Conditions for Award of Specialisations

In

MSc (Civil Engineering)
CONDITIONS FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE (CIVIL ENGINEERING) WITH SPECIALISATION

REGULATIONS

1. The programme leading to the degree of Master of Science (Civil Engineering) comprises thirty (30) AU of courses.

2. Candidates with demonstrable aptitude for research may be allowed to undertake a project on a topic approved by the Chair of the School of Civil and Environmental Engineering and submit a dissertation based on the project. Such candidates will be required to complete twenty-four (24) AU of courses.

3. The permission to undertake a project study is granted at the sole discretion of the Chair of the School of Civil and Environmental Engineering.

4. The courses will be selected from an approved list of graduate courses by the School of Civil and Environmental Engineering or any other graduate courses approved by the Chair.

5. Candidates who have opted for specialisation may take a longer time to complete the programme as not all courses on the approved list will be offered in any academic year. The courses offered in any academic year shall be determined by the School of Civil and Environmental Engineering.

6. There shall be an examination towards the end of each semester. Candidates will be examined in each of the courses taken in the Semester unless otherwise informed.

7. Candidates who successfully complete the programme and meet all the requirements stipulated in the Statute shall be awarded with the Degree of Master of Science (Civil Engineering).

CONDITIONS FOR THE AWARD OF SPECIALISATION

1. The degree of Master of Science (Civil Engineering) also provides opportunity for more concentrated study in various areas of specialisation in Civil Engineering.

2. Candidates who desire to undertake a programme of concentrated study in the available specialised areas shall:

   (1) Declare the area of specialisation they intend to undertake in the first semester of their candidature;

   (2) Choose only one (1) area of specialisation;

   (3) Read and pass the examination of at least fifteen (15) AU of courses in the chosen area of specialisation.

3. The listing of courses for specialisation is enclosed in Attachment A.

4. Candidates who have elected to pursue a specialisation, and, who have also been granted permission to undertake a project study shall normally work on a topic related to the area of specialisation unless otherwise exempted by the Chair of the School of Civil and Environmental Engineering.
5. Candidates who satisfy condition (2) and who meet all the requirements stipulated by the Statute for the award of the Degree of Master of Science (Civil Engineering) shall have their area of specialisation noted in the academic transcript.
LISTING OF COURSES

FOR THE

DEGREE OF MASTER OF SCIENCE
(CIVIL ENGINEERING)

and

COURSE GROUPINGS FOR SPECIALISATION
Candidates taking the Degree of Master of Science (Civil Engineering) can opt to follow a concentrated focus of study in one of the specialisation areas in addition to the general Civil Engineering curriculum. The specialisation areas are:

A. Geotechnical Engineering (for part-time only)
B. Structural Engineering
C. Sustainable Urban Systems

Each course listed below carries 3 AU.

A. Geotechnical Engineering Specialisation (for part-time only)

*(To be qualified for specialisation in Geotechnical Engineering, a student must take CV6311 plus any other four courses listed below.)*

**Courses**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>CV6311*</td>
<td>Soil Behaviour and Engineering Properties</td>
</tr>
<tr>
<td>CV6312</td>
<td>Slope Stability and Ground Improvement</td>
</tr>
<tr>
<td>CV6313</td>
<td>Shallow and Deep Foundations</td>
</tr>
<tr>
<td>CV6314</td>
<td>Excavation and Earth Retaining Systems</td>
</tr>
<tr>
<td>CV6315</td>
<td>Engineering Geology and Rock Engineering</td>
</tr>
<tr>
<td>CV6107</td>
<td>Behaviour and Design of Steel and Composite Structures</td>
</tr>
</tbody>
</table>

**Course Contents**

**CV6311 Soil Behaviour and Engineering Properties**

**CV6312 Slope Stability and Ground Improvement**
Slope stability: shear strength, total and effective stress analyses, methods of slices involving circular and noncircular slip surfaces, slope monitoring and stabilization, case studies.
Soil improvement: surface compaction, deep compaction, admixture stabilization, reinforced soil, preloading and vertical drains. Pre-treatment and post-treatment assessment.

**CV6313 Shallow and Deep Foundations**
Footing and raft foundations: design considerations, bearing capacity, settlement, combined footings, soil-raft interaction analysis, pile-raft foundations. Deep Foundations: response of piles to vertical and horizontal loads, load transfer, dynamic pile testing and static pile load tests.
CV6314 Excavation & Earth Retaining Systems
Retaining structures: Lateral earth pressure, design of earth retention systems, concrete retaining walls, reinforced soil walls and anchored bulkheads. Supported excavation: overview of braced/anchored excavations in soil, evaluation of soil properties, stability of excavations, design of excavation support systems, ground movements associated with excavation, construction monitoring.

CV6315 Engineering Geology and Rock Engineering

CV6107 Behaviour and Design of Steel and Composite Structures
Behaviour and design of steel structures: columns, beams, beam-columns and frames; behaviour and design of composite structures: shear connectors, composite beams, columns, slabs and joints.

B. Structural Engineering Specialisation
(To be qualified for specialisation in Structural Engineering, a student must take at least five courses from the list below.)

Courses
CV6103 Structural Dynamics
CV6104 Behaviour and Design of Reinforced Concrete Structures
CV6105 Seismic Design of Reinforced Concrete Structures
CV6106 Precast and Prestressed Concrete Structures
CV6107 Behaviour and Design of Steel and Composite Structures
CV6108 Analysis and Design of Tall Buildings
CV6109 Advanced Concrete Technology
CV6162 Structural Response to Blast Loading
CV6163 Design of Structures to Resist the Effects of Explosions
CV6313 Shallow & Deep Foundations

Course Contents

CV6103 Structural Dynamics
Free and forced vibration of single degree of freedom structures; damping; convolution integral; state space method; free and forced vibration of multi-degree of freedom structures; numerical methods; structural response to seismic loading; response spectra; time history analysis and response spectra analysis; special topics.

CV6104 Behaviour and Design of Reinforced Concrete Structures
Properties of concrete; flexure, shear, and torsion theories; time-dependent behaviour; slender columns; flat plate flat slab systems; yield line theory and strip method of design, strut and tie models for design.

**CV6105 Seismic Design of Reinforced Concrete Structures**
Introduction to seismic design; properties of concrete under dynamic loading; confinement, bond and anchorage; strength and ductility; design methods, structural system for seismic resistance; seismic design of frames; beam-column joints; shear walls.

**CV6106 Precast and Prestressed Concrete Structures**
Properties of concrete; prestressed concrete beams under flexure, shear, and torsion; time-dependent behaviour; statically indeterminate structures; post-tensioned slab systems; design of precast connections; bearing and non-load-bearing precast walls; moment resisting frames; precast buildings under lateral loads.

**CV6107 Behaviour and Design of Steel and Composite Structures**
Behaviour and design of steel structures: columns, beams, beam-columns and frames; behaviour and design of composite structures: shear connectors, composite beams, columns, slabs and joints.

**CV6108 Analysis and Design of Tall Buildings**
Philosophy and design criteria of tall buildings; structural systems for tall buildings: moment-resisting frames, shear walls, braced frames; P-Delta effects and instability; structural design process: functional requirements; design criteria and loading: dead, live, wind, and earthquake loads; preliminary and computer-aided proportioning; analysis of tall buildings; very tall buildings including framed tube, tube in tube, trussed tube and hat trusses, etc.

**CV6109 Advanced Concrete Technology**

**CV6162 Structural Response to Blast Loading**
Introduction of structural dynamics; blast load and structural response characteristics; energy solutions; equivalent systems method; numerical solutions; damage index and control limits; stress wave propagation from surface and buried explosions; impact and ballistic loading and associated responses; human response to blast loading; M & E considerations; Special topics.

**CV6163 Design of Structures to Resist the Effect of Explosions**
Blast effects on buildings: case histories of terrorist attacks and acts if war; identification of loading types and blast mitigation; ultimate design of reinforced concrete slabs and beams; ultimate design of steel structures to resist blast loading; blast door design; special considerations in explosive protective design. The emphasis will be on terrorist threats from vehicle bombs, but the fundamental concepts can be applied to other explosive scenarios.

**CV6313 Shallow & Deep Foundations**
Footing and raft foundations: design considerations, bearing capacity, settlement, combined footings, soil-raft interaction analysis, pile-raft foundations. Deep Foundations: response of piles to vertical and horizontal loads, load transfer, dynamic pile testing and static pile load tests.
C. Sustainable Urban Systems Specialisation

(To be qualified for specialisation in Sustainable Urban Systems, a student must take at least five courses from the list below.)

Courses

CV6112  Fundamentals of Catastrophe Risk Modeling
CV6521  Air Quality Management
CV6512  Integrated Solid Waste Management
CV6212  Construction Management
CV6481  Urban and Regional Transport Planning
CV6316  Planning and Development of Underground Space in Rock Caverns

Course Contents

CV6112 Fundamentals of Catastrophe Risk Modeling
Introduction to various catastrophe risks and modular structured ways to model the risks from various perils, probability distributions, basic framework of Catastrophe risk Models; treatment of uncertainties, risk quantification, aggregation across several perils, introduction to some advanced applications, risk management, risk transfer techniques, validation and use of Cat models, seminars and independent study cum presentation.

CV6521 Air Quality Management

CV6512 Integrated Solid Waste Management

CV6212 Construction Management
Structure and organization construction industry; Company and project organizational concepts; Construction contracts and professional issues in construction management; Management of the construction process including costing, estimating and tendering; Technology and application; Case Studies.

CV6481 Urban and Regional Transport Planning

CV6316 Planning and Development of Underground Space in Rock Caverns
Introduction to uses of underground rock caverns, benefits and challenges, review of cavern space development in Singapore, planning considerations for rock cavern facilities, cost planning, site investigations, design of rock caverns and layout options, stability analysis and rock support design, construction technology, blasting and vibrations, risk management, HSE aspects, special considerations for selected underground facilities, and case studies with two selected projects.