Master of Science Programs

STATUS REPORT

NOVEMBER 2008
CONSTRUCTION AND BUILDING ENGINEERING
Program Detailed Structure

M.Sc. Program

(C) Geotechnical Engineering
# M.Sc. in Construction and Building Engineering
## Program Structure

### (C) Geotechnical Engineering

## M.Sc. in Construction and Building Engineering

### (C) Geotechnical Engineering

#### Core Courses:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CB 731</td>
<td>Advanced Geotechnical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CB 732</td>
<td>Soil Sampling and Testing</td>
<td>3</td>
</tr>
<tr>
<td>CB 740-S</td>
<td>Finite Element Method</td>
<td>3</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>3 Courses * 3 Credit Hours</strong></td>
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#### Elective Courses: Group (1)

<table>
<thead>
<tr>
<th>Course Code</th>
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<th>Credit Hours</th>
</tr>
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<tbody>
<tr>
<td>CB 733</td>
<td>Earth Works and Dewatering</td>
<td>3</td>
</tr>
<tr>
<td>CB 734</td>
<td>Soil Stabilization Techniques</td>
<td>3</td>
</tr>
<tr>
<td>CB 735</td>
<td>Design and Construction of Slurry Walls</td>
<td>3</td>
</tr>
<tr>
<td>CB 736</td>
<td>Foundation on Problematic Soils</td>
<td>3</td>
</tr>
<tr>
<td>CB 737</td>
<td>Piling Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CB 738</td>
<td>Special Geotechnical Structures</td>
<td>3</td>
</tr>
<tr>
<td>CB 739</td>
<td>Environmental Geotechnics</td>
<td>3</td>
</tr>
<tr>
<td>CB 731-G</td>
<td>Soil Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>CB 732-G</td>
<td>Geotechnical Earthquake Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CB 733-G</td>
<td>Elastic Analysis of Soil–Foundation Interaction</td>
<td>3</td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td><strong>4 Courses * 3 Credit Hours</strong></td>
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*continued/…*
M.Sc. in Construction and Building Engineering
Program Structure

(C) Geotechnical Engineering

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**ELECTIVE COURSES: GROUP (2)**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>CB 713</td>
<td>Construction Equipment Management</td>
<td>3</td>
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<tr>
<td>CB 762</td>
<td>Design of Hydraulic Structures</td>
<td>3</td>
</tr>
<tr>
<td>CB 755</td>
<td>Off-the-Road Vehicle Mobility</td>
<td>3</td>
</tr>
<tr>
<td>CB 717</td>
<td>Project Planning and Control</td>
<td>3</td>
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<tr>
<td>CB 743</td>
<td>Concrete Durability</td>
<td>3</td>
</tr>
<tr>
<td>CB 722</td>
<td>Management of Solid, Hazardous and Radioactive Waste</td>
<td>3</td>
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</table>

**Subtotal**

1 Course * 3 Credit Hours

3

**RESEARCH THESIS:**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>CB 701</td>
<td>Master's Research Thesis (Part 1)</td>
<td>6</td>
</tr>
<tr>
<td>CB 702</td>
<td>Master's Research Thesis (Part 2)</td>
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</tr>
</tbody>
</table>

**Subtotal**

2 Parts * 6 Credit Hours

12

**Total**

36
Course Code : CB 731
Course Title : Advanced Geotechnical Engineering
Credit Hours : 3

Course Description

Course Objectives
To develop an understanding of a variety of state-of-art advanced techniques in geotechnical and geoenvironmental engineering utilized in construction projects.

Course Topics
- Compaction, precompression, vibroflotation, vibro-replacement
- Sand drains; Prefabricated Vertical Drains (PVDs) or wick drains
- Sand compaction piles, stone columns, and dynamic compaction
- Lime, cement and fly ash stabilization
- Mechanically stabilized earth structures
- Selection of pile construction method; Economics of design
- Drilling and sampling, monitoring wells
- Containment barrier, liners, covers, and walls
- Contaminant transport through liners, covers, and barriers
- Pump and treat, bioremediation, and soil washing
- Thermal treatment, solidification and extraction
- Ground improvement applications

References
Course Code :CB 732
Course Title :Soil Sampling and Testing
Credit Hours :3

Course Description
Planning an exploration program; Geophysical explorations; Sounding and probing; Excavation methods for exploration; Groundwater investigations; Test grouting; Disturbed samplers; Undisturbed samplers; Rock coring. Field tests: Field measurement of soil coefficient of permeability; Plate load test. Chemical analysis of soil and ground water composition; Contracting and supervising exploratory programs; Subsurface exploration reports.

Course Objectives
To develop understanding of the different techniques of site sampling and soil testing techniques with special emphasis on practical considerations and rational interpretation of data collected.

Course Topics
- Reconnaissance investigations
- Exploration for preliminary and detailed design
- Geophysical explorations; Sounding and probing; Boring methods
- Excavation methods for exploration; Groundwater investigations
- Test grouting; Disturbed samplers; Undisturbed samplers; Rock coring
- Field tests: SPT, CPT, Plate load test
- Field measurement of soil coefficient of permeability
- Chemical analysis of soil and ground water composition
- Logs of subsurface explorations
- Contracting and supervising exploratory programs; Subsurface exploration reports

References
Course Code : CB 733
Course Title : Earth Works and Dewatering
Credit Hours : 3

Course Description
Specifications of earth works and dewatering; Methods of excavations; Methods of embankment construction; Methods for slope stabilization; Analysis of slope stability; Use of geomembranes for slope stability; Specifications of the filling materials; Seepage problems; Methods of dewatering; Geotechnical problems associated with dewatering; Design of filters; Planning for site preparation.

Course Objectives
To illustrate to the student procedures and special precautions in the earth works with emphasis on soil stability considerations and dewatering techniques and safety measures.

Course Topics
- Specifications of earth works and dewatering;
- Different methods of excavations;
- Methods of embankment construction;
- Methods for slope stabilization;
- Analysis of slope stability
- Use of geomembranes for slope stability
- Specifications of the filling materials
- Two- and three-dimensional seepage problems
- Methods of dewatering
- Geotechnical problems associated with dewatering
- Selection of the dewatering method
- Design of filters;
- Planning for site preparation.

References
Course Code : CB 734
Course Title : Soil Stabilization Techniques
Credit Hours : 3

Course Description
Art and science of soil stabilization; Soils with granular bearing skeleton; Modification and substitution of natural soil binder; Stabilization of cohesive soils; Stabilization for base and surface courses; Specific methods for soil stabilization; Soil compaction; Purpose of grouting: planning the grouting projects, Injectable soils; Control of grouts and grouting operations

Course Objectives
To expose the student to the state-of-art in soil stabilization as applied in large construction and transportation projects.

Course Topics
- Art and science of soil stabilization;
- Soils with granular bearing skeleton;
- Producing an artificial granular skeleton;
- Modification and substitution of natural soil binder;
- Stabilization of cohesive soils without granular skeleton;
- Methods of stabilization for base and surface courses;
- Specific methods for soil stabilization;
- Soil compaction; Compaction equipment; Control of compaction; Problems in compaction;
- Purpose of grouting: advantages and disadvantages, planning the grouting projects,
- Injectable soils and injection process; Control of grouts and grouting operations; Example of applications of injection.

References
Course Code : CB 735
Course Title : Design and Construction of Slurry Walls
Credit Hours : 3

Course Description
General method of construction; Wall systems; Construction fundamentals; Load-bearing panels and foundation elements; Concrete technology and design; Design principles of wall-structure system; Underground transportation systems; Basic procedures for subway tunnels; Building and deep basements.

Course Objectives
To introduce the student to the various slurry excavated wall types and applications with emphasis on construction methods and limitations.

Course Topics
- General method of construction;
- Wall systems; Construction fundamentals;
- Geotechnical considerations;
- Analysis and design considerations;
- Load-bearing panels and foundation elements;
- Concrete technology and design;
- Design principles of wall-structure system;
- Underground transportation systems;
- Basic procedures for subway tunnels;
- Subway stations; Building and deep basements.

References
Course Code : CB 736
Course Title : Foundation on Problematic Soils
Credit Hours : 3

Course Description
Types of problematic soils; Swelling soil; Types of swelling soils, Basic definitions and characteristics, Classification, Laboratory experiments, methods for foundations on swelling soils; Collapsible soils; Types, Field tests for collapsible soils, Laboratory experiments, Foundations on collapsible soils; Soft clay soils; Basic definitions; Field tests for soft clays; Laboratory experiments; Foundations on soft clays.

Course Objectives
To introduce the student to the types of problematic soils and the special considerations taken when constructing projects on each type.

Course Topics
- Types of problematic soils;
- Swelling soil; Types of swelling soils,
- Basic definitions and characteristics, Classification,
- Laboratory experiments, methods for foundations on swelling soils;
- Collapsible soils; Types, Field tests for collapsible soils,
- Laboratory experiments,
- Foundations on collapsible soils;
- Soft clay soils; Basic definitions; Field tests for soft clays; Laboratory experiments;
- Foundations on soft clays.

References
Course Code : CB 737
Course Title : Piling Engineering
Credit Hours : 3

Course Description
Site investigation for piling; Basic piling methods; Design of single piles; Design of pile groups; Design of piles subjected to lateral loads; Special considerations for design and construction of offshore piles; Tension leg platforms; Load distribution among group piles; Retaining walls; Problems in pile construction; Integrity testing; Pile testing; Pile dynamics; Choice of pile construction method and economics of design.

Course Objectives
To illustrate to the student the types of piled foundations and the advantages and limitations in construction and performance for each type.

Course Topics
- Site investigation for piling; Basic piling methods;
- Design of single piles; Design of pile groups;
- Design of piles subjected to lateral loads;
- Special considerations for design and construction of offshore piles;
- Tension leg platforms; Load distribution among group piles;
- Retaining walls;
- Problems in pile construction;
- Integrity testing; Pile testing; Pile dynamics;
- Choice of pile construction method and economics of design.

References
- Fleming, Weltman, Randolph and Elson, “Piling Engineering”, Blackie, 1992
Course Code : CB 738
Course Title : Special Geotechnical Structures
Credit Hours : 3

Course Description
Cofferdams: Types; Single raw sheet pile cofferdam; method of analysis; construction sequence; Geotechnical construction considerations; Double raw sheet pile cofferdam; Construction sequence; Geotechnical construction considerations; Cellular cofferdams; Required data for cellular structure design and installation; design procedure; Field procedures and problems; Caissons: Types of caissons; Sinking and control; Carrying capacity of caisson as a foundation element.

Course Objectives
To introduce to the student types of special geotechnical structures implemented in large complex projects with emphasis on special considerations in the design and construction method of each type.

Course Topics
- Cofferdams: Types; Single raw sheet pile cofferdam;
- method of analysis; construction sequence;
- Geotechnical construction considerations;
- Double raw sheet pile cofferdam; Method of analysis;
- Construction sequence; Geotechnical construction considerations;
- Cellular cofferdams; Required data for cellular structure design and installation; design procedure;
- Field procedures and problems;
- Caissons: Types of caissons; Caisson design considerations; Sinking and control; Carrying capacity of caisson as a foundation element.

References
Course Detailed Structure

Construction and Building Engineering
(C) Geotechnical Engineering

Course Code: CB 739
Course Title: Environmental Geotechnics
Credit Hours: 3

Course Description
Environmental Geotechnics: Development of the field, types of projects and problems, waste characterization; Soils: formation, composition, structure and properties; Soil-Water-Waste System; Site Characterization: Geophysics, drilling and sampling, monitoring wells; Waste Containment Systems; Containment Barrier, Liners, Covers, and Walls; Contaminant Transport through Liners, Covers, and Barriers: Hydraulic conductivity, advection and dispersion; Remediation and Stabilization of Contaminated Ground: ground improvement applications, development over old landfills.

Course Objectives
To develop understanding of the scope of environmental geotechnics and to learn how to perform geotechnical investigations required for site characterization.

Course Topics
- Environmental Geotechnics: Development of the field,
- types of projects and problems,
- professional practice issues, health and safety issues, waste characterization;
- Soils: formation, composition, structure and properties;
- Soil-Water-Waste System: Properties of water, soil-water interaction;
- Site Characterization: Geophysics, drilling and sampling, monitoring wells;
- Waste Containment Systems; Containment Barrier, Liners, Covers, and Walls; Contaminant Transport through Liners, Covers, and Barriers:
- Hydraulic conductivity, advection and dispersion; Remediation and Stabilization of Contaminated Ground: Pump and treat, bioremediation, soil washing, thermal treatment, solidification and extraction, ground improvement applications, development over old landfills.

References
Course Code : CB 731-G
Course Title : Soil Dynamics
Credit Hours : 3

Course Description
Vibration of elementary systems; Wave propagation in elastic, homogenous, isotropic media; Elastic waves in layered systems; Propagation of waves in saturated media, Behavior of dynamically loaded soils, Theories for vibrations of foundations on elastic media; Isolation of foundations, Instrumentation for measurements; Design procedures.

Course Objectives
To introduce the student to the basics of dynamic properties, behavior and effect of soil on foundations when subjected to vibrations.

Course Topics
- Vibration of elementary systems;
- Wave propagation in elastic, homogenous, isotropic media;
- Elastic waves in layered systems;
- Propagation of waves in saturated media,
- Behavior of dynamically loaded soils,
- Theories for vibrations of foundations on elastic media;
- Isolation of foundations, Instrumentation for laboratory and field measurements;
- Design procedures for dynamically loaded foundations.

References
Course Detailed Structure

Course Code : CB 732-G
Course Title : Geotechnical Earthquake Engineering
Credit Hours : 3

Course Description
Introduction; Seismology and earthquakes; Strong ground motion; Seismic hazard analysis; Wave propagation; Dynamic soil properties; Ground response analysis; Liquefaction; Seismic slope stability; Seismic design of retaining walls; Soil improvement for remediation of seismic hazards.

Course Objectives
To illustrate to the student techniques to mitigate seismic effects on various geotechnical structures.

Course Topics
- Introduction;
- Seismology and earthquakes;
- Strong ground motion;
- Seismic hazard analysis;
- Wave propagation; Dynamic soil properties;
- Ground response analysis; Liquefaction;
- Seismic slope stability;
- Seismic design of retaining walls;
- Soil improvement for remediation of seismic hazards

References
Course Code : CB 733-G
Course Title : Elastic Analysis of Soil–Foundation Interaction
Credit Hours : 3

Course Description
Introduction to soil-foundation interaction problems; Idealized soil response models for analysis of soil–foundation interaction; Plane-strain analysis of an infinite plate and an infinitely long beam; Analysis of beams of finite length; Axisymmetric three–dimension problem of an infinite plate; Analysis of finite plates; Determination of soil parameters; Experimental investigation and field studies.

Course Objectives
To introduce to the student the analysis methods of elastic interaction between soil and foundations.

Course Topics
- Introduction to soil-foundation interaction problems;
- Idealized soil response models for analysis of soil–foundation interaction
- Plane-strain analysis of an infinite plate and an infinitely long beam
- Analysis of beams of finite length;
- Axisymmetric three–dimension problem of an infinite plate;
- Analysis of finite plates;
- Determination of soil parameters;
- Experimental investigation and field studies.

References