## List of CE Post-Grad Modules offered in Academic Year 2014/2015

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| CE4231      | Earth's Climate: Science & Modelling                   | 4  | II       | **CE4231 Earth’s Climate: Science & Modelling**  
Modular Credits: 4  
Workload: 3-1-0-1-5  
Prerequisite(s): MA1505 and MA1506, or equivalents  
Preclusion(s): Nil  
Cross-listing(s): Nil  

This course introduces the basic scientific principles of how the Earth’s climate system. This is done by first introducing and analyzing measurements of the climate system. This will then be followed-up with consideration of the basic physical processes involved. Finally, simple models will be introduced to allow students to explore and understand more deeply.  

The following topics will be covered:  
1. Conservation of energy & radiative forcing  
2. Large-scale flows on a rotating sphere  
3. Atmospheric thermodynamics  
4. Physics and chemistry of greenhouse gases & aerosols  
5. Land surface change  
6. Coupling Across Scales & non-linearities |
| CE4282      | Building Information Modeling for Project             | 4  | II       | **CE4282 Building Information Modeling for Project**  
Modular Credits: 4  
Workload: 3-0-1-2-4  
Prerequisite(s): Nil  
Preclusion(s): Nil  
Cross-listing(s): Nil  

Building Information Modeling (BIM) is a revolutionary technology and process that provides an integrated digital database and a variety of modelling tools to remarkably change the way buildings and infrastructure facilities are designed, analyzed, constructed, and managed. BIM is rapidly becoming the industry standard and best practice.  

This course provides a comprehensive coverage with essential details in several key aspects of project development, such as design, building performance, sustainability, engineering, construction, project delivery, and facilities management. It helps the students start their first integrated BIM project through the hands-on of a project assignment employing industry leading BIM software. |
| CE4247      | Treatment Plant Hydraulics                            | 4  | II       | **CE4247 Treatment Plant Hydraulics**  
Modular Credits: 4  
Workload: 3-1-0-1-5  
Prerequisite(s): CE3132 Water Resources Management or CE4-standing, or higher  
Preclusion(s): Nil  
Cross-listing(s): Nil  

This course introduces the student to the application of the basic concepts in pipe and open channel flows that were covered earlier to the design of the pumping system and associated facilities in a water or sewage treatment plant.  

Topics covered include selection of pumps for optimal efficiency, hydraulic design of the pump sump and the sewage/treated water delivery system and surge mitigation. Students will be involved in a project on the design of such a system. |
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| CE4257      | Linear Finite Element Analysis       | 4  | I        | **CE4257 Linear Finite Element Analysis**  
Modular Credits: 4  
Workload: 3-0-0-3-4  
Prerequisite(s): CE3155 Structural Analysis  
Preclusion(s): Nil  
Cross-listing(s): Nil  
This module equips students with the fundamentals of finite element principles to enable them to understand the behaviour of various finite elements and to be able to select appropriate elements to solve physical and engineering problems with emphasis on structural and geotechnical engineering applications. It covers weak formulation, element shape function, isoparametric concepts, 1-D, 2-D, 3-D and axisymmetric elements, field problems, modelling and practical considerations, and special topics.  
The module is targeted at undergraduate and graduate students involved in research or application of the finite element method in civil engineering problems. |
| CE4258      | Structural Stability & Dynamics      | 4  | II       | **CE4258 Structural Stability & Dynamics**  
Modular Credits: 4  
Workload: 3-0-0-3-4  
Prerequisite(s): CE3155 Structural Analysis  
Preclusion(s): Nil  
Cross-listing(s): Nil  
This module provides students with basic knowledge of structural stability and dynamics for the analysis of civil engineering structures.  
The topics covered include general principles of stability and dynamics; buckling of beam, columns and frames; design against local and overall stability. Dynamics analysis will cover single-degree-of-freedom systems, multi-degree-of-freedom systems and continuous systems. Students are taught to deal with general stability and vibration problems of frames including computer applications and numerical formulation.  
The module of specialised context targets at undergraduate and graduate students in research or engineering practices relating to structural engineering applications. |
| CE5101      | Seepage & Consolidation of Soils     | 4  | I        | **CE5101 Seepage & Consolidation**  
Modular Credits: 4  
Workload: 3-0-0-1-6  
Prerequisite(s): CE4 standing or higher  
Preclusion(s): Nil  
Cross-listing(s): Nil  
This is an advanced module in flow through a two-phase medium. The topics that are covered include steady state seepage and basic transient seepage, basic contaminant transport processes, measurement of hydraulic transport parameters, and its applications to dewatering of excavations and seepage through embankments as to their influence on slope stability. Consolidation theory from 1-D to 3-D consolidation analysis, and methods of accelerating consolidation, with application to computing settlements of foundations.  
Students are taught Darcy's Law, continuity equation, coupling between effective stress and pore pressure, and the solution methods inclusive of FEM modelling.  
The goals of the module are analysis of seepage problems, analysis of consolidation problems, design methods to accelerate consolidation to solve stability and settlements problems in geotechnical engineering. |
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| CE5104      | Underground Space                                | 4  | I        | **CE5104 Underground Space**  
Modular Credits: 4  
Workload: 3-0-0-2-5  
Prerequisite(s): CE2112 or CE4 standing or higher  
Preclusion(s): Nil  
Cross-listing(s): Nil  
This is an advanced module on analysis and design of underground structures such as tunnels and caverns.  
The topics covered include cut and cover construction, bored tunnelling methods, construction of caverns, New Austrian Tunnelling Method, jack tunnelling, stability of underground openings, ground movement prediction due to tunnels and caverns, effects of ground movements on buildings and structures, instrumentation and monitoring, stresses on lining, and finite element modelling of underground construction. The creation of underground structures to form subways, underpasses, metro stations and other uses is an increasing requirement in major urban areas world-wide.  
Students are taught the various methods of construction for creating underground space, and will be able to assess the effect of underground structure on surface structures. Students will appreciate the usefulness and difficulties of finite element method for analysis of underground structures. |
| CE5105      | Analytical & Numerical Methods in Foundation Engrg. | 4  | II       | **CE5105 Analytical & Numerical Methods in Foundation Engineering**  
Modular Credits: 4  
Workload: 3-0-0-3-4  
Prerequisite(s): CE2112 or equivalent  
Preclusion(s): Nil  
Cross-listing(s): Nil  
This is an advanced module on analytical and numerical methods in foundation engineering. Topics covered include soil models, analysis of beams and rafts on elastic foundations, analysis of piles subject to torsion, axial and lateral loads, and analysis of piles subject to dynamic loads.  
Students will learn how to assess the behaviour of shallow and deep foundations under more complex loading modes. Students gain an understanding of Winkler, Pasternak, and continuum soil models, conversant with analytical methods and numerical methods such as finite difference, Galerkin, energy and finite element methods, and applications to shallow and deep foundations. |
| CE5106      | Ground Improvement                               | 4  | II       | **CE5106 Ground Improvement**  
Modular Credits: 4  
Workload: 3-0-0-1-6  
Pre-requisite: CE2112 or CE4 standing or higher  
This is an advanced module on ground improvement techniques as well as its design, construction and monitoring in geotechnical engineering.  
Topics covered include ground improvement principles and design considerations, techniques of improving granular soils, techniques of improving cohesive soils and peaty soils, field controls and monitoring, field evaluation specification, performance evaluation and acceptance criteria, and case study.  
Student are taught the basic principles of various ground improvement techniques, and how to select the most appropriate ground improvement techniques to be used in specific circumstances. Specific learning objectives include understanding the principles and design of vibro-flotation method, dynamic compaction, dynamic replacement with mixing, vertical drains with preloading, chemical |
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| CE5107     | Pile Foundations                   | 4  | II       | **CE5107 Pile Foundations**  
Modular Credits: 4  
Workload: 3-0-0-2-5  
Prerequisite(s):  
  Undergraduates: CE2112 & CE3116; and  
  Graduates: Background in Soil Mechanics and Foundation Engineering  
Preclusion(s): Nil  
Cross-listing(s): Nil  
This is an advanced module in deep foundation engineering. Topics covered include bearing capacity and settlement, laterally loaded piles, piles subject to ground movement, piles in difficult ground, foundations for marine structures, construction related problems, pile driving analysis and dynamic testing, and static pile tests.  
Students will learn how to deal with design and construction issues pertaining to deep foundations under more general and realistic practical situations.  
Specific learning objectives include performing design calculations for piles and pile groups under more complex loading modes and ground conditions and pile installation and testing. |
| CE5108     | Earth Retaining Structures         | 4  | I        | **CE5108 Earth Retaining Structures**  
Modular Credits: 4  
Workload: 3-0-0-1-6  
Pre-requisite: CE2112 or CE4 standing or higher  
Preclusion(s): Nil  
Cross-listing(s): Nil  
This is an advanced module in earth-retaining structures and deep excavations.  
Topics include earth pressure theories, rigid retaining structures, flexible retaining structures, cellular cofferdams, retaining walls for deep excavations, support systems for deep excavations, and field monitoring.  
Students are taught to deal with design and construction issues pertaining to a spectrum of earth-retaining systems from low rigid retaining walls to flexible support systems for deep excavations. Students will also learn to apply the methods of limit state, such as BS8002 and Eurocode7, to the design of rigid and flexible retaining walls. Applications of commercial geotechnical FEM softwares are taught to aid in design of deep excavations to limit ground deformations and satisfy SLS requirements.  
At the end of the course, students are taught the application of advanced earth pressure theories, selection of appropriate retaining structures, and verification of capacity and movement requirements, using limit equilibrium and FEM analysis tools. |
| CE5111     | Underground Construction Design Project | 4  | I & II   | **CE5111 Underground Construction Design Project**  
Modular Credits: 4  
Workload: 0-2-0-8-0  
Pre-requisite: Nil  
Preclusion(s): Nil  
Cross-listing(s): Nil  
The objective of this module is to integrate the various concepts and components of temporary earth retaining structure, underground construction and major geotechnical works design which have been covered in the other modules into a properly executed geotechnical analysis and design project. As such, the student will be advised to take it only either in the last 2 semester. |
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<td></td>
<td><strong>CE5112 Structural Support Systems for Excavation</strong></td>
<td>4</td>
<td>II</td>
<td>The requirements of the project will include interpretation of site investigation data, derivation of design parameters, use of computer or finite element software for the wall and ground movement as well as drawdown and implications for adjacent structures, design of wall, strutting and waling systems, and proposal of an appropriate ground instrumentation programme. Student will be given a maximum of 2 semesters to complete their projects. At the end of the projects, students will be required to submit a report of their findings and give an oral presentation, which will be graded.</td>
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<tr>
<td>CE5112</td>
<td>Structural Support Systems for Excavation</td>
<td>4</td>
<td>II</td>
<td>Students will learn the various methods of excavation construction and apply the fundamental knowledge of structural mechanics to design a wide range of earth retaining walls and their support systems. The key focus is to develop the capability to design various types of retaining walls, ground anchorage, walers, struts, kingposts, bracing and connection details. It will also cover the design of working platforms which are often required in deep excavations, as well as methods of jointing and splicing to allow incorporation of instrumentation. The course will cover both steel and reinforced concrete retaining walls, such as sheetpiles, soldier piles, timber lagging, contiguous bored piles, diaphragm walls and etc. The course enables students to acquire further knowledge on soil-structure interaction and gain practical skills through the lectures, case studies and design projects.</td>
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<td>CE5113</td>
<td>Geotechnical Investigation &amp; Monitoring</td>
<td>4</td>
<td>I</td>
<td>This module teaches students the essential concepts and methodology for the planning, design and implementation of site investigation and ground instrumentation programmes. The module will be broadly divided into two parts. The first part covers various aspects of site investigation such as the planning, design, density of bore holes, sampling technology and disturbance, in-situ and laboratory testing and geophysical methods. The second part covers various aspects of ground instrumentation such as monitoring of ground movement, drawdown, excess pore pressures, strut forces, wall deflection and observational methods. This module enables students to acquire the knowledge and practical skills through the lectures, case studies and projects.</td>
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| CE5203      | Traffic Flow & Control              | 4  | I        | **CE5203 Traffic Flow & Control**  
Modular Credits: 4  
Workload: 3-0-0-3-4  
Pre-requisite: CE3121, or CE4 standing or higher  
Preclusion(s): Nil  
Cross-listing(s): Nil  
Understanding traffic flow phenomena and being able to describe them with mathematical models is fundamental to the effective traffic management and control strategies.  
This module aims to introduce students to the various theories and mathematical models that describe traffic flow and traffic operations. Deterministic and probabilistic, as well as microscopic and macroscopic models can be used to analyse and control traffic will be covered.  
The major topics include measurement of traffic flow parameters, car-following, gap acceptance, traffic stream models, shock waves, platoon dispersion, kinematic and hydrodynamic flow models, unsignalised and signalized intersections control. |
| CE5204      | Pavement Design & Rehabilitation    | 4  | II       | **CE5204 Pavement Design & Rehabilitation**  
Modular Credits: 4  
Workload: 3-0-0-1-6  
Prerequisite(s): Nil  
Preclusion(s): Nil  
Cross-listing(s): Nil  
The course introduces students to the basic principles and concepts of pavement design and rehabilitation for airfields and roads. Students will learn to understand the major aspects of structural and functional requirements of pavement, including load bearing capacity, material and thickness selection, durability against traffic and environmental loading, drainage and safety needs. Students will also learn the mechanisms of pavement distresses, and techniques and approaches of pavement rehabilitation. The principles of pavement rehabilitation in respect of nondestructive condition evaluation, pavement performance modelling and remaining life prediction will be addressed.  
The module requires each student to do a term project that involves identification of an aspect of pavement design or rehabilitation that warrants further study and description of the approach and technique of the proposed study. The module enables the students to acquire the knowledge of designing, maintaining and rehabilitating road and airfield pavements. |
| CE5205      | Transportation Planning             | 4  | I        | **CE5205 Transportation Planning**  
Modular Credits: 4  
Workload: 3-0-0-2-5  
Prerequisite(s): CE3121 or equivalent  
Preclusion(s): Nil  
Cross-listing(s): Nil  
Transportation planning is an exercise of forecasting travel demand, from the generation and distribution of trips, choices of transportation modes to how trips are traversed across the transportation network.  
Transportation planning is a basis for decisions about arranging in transportation facilities as well as a corner stone in shaping the patterns and tracks of urban and regional development. Major topics to be covered in this module include planning concept, land use and transportation, trip generation, trip distribution, mode choice, route choice, etc. It emphasizes both state-of-the-practice and state-of-the-art methods, theories, and tools aimed for urban land transportation planning. |
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| CE5207      | Pavement Network Management Systems         | 4  | II       | **CE5207 Pavement Network Management Systems**  
Modular Credits: 4  
Workload: 3-0-0-2.5  
Prerequisite(s): CE3121 or equivalent  
Preclusion(s): Nil  
Cross-listing(s): Nil  

The course introduces the basic principles and concepts of management systems for road and airfield pavement network. The major issues addressed include the conflicting objectives and requirements of pavement operations, challenges to developing sound pavement management system, and analytical tools and techniques involved in the development of the system.

Students will be introduced to the concept of pavement management, techniques of evaluating different financing and management strategies of pavement operations, methods of pavement conditions and performance data collection, optimal programming of pavement management activities, budget planning and life-cycle cost analysis, and examples of pavement management systems (PMS).

The module requires each student to do a term project to analyse a case study of PMS development, identify deficiencies of the system and propose schemes to improve the operational efficiencies of the system.                                                                                          |
| CE5307      | Wave Hydrodynamics and Physical Oceanography | 4  | I        | **CE5307 Wave Hydrodynamics and Physical Oceanography**  
Modular Credits: 4  
Workload: 3-0-0-4-3  
Prerequisite: CE2134 Hydraulics or CE4 standing or higher  
Preclusion(s): Nil  
Cross-listing(s): Nil  

This module is aimed at introducing the student to wave hydrodynamics and geophysical flows. It covers the basic concepts of the conservation of mass and momentum to the solution of the small amplitude waves together with its engineering properties such as particle kinematics, pressure fields, energy propagation, shoaling, refraction and diffraction. Some non-linear properties derivable from the linear theory such as mass transport, momentum flux and the radiation stress concept, would also be covered along with an introduction into non-linear waves.

The module also introduces the superposition principle and the concept of the wave spectrum. Generation of wind waves in deep water and their statistical properties using crossing and spectral analyses for short term and long term statistics which would be useful in design wave selection would be introduced.

There will also be a review of the dominant forces in the ocean, i.e. Gravity, Coriolis and friction, and some of the resulting phenomena including tides, Ekman currents, coastal upwelling and downwelling and storm surges.                                                                 |
| CE5308      | Coastal Processes & Sediment Transport      | 4  | II       | **CE5308 Coastal Processes & Sediment Transport**  
Modular Credits: 4  
Workload: 3-0-0-4-3  
Prerequisite: CE5307 Wave Hydrodynamics and Physical Oceanography *(the revised syllabi as of AY2010/2011)*  
Preclusion(s): Nil  
Cross-listing(s): Nil  

The student will be introduced to the concepts related to the current boundary layer, the wave boundary layer, the combined wave-current boundary layers and the bed friction in wave current motions. The basic concepts of sediment transport covering incipient motion, suspended and bed load transport, for current flow, wave action and combined current and wave would also be |
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<td>CE5310</td>
<td>Hydroinformatics</td>
<td>4</td>
<td>I</td>
<td>Current generated bed waves as well as wave generated bed forms will be covered. These concepts will be integrated into the wave current interactions. Understanding of the wave theory in the prerequisite CE5307 will facilitate the introduction of empirical approaches to the assessment of wave action (breaking and non-breaking) on coastal structures such as seawalls and breakwaters. The student will also be introduced to wave-driven longshore currents and longshore sediment transport models and the use of similarity analyses in physical movable bed model studies of coastal sediment movement.</td>
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| CE5310      | Hydroinformatics                    | 4  | I        | Modular Credits: 4  
Workload: 3-0-0-2-5  
Pre-requisite: CE Graduate standing  
Preclusion(s): Nil  
Cross-listing(s): Nil  
Hydroinformatics is concerned with the development and application of mathematical modelling and advanced information technology tools to hydraulics, hydrological and environmental problems of urban, inland and coastal waters. On the technical side, in addition to computational hydraulics, hydroinformatics has a strong interest in the use of techniques originating in data-driven techniques, such as artificial neural networks, support vector machines and evolutionary programming. |
| CE5311      | Environmental Modelling with Computers | 4  | I        | Workload: 3-0-0-2-5  
Pre-requisite: CE Graduate standing  
Preclusion(s): Nil  
Cross-listing(s): Nil  
This course deals with many of the chemical and biochemical fundamentals, as well as the behaviour of environment systems such as the atmosphere, freshwater systems, estuaries, coastal seas and oceans. The inter-linkages between environmental media and the major human and environmental impacts are explained at an introductory level. After this introduction of fundamental processes the course introduces widely used computational environmental modelling concepts, used for impact assessment, in different media such as air, water and soil. Also numerical aspects will be taken into account. |
| CE5312      | River Mechanics                     | 4  | I        | Workload: 3-0-0-2-5  
Pre-requisite: CE3132 Water Resources Engineering or CE4- standing or higher  
Preclusion(s): Nil  
Cross-listing(s): Nil  
The student will be introduced to open channel flows covering the conservation of mass, the momentum and energy equations. This is followed with the formulations for steady gradually varied flows with/without lateral inflows/outflows. The student is further introduced to the design of channels for steady gradually varied flows with lateral inflows (side spillways) and lateral outflows (side weirs). The concept of flow controls is also covered. The development of the continuity and momentum equations for unsteady flows is introduced. |
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<td>CE5313</td>
<td>Groundwater Hydrology</td>
<td>4</td>
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<td>Flood routing is also covered along with the concepts of the kinematic wave, the diffusive wave and the dynamic wave are covered. The concept of the characteristics and its application to the solution of simple wave problems associated with sluice gate operations and dam break is also introduced. Sediment transport concepts and the resistance to flow due to bedforms in alluvial channels are also covered with the view of estimating the total sediment transport capacity and the friction factor for composite roughnesses. Design concepts for a stable channel is also introduced.</td>
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<td>CE5314</td>
<td>HEWRM Project</td>
<td>8</td>
<td>I &amp; II</td>
<td>CE5314 HEWRM Project&lt;br&gt;Modular Credits: 8&lt;br&gt;Pre-requisite(s): Nil&lt;br&gt;Preclusion(s): Nil&lt;br&gt;Cross-listing(s): Nil&lt;br&gt;For students of the NUS Masters Programme in Hydraulic Engineering and Water Resources Management.&lt;br&gt;Students will select a project with the input from a faculty member from which to carry out independent research, report and present the research within 1- to 2-semester period, depending on scope and deliverables approved by Supervisor and Programme Manager.&lt;br&gt;Students should demonstrate scientific and technological skills, the ability to work independently, and demonstrate the capacity to manage both technically and time-wise a research or design project.</td>
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<td>CE5509</td>
<td>Advanced Structural Steel Design</td>
<td>4</td>
<td>I</td>
<td>CE5509 Advanced Structural Steel Design&lt;br&gt;Modular Credits: 4&lt;br&gt;Workload: 3-0-0-3-4&lt;br&gt;Pre-requisite(s): CE3166 or equivalent&lt;br&gt;Preclusion(s): Nil&lt;br&gt;Cross-listing(s): Nil&lt;br&gt;The primary objective of this module is to equip civil engineering students with sufficient design knowledge and skills on steel-concrete composite structures both for their further education and for their future engineering career.&lt;br&gt;This module provides students with fundamental approaches in designing structural steel-concrete components and buildings. The students will acquire fundamental knowledge and skills to perform structural design for composite beams, slabs, columns, joints, multi-storey buildings. This enables the students to conceive a safe and economical structural system.&lt;br&gt;The module is targeted at MSC civil engineering students and those with a keen interest on structural design.</td>
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| CE5510      | Advanced Structural Concrete Design  | 4  | I        | **CE5510 Advanced Structural Concrete Design**  
**Modular Credits:** 4  
**Workload:** 3-0-0-1-6  
**Pre-requisite:** CE3165 or CE4 standing or higher  
**Preclusion(s):** Nil  
**Cross-listing(s):** Nil  

The objective of this module is to further equip civil engineering students with design knowledge and skills in reinforced and prestressed concrete. The module provides students with fundamental approaches in designing structural concrete components and systems.

The students will learn refined methods in the design for action effects and for deflection and crack control, and in the structural design of flat slab systems, slender columns, concrete bridges, concrete water tanks, design and detailing of connections.

The module is targeted at MSc civil engineering students and those with a keen interest on advanced structural concrete design.  

| CE5513      | Plastic Analysis Of Structures       | 4  | II       | **CE5513 Plastic Analysis Of Structures**  
**Modular Credits:** 4  
**Workload:** 3-0-0-1-6  
**Pre-requisite:** CE2155 or CE4 standing or higher  
**Preclusion:** Nil  
**Cross-listing(s):** Nil  

This module provides students with basic knowledge on the theory of plasticity and their application for analysis and design of civil engineering structures.

The topics covered include basic concepts of plasticity; the plastic hinge; tools used in plastic analysis and design; plastic design of beams, portal frames and multi-storey buildings, and computer methods for analyzing large scale framework. Students are taught to deal with general inelastic problems of frames including computer applications and numerical formulation.

The module of specialized context targets at undergraduate and graduate students in research or engineering practices relating to structural analysis and design.  

| CE5514      | Plate & Shell Structures             | 4  | I        | **CE5514 Plate & Shell Structures**  
**Modular Credits:** 4  
**Workload:** 3-0-0-0-7  
**Pre-requisite:** CE4 standing or higher  
**Preclusion:** ME5103  
**Cross-listing(s):** Nil  

In this specialized module, students are taught fundamentals in plate bending and shell membrane theories including axisymmetric bending of shells of revolution.

Topics covered include a brief introduction to the theory of elasticity, fundamentals of plate structures, plate bending theories and plate equations, energy principles, analytical and numerical analyse of plates, vibration and buckling of plates, orthotropic plates, membrane theory for shells of revolution, membrane theory for shells of translations, axisymmetric bending of shells of revolution and design of plate and shell structures.

The module is intended for undergraduate and graduate students who wish to enhance their understanding in terms of analysis and design of plates and shells used in civil and infrastructure works. |
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| CE5603      | Engineering Economics & Project Evaluation       | 4  | II       | Modular Credits: 4  
Workload: 3-0-0-2-5  
Prerequisite(s): CE4 standing or higher  
Preclusion(s): Nil  
Cross-listing(s): Nil  

This module equips students with the analytical methods and techniques to evaluate projects from an economic perspective. The purpose of the evaluation is to enable rational project selection and capital allocation taking into consideration factors like risk, uncertainty, inflation, and foreign exchange. |
| CE5604      | Advanced Concrete Technology                     | 4  | II       | Modular Credits: 4  
Workload: 3-0-0-2-5  
Prerequisite(s): CE2155, or CE4 standing or higher  
Preclusion(s): Nil  
Cross-listing(s): Nil  

This module provides students with in-depth knowledge on the role of constituent materials of concrete such as cements, mineral admixtures, and chemical admixtures and their interactions that affect properties of fresh and hardened concrete. It also provides students with in-depth knowledge on concrete response to stresses, time-dependent deformations, and durability of concrete exposed to severe environments. The module discusses the basic considerations and design philosophy for performance-based design of concrete mixtures and production of concrete. It also discusses the progress in concrete technology and the latest development on high-strength, high-performance, lightweight, and self compacting concrete. Sustainable development in construction industry and use of recycled aggregates and other recycled materials will be discussed as well. The module is targeted at post-graduate and final year undergraduate students who will gain knowledge from the module to complement their skill in structural design and to prepare them for their career as professional engineers. |
| CE5610      | Assessment and Retrofit of Concrete Structures   | 4  | I        | Modular Credits: 4  
Workload: 3-0-0-1-6  
Prerequisite(s): CE3165 or graduate-standing  
Preclusion(s): Nil  
Cross-listing(s): Nil  

The primary objective of this module is to equip civil engineering students with sufficient knowledge and skills on the durability of concrete structures and the basic principles and concepts of repair and retrofitting. Various factors affecting durability of concrete will be dealt with including non-destructive tests to assess durability. The module also emphasizes the technological and application aspects in the assessment and retrofit of concrete structures including causes of deterioration and various in-situ and non-destructive tests. The module is targeted at MSc civil engineering students and those with a keen interest in durability of concrete, assessment of concrete and retrofitting of concrete structures. |
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<th>MC</th>
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<th>Brief Description</th>
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</table>
| CE5804      | Global Infrastructure Project Management         | 4  | I        | CE5804 Global Infrastructure Project Mgt  
Modular Credits: 4  
Workload: 3-0-0-3-4  
Prerequisite(s): CE4 standing or higher  
Preclusion(s): Nil  
Cross-listing(s): Nil  
In today's construction, there is an increasing need to venture into construction markets overseas. This course covers issues that affect engineering constructors involved in large-scale infrastructure projects in international construction markets.  
The course goes beyond the basics covered in the first undergraduate course and emphasizes the global characteristics of large-scale civil infrastructure projects.  
Specific topics include project feasibility, risk management, international construction, international contracting, project financing, value management, engineering and procurement management and project collaboration.  
Course participants will also benefit from the experience of speakers from large engineering constructor companies involved in the development of such infrastructure projects. |
| CE5805      | Construction Equipment and Methods               | 4  | II       | CE5805 Construction Equipment and Methods  
Modular Credits: 4  
Workload 3-0-0-3-4  
Prerequisite(s): CE4 standing or higher  
Preclusion(s): Nil  
Cross-listing(s): Nil  
In a project, the selection of construction method and equipment are important considerations that can affect project execution and even the bottom line profits. This course gives an overview of the construction methods available in civil engineering, industrial, offshore and building type projects, and the considerations in equipment selection and fleet size determination. It also introduces the student to some work improvement and optimization methods related to allocation of resources, transportation, process planning and inventory.  
Specific topics include construction methods, planning for earthwork construction, equipment planning and selection, estimating project cost, and systems analysis and optimization. |
| CE5881      | Topics in Geotechnical Engineering: Soil Dynamics| 4  | II       | CE5881 Topics in Geotechnical Engineering: Soil Dynamics  
Modular Credits: 4  
Workload: 3-0-0-3-4  
Pre-requisite: CE4 standing or higher  
Preclusion(s): Nil  
Cross-listing(s): Nil  
The main objective of this course is to introduce fundamental principles of soil dynamics and applications to construction vibrations. Construction activities inevitably introduce vibrations in the ambient environment and the sub-surface geological formations. These are usually experienced as noise and vibrations, and may also take the form of stress waves in soils and rocks which could damage foundation structures. Case studies will be used to illustrate construction vibrations issues and applicable mitigation techniques.  
Students will also be required to undertake and complete a Group Project. Students are free to discuss and agree with the Lecturers on their choice of topic. |
| CE5883B     | Topics in Hydraulic & Water Resources – Modelling Climate Change | 4  | II       | CE5883B Topics in Hydraulic & Water Resources – Modelling Climate Change  
Modular Credits: 4  
Workload: 3-1-0-1-5  
(Please note that CE5883B will run ONLY IF the enrollment s are at least 10 or above by Week 1)
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<tr>
<td>CE5883B</td>
<td>Modelling Climate Change</td>
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<td></td>
<td>Pre-requisite: UG: MA1505 and MA1506, or equivalents&lt;br&gt;P: Knowledge in Linear Algebra and Differential Equations, or Instructor Permission&lt;br&gt;Prerequisite(s): Nil&lt;br&gt;Cross-listing(s): Nil&lt;br&gt;This course introduces the basic mathematical, statistical, physical, and chemical knowledge required to model the Earth’s climate system. Given the complexity of the system, the theory of how to approximate equations and make them relevant over temporal and spatial scales is introduced. Through experimentation and hands on learning, students will learn to understand and build models of varying complexity describing the Earth and its Climate System. Finally, students will use and modify these models to perform their own studies on relevant questions.&lt;br&gt;Topics include: Conservation equations; Dynamics; Thermodynamics, physics, chemistry; Radiative Forcing, Response, and Feedbacks; Coupling Across Scales; Non-linearity.</td>
</tr>
<tr>
<td>CE6001</td>
<td>Operations &amp; Management of Infrastructure Systems</td>
<td>4</td>
<td>I</td>
<td>Pre-requisite(s): Graduate student standing&lt;br&gt;Prerequisite(s): Nil&lt;br&gt;Cross-listing(s): Nil&lt;br&gt;The effective operations and management of infrastructure systems involve the understanding of their constraints, and the allocation of scarce resources. This module aims to mathematically mode these systems such that the best operations and management strategies can be determined. Initially continuous type resources will be modelled and this is extended to deal with discrete type resources. Nonlinear constraints and objectives, and dynamic variations in the systems will also be investigated.&lt;br&gt;The systems covered will include water resources systems, transportation networks, and structural systems, among others. Solution methods solving the built models will be introduced and the implications of the solutions with respect to economics, society, and policy will also be addressed.</td>
</tr>
<tr>
<td>CE6002</td>
<td>Analysis of Civil Engineering Experiments</td>
<td>4</td>
<td>II</td>
<td>Pre-requisite(s): Graduate student standing&lt;br&gt;Prerequisite(s): Nil&lt;br&gt;Cross-listing(s): Nil&lt;br&gt;This module introduces students nature of civil engineering experiments and characteristics of data gathered. Fundamental methods to conduct in-laboratory and field experiments to verify civil engineering models will be covered.&lt;br&gt;Included in this module is also the procedure to construct empirical, deterministic and stochastic civil engineering models based on experimental measurements. Examples are drawn from the various fields in the civil engineering discipline, including structure, geotechnical, hydraulics and transportation engineering.</td>
</tr>
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</table>
| CE6003     | Numerical Methods in Engineering Mechanics        | 4  | I        | Pre-requisite(s): Graduate student standing<br>Prerequisite(s): Nil<br>Cross-listing(s): Nil<br>
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<tr>
<td>CE6006</td>
<td>Advanced Finite Element Method</td>
<td>4</td>
<td>II</td>
<td>The module introduces the basic principles of engineering mechanics modelling problems and the required numerical tools for analysis and design of engineering problems. Students will learn to understand the fundamental of finite element methods, finite difference methods, and boundary element methods in general. Related topics on numerical methods for civil engineering applications, such as linear equation solvers, eigenvalue solvers, numerical integration, solution of nonlinear problem and convergence and stability problems of numerical algorithms will be discussed. The module enables the students to acquire the numerical analysis knowledge and computational skills through mini-projects and homework assignment.</td>
</tr>
<tr>
<td>CE6101</td>
<td>Geotechnical Constitutive Modelling</td>
<td>4</td>
<td>I</td>
<td>This is an advanced graduate-level module aimed at research and geotechnical-specialist coursework students. Its aim is to introduce students to the constitutive behaviour of soils and some basic constitutive models for soil behaviour. Students will learn about the generalized Hooke’s Law for elasticity, description of stress changes using stress path parameters, mathematical description of elastic-perfectly plastic materials, with emphasis on the Mohr-Coulomb model and strain hardening plasticity with emphasis on the original and modified Cam Clay models. Students will learn about the basic characteristics of each type of models and how they can select and use appropriate constitutive models available in numerical softwares. More capable research students will be able to use this module as a stepping stone towards enabling them to develop their own soil-specific constitutive models.</td>
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<tr>
<td>CE6102</td>
<td>Geotechnical Analysis</td>
<td>4</td>
<td>II</td>
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<td>Brief Description</td>
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<tr>
<td>OT5001</td>
<td>Independent Study Module</td>
<td>8</td>
<td>I &amp; II</td>
<td><strong>OT5001 Independent Study Module</strong>&lt;br&gt;Modular Credit: 8&lt;br&gt;Workload: 0-0-0-10-0&lt;br&gt;Prerequisite(s): M.Sc. Offshore Technology&lt;br&gt;Preclusion(s): Nil&lt;br&gt;Cross-listing(s): Nil&lt;br&gt;This module involves independent study over two semesters, on a topic in Offshore Technology approved by the Programme Management Committee. The work may relate to a comprehensive literature survey, and critical evaluation and analysis, design feasibility study, case study, minor research project or a combination.</td>
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<tr>
<td>OT5101 (ex:CE5714)</td>
<td>Exploration and Production of Petroleum</td>
<td>4</td>
<td>I</td>
<td><strong>OT5101 Exploration and Production of Petroleum</strong>&lt;br&gt;Modular Credit: 4&lt;br&gt;Workload: 2-1-0-3-4&lt;br&gt;Prerequisite(s): CE4 standing or higher&lt;br&gt;Preclusion(s): CE5714&lt;br&gt;Cross-listing(s): Nil&lt;br&gt;The module objective is to provide a broad understanding of the petroleum industry, as a foundation for more advanced work and as a context and background.&lt;br&gt;Areas that are covered include the sources of petroleum, the geological context, how petroleum is discovered, how it is produced and transported, the environmental, historical and societal impact of petroleum, and the special problems of deep water and in the Arctic.&lt;br&gt;Core is taken to go into some problem areas in depth, so that the module is more than just superficial survey.</td>
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| OT5102 (ex:ME5102) | Oil & Gas Technology<br>- priority will be given to MSc (Offshore Technology) students, BEng (Mechanical Engineering) students. | 4  | I        | **OT5102 Oil & Gas Technology**<br>Modular Credits: 4<br>Workload: 3-0-0-4-3<br>Prerequisite(s): Nil<br>Preclusion(s): ME5102<br>Cross-listing(s): Nil
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<tr>
<td>OT5201</td>
<td>Marine Statics &amp; Dynamics</td>
<td>4</td>
<td>I</td>
<td>This module will focus on drilling and completion technologies, crude oil and natural gas production and recovery methods, surface and subsea processing technologies and the respective equipments and hardware used. It will give students a broad overview of the upstream oil &amp; gas industry to prepare them for entry into this specialized field of engineering. Mini-projects will be included to increase students’ knowledge and understanding in the technologies involved. This module will be more oriented towards the petroleum geology, reservoir and environment.</td>
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<tr>
<td>OT5202 (ex: CE5703)</td>
<td>Analysis &amp; Design of Offshore Structures</td>
<td>4</td>
<td>I</td>
<td>OT5202 Analysis &amp; Design of Offshore Structures Modular Credits: 4 Workload:3-0-0-3-4 Pre-requisite: CE2155 or Graduate Student Standing Preclusion(s): CE5703 This module provides students with design knowledge on steel offshore structures. The major topics covered include planning considerations; design criteria and procedures; methods for determining loads; structural analysis methods; member and joint designs; material selection and welding requirements; and design for fabrication, transportation and installation phases. The module will be valuable to students interested in offshore engineering.</td>
</tr>
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</table>
| OT5203 (ex: CE5710) | Design of Floating Structures | 4 | II       | OT5203 Design of Floating Structures Modular Credits: 4 Workload: 3-1-0-2-4 Pre-requisite: OT5201 Marine Statics and Dynamics (as of AY2011/12 onwards) or an equivalent, or CE5887 Topics in Offshore Engineering: Marine Statics & Dynamics (in Semester 1 AY2010/2011) Preclusion(s): CE5710 This module is concerned with the design of floating offshore structures and elements. Floating structures dealt with in this module include semi-submersibles, FPSOs, spar platforms, floating jack-up structures and elements such as reinforced (hull) plating and mooring turntables. The important design parameters for floating structures will be highlighted. Also covered are the methods of analysis and criteria in design
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<tr>
<td>OT5204 (ex: CE5711)</td>
<td>Moorings &amp; Risers</td>
<td>4</td>
<td>II</td>
<td>OT5204 Moorings &amp; Risers&lt;br&gt;Module Credits: 4&lt;br&gt;Workload: 3-1-0-1-5&lt;br&gt;Pre-requisite: CE 5307 or OT5201&lt;br&gt;Preclusion(s): CE5711&lt;br&gt;The module will cover various mooring and riser systems; hydrodynamics and vortex-induced vibrations; moored object dynamics; design of deepwater moorings and risers; design codes and criteria; material selection; fatigue and structural integrity; offshore installation and practical applications.</td>
</tr>
<tr>
<td>OT5205 (ex: CE5712)</td>
<td>Offshore Pipelines</td>
<td>4</td>
<td>II</td>
<td>OT5205 Offshore Pipelines&lt;br&gt;Module Credits: 4&lt;br&gt;Workload: 3-0-0-2-5&lt;br&gt;Pre-requisite: CE4 standing&lt;br&gt;Preclusion(s): CE5712&lt;br&gt;Cross-listing(s): Nil&lt;br&gt;Marine pipelines are the arteries of the offshore industry, and form part of almost every project. They are also important for transport of fresh water. Their design and construction engage with many aspects of engineering, among them oceanography, structural engineering, hydrodynamics, geotechnics, materials science and project management.&lt;br&gt;This introductory course covers the whole subject, from the ocean environment through route selection and design to construction and the investigation of mishaps. The lecture course is supplemented by videos, design exercises, and case studies drawn from projects in many parts of the world.</td>
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<tr>
<td>OT5206 (ex: CE5713)</td>
<td>Offshore Foundations</td>
<td>4</td>
<td>II</td>
<td>OT5206 Offshore Foundations&lt;br&gt;Module Credits: 4&lt;br&gt;Workload: 3-0-0-3-4&lt;br&gt;Prerequisite(s):&lt;br&gt;Undergraduates: CE2112 &amp; CE3116; and&lt;br&gt;Graduates: Background in Soil Mechanics &amp; Foundation Engineering&lt;br&gt;Preclusion(s): CE5713&lt;br&gt;Cross-listing(s): Nil&lt;br&gt;This module is concerned with the analysis and design of foundations for offshore structures. Students will learn the principles, concepts, analysis methodology and design considerations that are applied to the offshore environment.&lt;br&gt;The major topics covered include: offshore design considerations; offshore site investigation; foundations for jack-up rigs and offshore gravity platforms; anchor foundations; suction caissons; and offshore pile foundations installation, analysis and design.&lt;br&gt;Students gain an understanding of the design methodology for offshore foundations for fixed and floating structures.</td>
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<tr>
<td>OT5207 (ex: CE5715)</td>
<td>Arctic Engineering</td>
<td>4</td>
<td>I</td>
<td>OT5207 Arctic Engineering&lt;br&gt;Module Credits: 4&lt;br&gt;Workload: 2-1-0-0-7&lt;br&gt;Prerequisite(s): CE4 standing or higher&lt;br&gt;Preclusion(s): CE5715</td>
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<td>Module Code</td>
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| OT5301      | Subsea Systems Engineering | 4  | II       | Cross-listing(s): Nil  
The Arctic regions have enormous economic potential as a source of energy and raw materials. Their development generates many environmental, human, and technical questions, among them frozen ground, sea ice, transport, societal impact on the existing inhabitants, and the need to give workers an acceptable quality of life.  
Unhappy experience shows that the Arctic environment is extremely vulnerable to damage, and slow to repair itself, and so great care has to be taken.  
The Arctic is a new frontier, and there are many opportunities for creative engineering.  
- priority will be given to MSc (Offshore Technology) students, BEng (Mechanical Engineering) students specialization in Offshore Oil & Gas Technology, & MSc (CE) with specialization in Offshore Engineering |
| OT5302      | Flow Assurance | 4  | II       | OT5302 Flow Assurance  
Module Credits: 4  
Workload: 3-0-0-4-3  
Prerequisite(s): Nil  
Preclusion(s): OT5882A  
Cross-listing(s): Nil  
Flow Assurance is a relatively new term in the Oil & Gas industry which is all about ensuring the safe and uninterrupted transportation of a multiphase mixture of oil, gas and water from the reservoir to the delivery location.  
This module is designed for students interested in offshore oil and gas production and the multiphase transportation of oil, water and gas. Its contents are focused on giving an overview and understanding of the various aspects in both single phase and multiphase flow transportation and assurance issues in the oil & gas industry with emphasis on the subsea production and transportation of oil, gas and water.  
A structured programme of lectures, seminars, term papers, mini-projects and a final examination are included in this module.  
- priority will be given to MSc (Offshore Technology) students, BEng (Mechanical Engineering) students specialization in Offshore Oil & Gas Technology, & MSc (CE) with specialization in Offshore Engineering |
| OT5303      | Subsea Control  
- First priority will be given to MSc (Offshore Technology) students, then MSc (ME) and MSc | 4  | I        | OT5303 Subsea Control  
Module Credits: 4  
Workload: 3-0-0-4-3  
Prerequisite(s): Nil  
Preclusion(s): Nil  
Cross-listing(s): Nil |
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<td>(CE)</td>
<td>students.</td>
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<td>Subsea Control is an essential and integral part of all subsea systems. This module introduces the fundamentals and principles of subsea control used in subsea systems for oil &amp; gas production. Subsea data communication systems as well as various subsea protocols used are also addressed in this module.</td>
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<tr>
<td>OT5304</td>
<td>Subsea Construction &amp; Operational Support</td>
<td>4</td>
<td>I</td>
<td><strong>OT5304 Subsea Construction &amp; Operational Support</strong>&lt;br&gt;Modular Credits: 4&lt;br&gt;Workload: 3-0-0-4-3&lt;br&gt;Prerequisite(s): Nil&lt;br&gt;Preclusion(s): Nil&lt;br&gt;Cross-listing(s): Nil&lt;br&gt;The design of subsea systems is significantly affected by operational considerations and can radically change a system configuration. Key considerations that must be taken into account in a subsea system design include vessel availability, design for weather window, reduction in number of operations, elimination of construction risk and ability to perform an early production start-up. This module considers key operational aspects that will be encountered in everyday offshore operations, and will look specifically at technologies that are used in subsea operations that are essential to understand their use and limitations.</td>
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<tr>
<td>TP5025</td>
<td>Intelligent Transportation Systems</td>
<td>4</td>
<td>I</td>
<td><strong>TP5025 Intelligent Transportation Systems</strong>&lt;br&gt;Modular Credits: 4&lt;br&gt;Workload: 3-0-0-2-5&lt;br&gt;Prerequisite(s): CE3121 or CE4 standing or higher&lt;br&gt;Preclusion(s): Nil&lt;br&gt;Cross-listing(s): Nil&lt;br&gt;A broad range of diverse technologies, including information processing, computing, communications, control and electronics can be applied to our transportation and systems. The combination of these technologies, known commonly as intelligent transportation systems (ITS), enables engineers to effectively manage transportation problems at the system level. The topics covered in this module include state-of-the-practice and state-of-the-art systems and technologies in rapidly progressing ITS research and development. This module enables the student opportunity acquiring the knowledge and practical skills through the lectures, field investigations, and course projects.</td>
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<tr>
<td>TP5026</td>
<td>Transportation Management &amp; Policy</td>
<td>4</td>
<td>II</td>
<td><strong>TP5026 Transportation Management &amp; Policy</strong>&lt;br&gt;Modular credits: 4&lt;br&gt;Workload: 3-0-0-2-5&lt;br&gt;Prerequisite(s): CE3121 Transportation Engineering or equivalent&lt;br&gt;Preclusion(s): Nil&lt;br&gt;Cross-listing(s): Nil&lt;br&gt;This module is designed to provide senior level undergraduate and graduate students an overall view of the transportation systems, means of managing and influencing the systems to achieve planning, design, and operation goals. The topics covered include the characteristics of transportation systems; roles and structure of government agencies in transportation management; environmental and social impact of transportation systems, travel demand management; public</td>
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<tr>
<td>TP5027</td>
<td>Transport &amp; Freight Terminal Management</td>
<td>4</td>
<td>I</td>
<td>transport management; models of assessing transportation services; regulation and deregulation of transportation services; roles of transportation systems with the agenda of global warming and energy conservation; case studies of transportation policies in several countries.</td>
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</table>
|             | **TP5027 Transport & Freight Terminal Management** |    |          | **Modular Credits:** 4  
**Workload:** 3-0-0-2-5  
**Prerequisite(s):** CE3121 Transportation Engineering or equivalent  
**Preclusion(s):** Nil  
**Cross-listing(s):** Nil  
The module highlights critical issues concerning the sustainable development of sea and air transport terminal systems. The planning and management of infrastructure capacity and operations, and design parameters in terminal facilities will be examined.  
The systems concept, life-cycle cost analysis, and advanced queuing models will be applied in the operational efficiency and capacity evaluation of air and sea transport terminals. Also, optimization methods will be employed for investigating decision-making problems arisen from transport and freight terminal management. |
| TP5028      | Intermodal Transportation Operations  | 4  | II       | The module introduces the principles, practices and quantitative analysis methods for intermodal transportation operations. As the most important components in the global intermodal transport system, empty container transport issue, and port logistics will be examined.  
The module will highlight the evolving roles of the many complex channels of distribution including the carriers, shippers, third parties and government agencies in response to the need for seamless intermodalism.  
This module also includes quantitative analysis methods for intermodal transport operation analysis such as freight demand forecasting, transport mode choice, intermodal transportation routing and vehicle routing. |

*Information is correct as @ 03 Dec 2014. CEE reserves the right to update in short notice.*