for credit. *Occasionally.*
- PSPA 346** **Special Topics in Natural Resource Policy and Politics** **3 cr.**
May be repeated for credit. *Occasionally.*
- PSPA 351** **Foundations of Public Administration** **3 cr.**
This seminar is an advanced study and analysis of the field of public administration, from its foundations and origins up to the present. It covers topics such as: historical public administration, the traditional model of public administration, new public management, and collaborative public administration. The course will also review contemporary research activities and findings related to public administration. *Annually.*
- PSPA 352** **Foundations of Public Policy** **3 cr.**
This seminar covers topics related to the substance, methods and frameworks of public policy in a variety of disciplines including: welfare economics, political science, political economy, and organization theory. Emphasizing the role of theory in empirical policy research, the course illuminates the various policies and policy challenges in the following substantive areas: economics; education; the environment; national security; and immigration. *Annually.*
- PSPA 360** **Public Policy Research and Analysis** **3 cr.**
This seminar provides an introduction to policy analysis typologies, policy tools, and the factors that shape the utilization of policy analysis. It is designed to give students the theoretical and practical exposure to the process of the analysis of public policy as well as to its relevant qualitative, survey, and mixed method approaches and techniques. *Annually.*
- ENSC 659/
PSPA 362** **Public Policy and Administration** **3 cr.**
This seminar covers topics and frameworks related to the substance and approaches of public policy as they relate to public administration. Students will engage in a serious analysis of the economic, social, and cultural assumptions that underpin government and its relationship to the polity. The course is also designed to give students an organized opportunity to investigate their own interests within a specific key policy area. *Annually.*
- BIOL 362** **Advanced Ecology** **3 cr.**
A discussion and analysis of topics of current interest in ecology with emphasis on population and community dynamics; methods of ecological investigation and analysis; includes field work.
- ENSC 661/
BIOL 363** **Population and Community Ecology** **3 cr.**
A course that introduces the various models and theories of population dynamics and community structure, and their applications in assessing the complex interactions that occur in natural plant-animal systems as a result of long co-evolution, with emphasis on chemical ecology.

- ECON 333** **Energy Economics and Policy** **3 cr.**
A study of the theories related to energy economics, such as economics of natural and energy resources, and the interrelationship between energy, economics and the environment, as well as some important issues in energy policy. *Students cannot receive credits for both ECON 333 and MECH 674 Energy Economics and Policy. Occasionally.*
- ENSC 662/
ECON 338** **Economics of Natural Resources and the Environment** **3 cr.**
An analysis of economic issues regarding the efficient use of natural resources and the management of environmental quality. *Occasionally.*
- ENSC 654** **Physical and Biological Resources
in Terrestrial Ecosystems** **3 cr.**
Physical and biological resources in ecosystems. Soils in the ecosystem. Soil conservation. Principles of soil chemistry and microbiology. Plant and animal biodiversity. Collection and conservation of wild types. Preservation of endangered species. Plant response to environmental stress. *Alternate years.*
- ENSC 655/
AGSC 301** **Statistical Methods in Agriculture** **3 cr.**
An investigation of the statistical techniques needed to design experiments and analyze and interpret agricultural research data. *Prerequisites: STAT 210 or EDUC 227 and CMPS 209. Fall and spring.*
- AGSC 376** **Resource and Environmental Economics** **3 cr.**
Addresses and analyzes resource and environmental problems facing today's society, with an emphasis on providing the student with an intensive introduction to the qualitative theory necessary for an effective analysis of resource problems.
- AGSC 384** **Rural Social Change, Development and the Environment** **3 cr.**
Provides an understanding of economic development and underdevelopment as it relates to environmental degradation and demographic, social and cultural change; with special application to the economies of the Middle East.
- URPL 664** **Urban Land Use Planning** **3 cr.**
This course examines the theory and practice of land use planning as it has developed within the wider practice and theorization of planning. The course explores the ways in which land use controls have been developed and managed in different institutional and regional contexts, unraveling the different conceptualizations of planning that support each of them. Special emphasis is placed on the case of Lebanon where the practice of land use planning is explored through a detailed introduction to planning institutions, agencies, and regulations.
- URPL 665/
ARCH 062** **Development and Planning Policies** **3 cr.**
The course examines local and regional development and spatial planning projects and policies. It investigates the policy governance and institutional setup, the role of professional expertise, the spatial impacts on the built and un-built environments, as well as the social and environmental impacts. Using case-study analysis of selected cities and regions, students learn how the built environment's growth and development is being managed, across different contexts, by a constellation of stakeholders negotiating conflicting interests, often yielding benefits and costs unequally distributed across various constituent groups.

ENSC 690 Seminar in Environmental Engineering and Sciences 0 cr.
CIVE 601

Current research or applied projects are presented by faculty members, students, or invited speakers. *Annually.*

ENSC 695 Comprehensive Exam 0 cr.**ENSC 697 Project 3 cr.**

The project must be undertaken, in partial fulfillment of the requirements for the degree, upon the completion of at least 27 credits of core and elective courses. A student who is unable to finish the project in one semester can register for one additional time

ENSC 699 Thesis 6 cr.