Department of Civil and Environmental Engineering

Chairperson: Sadek, Salah
Professors: Ayoub, George; Basha, Habib; El-Fadel, Mutasem; Hamad, Bilal; Harajli, Mohamed; Kaysi, Isam; Mabsout, Mounir; Sadek, Salah
Professor Emeritus: Iliya, Raja
Associate Professor: Inglessis, Constantine
Assistant Professors: Abou Zeid, Maya; Chehab, Ghassan; El-Khoury, Hiam; Najjar, Shadi; Saad, George; Saikaly, Pascal
Senior Lecturer: Azar, Kamal
Lecturers: Basha, Hisham; El Khatib, Helmi; El Khatib, Ibrahim; Fawwaz, Youssef; Hatem-Musallem, Manal; Karnib, Ali; Kasti, Fuad; Nader, Halim; Nasreddine, Khaldoun; Sadeck, Salah El-Dinn; Semerjian, Lucy
Instructors: Abboud, Antoine; Haroun, Akram; Hasbini, Hayssam; Nehme, Elias

Undergraduate Programs

The Department of Civil and Environmental Engineering (CEE) offers the degrees of Bachelor of Engineering (BE): major, Civil Engineering (CE); and Bachelor of Science (BS): major, Construction Engineering (ConsE).

The mission of the undergraduate programs 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.

Bachelor of Engineering (BE), Specialization: Civil Engineering (CE)

Program Educational Objectives

The objectives of the CE program are to see our graduates move on to become:

- Engineers who hold central positions in various sub-disciplines of civil engineering in local, regional, and international practice.
- Graduates who are admitted and successfully completing advanced degrees in leading universities around the world.
- Leaders in their profession and in the service of their community.
## Curriculum

### Term I (Fall)

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIVE 200</td>
<td>Introduction to Civil Engineering</td>
</tr>
<tr>
<td>EECE 230</td>
<td>Introduction to Programming</td>
</tr>
<tr>
<td>MATH 201</td>
<td>Calculus and Analytical Geometry III</td>
</tr>
<tr>
<td>PHYS 210</td>
<td>Introductory Physics II</td>
</tr>
<tr>
<td>PHYS 210L</td>
<td>Introductory Physics Laboratory II</td>
</tr>
<tr>
<td>Arabic Communication Skills Elective</td>
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### Term II (Spring)

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>CIVE 210</td>
<td>Statics</td>
</tr>
<tr>
<td>EECE 210</td>
<td>Electric Circuits</td>
</tr>
<tr>
<td>MECH 220</td>
<td>Engineering Graphics</td>
</tr>
<tr>
<td>MATH 202</td>
<td>Differential Equations</td>
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<td>ENGL 206</td>
<td>Technical English</td>
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<tr>
<td>Ethics Elective (An Approved General Education Humanities Course)</td>
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### Term III (Summer)

<table>
<thead>
<tr>
<th>Course</th>
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<tbody>
<tr>
<td>CIVE 360</td>
<td>Surveying</td>
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<tr>
<td>STAT 230</td>
<td>Introduction to Probability and Random Variables</td>
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### Term IV (Fall)

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CIVE 310</td>
<td>Mechanics of Materials</td>
</tr>
<tr>
<td>CIVE 320</td>
<td>Construction Materials and Technologies</td>
</tr>
<tr>
<td>CIVE 350</td>
<td>Environmental Engineering</td>
</tr>
<tr>
<td>CIVE 370</td>
<td>Introduction to Information Technology</td>
</tr>
<tr>
<td>MATH 251</td>
<td>Numerical Computing</td>
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<tr>
<td>Humanities Elective</td>
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### Term V (Spring)

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CIVE 311</td>
<td>Structures I</td>
</tr>
<tr>
<td>CIVE 340</td>
<td>Fluid Mechanics and Laboratory</td>
</tr>
<tr>
<td>CHEM 202</td>
<td>Introduction to Environmental Chemistry</td>
</tr>
<tr>
<td>CHEM 203</td>
<td>Introductory Chemical Techniques</td>
</tr>
<tr>
<td>Biology Elective or</td>
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<tr>
<td>CIVE 351</td>
<td>Environmental Microbiology</td>
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<td>Humanities Elective</td>
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<tr>
<td>Term VI (Summer)</td>
<td>Credits</td>
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<td>------------------------------------------</td>
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<tr>
<td>CIVE 430 Engineering Geology</td>
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<tr>
<td>ENMG 400 Engineering Economy</td>
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<tr>
<td>English Elective</td>
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<table>
<thead>
<tr>
<th>Term VII (Fall)</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CIVE 410 Structures II</td>
<td>3</td>
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<tr>
<td>CIVE 420 Concrete I</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 440 Hydraulics and Laboratory</td>
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<tr>
<td>CIVE 460 Highway Engineering</td>
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<tr>
<td>Math Elective (MATH 212, MATH 218, MATH 281, or an approved math course )</td>
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<thead>
<tr>
<th>Term VIII (Spring)</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CIVE 421 Concrete II</td>
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<tr>
<td>CIVE 431 Soil Mechanics and Laboratory</td>
<td>3</td>
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<tr>
<td>CIVE 441 Engineering Hydrology</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 450 Water and Wastewater Treatment and Laboratory</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 461 Transportation Engineering and Laboratory</td>
<td>3</td>
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<td><strong>Total 15</strong></td>
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<table>
<thead>
<tr>
<th>Term IX (Summer)</th>
<th>Credit</th>
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<tbody>
<tr>
<td>CIVE 500 Approved Experience</td>
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<table>
<thead>
<tr>
<th>Term X (Fall)</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CIVE 501 Final Year Project I</td>
<td>1</td>
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<tr>
<td>CIVE 530 Foundation Engineering</td>
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<tr>
<td>CIVE 580 Construction Management</td>
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<tr>
<td>Technical Elective I</td>
<td>3</td>
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<tr>
<td>Technical Elective II</td>
<td>3</td>
</tr>
<tr>
<td>Social Science Elective</td>
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<td><strong>Total 16</strong></td>
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<table>
<thead>
<tr>
<th>Term XI (Spring)</th>
<th>Credits</th>
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<tbody>
<tr>
<td>CIVE 502 Final Year Project II</td>
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<tr>
<td>Technical Elective III</td>
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<tr>
<td>Technical Elective IV</td>
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<tr>
<td>Free Elective</td>
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<tr>
<td>Social Science Elective</td>
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<td><strong>Total 15</strong></td>
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<td><strong>Total = 143 credit hours</strong></td>
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</table>

*b. stands for billing
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

Bachelor of Science (BS), Specialization: Construction Engineering (ConsE)

Program Educational Objectives

The objectives of the ConsE program are to see our graduates move on to become:

- Engineers who hold central positions in in local, regional, and international construction engineering practice;
- Engineers who are involved in landmark projects and who contribute to the advancement of the local and regional construction industry;
- Leaders in their profession and in the service of their community.

Curriculum

<table>
<thead>
<tr>
<th>Term I (Fall)</th>
<th>Credit Hours</th>
</tr>
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<tbody>
<tr>
<td>CIVE 200 Introduction to Civil Engineering</td>
<td>2</td>
</tr>
<tr>
<td>CIVE 210 Statics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 210 Introductory Physics II</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 210L Introductory Physics Laboratory II</td>
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</tr>
<tr>
<td>MATH 201 Calculus and Analytical Geometry III</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 203 Academic English</td>
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<td><strong>Total</strong></td>
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<table>
<thead>
<tr>
<th>Term II (Spring)</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIVE 310 Mechanics of Materials</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 220 Construction Drawing</td>
<td>2</td>
</tr>
<tr>
<td>EECE 210 Electric Circuits</td>
<td>3</td>
</tr>
<tr>
<td>CIVE 371 Introduction to Information Technology</td>
<td>3</td>
</tr>
<tr>
<td>ARAB 2nn Arabic Elective</td>
<td>3</td>
</tr>
<tr>
<td>2nn Humanities Elective</td>
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<td><strong>Total</strong></td>
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</table>
### Term III (Summer)
- **CIVE 361** Surveying for Construction Engineering 3
- **STAT 230** Introduction to Probability and Random Variables 3
- **ENGL 206** Technical English 3

**Total 9**

### Term IV (Fall)
- **CIVE 311** Structures I 3
- **CIVE 321** Construction Materials and Quality Control 3
- **CIVE 350** Environmental Engineering 3
- **CHEM 202** Introduction to Environmental Chemistry 3
- **CHEM 203** Introduction Chemical Techniques 2
  - 2nn Math/Science Elective 3

**Total 17**

### Term V (Spring)
- **CIVE 340** Fluid Mechanics and Laboratory 3
- **CIVE 420** Concrete I 3
- **CIVE 580** Construction Management 3
- **CIVE 582** Construction Methods and Safety 3
- **CIVE 460** Highway Engineering 3
  - Social Science Elective 3

**Total 18**

### Term VI (Summer)
- **CIVE 583** Supervised Internship 1

**Total 1**

### Term VII (Fall)
- **CIVE 440** Hydraulics and Laboratory 3
  - 2nn Humanities Elective 3
- **CIVE 584** Construction Systems Integration 3
- **CIVE nnn** Free Construction Engineering Elective 3
- **ECON 212** Elementary Macroeconomic Theory
  - An Ethics Course Approved for GE Humanities Credit 3

**Total 18**

### Term VIII (Spring)
- 2nn MATH/Science Elective 3
- **CIVE 431** Soil Mechanics and Lab 3
- **CIVE 585** Construction Planning and Scheduling 3
- **CIVE nnn** Free Construction Engineering/CEE Elective 3
  - 2nn Humanities Elective 3

**Total 15**

*Total = 110 credit hours*
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 hands-on group projects.

CIVE 220  Construction Drawing  2 cr.
An introductory course on 2-D drawing, orthogonal projection, auxiliary views, sectioning and sectional views, dimensioning and tolerance schemes, and standard layouts. Introduction to use of CAD in civil and construction engineering. Interpretation of typical civil engineering drawings. Using CAD to generate plans, cross section and profile drawings, and detail drawings.

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.

CIVE 310  Mechanics of Materials  3 cr.
A course on stresses, strains, and stress-strain relationships; temperature; axial bars in tension and compression; torsion of circular bars; bending and shear stresses in beams; combined stresses; stress transformation and Mohr’s circle; and computer spreadsheet Prerequisite: CIVE 210.

CIVE 311  Structures I  3 cr.
An introductory course covering equilibrium, stability, and determinacy; influence lines for beams and trusses; deflection of beams and frames by double-integration method, moment-area theorems, and conjugate beam; introduction to indeterminate structures; approximate analysis of indeterminate building frames; computer structural analysis applications; project building modeling and assessment. Prerequisite: CIVE 310.

CIVE 320  Construction Materials and Technologies  2 cr.
Introduction to the composition and properties of engineering materials such as asphalt, cement, concrete, geological materials, steel, polymers, and wood. Hands on laboratory experiments and demonstrations are part of the course, and are designed to familiarize the student with the materials, testing methods, equipments, and standards.

CIVE 321  Construction Materials and Quality Control  3 cr.
A course that covers materials used in construction; physical and mechanical properties of construction materials such as asphalt, pavement base materials, Portland cement concrete, steel, polymers, wood, aluminum, and advanced composite materials; proportioning of concrete mixtures including admixtures; and hands on laboratory experiments and demonstrations to familiarize students with testing methods, equipment, standards, and quality control procedures.

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.

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, environmental modeling, and hazardous waste.
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 micro-organisms involved in environmental systems, their ecology, their interactions with various pollutants, and their beneficial or harmful effects on humans.

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.

CIVE 361  Surveying for Construction Engineering  3cr.
A course on the theory of measurements and errors; linear measurements; surveying principles and instruments; leveling; angles, bearings, and azimuths; stadia measurements; traversing–field aspects; traverse computations and adjustment; topographic surveying; triangulation; fundamentals of surveying for building and infrastructure construction; setting out horizontal and vertical curves; setting out engineering structures and construction projects.

CIVE 370  Introduction to Information Technology  3 cr.
The course introduces students to the main features of the Information Technology (IT) with emphasis on applications to civil engineering. Specifically, the course content includes presentation of several software applications and programming tools including: MS Word, Excel, PowerPoint, VBA, Visio, GIS and database technology and object-oriented programming.

CIVE 371  Introduction to Information Technology (ConsE)  4 cr.
A course introducing students to the main features of Information Technology (IT) with emphasis on applications to civil engineering. This course covers several software applications and programming tools including: FrontPage, Excel, VBA, Access, Visio, and database technology. The course also introduces students to basic programming skills using Matlab.

CIVE 410  Structures II  3 cr.
A course on the stability and determinacy of structures; energy theorems and applications to trusses, beams, and frames; analysis of statically indeterminate structures by flexibility (force) and stiffness methods; introduction to the direct stiffness method; influence lines for indeterminate structures. Prerequisite: CIVE 311.

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 310.

CIVE 421  Concrete II  3 cr.
This is a course that covers continuous beams, short columns, lender columns, and biaxially bent columns; wall footings, concentrically and eccentrically loaded single column footings, and combined footings; staircases; bearing walls; cantilever retaining Prerequisite: CIVE 420.

CIVE 430  Engineering Geology  3 cr.
This is a course that discusses the composition and properties of rocks; geologic processes; geologic hazards; geologic structure 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; and laboratory experiments. Prerequisites: CIVE 310 and CIVE 430.

CIVE 440  Hydraulics and Laboratory  3 cr.
A course that covers flow in conduits, flow in open channels, flow measurements, and laboratory experiments. Prerequisite: CIVE 340.

CIVE 441  Engineering Hydrology  3 cr.
A course outlining hydrologic principles, rainfall-runoff analysis, flood routing, frequency analysis, and ground water hydrology.

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.

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.

CIVE 461  Transportation Engineering and Laboratory  3 cr.
Introduction to the field of transportation engineering through presenting 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.

CIVE 580  Construction Management  3 cr.
A course that seeks to impart in students a sound understanding of the fundamental principles of construction management as applied to development of building and infrastructure projects. The course includes construction company and project organization, pre-construction activities, estimating and bidding, staffing for construction, macro-level planning and scheduling, and quality control.

CIVE 582  Construction Methods and Safety  3 cr.
A course that exposes students to the real world of construction and the complexity of managing machines, material and people with the one goal, to be on time and on budget while performing safely. The course content includes the selection of construction equipment and material based on applications, methods, and production requirements for earthmoving, heavy and building construction. Prerequisite: CIVE 321.

CIVE 583  Supervised Internship  1 cr.
Prerequisites: CIVE 580 and CIVE 582.

CIVE 584  Construction Systems Integration  3 cr.
The course exposes students to building systems and how to integrate them by best choosing materials and methods. The course will have particular emphasis on mechanical and electrical equipment in buildings, roofing, glazing, cladding, interior finishes, partitions, cost estimation and construction of the various systems. Presentation of professional construction documents including execution drawings, details, and specifications. Prerequisite: CIVE 583.
CIVE 585 Construction Planning and Scheduling 3 cr.
The course exposes students to basic concepts and methodology for making rational decisions in the design and implementation of real construction projects. The course content includes the investigation of the planning activities and scheduling techniques used in construction projects. This includes basic CPM-related techniques such as precedence diagrams computations, resource allocation and leveling, cost analysis, time-cost trade-off analysis, updating schedule, etc. in addition to Program Evaluation Review Techniques (PERT), and computer applications (Primavera). Prerequisite: CIVE 584.

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.

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 estimation processes; and unit rates determination and pricing.

Special Courses

CIVE 500 Approved Experience 0 cr.
Students are placed for eight full weeks at a recognized consulting and/or contracting firm in Lebanon or abroad, in a capacity which ensures that they apply their knowledge and acquire professional experience in the field of Civil Engineering.

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.

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.

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

Construction Sequence

CIVE 680 Construction Business Management and Financing 3 cr.
A course that covers the principles of business management of construction companies – theory as well as international and regional practice; an overview of construction business operations including strategic planning, organizational structure, marketing, accounting, financing, risk analysis, and quality; and the principles and sources of construction funding for contracting firms and projects.

CIVE 681 Design and Analysis of Construction Operations 3 cr.
A course that covers planning and modeling of construction operations, design of efficient processes, productivity and resource use considerations, site layout design and analysis, use of quantitative methods and queuing theory, effects of new technologies on construction operations, and an introduction to construction automation.
CIVE 682  Building Information Modeling  3 cr.
A course on generating and managing building data during its life cycle; three-dimensional, real-time, dynamic building modeling techniques to increase productivity in building design and construction; producing the Building Information Model which encompasses building geometry, spatial relationships, geographic information, and quantities and properties of building components.

CIVE 683  Infrastructure Construction and Evaluation  3 cr.
A course on urban requirements and engineering technologies and procedures for construction of infrastructure facilities including roads and pavements, bridges, water and sanitary networks, electric power lines, and telephone/communication lines; with applications to urban and rural areas. Nondestructive evaluation techniques for infrastructure systems; accelerated and full-scale testing; instrumentation, video logging, and remote sensing will be covered.

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; and computer programming and applications. **Prerequisite:** CIVE 410.

CIVE 620  Plain Concrete  3 cr.
This is a course that examines portland cements; aggregates; pozzolans; proportioning normal concrete mixtures; pumping concrete; consolidating, finishing, and curing concrete; durability; testing hardened concrete; high-strength concrete; light and heavy weight concretes; and hot and cold weather concreting.

CIVE 621  Special Topics in Concrete  3 cr.
This is a course that reviews reinforced concrete (R/C) design; torsion in R/C members; wind load on structures; earthquake load and seismic design of structures; design of shear walls; design of corbels, brackets and deep girders; circular and rectangular water tanks; and spherical. **Prerequisites:** CIVE 410 and CIVE 421.

CIVE 622  Prestressed Concrete  3 cr.
A course on material characteristics; prestress losses; working strength design procedures; composite construction; ultimate flexural strength and behavior; shear design; continuous prestressed concrete members. **Prerequisites:** CIVE 420 and CIVE 421.

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.

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.

CIVE 625  Strengthening and Rehabilitation of Concrete Structural Systems  3 cr.
This is a course on assessment of materials and structural deficiency using field test or analytical methods; repair and strengthening materials; strengthening and repair techniques; strengthening of structural members in flexure, shear and axial load; and upgrading of gravity load-designed buildings for earthquake load resistance. **Prerequisites:** CIVE 410 and CIVE 421.
CIVE 626  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.

CIVE 632  Reliability Based Design of Civil Systems  3 cr.
This is a course that covers applications of reliability theory in assessing the safety and reliability of civil systems in the presence of uncertainty; decision making and risk analysis; definition of the probability of failure; modeling uncertainty in resistance and load; limit states and limit state functions; approximate and exact methods for assessing reliability; load and resistance factor design (LRFD) in structural and geotechnical engineering; basics of design code calibration; reliability assessments of existing structures, updating reliability with load tests.

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.

CIVE 631  Environmental Geotechnics  3 cr.
A course on geotechnical practice in environmental protection and restoration; methods of soil and site characterization for siting 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 633  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.

CIVE 634  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 635  Shear Strength of Soils  3 cr.
A course that covers stresses within a soil mass, tests to measure stress strain properties, stress-strain relationships, shear strength, drained conditions, undrained, constitutive models, and failure criteria applications. Prerequisite: CIVE 431.

Environmental and Water Resources Sequence

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.

CIVE 641  Surface Water Hydrology  3 cr.
A course on design storm, rainfall-runoff modeling, overland flow, flood routing, reservoir routing, simulation models, and stochastic hydrology. Prerequisite: CIVE 441 or equivalent.
CIVE 642  Groundwater Hydrology  3 cr.
This is a course that deals with properties of groundwater, Darcy’s Law, steady groundwater flow, unsteady groundwater flow, well hydraulics, unsaturated flow, sea-water intrusion, and numerical modeling. Prerequisite: CIVE 441.

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.

CIVE 644  Coastal Engineering  3 cr.
A course on small-amplitude wave theory (linear theory); finite-amplitude wave theory (nonlinear theory); cnoidal wave theory; solitary wave theory; wave refraction, diffraction, and reflection; wave forces and interaction with man-made structures; and design of maritime structures e.g. breakwaters. Prerequisite: CIVE 440.

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.

CIVE 646  Water Resource Systems: Planning and Management  3 cr.
A course that introduces the concepts and principles of water resources planning and management. It demonstrates the logical steps in engineering planning as it applies to water resources management. The course provides coverage of mature and state of the art technologies and tools applied in the water resources industry. Emphasis will be placed on systems analysis, GIS, and economic and financial analysis, environmental impact assessment techniques.

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.

CIVE 648  Climate Change and Water Resources  3 cr.
The course introduces students to the global issue of climate change and its potential impact on water resources and implications for their management particularly in the semi-arid MENA region. It explores the drivers of climate change, greenhouse gases mitigation efforts, and adaptation options in the water resources sector with special emphasis on the Integrated Water Resources Management (IWRM) and adaptive management approach.

CIVE 649  Microbial Ecology and Molecular Biology for Engineers  3 cr.
A course that introduces students (undergraduate and graduate) from different engineering disciplines to the concepts and tools in microbial ecology and how to apply these concepts and tools to understand microbial communities underpinning environmental biotechnology processes. Prerequisites: CHEM 202, BIOL 210, or equivalent.

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.
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 micro-organisms; energy, metabolism, and synthesis; growth, decay, and kinetics; and biological water quality indicators. 
Prerequisites: CHEM 202, BIOL 210, or equivalent.

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.

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.

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.

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.

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.

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.

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; disposal and fate of industrial wastes. 
Prerequisites: CIVE 450 and CIVE 651, or consent of instructor.

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.
Materials and Pavement Sequence

CIVE 660  Pavement Engineering  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.

CIVE 667  Highway Materials and Construction  3 cr.
The course covers various materials constituents in highway pavement structures with emphasis on asphalt concrete, aggregate-soil mixtures, geotextiles, and bituminous liquids. Materials properties, design, quality control and methods of construction will be described. Forensic studies, distress surveys, non-destructive and accelerated pavement testing are also discussed. Prerequisite STAT 230.

Transportation Sequence

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.

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.

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.

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.
CIVE 666  Transport Operations  3 cr.
A course that introduces probabilistic and optimization methods for designing efficient operations in freight carrier, airline, transit, and traffic modes. Topics include crew and vehicle scheduling in freight, airline, and transit modes; vehicle routing problems in carrier systems; runway and air traffic operations; operations control in transit services; and fundamental relations and models of traffic flow. Prerequisite: CIVE 461.

Common Courses

CIVE 586/481  Construction Methods and Safety  3 cr.
The course exposes students to the real world of construction and the complexity of managing machines and people with the one goal, to be on time and on budget while performing safely. The course content includes the selection and utilization of construction equipment such as scrapers, dozers, cranes, etc., based on applications, methods, and production requirements for heavy and building construction. Specific topics cover power generation, transmission, and output capacity of equipment engines as well as calculation of transport cycle times, concreting methods including mixing, delivery, and placement, design of forms for concrete walls and supported slabs and safety and inspection requirements for construction sites and projects. Prerequisite: CIVE 320.

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.

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.

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 satisfies the departmental requirements in all graduate engineering programs.

CIVE 673  Infrastructure Systems Management  3 cr.
A course on modeling and optimization methods and their application to inspection, performance prediction and maintenance decision making for the management of infrastructure systems.