

Department of Civil and Environmental Engineering

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Undergraduate Program

The Department of Civil and Environmental Engineering (CEE) offers the degree of Bachelor of Engineering (BE): major, Civil Engineering (CE).

The mission of the undergraduate program of the CEE Department is to provide a stimulating and supportive environment for high-standard education; to prepare graduates for a lifelong productive career in addressing problems in a rapidly-changing world, while instilling in them an appreciation of leadership qualities, professionalism, and ethics; to provide professional services of the highest quality to the community; and to contribute to expanding the knowledge and technological base in civil and environmental engineering.

Program Educational Objectives

The program is based on the following set of educational objectives:

- To impart a sound understanding of the fundamental principles and concepts of civil and environmental engineering while allowing sufficient specialization in sub-disciplines: structural, geotechnical, transportation, environmental and water resources engineering
- To develop the engineering principles and the mathematical, scientific, and computational skills in formulating and solving civil and environmental engineering problems
- To cultivate the skills pertinent to the engineering design process, conduct of experiment, analysis, and interpretation of data
- To expose students to real-world problems that consider multi-disciplinary approaches while addressing relevant social, environmental, economical, and aesthetic concerns
- To encourage independent thinking and the use of novel technologies to meet technical challenges and advance creative solutions

- To develop effective teamwork and communication skills
- To promote issues of professional and ethical conduct to prepare students for leading roles in the profession and the community

Curriculum

Term I (Fall)			Credit
CIVE	200	Introduction to Civil Engineering	2
EECE	230	Introduction to Programming	3
MATH	201	Calculus and Analytical Geometry III	3
PHYS	210	Introductory Physics II	3
PHYS	210L	Introductory Physics Laboratory II	1
Arabic Elective			3
			Total 15

Term II (Spring)			Credit
CIVE	210	Statics	3
EECE	210	Electric Circuits	3
MECH	320	Engineering Graphics	1
MATH	202	Differential Equations	3
ENGL	206	Technical English	3
Ethics Elective (PHIL 205, PHIL 206, PHIL 209, PHIL 210, or Approved Ethics)			3
			Total 16

Term III (Summer)			
CIVE	360	Surveying	2
STAT	230	Introduction to Probability and Random Variables	3
Humanities Elective			3
			Total 8

Term IV (Fall)			Credit
CIVE	310	Mechanics of Materials	3
CIVE	320	Construction Materials and Technologies	2
CIVE	350	Environmental Engineering	3
CIVE	370	Introduction to Information Technology	3
MATH	251	Numerical Computing	3
Humanities Elective			3
			Total 17

Term V (Spring)			Credit
CIVE	311	Structures I	3
CIVE	340	Fluid Mechanics and Laboratory	3
CHEM	202	Introduction to Environmental Chemistry	3
CHEM	203	Introductory Chemical Techniques	2
Biology Elective or			
CIVE	351	Environmental Microbiology	3
Humanities Elective			3
			Total 17

Term VI (Summer)			Credit
CIVE	430	Engineering Geology	3
ENMG	400	Engineering Economy	3
English Elective			3
			Total 9

Term VII (Fall)			Credit
CIVE	410	Structures II	3
CIVE	420	Concrete I	3
CIVE	440	Hydraulics and Laboratory	3
CIVE	460	Highway Engineering	3
Math Elective (MATH 212, MATH 218, MATH 281, or Approved Math)			3
			Total 15

Term VIII (Spring)			Credit
CIVE	421	Concrete II	3
CIVE	431	Soil Mechanics and Laboratory	3
CIVE	441	Engineering Hydrology	3
CIVE	450	Water and Wastewater Treatment and Laboratory	3
CIVE	461	Transportation Engineering and Laboratory	3
			Total 15

Term IX (Summer)			Credit
CIVE	500	Approved Experience	0

Term X (Fall)			Credit
CIVE	501	Final Year Project I	1
CIVE	530	Foundation Engineering	3
CIVE	580	Construction Management	3
Technical Elective I			3
Technical Elective II			3
Social Sciences Elective			3
			Total 16

Term XI (Spring)			
CIVE	502	Final Year Project II	3
Technical Elective III			3
Technical Elective IV			3
Economics Elective			3
Social Sciences Elective			3
			Total 15

Total = 143 credit hours

Technical Electives of Term X and Term XI

- CIVE 503 Special Topics in Civil and Environmental Engineering
- undergraduate (500 series) or graduate (600 series) courses in Civil and Environmental Engineering
- approved courses from other departments

Course Descriptions

CIVE 200 Introduction to Civil Engineering 2 cr.

An introductory course to the world of civil engineering including significant developments in the field, both current and future. The course gives an overview of civil engineering as a profession covering aspects of concept, design, and execution through seminars, case studies, field trips, laboratory experimentation, and a hands-on group project. *Annually.*

CIVE 210 Statics 3 cr.

A course outlining vector mechanics of forces and moments; free-body diagrams; equilibrium of particles and rigid bodies in two and three dimensions; plane and space trusses; frames and machines; axial, shear, and moment diagrams of beams and simple frames; friction; center of gravity and centroid; area moment of inertia; computer applications.

Pre- or co-requisite: MATH 201. Every regular term.

CIVE 310 Mechanics of Materials 3 cr.

A course on stresses, strains, and stress-strain relationship; tension and compression; torsion of circular bars; bending and shear stresses in beams; combined stresses; stress transformation and Mohr's circle. *Prerequisite: CIVE 210. Annually.*

CIVE 311 Structures I 3 cr.

An introductory course covering influence lines; deflection of beams and frames by double integration method, moment-area theorems, and conjugate beam; introduction to indeterminate structures; approximate analysis of building frames. *Prerequisite: CIVE 310. Annually.*

CIVE 320 Construction Materials and Technologies 2 cr.

A course that covers the composition and properties of engineering construction materials through hands-on laboratory experiments. The course introduces students to developments in construction equipment and technologies and includes field demonstrations. *Annually.*

CIVE 340 Fluid Mechanics and Laboratory 3 cr.

A course that deals with fluid properties, fluid static, continuity equation, Bernoulli's equation, energy principle, momentum principle, laboratory experiments. *Annually.*

CIVE 350 Environmental Engineering 3 cr.

A course that introduces the fundamentals of environmental engineering. A screening course of major topics in environmental engineering including water and wastewater, environmental hydrology, environmental hydraulics and pneumatics, air, solid waste, noise, environmental modeling, and hazardous waste. *Annually.*

CIVE 351 Environmental Microbiology 3 cr.

A course that introduces the basic principles of environmental microbiology and discusses example applications from the natural and engineered worlds. The main goals of this course are to present an overview of important microorganisms involved in environmental systems, their ecology, their interactions with various pollutants, and their beneficial or harmful effects on humans. *Prerequisites: CHEM 202 (or equivalent), MATH 201 (or equivalent). Annually.*

CIVE 360 Surveying 2 cr.

A course on the theory of measurements and errors; linear measurements; surveying instruments; leveling; angles, bearings, and azimuths; stadia measurements; traversing—field aspects; traverse computations and adjustment; topographic surveying; triangulation. *Annually.*

CIVE 370 Introduction to Information Technology 3 cr.

An introductory course on computer hardware. This course covers Internet technology, database systems, and the use of software tools and their integration into projects to create, manage, and exchange information with reference to civil and environmental engineering applications. *Annually.*

CIVE 410 Structures II 3 cr.

A course on the stability and determinacy of structures; energy theorems and applications to trusses, beams, and frames; solution of statically indeterminate structures by flexibility (force) and stiffness methods; introduction to the direct stiffness method; influence lines for indeterminate structures. *Prerequisite: CIVE 311. Annually.*

CIVE 420 Concrete I 3 cr.

A course that covers the mechanical properties of concrete materials; ultimate strength theory of flexure and shear; flexural and shear design of beams; service load behavior; bond properties of reinforcing bars; design of solid and ribbed one-way slabs. *Prerequisite: CIVE 311. Annually.*

CIVE 421 Concrete II 3 cr.

A course that builds upon Concrete I and covers continuous beams; short columns, slender columns, and biaxially bent columns; wall footings, concentrically and eccentrically loaded single column footings, and combined footings; staircases; bearing walls; cantilever retaining walls; two-way slabs. *Prerequisites: CIVE 410 and CIVE 420. Annually.*

CIVE 430 Engineering Geology 3 cr.

A course that discusses the composition and properties of rocks; geologic processes; geologic hazards; geologic structures and engineering consequences; terrain analysis and geologic mapping; interpretation and use of geologic maps; application of geology to engineering practice. *Annually.*

CIVE 431 Soil Mechanics and Laboratory 3 cr.

A course on soil classification and index properties; soil structure and moisture; compaction; seepage; effective stress concept; compressibility and consolidation; stress and settlement analysis; shear strength. Laboratory tests are conducted to familiarize students with soil characterization and the engineering behavior of soils. *Prerequisite: CIVE 310. Annually.*

CIVE 440 Hydraulics and Laboratory 3 cr.

Flow in conduits, flow in open channels, flow measurements, and laboratory experiments. *Prerequisite: CIVE 340. Annually.*

CIVE 441 Engineering Hydrology 3 cr.

A course outlining hydrologic principles, rainfall-runoff analysis, flood routing, frequency analysis, and ground water hydrology. *Annually.*

CIVE 450 Water and Wastewater Treatment and Laboratory 3 cr.

A course that examines the quality and treatment methods of water and wastewater; testing for physical, chemical, and biological parameters. *Prerequisite: CIVE 350. Annually.*

CIVE 460 Highway Engineering 3 cr.

A course that examines road vehicle performance; principles of geometric design and highways; horizontal and vertical alignment; earthwork; intersections and interchanges; parking facilities; basic traffic models; queuing theory and traffic analysis; travel demand forecasting. *Prerequisite: CIVE 360. Annually.*

CIVE 461 Transportation Engineering and Laboratory 3 cr.

A course that introduces the field of transportation engineering through a presentation of the basics of traffic engineering, traffic flow theory, and pavement design. The laboratory component consists of carefully structured experiments that reinforce students' understanding of the academic concepts and principles. *Prerequisite: CIVE 460. Annually.*

CIVE 530 Foundation Engineering 3 cr.

A course that covers site investigations; evaluation of data from field and laboratory tests; estimation of stresses in soil masses; applications of principles of soil mechanics to determination of bearing capacity and settlement of spread footings, mats, single piles, and pile groups. *Prerequisite: CIVE 431. Annually.*

CIVE 580 Construction Management 3 cr.

A course on organizing for construction projects; pre-construction activities; bidding and contracts; fundamentals of construction planning, monitoring, and control; application of construction control tools: CPM, materials management, operations analysis, and quality control. *Annually.*

CIVE 581 Specifications and Cost Estimation 3 cr.

A course on the structure of construction documents and their interrelationships, bidding requirements; general and particular contract conditions; administrative and procedural requirements for construction; technical specifications; construction cost estimations process; unit rates determination. *Annually.*

Special Courses**CIVE 500 Approved Experience 0 cr.****CIVE 501 Final Year Project I 1 cr.**

A chosen design topic and preparation of a detailed execution program for CIVE 502, through comprehensive research with the guidance and approval of the faculty. *Annually.*

CIVE 502 Final Year Project II 3 cr.

A supervised project in groups of normally three students aimed at providing practical design experience in a civil and environmental engineering application. *Prerequisite: CIVE 501. Annually.*

CIVE 503 Special Topics in Civil and Environmental Engineering 3 cr.

Graduate Programs

Master of Engineering/Master of Science Programs

Programs are available leading to the ME degree in Civil and Environmental Engineering with the following specializations:

- Master of Engineering (ME); specialization, Civil Engineering (CE)
- Master of Engineering (ME); specialization, Environmental and Water Resources Engineering (EWRE)

Also available is a program leading to the MS degree in Environmental Science with the following specialization:

- Master of Science (MS); specialization, Environmental Technology (ET)

The master's degree programs prepare students through teaching and research for in-depth knowledge in the various fields of civil and environmental engineering. They provide students with significant research experience, and they equip graduates with the necessary tools for professional practice and/or the pursuit of higher education.

Doctor of Philosophy Programs

Programs are available leading to the PhD degree in Civil and Environmental Engineering with the following specializations:

- Doctor of Philosophy (PhD); specialization, Civil Engineering areas of concentration:
 - Structural and Materials Engineering
 - Geotechnical Engineering
 - Transportation Systems
- Doctor of Philosophy (PhD); specialization, Environmental and Water Resources Engineering (EWRE)

Graduates of the PhD programs will cultivate an expertise in specialized concentration areas; develop the ability to research, formulate, and study original ideas; attain an enhanced level of written and oral communication skills; and, acquire teaching expertise through tutoring and assisting in courses and labs.

The PhD Programs will be offered pending final approval by the New York State Education Department. For admission and graduation requirements, refer to the faculty and department webpages.

Master of Engineering (ME), Specialization: Civil Engineering (CE)

General Information

The Department of Civil and Environmental Engineering offers a graduate program leading to the degree of Master of Engineering (ME): specialization, Civil Engineering (CE). The program prepares students through teaching and research for in-depth knowledge in the following fields of civil engineering: structures, transportation, and geotechnical engineering.

In order to fulfill graduation requirements a student must complete a minimum of 24 credit hours of graduate courses and a thesis based on independent research, equivalent to at least six credit hours. The required course work for the degree with a major in civil engineering is distributed as follows:

- A minimum of four courses (12 credit hours) in the field of specialty
- A maximum of two courses (6 credit hours) in an allied field
- A maximum of two courses (6 credit hours) in free electives

All students registered in the program must take CIVE 797, Civil Engineering Seminar (0 credit), whenever offered.

A minimum of one calendar year of residence is required for graduation.

Requirements

- To be eligible for admission to the civil engineering graduate program a student must hold a bachelors degree in civil engineering or its equivalent. Engineering graduate in majors other than civil engineering may be admitted to the program and required to take prerequisite courses set by the department. Students must and also satisfy the requirements of the University and the Faculty of Engineering and Architecture for admission to graduate study, as specified in the relevant sections of the AUB catalogue (refer to the Graduate Studies section).
- Graduates of universities other than AUB may be required to take undergraduate prerequisite courses to make up for any deficiencies they may have. A minimum grade of 70, or its equivalent, is required in each of these courses, and no credit is given for these courses toward the graduate degree.

Course Descriptions

Structural Sequence

CIVE 610 Advanced Structural Analysis 3 cr.

A course that offers a review of matrix algebra; basic principles of structural analysis: stiffness, flexibility, and energy methods; direct stiffness method for plane and space trusses and frames; linear and non-linear problems; special problems; computer programming.

Prerequisite: CIVE 410. Annually.

CIVE 620 Plain Concrete 3 cr.

A course that examines portland cements; aggregates; fly ash and silica fume; admixtures for concrete; proportioning normal concrete mixtures; pumping concrete; consolidating, finishing, and curing concrete; durability; testing hardened concrete; high-strength concrete; light and heavy weight concretes; hot and cold weather concreting. *Prerequisite: advanced standing level. Annually.*

CIVE 621 Special Topics in Concrete 3 cr.

A course that reviews reinforced concrete design; wind load on structures; seismic design of structures; design of shear walls; brackets, corbels, and deep girders; torsion in concrete members; circular, rectangular, and elevated water tanks; spherical, conoidal, and ellipsoidal domes. *Prerequisite: CIVE 421. Annually.*

CIVE 622 Prestressed Concrete 3 cr.

A course on materials characteristics; prestress losses; working strength design procedures; composite construction; ultimate flexural strength and behavior; shear design; continuous prestressed concrete members. *Prerequisite: CIVE 421. Alternate years.*

CIVE 623 Bridges 3 cr.

A course that discusses types of bridges; influence lines; loads and their distribution on bridges; serviceability of bridges; methods of design of bridge deck, superstructure, and substructure. *Prerequisites: CIVE 410 and CIVE 421. Alternate years.*

CIVE 624 Steel Design 3 cr.

A course that examines loads on structures; philosophies of design: LRFD versus ASD; behavior, analysis, and design (according to AISC) of tension members, bolted connections, welded connections, compression members, and beams. *Prerequisite: CIVE 410. Alternate years.*

**CIVE 625 Strengthening and Rehabilitation of
Concrete Structural Systems 3 cr.**

A course on assessment of structural deficiency using analytical and field test methods; strengthening materials; strengthening of structural members in flexure, shear, and axial load; upgrading of gravity load-designed members for earthquake load resistance. *Prerequisite: advanced standing level. Alternate years.*

CIVE 710 The Finite Element Method 3 cr.

A course on matrix algebra; energy theorems; analysis of discrete member systems; interpolation functions; numerical integration; plane stress and plane strain problems; axisymmetric problems; problems in three dimensions; plate bending. *Prerequisite: CIVE 610. Alternate years.*

CIVE 711 Advanced Mechanics of Solids 3 cr.

A course that covers theories of stress and strain; stress-strain relations, generalized Hook's law; modes of failure, failure criteria; energy principles and applications; torsion; beams on elastic foundations; introduction to the theory of plates; thin-wall and thick-wall cylinder. *Prerequisite: CIVE 310. Alternate years.*

CIVE 712 Structural Dynamics 3 cr.

A course on analysis of vibration of single degree, multi-degree, and infinite degree of freedom systems; free and forced vibration response; analysis of dynamic response by approximate methods; introduction to earthquake engineering. *Prerequisite: advanced standing level.*

CIVE 720 Behavior of Reinforced Concrete Members 3 cr.

A course on building codes; limit state design; mechanical characteristics of concrete and steel reinforcement; creep and shrinkage; flexure: moment-curvature and force-deformation relationships; columns: axial force-moment-curvature relationships; shear: mechanisms of shear resistance, and truss analogy; bond and anchorage of reinforcement. *Prerequisite: CIVE 421. Alternate years.*

CIVE 721 Earthquake Engineering 3 cr.

A course that examines the nature of earthquake ground motion; seismic hazard evaluation in engineering practice; response analysis of structures and effect of soil conditions on structural response and behavior under earthquake ground motion; design of structures under earthquake loading. *Prerequisite: advanced standing level. Alternate years.*

CIVE 722 Advanced Steel Design 3 cr.

A course investigating stability, column strength, beam-columns, composite steel-concrete construction, plate buckling, plate girders, torsion, and combined torsion and bending. *Prerequisite: CIVE 624.*

Geotechnical Sequence**CIVE 630 Applied Foundation Engineering 3 cr.**

A course on braced excavations, retaining structures, deep foundations, slope stability, and computer applications. *Prerequisite: CIVE 530. Alternate years.*

CIVE 631 Environmental Geotechnics 3 cr.

A course on geotechnical practice in environmental protection and restoration; methods of soil and site characterization for sifting of waste repositories and site restoration; influence of physical and chemical processes in soils on the evaluation of contaminant distribution; design of waste containment systems including landfills, slurry walls, and soil stabilization; the applicability and use of geosynthetics; and, technologies for site restoration and cleanup. *Prerequisite: CIVE 431.*

CIVE 730 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. *Prerequisite: advanced standing level. Alternate years.*

CIVE 731 Earth Dams 3 cr.

A course that examines hydraulic dams, rolled earth dams, homogenous dams, thin core dams, filters, causes of dam failures, seepage control, and seismic stability of dams. *Prerequisite: advanced standing level.*

CIVE 732 Geotechnical Earthquake Engineering 3 cr.

A course on causative mechanisms of earthquake, earthquake magnitudes, ground motion; influence of soil conditions on site response; seismic site response analysis; evaluation and modeling of dynamic soil properties; analysis of seismic soil-structure interaction; evaluation and mitigation of soil liquefaction and its consequences; seismic code provisions and practice; seismic earth pressures, seismic slope stability and deformation analysis, seismic safety of dams and embankments, seismic performance of pile foundations, and additional current topics. *Prerequisite: CIVE 431.*

CIVE 733 Soil Behavior 3 cr.

A course on soil mineralogy, soil formation, and composition; influence of geological factors on properties; colloidal phenomena in soils; soil structure; analysis of conduction phenomena (hydraulic, diffusive, thermal, and electrical); compressibility, strength, and deformation properties. *Prerequisite: CIVE 431.*

Transportation Sequence**CIVE 660 Pavement Design 3 cr.**

A course examining highway and airport pavement design; flexible and rigid pavement types and wheel loads; stresses in flexible and rigid pavements; pavement behavior under moving loads; soil stabilization. *Prerequisite: CIVE 461. Alternate years.*

CIVE 661 Urban Transportation Planning I 3 cr.

An introductory course on methods and models used in transportation planning with emphasis on the urban context. *Prerequisite: CIVE 461. Alternate years.*

CIVE 662 Traffic Engineering 3 cr.

A course outlining traffic engineering studies; traffic control of signalized and unsignalized intersections; signal control hardware and maintenance; arterial performance and operations; and, network optimization. *Prerequisite: CIVE 461. Alternate years.*

CIVE 663 Transportation Systems Analysis 3 cr.

A course on transportation and traffic problems in modern society. Among the topics covered are travel forecasting problems and methods; theoretical techniques for traffic flow description and management; highway, railway, and runway capacity and performance characteristics; economic considerations; and, cost functions. *Prerequisite: advanced standing level. Alternate years.*

CIVE 664 Design and Management of Transport Operations 3 cr.

A course that covers the application of quantitative techniques from operations research and probabilistic analysis to transportation problems. Applications covered include: pickup and delivery systems, emergency urban services, facility location, and network problems. *Prerequisite: STAT 230 or equivalent.*

CIVE 665 Transportation Economics 3 cr.

A course that investigates the application of economic principles to the evaluation of projects and policies in the transport sector such as transport project benefits, costs, and financing, and pricing in the transport sector. *Prerequisite: advanced standing level. Alternate years.*

CIVE 760 Public Transportation 3 cr.

A course on public transportation modes and services; single route, network, and strategic planning; tasks involved in system operations; management of public transportation; privatization issues. *Pre- or corequisite: CIVE 661.*

CIVE 761 Urban Transportation Planning II 3 cr.

A course examining advanced topics in urban transportation planning; transportation systems management techniques; travel demand analysis; and, discrete choice modeling of travel demand. *Prerequisite: CIVE 661.*

CIVE 762 Traffic Flow Theory 3 cr.

A course on characteristics of traffic flow, density, and speed; models describing traffic flows; hydrodynamic analogue; and, computer simulation models. *Prerequisite: CIVE 461 or equivalent.*

Common Courses**CIVE 670 Computer Methods in Civil Engineering 3 cr.**

A course on the use of the computer for analysis, design, and decision making in civil engineering, including programming, numerical, and CAD methods and applications. *Prerequisites: EECE 230 and CIVE 370. Alternate years.*

CIVE 671 Numerical Modeling 3 cr.

A course that deals with ordinary differential equations: initial-, boundary-, and characteristic-value problems; partial differential equations: steady state, time dependent, and oscillatory problems; techniques: Runge-Kutta, shooting, iterative, finite difference, and finite element methods. *Prerequisite: advanced standing level. Alternate years.*

CIVE 672 Introduction to Geographic Information Systems 3 cr.

An introductory course on Geographic Information Systems (GIS) and their applications in the planning and engineering fields, alternatives in computer-based graphics, data concepts and tools, network data management and planning applications, and implementation issues. This course is considered to satisfy the departmental requirements in all engineering graduate programs. *Annually.*

Special Courses and Thesis**CIVE 796 Special Projects 3 cr.****CIVE 797 Civil Engineering Seminar 0 cr.**

A seminar that consists of current research or applied projects presented by faculty members, students, or invited speakers.

CIVE 798 Special Topics 3 cr.**CIVE 799 Thesis 6 cr.**

Master of Engineering (ME), specialization: Environmental and Water Resources Engineering (EWRE)

General Information

The Department of Civil and Environmental Engineering offers a graduate program leading to the degree of Master of Engineering (ME): major, Environmental and Water Resources Engineering (EWRE). The program prepares students through teaching and research for in-depth knowledge in the fields of environmental and water resources engineering.

In order to fulfill graduation requirements, a student must complete a minimum of 24 course credit hours as well as a six credit hour thesis accomplished on a full, or part-time, basis. A minimum of one calendar year of residence is required for graduation.

The ME program in Environmental and Water Resources Engineering offers two tracks with course requirements as listed in the Requirements section below:

Track A

Major in Environmental Engineering

Minor in Water Resources Engineering

Track B

Major in Water Resources Engineering

Minor in Environmental Engineering

Requirements

- To be eligible for admission to the environmental and water resources engineering graduate program, a student must hold a bachelor's degree in any approved discipline of engineering and must satisfy the requirements of the University and the Faculty of Engineering and Architecture for admission to graduate study, as specified in the relevant sections of the university catalogue.
- All students admitted to the program are required to take, or to have taken, the following courses, or their equivalent, as prerequisites:

MATH	202	Differential Equations	3 cr.
CIVE	340	Fluid Mechanics and Laboratory	3 cr.
CIVE	350	Environmental Engineering	3 cr.
CIVE	441	Hydrology	3 cr.
CIVE	450	Water and Wastewater Treatment and Laboratory	3 cr.

- A minimum grade of 70, or its equivalent, is required in each of these courses, and no credit is given for these courses toward the graduate degree. Graduates of universities other than AUB may be required to take undergraduate prerequisite courses to make up for any deficiencies.
- All students registered in the program must take ENSC 690, Seminar in Environmental Sciences (0 credit), whenever offered.

Course Requirements

Track A

Course Type

Major: Environmental Engineering
Minor: Water Resources Engineering

Core	Group A1	9
Electives I	Group A2+AB	9
Electives II	Group B1+B2	6
Thesis	CIVE 799	6
		Total 30

Track B

Course Type

Major: Water Resources Engineering
Minor: Environmental Engineering

Core	Group B1	6
Electives I	Group B1+B2+AB	12
Electives II	Group A1+A2	6
Thesis	CIVE 799	6
		Total 30

Other relevant graduate courses from any faculty may be taken as Electives I (up to a maximum of two courses) with consent of the academic adviser and approval of the chairman.

Group A1	Core Courses in Environmental Engineering		credits
CIVE	651	Environmental Chemistry and Microbiology	3
CIVE	654	Solid Waste Management I	3
CIVE	656	Air Pollution and Control I	3

Group A2	Electives in Environmental Engineering		credits
CIVE	650	Methods of Environmental Sampling and Analysis	3
CIVE	652	Environmental Management and Decision Making	3
CIVE	653	Water and Sewage Works Design	3
CIVE	655	Solid Waste Management II	3
CIVE	657	Air Pollution and Control II	3
CIVE	658	Industrial/Hazardous Waste Management	3
CIVE	659	Environmental Impact Assessment	3
CIVE	750	Wastewater Reclamation and Reuse	3
CIVE	751	Air Pollution Modeling	3
CIVE	752	Environmental Case Studies and Conflict Resolution	3
CIVE	753	Processes in Water and Wastewater Treatment	3

Group B1 Core Courses in Water Resources Engineering			
CIVE	640	Hydraulic Structures	3
CIVE	641	Surface Water Hydrology	3
CIVE	642	Ground Water Hydrology	3
CIVE	644	Coastal Engineering	3
CIVE	646	Water Resources Systems: Planning and Management	3
CIVE	647	GIS for Water Resources and Environmental Engineering	3
Group B2 Electives in Water Resources Engineering			
CIVE	643	Hydraulics of Open Channels	3
CIVE	645	Transport Phenomena in Surface and Subsurface Waters	3
Group AB Common Requirements/Electives in Environmental and Water Resources Engineering			
CIVE	796	Special Projects	3
ENSC	690	Seminar in Environmental Sciences	0
CIVE	798	Special Topics	3
CIVE	799	MS Thesis	6
CIVE	670	Computer Methods in Civil Engineering	3
CIVE	671	Numerical Modeling	3
ENMG	623	Stochastic Models of Applications	3

Course Descriptions

CIVE 640 Hydraulic Structures 3 cr.

A course that covers closed conduit flow, water distribution systems, transient analysis, open channel flow, flood control, culvert hydraulics, design of various hydraulic structures. *Prerequisite: CIVE 440. Alternate years.*

CIVE 641 Surface Water Hydrology 3 cr.

A course on design storm, rainfall-runoff modeling, overland flow, flood routing, reservoir routing, simulation models, hydrologic design, urban hydrology, and stochastic hydrology. *Prerequisite: CIVE 441 or equivalent. Annually.*

CIVE 642 Groundwater Hydrology 3 cr.

A course that deals with properties of groundwater, groundwater movement, general flow equations, steady-state well hydraulics, seepage forces, unsteady well hydraulics, infiltration, and groundwater modeling. *Prerequisite: CIVE 441. Annually.*

CIVE 643 Hydraulics of Open Channels 3 cr.

A course that examines gradually varied flow theory and analysis, spatially varied flow, and numerical modeling of unsteady flow in open-channels. *Prerequisite: CIVE 440. Alternate years.*

CIVE 644 Coastal Engineering 3 cr.

A course on small-amplitude wave theory, finite-amplitude wave theory, conoidal waves, solitary wave theory, wave refraction, diffraction, and reflection, wave forces, and design of maritime structures (e.g., breakwaters). *Prerequisite: CIVE 440. Alternate years.*

**CIVE 645 Transport Phenomena in Surface
and Subsurface Waters 3 cr.**

A course on advection, diffusion, and dispersion of pollutants; transport in rivers and estuaries; transport in groundwater; numerical modeling; design of wastewater discharge system. *Prerequisite: advanced standing level.*

CIVE 646 Water Resources Systems: Planning and Management 3 cr.

A course that introduces the main concepts and principles of water resources planning and management; logical steps in engineering planning and decision making; water resources systems analysis, modeling, simulation, and optimization; economic and financial analysis; flood protection and reservoir operation; and water resources management case studies. *Prerequisite: advanced standing level. Alternate years.*

**CIVE 647 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. It provides coverage of state-of-the-art GIS methods and tools, specifically targeting water resources and environmental applications including: spatial and terrain analysis, geostatistical analysis, watershed delineation and identification of river networks, representation of groundwater and aquifer systems, time series analysis, and development of GIS integrated water and environmental models. *Prerequisite: advanced standing level. Alternate years.*

CIVE 650 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. *Prerequisite: advanced standing level. Alternate years.*

CIVE 651 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; biological water quality indicators. *Prerequisite: CHEM 202, BIOL 210, or equivalent. Alternate years.*

CIVE 652 Environmental Management and Decision Making 3 cr.

A course that deals with mathematical programming techniques, multi-objective optimization, and the generation of alternatives, as these are used in environmental systems analysis and management; as well as introducing how considerations such as economics, uncertainty, equity, and other sociopolitical parameters may influence environmental management and decision making. *Prerequisite: advanced standing level. Alternate years.*

CIVE 653 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. *Prerequisite: CIVE 450. Alternate years.*

CIVE 654 Solid Waste Management I 3 cr.

A course on nature and effects of solid wastes including hazardous wastes; engineering management principles, practices, and techniques for management of solid wastes administration; solid waste generation, storage, collection and transport, processing, resource recovery, and disposal; and, trip to a local facility. *Prerequisite: advanced standing level. Annually.*

CIVE 655 Solid Waste Management II 3 cr.

A course on the design of solid waste disposal schemes, including design reports and a literature search on the development of conventional treatment and disposal processes. *Prerequisite: CIVE 654 or consent of instructor. Alternate years.*

CIVE 656 Air Pollution and Control I 3 cr.

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

CIVE 657 Air Pollution and Control II 3 cr.

A course that examines process analysis, operational limitations, cost and performance, and evaluation of control process and equipment; and, case studies, field visits, and inspection of industrial installations. *Prerequisite: CIVE 656 or consent of instructor. Alternate years.*

CIVE 658 Industrial/Hazardous Waste Management 3 cr.

A course that deals with sources, quantity, and quality of industrial wastes; basic industrial waste treatment processes; major industries, types of wastes, and existing treatment practices; and, disposal and fate of industrial wastes. *Prerequisites: CIVE 450 and CIVE 651, or consent of instructor. Alternate years.*

CIVE 659 Environmental Impact Assessment 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. Alternate years.*

CIVE 750 Wastewater Reclamation and Reuse 3 cr.

A course examining 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. *Prerequisites: CIVE 651 and CIVE 450, or CIVE 652. Alternate years.*

CIVE 751 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 656 or consent of instructor.*

CIVE 752 Environmental Case Studies and Conflict Resolution 3 cr.

A course on case studies in environmental management: pesticide application, air pollution, solid waste landfilling, wastewater treatment facilities, oil exploration, ocean dumping, deep well injection, reservoirs, and water resources. *Prerequisites: CIVE 450, CIVE 654, and CIVE 656; or consent of instructor. Alternate years.*

CIVE 753 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. *Prerequisite: CIVE 450 or consent of instructor. Alternate years.*

CIVE 670 Computer Methods in Civil Engineering 3 cr.

A course on the use of the computer for analysis, design, and decision making in civil engineering, including programming, numerical, and CAD methods and applications. *Prerequisites: EECE 230 and CIVE 370. Alternate years.*

CIVE 671 Numerical Modeling 3 cr.

A course that deals with ordinary differential equations: initial-, boundary-, and characteristic-value problems; partial differential equations: steady state, time dependent, and oscillatory problems; techniques: Runge-Kutta, shooting, iterative, finite difference, and finite element methods. *Prerequisite: advanced standing level. Alternate years.*

Special Courses and Thesis**CIVE 796 Special Projects 3 cr.****ENSC 690 Seminar in Environmental Sciences 0 cr.**

A seminar that consists of current research or applied projects presented by faculty members, students, or invited speakers.

CIVE 798 Special Topics 3 cr.**CIVE 799 Thesis 6 cr.**

Master of Science (MS), Specialization: Environmental Technology (ET)

The Department of Civil and Environmental Engineering offers a graduate program leading to the degree of Master of Science (MS): specialization, Environmental Technology (ET). The program, which is part of the Interfaculty Graduate Environmental Sciences Program (IGESP), is open to non-engineering students who hold a degree in basic sciences.

For more details on the Environmental Technology program refer to the Interdisciplinary Research Centers and Programs section of this catalogue, under IGESP.