CIVIL AND ENVIRONMENTAL ENGINEERING

2013/2014 academic year

Timetables can be accessed at: [http://timetable.ucc.ie/1314/department.asp](http://timetable.ucc.ie/1314/department.asp)

Click on Biochemistry

For information on building codes click on: [http://timetable.ucc.ie/1314/buildingcodes.asp](http://timetable.ucc.ie/1314/buildingcodes.asp)

Please note that no guarantee is given that modules may not be altered, cancelled, replaced, augmented or otherwise amended at any time.

**Autumn Semester/Teaching Period 1 Modules**

Students studying at UCC for the Autumn Semester – please check with the International Education Office to confirm the method of assessment for each module.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Teaching Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE1005</td>
<td>Engineering Computation and Problem Solving</td>
<td>5</td>
<td>1</td>
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<tr>
<td>CE2001</td>
<td>Solid and Structural Mechanics I</td>
<td>5</td>
<td>1</td>
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<tr>
<td>CE2003</td>
<td>Fluids I</td>
<td>5</td>
<td>1</td>
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<tr>
<td>CE2005</td>
<td>Measurement and Surveying</td>
<td>5</td>
<td>1</td>
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<tr>
<td>CE3002</td>
<td>Solid and Structural Mechanics III</td>
<td>5</td>
<td>1</td>
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<tr>
<td>CE3003</td>
<td>Computer Aided Design II (Steel and Timber)</td>
<td>5</td>
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<tr>
<td>CE3004</td>
<td>Mechanics of Soils I</td>
<td>5</td>
<td>1</td>
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<td>CE3006</td>
<td>Construction Project Management</td>
<td>5</td>
<td>1</td>
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<tr>
<td>CE3007</td>
<td>Hydraulics I</td>
<td>5</td>
<td>1</td>
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<tr>
<td>CE3010</td>
<td>Energy in Buildings</td>
<td>5</td>
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<tr>
<td>CE3016</td>
<td>Sustainable Energy</td>
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<td>CE3907</td>
<td>Hydraulics I</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>CE3910</td>
<td>Energy in Buildings</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>CE3915</td>
<td>Environmental Management: Buildings and Industry</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>CE3916</td>
<td>Sustainable Energy</td>
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<td>Teaching Period</td>
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<td>Computer Aided Design IV (Reinforced Concrete)</td>
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<td>CE4006</td>
<td>Structures</td>
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<tr>
<td>CE4010</td>
<td>Water and Wastewater Treatment</td>
<td>5</td>
<td>1</td>
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<tr>
<td>CE4011</td>
<td>Transportation and Energy</td>
<td>5</td>
<td>1</td>
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<td>CE4018</td>
<td>Fire and safety Engineering</td>
<td>5</td>
<td>1</td>
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<tr>
<td>CE4020</td>
<td>Environmental Hydrodynamics</td>
<td>5</td>
<td>1</td>
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<tr>
<td>CE4022</td>
<td>Sustainable Operation and management of Buildings</td>
<td>5</td>
<td>1</td>
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<td><strong>Spring Semester/Teaching Period 2 Modules</strong></td>
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<tr>
<td>CE1003</td>
<td>Engineering Structures</td>
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<td>CE2002</td>
<td>Solid and Structural Mechanics II</td>
<td>5</td>
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<td>CE2004</td>
<td>Fluids II</td>
<td>5</td>
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<td>CE2007</td>
<td>Structural Design – Elements and systems</td>
<td>5</td>
<td>2</td>
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<tr>
<td>CE2009</td>
<td>Modelling and Visualisation</td>
<td>5</td>
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</tr>
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<td>CE3005</td>
<td>Mechanics of Soils II</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>CE3008</td>
<td>Computer Aided Design III (Reinforced Concrete and Masonry)</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>CE3009</td>
<td>Environmental Engineering</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>CE3011</td>
<td>Engineering Computation</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>CE3012</td>
<td>Materials and Sustainability</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>CE4001</td>
<td>The Engineer in Society (Law, Architecture and Planning)</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>CE4005</td>
<td>Civil Engineering Systems</td>
<td>5</td>
<td>2</td>
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<td>CE4007</td>
<td>Geotechnical Engineering</td>
<td>5</td>
<td>2</td>
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<td>CE4008</td>
<td>Computer Aided Design V (Structural)</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>CE4009</td>
<td>Applied Elasticity</td>
<td>5</td>
<td>2</td>
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<tr>
<td>CE4012</td>
<td>Traffic and Highways</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>CE4013</td>
<td>Harbour and Coastal Engineering</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>CE4014</td>
<td>Computer Aided Design VI (Environmental)</td>
<td>5</td>
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</tbody>
</table>
CE4015 Environmental Hydraulics (5 credits; Teaching Period 2)
CE4016 Energy Systems in buildings (5 credits; Teaching Period 2)
CE4019 Computer Aided Design VII (Heating, Ventilation and Air Conditioning) (5 credits; Teaching Period 2)
CE4021 Work Placement (5 credits; Teaching Period 2)
CE4911 Transportation and Energy (5 credits; Teaching Period 2)

CIVIL AND ENVIRONMENTAL ENGINEERING MODULE DESCRIPTIONS

Autumn Semester/Teaching Period 1

CC1005 Engineering Computation and Problem Solving (5 credits; Teaching Period 1)

The objective of the module is to give the student experience in developing software solutions to engineering problems using a modern object oriented programming language.

The contents of the module are algorithm development using engineering examples from civil, electrical, energy and/or process engineering, structured programming, object based programming; file I/O, Windows applications;

On successful completion of this module, students should be able to:
· Formulate algorithms from prescribed engineering problem specifications.
· Develop, test and debug a software application that implements algorithmic solutions to engineering problems using an object oriented programming language.
· Develop a basic Windows application that integrates engineering solution algorithms.

Assessment: Total Marks 100: End of Year Written Examination 60 marks; Continuous Assessment 40 marks (Engineering problem based programming assignment. A detailed description of the Continuous Assessment will be provided to the students at the beginning of the Teaching Period).

CE2001 Solid and Structural Mechanics I (5 credits; Teaching Period 1)

The objective of the module is to teach the basics of Solid and Structural Mechanics.

The contents of the module are introduction to stress and strain, introduction to bending, shear and torsional stresses, introduction to thin-walled pressure vessels, analysis of stress in plane systems and Mohr's circle of stress, introduction to structural failure and concepts of
safety factors, generalised Hooke’s Law for 3D system, introduction to measurement of structures.

On successful completion of this module, students should be able to:
· Compute axial stress and strains for different structures using Hooke’s Law.
· Compute stresses/strains in symmetrical beams made of a single material or composite materials under transverse loading about their principal axes.
· Compute shear stress on various cross sections of beams under shear.
· Compute shear stress/strains on beams with circular or annular cross-sections under torsion.
· Compute stresses and strains in thin-walled pressure vessels.
· Analyse and combine stresses and strains in two dimensions.
· Use Mohr’s circle of stress/strain to obtain stresses/strains in an arbitrary direction for two-dimensional conditions.
· List basic modes of structural failure, assess failure conditions from a combination of stresses employing some failure theories and establish safety factors for simple structural systems.
· Qualitatively assess choice of experiments and locations of monitoring structural response in simple structures.

Assessment: Total Marks 100: End of Year Written Examination 80 marks; Continuous Assessment 20 marks (Lab work / Projects).

CE2003 Fluids

(5 credits; Teaching Period 1)

The objective of the module is to convey the fundamentals of Fluid Mechanics.

The contents of the module are properties of fluids, fluid Statics - liquids and gases, buoyancy and stability problems, fluids in motion - dynamics of flow patterns, continuity, acceleration, force, energy and momentum principles, effects of weight, compressibility, viscosity, laminar and turbulent flow, steady incompressible flow through pipelines.

On successful completion of this module, students should be able to:
· Define and explain the fundamental properties of fluids.
· Derive fundamental fluid mechanics equations.
· Explain concepts and calculate forces associated with stationary and moving fluids.
· Apply fundamental equations of fluid mechanics to solve fluid statics problems.
· Apply fundamental equations of fluid mechanics to solve fluid dynamics problems.
· Carry out experiments to validate fluid mechanics principles.

Assessment: Total Marks 100: End of Year Written Examination 85 marks; Continuous Assessment 15 marks (Laboratory Practicals).
CE2005 Measurement and Surveying (5 credits; Teaching Period 1)

The objective of the module is to explain the principles of measurement including the quantification and distribution of errors. To provide training in land surveying techniques so that appropriate maps and drawings can be produced. The contents of the module are linear measurement and surveying, levelling, the theodolite and traverse surveying, tacheometry, electronic distance measurement, total station and GPS surveying, error analysis and distribution.

On successful completion of this module, students should be able to:
- Assess the accuracy associated with the principal instruments used in land surveying.
- Check the principal temporary and permanent adjustments required for steel bands, levels and theodolites.
- Evaluate the concepts of errors, accuracy and precision as applied to measurement science.
- Correctly use measuring tapes, levels and theodolites.
- Quantify the probable accuracy of specific measurements and land survey methods.
- Calculate and distribute closing errors in land survey measurements.
- Reduce levels and draw longitudinal sections.
- Carry out a traverse survey including error checks and determine the traverse accuracy.

Assessment: Total Marks 100: End of Year Written Examination 60 marks; Continuous Assessment 40 marks.

CE3002 Solid and Structural Mechanics III (5 credits; Teaching Period 1)

The objective of the module is to advance students' knowledge of Solid and Structural Mechanics.

The contents of the module are Elastic buckling theory for columns, effect of end conditions and imperfections, Beams on an elastic foundation, Static and kinematic indeterminacy, internal and external stability, Strain energy and virtual work method with applications on indeterminate structures, stiffness and flexibility, Approximate iterative solutions of indeterminate structures including moment distribution, Introduction to dynamics of structures

On successful completion of this module, students should be able to:
· Compute the Euler buckling load for straight and initially curved columns for various end conditions; compute the elastic buckling load for eccentrically loaded columns; derive, solve and apply the Perry-Robertson column buckling equation.
· Determine the elastic deformations and member forces for statically indeterminate structures using virtual work.
· Determine the reactions, elastic deformations and member forces for statically indeterminate structures using the Stiffness Method.
· Compute the bending moments for beams and frames without side-way using the method of Moment Distribution
· Compute the deformation, bending and shear forces of beams on elastic foundations for simple loading conditions.
· Compute the dynamic response of a single degree of freedom system under simple dynamic loads.

Assessment: Total Marks 100: End of Year Written Examination 100 marks.

CE3003 Computer Aided Design II (Steel and Timber) (5 credits; Teaching Period 1)

The objective of the module is to study the design of structural elements in steel.
The contents of the module are Design of steel beams, columns and connections, introduction to steel design codes.

On successful completion of this module, students should be able to:
· Understand the properties of steel and the structural behaviour of steel elements in buildings.
· Fundamentally understand the phenomenon of buckling as applied to columns and beams.
· Apply design principles to columns, beams, tension members, beam columns and lattice girders.
· Design for lateral stability in buildings.
· Understand the principles for designing welded and bolted connections, including the use of HSFG.
· Appreciate how steel contracts are procured in the Irish building industry.

Assessment: Total Marks 100: End of Year Written Examination 50 marks; Continuous Assessment 50 marks (Design Project - 40 marks; In Class Test - 10 marks).
**CE3004 Mechanics of Soils** (5 credits; Teaching Period 1)

The objective of the module is the development of an understanding of the basic principles of soil mechanics with specific reference to civil engineering design. The contents of the module are the scope of soil mechanics - Burland's triangle, description and classification of engineering soils, physical properties of soils, steady state seepage theory and groundwater flow, flow to wells, effective stress, consolidation of soils, Settlement Analysis, laboratory testing of soils.

On successful completion of this module, students should be able to:
- Describe and classify soils as engineering materials.
- Derive and apply mass: weight: volume relationships in soil mechanics.
- Apply the principle of effective stress to problems of overall stability in soil mechanics.
- Apply steady state seepage theory to practical plane groundwater flow problems and to groundwater flow to wells.
- Apply Terzaghi's theory of one-dimensional consolidation to the analysis of oedometer tests and to the calculation of the magnitude and rate of compression of compressible soils of low permeability.
- Execute and analyse standard laboratory soil tests (soil classification tests, compaction test, permeability tests, oedometer test).

**Assessment:** Total Marks 100: End of Year Written Examination 80 marks; Continuous Assessment 20 marks (Laboratory Practicals and Reports).

**CE3006 Construction Project Management** (5 credits; Teaching Period 1)

The objectives of the module are to give knowledge of methods available for control and construction of civil and building projects, to allow students increase existing knowledge base using own initiative, with guidance and to develop written and oral communication skills.

The contents of the module are prescribed reading, project construction planning, design and safety of temporary works on site.

On successful completion of this module, students should be able to:
- Define the principal human, occupational health and safety, environmental and legal issues involved in construction projects.
- Formulate project objectives, scope, approach, methods, timing, cost estimation, considerations and assumptions while meeting the client’s requirements.
Define the fundamental building construction types and processes and break down a project into manageable parts (work breakdown structure).

· Draw up a typical organisation chart for construction projects.

· Schedule projects using appropriate commercial software.

· Specify what constitutes a contract and what are typical engineering contract conditions (IEI Conditions of Contract 1995).

· Specify the plant and labour resources necessary for construction projects.

· Develop a BoQ from project drawings and specifications and attach appropriate construction costings.

**Assessment:** Total Marks 100: Continuous Assessment 100 marks (Ten in-class tests – 5 marks each; Project Report – 50 marks).

**CE3007 Hydraulics** (5 credits; Teaching Period 1)

The objectives of the module are to provide a grounding for certain hydraulic engineering problems and to provide students with the background theory for open channel flow, hydraulic modelling, hydraulic machines, pipe flow and pipeline systems (steady and unsteady flow).

The contents of the module are pipe networks, Water Hammer/Pipeline Surges, Pumps/Turbines, introduction to free surface flow, uniform flow in open channels, non-uniform flow in open channels, unsteady flow - surge waves, hydraulic modelling.

On successful completion of this module, students should be able to:

· Select a pump for a hydraulic system using system and performance characteristics.

· Describe the differences in application for different hydraulic turbines.

· Derive equations for water hammer and surge in pipelines and analyze unsteady flow in full pipelines for different operating conditions.

· Apply dimensional analysis concepts to rotodynamic machines.

· Derive the performance characteristics of different types of hydraulic turbines and pumps.

· Quantify uniform flow in partly full pipes.

· Calculate the changes in free surface elevations in short channel transitions, quantify the rating equations for hydraulic structures in open channels and describe the use of hydraulic structures as flow gauging systems.

· Quantify the flow parameters in the hydraulic jump and calculate the energy losses.

· Derive the expression for free surface flow profiles in long lengths of open channel and quantify the free surface profiles in a variety of channel/structure configurations.
Assessment: Total Marks 100: End of Year Written Examination 85 marks; Continuous Assessment 15 marks (Laboratory Practicals).

CE3010 Energy in Buildings (5 credits; Teaching Period 1)

The objective of the module is to explain the fundamental theory and application of energy systems relating to buildings.

The contents of the module are identification of energy exchanges between buildings and their internal and external environments. Definition of prescribed internal and external design conditions for buildings, definition of best-practice building envelopes that include heat transmission coefficients and air change rates, identification and quantification of the heat transfer modes in buildings including passive solar, psychometrics of energy exchange in buildings, development of numerical models representing energy exchange in buildings, introduction to and analysis of a range of HVAC systems for buildings using off-the-shelf industrial HVAC software systems, models for energy procurement, environmental and economic impact of energy systems in buildings.

On successful completion of this module, students should be able to:
- Describe the building physics that underpin energy transfer in buildings. Quantify the possible modes of heat and mass transfer in buildings. Identify the operating design conditions for a range of building types and function.
- Quantify the possible modes of heat and mass transfer in buildings.
- Identify the operating design conditions for a range of building types and function
- Calculate the thermal transmission of the building envelope.
- Calculate the ventilation loads associated with infiltration and exfiltration.
- Determine building heating and cooling loads.
- Demonstrate an understanding of the principles of psychometrics and the utilization of the psychometric chart.
- Analyse and design HVAC distribution and generation equipment.

Assessment: Total Marks 100: End of Year Written Examination 80 marks; Continuous Assessment 20 marks (Practicals and Reports).
The objectives of the module are to introduce the concept of sustainable energy and the interaction between cost competitiveness, security of supply and environmental responsibility, to make students aware of the link between energy and the environment, with a particular focus on climate change, to provide students with the basic tools to assess energy trends and their policy implications and to introduce the topics of energy policy and economics. Introduce renewable energy sources and technologies.

The contents of the module are definition of sustainable energy, global and regional energy trends in terms of fuel supply and sectoral consumption, electrical, transport and thermal energy consumption. Energy end use. Pillars of sustainable energy policy, environmental impacts of energy, Climate Change, transboundary gas emissions, security of energy supply, cost competitiveness, policy instruments, energy efficiency indicators, socio-economic assessment of energy supply systems, renewable energy market development, fuel cells and the hydrogen economy.

On successful completion of this module, students should be able to:
- Analyse energy supply and consumption trends.
- Understand impact of policy decisions on energy trends.
- Understand energy related environmental impacts, focussing on climate change.
- Apply knowledge of energy to quantify impacts on energy trends.
- Compare renewable energy environmental impacts with fossil fuels.
- Understand different facets of security of energy supply.

Assessment: Total Marks 100: End of Year Written Examination 80 marks (Written Exam);
Continuous Assessment 20 marks (Coursework Assignments).

The objectives of the module are to provide a grounding for certain hydraulic engineering problems and to provide students with the background theory for open channel flow, hydraulic modelling, hydraulic machines, pipe flow and pipeline systems (steady and unsteady flow).

The contents of the module are pipe networks, Water Hammer/Pipeline Surges, Pumps/Turbines, introduction to free surface flow, uniform flow in open channels, non-uniform flow in open channels, unsteady flow - surge waves, hydraulic modelling.
On successful completion of this module, students should be able to:

· Select a pump for a hydraulic system using system and performance characteristics.
· Describe the differences in application for different hydraulic turbines.
· Derive equations for water hammer and surge in pipelines and analyze unsteady flow in full pipelines for different operating conditions.
· Apply dimensional analysis concepts to rotodynamic machines.
· Derive the performance characteristics of different types of hydraulic turbines and pumps.
· Quantify uniform flow in partly full pipes.
· Calculate the changes in free surface elevations in short channel transitions, quantify the rating equations for hydraulic structures in open channels and describe the use of hydraulic structures as flow gauging systems.
· Quantify the flow parameters in the hydraulic jump and calculate the energy losses.
· Derive the expression for free surface flow profiles in long lengths of open channel and quantify the free surface profiles in a variety of channel/structure configurations.

Assessment: Total Marks 100: End of Year Written Examination 85 marks; Continuous Assessment 15 marks (Laboratory Practicals).

CE3910 Energy in Buildings (5 credits; Teaching Period 1)

The objective of the module is to explain the fundamental theory and application of energy systems relating to buildings.

The contents of the module are identification of energy exchanges between buildings and their internal and external environments. Definition of prescribed internal and external design conditions for buildings, definition of best-practice building envelopes that include heat transmission coefficients and air change rates, identification and quantification of the heat transfer modes in buildings including passive solar, psychometrics of energy exchange in buildings, development of numerical models representing energy exchange in buildings, introduction to and analysis of a range of HVAC systems for buildings using off-the-shelf industrial HVAC software systems, models for energy procurement, environmental and economic impact of energy systems in buildings.

On successful completion of this module, students should be able to:

· Describe the building physics that underpin energy transfer in buildings. Quantify the possible modes of heat and mass transfer in buildings. Identify the operating design conditions for a range of building types and function.
· Quantify the possible modes of heat and mass transfer in buildings.
- Identify the operating design conditions for a range of building types and function
- Calculate the thermal transmission of the building envelope.
- Calculate the ventilation loads associated with infiltration and exfiltration.
- Determine building heating and cooling loads.
- Demonstrate an understanding of the principles of psychometrics and the utilization of the psychometric chart.
- Analyse and design HVAC distribution and generation equipment.

Assessment: Total Marks 100: End of Year Written Examination 80 marks; Continuous Assessment 20 marks (Practicals and Reports).

CE3915 Environmental Management: Buildings and Industry
(5 credits; Teaching Period 1)

The objective of the module is to provide a theoretical and practical grounding in the sustainable environmental management of construction, manufacturing and service industries.

The contents of the module are design for Environment (DFE): sustainable building design, product design, process design, energy conservation and management, resource conservation and waste prevention - policies and implementation strategies, materials recovery, re-use, recycling, producer responsibility, product stewardship, Environmental Management Systems in manufacturing and service industries, Environmental Performance indicator.

On successful completion of this module, students should be able to:
- Define principles of sustainable development and identify applications in industry.
- Differentiate between end-of-pipe treatment and sustainable production strategies.
- Show how to promote waste prevention and resource conservation at the design stage of products and processes.
- Analyse why economic and socio-cultural aspects of environment management must be addressed to achieve sustainability.
- Compose an EMS for a basic construction or industrial process.
- Evaluate the contribution of an EMS to improved performance.

Assessment: Total Marks 100: End of Year Written Examination 70 marks; Continuous Assessment 30 marks (Field Report).
CE3916 Sustainable Energy (5 credits; Teaching Period 1)

The objectives of the module are to introduce the concept of sustainable energy and the interaction between cost competitiveness, security of supply and environmental responsibility, to make students aware of the link between energy and the environment, with a particular focus on climate change, to provide students with the basic tools to assess energy trends and their policy implications and to introduce the topics of energy policy and economics. Introduce renewable energy sources and technologies.

The contents of the module are definition of sustainable energy, global and regional energy trends in terms of fuel supply and sectoral consumption, electrical, transport and thermal energy consumption, Energy end use, Pillars of sustainable energy policy, environmental impacts of energy, Climate Change, transboundary gas emissions, security of energy supply, cost competitiveness, policy instruments, energy efficiency indicators, socio-economic assessment of energy supply systems, renewable energy market development, fuel cells and the hydrogen economy.

On successful completion of this module, students should be able to:
- Analyse energy supply and consumption trends.
- Understand impact of policy decisions on energy trends.
- Understand energy related environmental impacts, focussing on climate change.
- Apply knowledge of energy to quantify impacts on energy trends.
- Compare renewable energy environmental impacts with fossil fuels.
- Understand different facets of security of energy supply.

Assessment: Total Marks 100: End of Year Written Examination 80 marks (Written Exam);
Continuous Assessment 20 marks (Coursework Assignments).

CE4004 Computer Aided Design IV (Reinforced Concrete) (5 credits; Teaching Period 1)

The objective of the module is to study the design of structural elements.

The contents of the module are the nature of the design process, methodology, organisation, factors in design - function, safety, economy and innovation, case histories, current design methods in steel, reinforced and pre-stressed concrete, and composite construction, MOT loading, a structural design project to be presented in the first teaching
period, design work includes the presentation of calculations, working drawings and bills of quantities.

On successful completion of this module, students should be able to:

· Design simple reinforced concrete structural elements to an approved Code of Practice/Design Standard. Design a simple reinforced concrete structure as a safe collection/arrangement of various RC design elements to an approved Code of Practice/Design Standard. Identify the key aspects of a typical client/design team structural design brief.

· Prepare preliminary structural scheme designs to demonstrate load-paths and to determine preliminary structural member sizes including preparation of preliminary general arrangement drawings and sketches.

· Generate representative structural analysis numerical model(s) using industry standard analysis software and interpret structural analysis results for structural design purposes.

· Prepare detailed structural design calculations to an approved Design Standard.

· Demonstrate engineering judgement in the rationalisation of theoretical structural solutions into a practical buildable and workable design solution.

· Prepare detailed working sketches for reinforcement to an industry standard.

· Prepare detailed reinforcement drawings and bar bending schedules to an industry standard.

· Compile and submit a structural design technical report including outline of project brief, project geometry & scope diagrams, list of design & material assumptions, design loadings, possible structural solutions, loading diagrams, preliminary design calculations, outline of structural analysis model and results, internal member force diagrams, structural design calculations - manual & spreadsheets, justification for chosen solution, completion of detailed design calculations, rationalisation of theoretical design solutions, summary reinforcement working sketches, final drawings (General Arrangement and Detailed Reinforcement) and reinforcement bar bending schedules.

· Communicate effectively and efficiently with industry on structural design and information flow issues. Identify the key role of statutory Building Regulations and the associated role of various Design Standards.

Assessment: Total Marks 100: Continuous Assessment 100 marks (Two Design Projects - 50 marks each. Each Project: Interim Reports - 3 x 10 marks; Final Report - 20 marks).
CE4006 Structures (5 credits; Teaching Period 1)

The objective of the module is to achieve an understanding of structural behaviour as well as structural analysis experience for use in engineering design.

The contents of the module are stiffness matrix methods, qualitative analysis methods for continuous beams and 2-D frames, plastic behaviour of structures, introduction to structural dynamics, introduction to pre-stressed concrete analysis and design, influence lines, beam on elastic foundation.

On successful completion of this module, students should be able to:
· Model linear elastic 2-D structures with small displacements using the stiffness method.
· Analyse simple beam and frame structures qualitatively.
· Determine the response of both sections and simple structures where the material is elasto-plastic.
· Formulate basic relationships between mass, stiffness, damping and natural frequency in linear elastic structures (1 dof, 2 dof and beam structures).
· Derive the natural frequencies of 1, 2 and n-dof structures.
· Analyse pre-stressed concrete simple supported beams.
· Derive the governing ODE of the Beam on Elastic Foundation problem.
· Formulate the influence line methodology from the Muller-Breslau principle and apply to beam structures.

Assessment: Total Marks 100: End of Year Written Examination 60 marks; Continuous Assessment 40 marks (In-class tests).

CE4010 Water and Wastewater Treatment (5 credits; Teaching Period 1)

The objective of the module is to develop a physical, chemical and microbiological understanding of environmental engineering technologies.

The contents of the module are water treatment processes, Wastewater treatment processes, and municipal solid waste management.

On successful completion of this module, students should be able to:
· Define and quantify flowrates for foul and stormwater and size pipelines and equalization basins.
· Define water quality standards for rivers and develop models of effluent discharge and
Define the preliminary, primary, secondary and tertiary wastewater treatment processes.

- Quantify the physical and biological processes of wastewater treatment.
- Design the facilities for each unit process of wastewater treatment.
- Define and quantify the unit processes in potable water treatment.
- Design the facilities for each unit process of potable water treatment.

Assessment: Total Marks 100: End of Year Written Examination 100 marks.

**CE4011 Transportation and Energy**  
(5 credits; Teaching Period 1)

The objective of the module is to give a detailed understanding of sustainable transportation policies, including for energy minimization in transportation through use of public transport (trains, metros, light rails and buses), biofuels and electric vehicles.

The contents of the module are transport policy, Public Transport (trains, metros, light rail systems, buses), energy and green house gases associated with transportation systems, biofuels, energy use in transport (kJ/passenger/km), transportation and land use planning.

On successful completion of this module, students should be able to:

- Assess transportation policies.
- Describe the technological and economic characteristics of the different modes of travel and understand their appropriate roles in the transportation system.
- Differentiate between different rail systems (trains, metros, light rail).
- Analyse the transport requirements for a specific situation and select appropriate modes (train or metro or light rail or bus or guided bus or car or bicycle)
- Generate the energy production per km per passenger for various transportation systems.
- Distinguish between different biofuel systems.

Assessment: Total Marks 100: End of Year Written Examination 85 marks; Continuous Assessment 15 marks (Reports on practicals).

**CE4018 Fire and Safety Engineering**  
(5 credits; Teaching Period 1)

The objective of the module is to attain knowledge of fire safety in relation to building design.

The contents of the module are Fire Protection, Spatial Planning, Means of Escape, effects of smoke (modelling), Risk Management, Safety Engineering and Machinery Construction Safety.
On successful completion of this module, students should be able to:

- Describe the application of fire engineering and fire safety techniques to the design and construction of buildings, management and operation of business, protection of assets/resources, protection of the environment and the economy of relevance to engineering practice in its social and business context.
- Describe the application of safety engineering and safety management systems to the design and construction of buildings, management and operation of business, risk management, protection of assets/resources, protection of the environment and the economy of relevance to engineering practice in its social and business context.
- Demonstrate an understanding of accident multi-causation theory and mechanisms to analyse accident outcomes, simple PI diagrams, simple processes. Derive and apply the mathematical safety engineering techniques of reliability, fault tree analysis and event tree analysis to the aforementioned and simple mechanical systems.
- Demonstrate an understanding of the impact of elevated temperatures on the strength/load carrying capabilities of concrete, steel and timber and the benefits and limitations of standard passive fire protection materials.
- Derive and apply the mathematical techniques for the determination of the fire resistance of unprotected structural steel members and structural timber members consistent with the requirements of Eurocodes.
- Identify, formulate, analyse and solve universal access design issues and spatial planning/means of escape issues in buildings drawn from engineering practice in building design / refurbishment.
- Demonstrate an understanding of the socio economic costs of occupational and ill health, together with key provisions of the SHWW legislation and the SHWW Construction Regulations relevant to engineering practice in its social and business context.
- Identify hazards, assess and compare risks emanating from all facets of the business spectrum (Life, economic, environment and PR risks).
- Identify and demonstrate an understanding of risk control hierarchies and common H&S hazards, construction safety hazards and machinery hazards relevant to engineering practice. Demonstrate an understanding of the need for ethical standards, observe regulatory requirements and discharge professional responsibilities towards people, clients and the environment.

Assessment: Total Marks 100: End of Year Written Examination 85 marks; Continuous Assessment 15 marks (Assignments).
The objective of the module is to give the student the capability to analyse the hydrodynamic behaviour of the natural environment.


On successful completion of this module, students should be able to:
- Develop mathematical description of hydrodynamic behaviour.
- Derive expressions for Stream Function and Potential Function.
- Quantify flow patterns for fluid / structure interactions.
- Calculate wave behaviour using the Airy linear wave theory and understand the limitations in the derivation.
- Quantify the kinematics and dynamics of surface wave motions.
- Quantify the propagation of a surface wave into the shoreline.
- Describe the options for measurement and description of real sea waves.
- Develop models for tides in the ocean.
- Develop solutions for diffusion in one dimensional stream.

**Assessment:** Total Marks 100: End of Year Written Examination 100 marks.

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The objective of the module is to discuss the impact of design decisions on Sustainable Operation and Management of Buildings and Supply Systems.


On successful completion of this module, students should be able to:
- Consider and evaluate the impact of design decisions on the operation of built artifacts.
- Analyse Performance Data and apply Data Mining techniques to provide decision support for renovation, maintenance and retrofit of built artifacts.
· Design, implement and evaluate IT-platforms and data structures for the electronic monitoring and documentation of built artifacts.
· Categorize, define and specify Operational and Management processes (e.g. Facility and Energy Management activities)
· Develop instruments for the co-ordination of Operational and Management Activities with the core activities of relevant stakeholders (owners, operators, users).

Assessment: Total Marks 100: End of Year Written Examination 60 marks; Continuous Assessment 40 marks (Assignments).

Spring Semester/Teaching Period 2 Modules

**CE1003 Engineering Structures**  
(5 credits; Teaching Period 2)

The objective of this module is to develop an appreciation of the role of equilibrium calculations in analysing structures and to acquire qualitative skills in relating deformation of a structure to its loading and boundary conditions.

The contents of this module are equilibrium, shear force, bending moment and deflected shape for statically determinate beams and plane frames, simple and compound plane trusses, simple cable structures, arches, qualitative analysis of simple statically indeterminate structures.

On successful completion of this module students should be able to:
· Apply the equations of equilibrium to calculate the support forces on externally loaded statically determinate structures;
· Use free body diagrams to calculate the internal forces in a statically determinate structure;
· Draw shear force and bending moment diagrams for statically determinate beams and plane frames;
· Sketch approximate deflected shapes of statically determinate beams and plane frames from a knowledge of the boundary conditions and the bending moment distribution;
· Calculate the internal forces in statically determinate simple and compound plane trusses;
· Calculate the internal forces in simple cable structures and three-pinned arches;
· Develop, through qualitative analysis, approximate solutions to statically indeterminate beams and single bay rectangular portal frames.

Assessment: Total Marks 100: End of Year Written Examination 75 marks; Continuous Assessment 25 marks (Course/Project Work).
CE2002 Solid and Structural Mechanics II  
(5 credits; Teaching Period 2)

The objective of the module is to develop students’ knowledge of the basics of Solid and Structural Mechanics.

The contents of the module are Differential equation of bending; solution by Macaulay's method, Non-symmetric bending of beams, Compatibility and fabrication stresses, Strain energy and virtual work with applications to determinate structures, fundamentals of deformation beyond elastic limit, introduction to fatigue.

On successful completion of this module, students should be able to:
· Solve the differential equation of bending to determine the elastic deformation and structural actions of statically determinate and indeterminate beams.
· Determine the principal values of second moment of area of a beam of non-symmetric cross-section and determine the bending stresses.
· Determine the centre of twist for beams
· Apply compatibility, equilibrium and constitutive laws to simple and compound structures under thermal and fabrication stresses
· Determine the elastic deflections of statically determinate structures using virtual work principles
· Compute static responses of simple structures beyond elastic limit
· Determine fatigue effects on simple structures.

Assessment: Total Marks 100: End of Year Written Examination 80 marks; Continuous Assessment 20 marks (Lab work / Projects).

CE2004 Fluid II  
(5 credits; Teaching Period 2)

The objective of the module is to convey the fundamentals of Fluid Mechanics.

The contents of the module are introduction to pumps and turbines, introduction to boundary layer effects and surface drag, dimensional analysis and hydraulic modelling, Pipeline Systems, uniform flow in open channels.

On successful completion of this module, students should be able to:
· Calculate the friction head and pressure losses in pipes using standard formula and techniques.
· Analyze the flow through pipe networks to calculate the flow rate and pressure distribution.
· Describe the energy transfer principles in pumps and the detail of how pumps work.
· Explain the importance and design relevance of the performance characteristics of pumps.
· Describe the energy transfer principles of turbines and the detail of how turbines work.
· Explain the importance and design relevance of the performance characteristics of turbines.
· Derive basic open channel flow equations.
· Use dimensional analysis to analyze and solve hydraulic problems.

Assessment: Total Marks 100: End of Year Written Examination 100 marks.

CE2007 Structural Design – Elements and Systems  (5 credits; Teaching Period 2)

The objective of the module is to introduce students to the design of structures.

The content of the module is Civil Engineering Design Exercises.

On successful completion of this module, students should be able to:
· Determine the loads on a floor system.
· Design simple timber joists.
· Design simple steel beams.
· Design simple steel columns.
· Design simple bolted and welded connections.
· Design and detail a simple steel truss.
· Detail a simple floor system.

Assessment: Total Marks 100: Continuous Assessment 100 marks (Analysis Assignment - 10 marks; Design Project 1 - 20 marks, Design Project 2 - 55 marks, In-class test - 15 marks).

CE2009 Modelling and Visualisation  (5 credits; Teaching Period 2)

The objective of the module is to understand fundamentals of computer graphics, computer aided design and product data technology, including application areas such as 3D-CAD, VR.

The contents of the module are introduction and Re-Visiting Basic Graphics, data acquisition for computer graphics, fundamentals of computer graphics, graphic databases, graphic file
formats, feature modelling, parametric design, fundamentals of product modelling, visualization and CAD, examples of computer graphics, presentation systems and instruments.

On successful completion of this module, students should be able to:
· Explain the basic principles of 2D and 3D Computer Graphics
· Differentiate between visualization, animation and simulation
· Differentiate between graphical modelling, product modelling and Building Information Modelling
· Evaluate the advantages and disadvantages of AEC-specific methods and file formats for data exchange
· Explain advanced methodologies for modelling and design in AEC (e.g. feature modelling and parametric design)
· Use, manage, and administer Computer Aided Design software to support engineering activities in Architecture, Engineering, and Construction.

Assessment: Total Marks 100: End of Year Written Examination 60 marks; Continuous Assessment 40 marks (Assignments - 30 marks; In-class test - 10 marks).

**CE3005 Mechanics of Soils II** (5 credits; Teaching Period 1)

The objective of the module is the development of an understanding of the basic principles of soil mechanics with specific reference to civil engineering design.

The contents of the module are effective stress, shear strength and deformation of soil - friction, dilation, contraction, critical states, drained strength, undrained strength, stress paths, application of shear strength concepts to slope stability, lateral earth pressure and shallow foundation problems, laboratory testing of soils and rock.

On successful completion of this module, students should be able to:
· Understand the essentially frictional nature of the shear strength of soil.
· Understand the role of volumetric deformation in the development of shear strength of soil.
· Apply the concept of a critical state of shear strength to the analysis of laboratory shear strength tests (direct shear test, triaxial test) on loose/dense sands and soft/stiff clays.
· Apply the different methods of ultimate limit state analysis (lower bound analysis, upper bound analysis, limit equilibrium analysis) to simple problems in soil mechanics.
· Apply the concept of soil shear strength to practical problems in geotechnical engineering (slope stability, lateral earth pressure on retaining walls, ultimate bearing capacity of shallow
foundations).
· Execute and analyse standard laboratory soil strength tests (direct shear test, triaxial test, unconfined compression test, vane shear test, and drop cone shear test).

Assessment: Total Marks 100: End of Year Written Examination 80 marks; Continuous Assessment 20 marks (Laboratory Practicals).

CE3008 Computer Aided Design III (Reinforced Concrete and Masonry)
(5 credits; Teaching Period 2)

The objective of the module is to provide study the design of structural elements in reinforced concrete.

The contents of the module are design of reinforced concrete beams, columns and slabs, introduction to design codes.

On successful completion of this module, students should be able to:
· Define and describe limit state design concepts including ultimate limit state and serviceability limit states, with or without partial safety margin/factor for reinforced concrete structures. Principles of limit state design.
· Define axially loaded reinforced concrete columns, stress-strain characteristics of steel and ultimate strain of concrete; elastic behaviour, condition of equilibrium, compatibility, modular ratio and transformed/equivalent section, ultimate strength behaviour and design.
· Define concepts of reinforced concrete beams - ultimate limit state; condition of equilibrium, compatibility, stress block and strain profile, and characteristics of stress blocks and their different simplification methods. Balanced over or under reinforced section of a beam.
· Describe the use of BS8110 beam design charts (ultimate limit state); design formulae and procedure (BS8110 simplified stress block); designing from first principles; design procedure (BS8110/Institute of Structural Engineers Manual).
· Define reinforced concrete beam design with shear, bond and torsion; shear failure modes of beams with shear reinforcement; effect of shear reinforcement, shear resistance and design calculation (BS8110); Bondage and anchorage; equilibrium torsion and compatibility (BS8110).
· Define electrically loaded reinforced concrete columns; principles of column load moment interaction diagram, calculation of eccentricity, balanced failure design, load and moment analysis, and BS8110 design procedure.
- Define concepts on reinforced concrete slabs and yield-line analysis; conditions for use of yield-line analysis; Johansen's stepped yield criterion, energy dissipation in a yield line (and for rigid region); Hillerborg's strip method; Design theory for reinforced concrete slabs (BS8110).

**Assessment: Total Marks 100:** End of Year Written Examination 50 marks; Continuous Assessment 50 marks (Two Design Office Projects - 25 marks each. Each project: Interim reports - 3 x 5 marks; Final report - 10 marks).

**CE3009 Environmental Engineering – Wet**

(5 credits; Teaching Period 2)

The objective of the module is to develop a physical understanding of the fundamentals of water and its transport processes in environmental engineering, dealing with the water, soil and air environments.

The contents of the module are the hydrologic cycle, water and energy balance, land-atmosphere interaction processes; groundwater and unsaturated zone water dynamics; hillslope and catchment hydrology; statistical hydrology; introduction to water and wastewater treatment.

On successful completion of this module, students should be able to:

- Define the water and energy cycles.
- Quantify the components of the water cycle - precipitation, evaporation and streamflow.
- Define and quantify infiltration, soil moisture and their measurement.
- Define and quantify groundwater.
- Quantify low flow and flood flows in rivers - unit hydrograph, catchment characteristics methods.
- Define and quantify components of the energy cycle - radiation, sensible and latent heat fluxes.
- Define and quantify water quality in rivers - Streeter Phelps analysis.

**Assessment: Total Marks 100:** End of Year Written Examination 100 marks.

**CE3011 Engineering Computation**

(5 credits; Teaching Period 1)

The objective of the module is to introduce students to Information Modelling and Database Management Technology as applied to Engineering problems.
The contents of the module are information Modelling and analysis with application to engineering problems.

On successful completion of this module, students should be able to:
· Explain the basic principles of Information Modelling.
· Identify the major models for Information Modelling.
· Specify information management requirements in the different phases of the life-cycle of products in Architecture, Engineering and Construction
· Explain major components of Database Management Systems
· Develop simple database schemata and formulate simple database queries
· Use, manage, and administer database management systems to support engineering activities.

Assessment: Total Marks 100: End of Year Written Examination 60 marks; Continuous Assessment 40 marks (Assignements). A detailed description of the Continuous Assessment will be provided to the students at the beginning of the Teaching Period.

CE3012 Materials and Sustainability (5 credits; Teaching Period 2)

The objectives of the module are to explore concepts of sustainability and industrial ecology as applied to engineering materials, to show how concepts of simulation and modelling can be applied to materials and manufacturing design in engineering and to understand mapping methods for materials characterisation and selection.

The contents of the module are the course will initially outline the evolution, characterisation and selection of engineering materials via a synthesis, mapping approach based on a progressive property criteria and engineering fitness for purpose. The module will then focus on the evolution of industrial ecology as an engineering discipline based on the asset sustainability paradigm, within an overall context of integrated asset management. The module concludes with a material case study analysis towards design for environment.

On successful completion of this module, students should be able to:
· Describe the four phases of the material life-cycle of engineered objects and associated eco-flows of energy, materials and wastes involved the design and manufacturing process and its influence.
· Grasp material charts showing the range of material properties within families of materials:
metals, ceramics, glasses, elastomers, polymers and composite hybrids.
· Select from a very large set of materials that best suit the function of an engineered object, with an appropriate material index & constraints.
· Describe the hierarchy of manufacturing processes and their attributes (Material, shape, size, tolerance, roughness etc...)
· Calculate economic and eco-properties such as energy consumption and carbon for the selected materials in engineering design.
· Select from a large set of manufacturing processes for the best process, regarding to cost, time that meets the constraints on process attributes.
· Participate in a group project (case study and lab experiment) that requires the selection and fabrication of materials for function in a typical engineered product, carrying out assigned tasks in experiments and desk research.
· Prepare a group report on the project, identifying clearly the written contributions of each student, cross-referenced to all meetings that record the allocation and completion of tasks.
· Prepare a short “individual” reflective statement on professional performance and ethical issues that arose during the multi-disciplinary project, and on any implications for individual life-long learning.

Assessment: Total Marks 100: Continuous Assessment 100 marks (Case Study: Project Objective – 15 marks, literature Review / Technology Advance – 25 marks, Data Acquisition – 15 marks, Analysis and Conclusion - 25 marks, Presentation – 20 marks).

CE4001 The Engineer in Society (Law, Architecture and Planning) (5 credits; Teaching Period 2)

The objectives of the module are to study the objectives and operation of Town Planning in Ireland and to introduce many broad topics and issues relating to architecture and address selected aspects of law vis-a-vis a construction contract.

The contents of the module are objectives and operation of Town Planning in Ireland, introduction to Architecture, addressing selected aspects of law vis-a-vis a construction contract.

On successful completion of this module, students should be able to:
· Describe the planning process in Ireland.
· Work effectively as a professional member of the multi-disciplinary team in a simulated planning appeal, having collected and analysed the necessary documentation and
contributing to the formulation of technical memoranda in standard correct English.

· Identify and specify potential ethical issues and engineering responsibility towards people and the environment that arise during the appeal process; recognise and deal with some issues related to the "common good" in a participatory democracy.

· Reflect on the learning experience of all parties to the appeal and on the lessons for individual life-long learning.

· Describe the role of the client, planning authority, architect, civil/structural engineer, building services engineer, environmental engineer, engineering geologist, quantity surveyor, contractor, site agent, safety officer and sub-contractors, in relation to a specific building project presented to the class by the professionals involved, in the lecture theatre and design office and on the construction site.

· Describe the contribution of related design exercises in the design modules of the fourth year programme to the overall success of the specific building.

· Describe the structure of the Irish Legal System.

· Identify which law applies in situations relevant to Civil Engineering.

· Apply the law to simple cases.

Assessment: Total Marks 100: End of Year Written Examination 100 marks.

**CE4005 Civil Engineering Systems**

(5 credits; Teaching Period 2)

The objectives of the module are to introduce students to the methods and techniques of Applied Systems Analysis, to illustrate their application to the design and planning of complex and large-scale civil engineering systems.

The contents of the module are methods and techniques of ASA, illustrations of the applications of ASA to design and planning civil engineering systems.

On successful completion of this module, students should be able to:

· Describe relevant parts of the Applied Systems Analysis method for system engineering planning and design, and technology management, of relevance to engineering practice in its social and business context.

· Identify, formulate, analyse and solve problems drawn from engineering practice in transportation and water resource systems, building design, etc. in their technical, social and business context using the relevant parts of Applied Systems Analysis method and techniques.

· Derive and apply selected techniques of Applied System Analysis, Optimization, and Evaluation to examples (e.g. Information Gathering, Information Analysis, Process Modelling,
Economic and Social Benefits Analysis (incl. risk analysis).
· Complement examples for Applied Systems Analysis with relevant technical analysis of complex engineering systems (e.g. stormwater sewers for a group of buildings including, domestic, industrial and institutional).
· Write a memorandum in standard correct English to communicate with a senior engineer, or manager, on the analysis of a problem together with a technical appendix on the application of ASA, and the selection of ASA techniques to solve the problem. The memorandum should demonstrate a relevant understanding of the need for ethical standards and professional responsibilities towards people and the environment.

Assessment: Total Marks 100: End of Year Written Examination 80 marks; Continuous Assessment 20 marks (Assignments).

CE4007 Geotechnical Engineering (5 credits; Teaching Period 2)

The objective of the module is the application of the principles of soil mechanics to the design of geotechnical structures in soil and rock.

The contents of the module are Foundation Engineering: Ultimate and serviceability limit states, design and construction of shallow and deep foundations, soil-structure interaction, design and construction of earth retaining structures, stability of slopes, ground improvement techniques, ground investigation, geotechnical instrumentation, computer applications in geotechnical engineering, rock Mechanics: Rock mass and rock material - significance of discontinuities, geological data collection, strength of jointed rock masses, rock slope stability, stability of underground excavations, foundations on rock.

On successful completion of this module, students should be able to:
· Apply principles of soil mechanics to design of shallow foundations under combined loading;
· Apply principles of soil mechanics to design of embedded retaining walls;
· Apply principles of soil mechanics to design of piled foundations;
· Develop awareness of ground improvement techniques;
· Design a geotechnical site investigation for a typical project.

Assessment: Total Marks 100: End of Year Written Examination 100 marks.
The objective of the module is to study the design of structural elements and systems.
The contents of the module are design of structural elements and systems.

**Assessment:** Total Marks 100: Continuous Assessment 100 marks (Design Project: Interim Reports - 4 x 10 marks; Final Report 40 marks; Oral Examination - 20 marks).

**CE4009 Applied Elasticity**

The objective of the module is to study the principles of elasticity and introduce the finite element method.

The contents of the module are three dimensional stresses, strain displacement relationships and generalised constitutive law, equilibrium, compatibility, kinematic and traction boundary conditions, airy stress functions, St. Venant’s theory of Torsion and Prandtl’s membrane analogy, ritz energy method, Kirchhoff’s theory for laterally loaded thin rectangular plates, potential energy, strain energy and virtual work for thin plates, governing equation for the bending of thin circular plates, elastic buckling of thin rectangular plates, introduction to the Finite Element Methods.

On successful completion of this module, students should be able to:
- Derive the equations of equilibrium and compatibility for 2-D elastic domains.
- Establish the admissibility of Airy stress functions and solve a variety of elastostatic problems, including radial stress systems associated with thick cylinders, wedges, half-planes and strip-footings.
- Derive solutions for a circular hole in a plate with a variety of prescribed boundary traction systems and compute the elastic stress concentration factor Kt.
- Combine a series of Flamant solutions together with an appropriate hydrostatic system to obtain the solution for a solid circular cylinder subjected to a set of radial loads.
- Analyse the torsional behaviour of prismatic members of open and multi-cellular closed cross-section by the application of St. Venant’s theory and Ritz energy methods.
- Analyse the elastostatic behaviour of thin rectangular plates subjected to laterally applied loads using Kirchhoff’s theory and virtual work.
- Derive, interpret and solve the equation for the elastic buckling load of a thin rectangular plate subjected to in-plane traction.
- Solve the differential equation of bending for thin laterally loaded circular plates.
· Set up and solve the system equations for plane stress and torsion problems using the Finite Element Method.

Assessment: Total Marks 100: End of Year Written Examination 100 marks.

CE4012 Traffic and Highways (5 credits; Teaching Period 2)

The objective of the module is to introduce to Traffic Engineering and Highway Design, Traffic measurement, management and quantification, Design and evaluation of highways.

The contents of the module are Traffic Engineering, Traffic studies (land use, volume, speed, travel time, parking), road safety engineering, urban traffic management including traffic signal systems, geometric design of roads and intersections, structural design of road pavements, road and traffic law.

On successful completion of this module, students should be able to:
· Generate the relationships between concentration, flow and speed on roads.
· Assess the likely capacity of specific road types in terms of Average Annual Daily Traffic (AADT) and peak flow.
· Quantify the traffic volumes and patterns on interurban road networks.
· Predict the future traffic on interurban road networks.
· Quantify the current traffic and safety situation at a specific junction or road.
· Design alternative traffic signal staging and timings for simple urban junctions.
· Describe the process involved in the design and construction of roads.
· Describe the functions of the different elements of geometric road design.
· Carry out preliminary design of roads and intersections.
· Describe the requirements of pavement materials and the tests used to determine the suitability of the principal type of materials.

Assessment: Total Marks 100: End of Year Written Examination 85 marks; Continuous Assessment 15 marks (Reports on practicals).

CE4013 Harbour and Coastal Engineering (5 credits; Teaching Period 2)

The objective of the module is to introduce students to Maritime Civil Engineering design and practice.
The contents of the module are Coastal Engineering principles, Coastal Erosion and Deposition, Coastal Protection Methods, Harbour Design, Breakwater Construction, Port Structures, Data Collection and Hydrographic Surveying.

On successful completion of this module, students should be able to:
· Describe the morphodynamics of coastal systems.
· Quantify the longshore transport of sediments by given wave climates.
· Determine the impact of coastal structures on coastal systems.
· Design a coastal protection system.
· Describe the constructional details of typical coast protection systems.
· List the design requirements for new harbours.
· Provide preliminary design for the layout for a new harbour.
· Undertake the preliminary design for the breakwater structures in a new harbour.
· Describe the constructional details of breakwater structures.

Assessment: Total Marks 100: End of Year Written Examination 85 marks; Continuous Assessment 15 marks (Laboratory Reports and Assignments).

CE4014 Computer Aided Design VI (Environmental) (5 credits; Teaching Period 2)

The objective of the module is to equip the student with a facility for the design of sanitary services.

The contents of the module are design work includes the presentation of calculations and working drawings.

On successful completion of this module, students should be able to:
· Analyse existing waste water treatment plant - check capacity.
· Quantify existing loads (hydraulic and BOD) - assess future loads (census figures).
· Examine existing sewers for capacity and physical condition - Decide to upgrade or abandon.
· Design new sewers, pumping station (s) and rising main (s).
· Assess capacity of receiving waters - decide on standards of new Waste Water Treatment Plant.
· Design unit processes of new Waste Water Treatment Plant. Decide layout of site.
· Design water supply scheme - assess water demand - identify source - decide on treatment. Identify storage location near distribution area - design storage reservoir.
· Examine existing water distribution. Decide to upgrade or abandon.
· Assess static/working pressures in pipeline - design distribution network for fireflows etc.

**Assessment:** Total Marks 100: Continuous Assessment 100 marks (Project Report – 70 marks; Oral Examination – 30 marks).

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### CE4015 Environmental Hydraulics

(5 credits; Teaching Period 2)

The objective of the module is to introduce the student to practical engineering problems in environmental hydraulics.


On successful completion of this module, students should be able to:
· Understand the causes of river flooding and engineering responses for mitigation.
· Quantify the propagation of a flood in a river channel.
· Quantify the effect of a reservoir on the flood propagation.
· Describe typical engineering solutions to coastal flooding risks.
· Design an effluent disposal system to comply with receiving water standards.
· Describe the constructional details for diffuser systems.
· Design an overflow spillway system with adequate energy dissipation.
· Describe the constructional details of a spillway system.
· Quantify the effects of sediment transport in a river channel.

**Assessment:** Total Marks 100: End of Year Written Examination 100 marks.

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### CE4016 Energy Systems in Buildings

(5 credits; Teaching Period 2)

The objective of the module is to develop knowledge of energy engineering elements and systems in buildings.

The contents of the module are advanced or applied thermodynamics considering refrigeration systems and heating systems, introduction to a range of HVAC systems in buildings, analysis and design of advanced HVAC systems including renewable energy systems, analysis and design of natural ventilation systems.

On successful completion of this module, students should be able to:
- Calculate the thermal heating and cooling loads in buildings.
- Describe the advantages and disadvantages of different heating and cooling systems.
- Determine the energy performance of heating and cooling systems.
- Analyse and Design HVAC systems including natural ventilation.
- Determine appropriate HVAC systems for given buildings.
- Analyse the control of a range of HVAC systems for air conditioning.
- Calculate thermal comfort indices that include PMV and PPD thermal indices.

**Assessment: Total Marks 100: End of Year Written Examination 80 marks; Continuous Assessment 20 marks (Practicals and Reports).**

### CE4019 Computer Aided Design VII (Heating, Ventilation and Air Conditioning)

(5 credits; Teaching Period 2)

The objective of the module is to undertake a Design Project in environmental services in buildings.

The contents of the module are design of HVAC systems for a range of building types. This includes heating, ventilation and air conditioning systems, lighting design, acoustics and energy recovery and efficiency.

On successful completion of this module, students should be able to:
- Appraise buildings service requirements.
- Execute a conceptual design of HVAC systems by considering alternative solutions.
- Detail the preliminary design of HVAC systems.
- Calculate the preliminary estimation of electrical loads.
- Determine the sizing of services risers and plant rooms.
- Demonstrate an understanding of the key services related design issues.
- Appreciate the importance of Services Design Requirements at an early stage.

**Assessment: Total Marks 100: Continuous Assessment 100 marks (Design Project - Assignments - 10 marks, Presentation - 20 marks, Design Project - 35 marks, Oral Examination - 35 marks).**

### CE4018 Fire and Safety Engineering

(5 credits; Teaching Period 2)

The objective of the module is to attain introduce the student to the world of professional engineering and broaden his/her engineering experience by: (1) providing the student with a supervised structured work placement in an engineering organisation or research institute;
(ii) requiring the student to produce reflective reports at regular intervals during the work placement; (iii) requiring the student to prepare a work placement report; (iv) requiring the student to make a formal presentation on the work placement.

The contents of the module are Work experience by placement in an organization relevant to Civil and Environmental Engineering.

On successful completion of this module, students should be able to:
· Apply knowledge gained through academic study to the practice of engineering;
· Work effectively as part of an engineering team;
· Produce on a weekly basis a reflective journal on learning through work placement;
· Deliver oral and written reports on the experience of learning through work placement.

Assessment: Total Marks 100: Continuous Assessment 100 marks (Regular Written Reports - 10 marks; Academic Supervisor's Report - 10 marks; Final Written Report - 50 marks; Oral Presentation - 30 marks. The Final Written Report and Oral Presentation must be completed by 31 October.).

CE4911 Transportation and Energy (5 credits; Teaching Period 2)

The objective of the module is to give a detailed understanding of sustainable transportation policies, including energy minimization in transportation through the use of public transport (trains, metros, light rail and buses), biofuels and electric vehicles.

The contents of the module are Technological and economic characteristics of air, road, rail, sea and continuous flow modes, traffic signal systems, intelligent transport systems, transportation and land use planning, urban simulation models and urban traffic study.

On successful completion of this module, students should be able to:
· Assess transportation policies.
· Describe the technological and economic characteristics of the different modes of travel and understand their appropriate roles in the transportation system.
· Differentiate between different rail systems (trains, metros, light rail).
· Analyse the transport requirements for a specific situation and select appropriate modes (train or metro or light rail or bus or guided bus or car or bicycle)
· Generate the energy production per km per passenger for various transportation systems.
· Distinguish between different biofuel systems.

Assessment: Total Marks 100: End of Year Written Examination 85 marks; Continuous Assessment 15 marks (Reports and practicals).