SEMESTER 1, 2013-14

MODULES ON OFFER FROM THE COLLEGE OF ENGINEERING

Understanding Course Codes/Levels

The structure of a module's code is made up of a sequence of letters and numbers. The module code starts with two letters which denote the Discipline teaching the module (e.g., CE – Civil Engineering, BME – Biomedical Engineering, ME – Mechanical Engineering etc). The remainder of the module code is made up of three numbers.

The first number in the sequence indicates the year the module is delivered to e.g. CT101 is an information technology course offered to first year domestic students. CE223 is a civil engineering module offered to second year domestic students. BME326 is a biomedical engineering module offered to third year domestic students etc. Module codes starting with the numbers 4 or 5 are normally offered to 3rd and/or 4th year students. Visiting students are offered courses from 1st, 2nd, 3rd and 4th year.

Many courses available to visiting students are not at a foundation level and therefore require applicants to have previously studied in the discipline. The higher the first number in the sequence, the more advanced the course is.

Visiting students wishing to take engineering courses other than those offered to first year domestic students must have previously studied in the discipline. The more advanced the course on offer, the greater must be the applicant's previous familiarity with material in that discipline.

Biomedical Engineering

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Biomedical Engineering	BME326	Biomedical Design	15	Full year	Spring	Continuous Assessment

In this module students complete a significant design project in the area of biomedical engineering and medical device technology. This module covers the fundamentals of engineering planning and decision making, the mathematical and analytical tools required, and the subject matter employed in using these tools. These fundamentals are applied to a variety of biomedical engineering and medical technology design situations. The module involves the application of mathematics, materials sciences and engineering mechanics to problems in the analysis and design of mechanical, electromechanical elements and the interaction of such elements with the human body. The module takes into account consideration of product specification, manufacturing methods, safety and economic factors. Detailed design of a selection of components is covered based on analytical solutions, empirical techniques and test results. The third year design project is used to integrate in one project a number of elements that the students have acquired through 1st, 2nd and 3rd year including: workshop practice, design, CADD, mechanics of solids, mechanical analysis and design, materials, thermofluids, electrical instrumentation, communication and report writing skills. The module also includes a dedicated CAE (including CADD) component.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Biomedical Engineering	BME328	Principles of Biomaterials	5	1	1	2 hour exam

The course is designed to provide hands-on experience on biomaterials design; fabrication; and in vitro and in vivo assessments. It provides experience in experimental skills for the biomedical engineer of the future.

The in class sessions will cover how to write a scientific report and how to conduct data analysis.

The laboratory practicals will cover between others the following: biopolymer extraction and characterisation; principles of biomaterials design and fabrication; in vitro and in vivo assessment.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Biomedical Engineering	BME401	Biomedical Engineering Individual Project	15	Full year	2	Continuous Assessment

In this module students complete a major senior level project in biomedical engineering that involves one or more of the following aspects: design and analysis, experimental testing, mathematical modelling, materials characterisation, product manufacture, process development

All PEP students are required to give a presentation on the work experience they have gained while on placement. The presentation is given when the student returns to the university and the audience consists of class members and academic staff. PEP students are also required to submit a written report in a format specified for them before going on placement.

Each student is assigned an individual project at the start of the academic year based on work done during industrial placement or topics assigned by staff members. Assessment is based on a comprehensive final report and oral presentation of the project results to the class and staff.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Biomedical Engineering	BME402	Computational Methods in Engineering Analysis	10	1	1	2 hour exam

This module provides a comprehensive presentation of the finite element (FE) method and computational fluid dynamics (CFD), both of which form critically important parts of modern engineering analysis and design methods. Details of theoretical formulations, numerical implementations and case study applications are presented. The descriptive and analyical content in the lectures is supported by computer laboratory practicals using commercial analysis code (both FE and CFD).

Development of finite element equations from a governing functional. Basic element shapes and associated interpolation functions. Formulation of the element stiffness matrices and load vectors for elasticity problems. Development of higher order elements, including curved elements and numerical integration. Natural coordinates Real space mapping and the calculation of spatial gradients. Structure and organisation of a finite element computer programme. Finite element formulations for thin beam bending and thermal conductivity problems.
Development of conservation equations for mass, momentum and energy for the finite volume method. Selection of appropriate boundary conditions, discretisation techniques and solution methods for a range of thermofluid problems. Structure and organisation of a CFD computer programme. Application of course content to modelling a wide range of steady-state, dynamic, mixing and heat transfer problems.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Biomedical Engineering	BME405	Tissue Engineering	5	1	1	Continuous Assessment

This course integrates the principles and methods of engineering and life sciences towards the fundamental understanding of structure-function relationships in normal and pathological mammalian tissues especially as they relate to the development of biological tissues to restore, maintain, or improve tissue/organ function. The course builds on the three principal components of tissue engineering namely, biomaterials, cells and signalling mechanisms. Concepts of in vivo and in vitro colonisation, biocompatibility, bioreactors, standards, ethics and regulation are then introduced. Laboratory techniques of tissue culture are also integrated within the course and the students perform hands-on cell culture assays. A individual project is undertaken for the development of a tissue engineering construct in one of the following areas: bone, nerve, heart and skin.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Biomedical Engineering	BME503	Biomechanics	5	1	1	2 hour exam

This module entails the study of fundamental biomechanics concepts ranging from bio-solid mechanics to bio-fluid mechanics. Topics covered include from mechanics of joints in the human body, biomechanics of soft tissue, bone biomechanics, cardiac biomechanics, biomechanics of blood flow and biomechanics of muscle.

Fundamentals of solid mechanics (stress, strain, constitutive formulations); Principles of statics; Analysis of the mechanical behaviour of joints in the human body; Viscoelasticity of soft tissue; Microstructure of bone; Fatigue and fracture of bone; Bone remodelling; Structure of muscle; Biomechanics of muscle contractility; Biomechanics of the cardiac cycle; Windkessel model for pressure in compliant vessels; Newtonian flow in elastic vessels; Non-newtonian flow of blood; Unsteady Bernoulli's equation and the mechanics of heart value closure; Biomechanics of atherosclerosis and the effect of lesions on blood flow; Cellular cytoskeletal structures and mechanotransduction.

Laboratory Practicals

1. Determination of the mechanical properties (Young's modulus, yield stress, UTS) of cortical bone using an INSTRON servo-hydraulic testing machine. Determination of the fracture toughness of notched cortical bone specimens.
2. Heart dissection and extraction of aortic tissue. Determination of the orthotropic properties and compliance of an ovine aorta using a ZWICK biaxial testing machine.

CIVIL ENGINEERING

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Civil Engineering	CE223	Computer Aided Design and Surveying	5	1	1	2 hour exam

This module examines both computer aided drawing and surveying. The work on CAD represents an extension of the material that is covered in Engineering Graphics in the first year. The surveying portion includes both coursework and practical assignments. In the latter, the students, working in teams, produce a drawing of an area that they surveyed.

Surveying
This component consists of integrated lectures and laboratories that include:

- Tape and offset surveying
- Adjustments of the level and theodolite
- Levelling. Traverse surveying
- Electronic Distance Measurement
- Field work

AutoCAD
This is a laboratory based course and all students are required to attend the computer based laboratories. Students must prepare general arrangement and sectional drawings of reinforced concrete slabs, beams and columns. Four drawings must be produced using AutoCAD and submitted on a single A1 sheet at different scales.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Civil Engineering	CE225	Engineering Materials	5	1	1	2 hour exam

This is an introductory module on engineering materials and it is common to all engineering student cohorts. The coursework topics include lectures on (i) the fundamental behaviour of the wide spectrum of materials used across the differing engineering disciplines, (ii) an introduction to the microstructure of metals and (iii) concepts of strength of materials such as stress, strain, loads. These concepts are supplemented by a number of laboratory assignments.

Coursework
Behaviour and use of engineering materials including metals, timber, polymers, fibre reinforced composites, concrete and ceramics
Equilibrium
Concepts of stress and strain
Axially loaded members, pin-jointed trusses
Bending moment and shear force for beams
Laboratories
1) Theoretically and experimentally evaluate forces in a structure under two different loading conditions:
a. using micrometer/callipers;
b. understanding of the strain gauges;
c. converting units;
d. comparing theoretical and experimental data;
e. writing conclusions of the experiment and identify sources of error.
2) Examine properties of mild steel based on the tensile test experiment:
a. using micrometer/callipers;
b. converting units;
c. drawing graphs for better data representation;
d. comparing theoretical and experimental data;
e. writing conclusions of the experiment and identify sources of error

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Civil Engineering	CE227	Strength of Materials	10	Full year	2	2 hour exam

This module extends the strength of materials concepts that were introduced in the Engineering Materials module. All students are required to also complete a number of laboratory experiments that illustrate the theoretical concepts from the coursework. In addition, the students are required to complete a number of computational laboratories in which they use a structural analysis package.

Coursework

- Moment of Inertia
- Simple torsion
- Shear force and Bending moment diagrams
- Simple bending theory
- Shear stresses
- Stress/strain transformations and Mohr circle
- Inelastic behaviour of beams
- Slope and deflection of beams
- Buckling of pin-jointed members
- Structural connections

Experimental Laboratories
1 Measure strains in a beam and with strain gauge rosettes and calculate bending stresses
2 Measure and calculate deflection of the simply supported beam under the central load:
3 Evaluate theoretical and experimental buckling load of struts:
Computational Laboratories
Each student must attend and complete computational analysis laboratories during which they must learn to use the CADS analysis package and they must carry out the following:
Lab 1: Determination of the reactions and member forces on a girder when subjected to an imposed load.
Lab 2: Given dead and imposed loads for a flat roof truss and lattice girder, plot the displaced shape and the axial force distribution.
Lab 3: Given dead, imposed and wind loads on a structure, plot the displaced shape, the axial and shear force distribution and bending moment diagrams.
Lab 4: A computer based examination in which students individually analyse a structure.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Civil Engineering	CE335	Engineering Hydraulics II	10	1	1	2 hour exam

This module will cover fundamental areas of engineering hydraulics; theorical content will be augmented by a detailed group design project.

Open channel flow
- Pipe flow
- Pipe flow with friction
- Reservoir hydraulics
- Pumps
- Water distribution systems
- Sewer design
- Culvert design

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Civil Engineering	CE336	Environmental Engineering	10	1	1	2 hour exam

This module covers: characterisation and measurement of water parameters, regulations, septic tank design and on-line resources used in the planning applications, 'passive' wastewater treatment using constructed wetlands and sand filters and issues of public acceptance; wastewater and water treatment at municipal-scale, including growth and food utilisation kinetics, attached and suspended culture systems; agricultural wastewater treatment, and greenhouse gas emisssions measurement.

Course Work
General introduction to concepts (characteristics, measurement of parameters, regulations); Septic tank design (internet resources, percolation test, processes, planning applications); Constructed wetlands; Filtration (design criteria, P adsorption isotherms); Natural purification processes (physical, biochemical); Dissolved oxygen model; Wastewater treatment (population equivalents; grit removal, sedimentation tanks; growth and food utilisation, kinetics, suspended culture system, attached culture systems); Water treatment (coagulation, sedimentation, filtration, disinfection); Agricultural engineering (soil quality vs. spreading, volumes produced, legalisation, loading rates); Greenhouse gas emissions (measurement, importance).
Laboratories
1. Nutrient removal
2. Determination of the oxygen transfer coefficient
3. BOD test,
4. Suspended solids test
5. COD test

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Civil Engineering	CE340	Solids & Structures	10	Full year	1 & Spring	2 hour exam

In this module the students consider more advanced topics on structural behaviour and use a variety of methods to solve for bending moments and shear forces in different structures. The analytical methods are supplemented by a number of computational analysis laboratories. Soild mechanics topics such as torsion, bending, shear and buckling are also considered in addition to dynamics. Some of the theoretical concepts are also illustrated through laboratory experiments.

Theory of Structures
Structural Form; Qualitative Structural Analysis; Computer-based Structural Analysis; Moment Distribution Method; Principle of Virtual Work;
Approximate methods of analysis applied to frames. Analysis of multi-storey frames by division into free bodies and use of the inflection points, from where analysis by equilibrium can proceed; Analysis of statically indeterminate trusses by approximate methods; Defining the duality of structural analysis: structural approach and flexibility approach. Study of a propped cantilever to enable the flexibility and stiffness methods to be compared. Implementation of the flexibility method and application to frames and trusses to calculate internal forces and deflections; Construction of influence lines for beams, parabolic arches and trusses; Proof of several theorems on influence lines. Application of moment distribution to a variety of frames.

Mechanics of Solids
Properties of Area: moment of inertia, parallel axis theorem, product of inertia; Torsion: basic equations, varying cross section, rectangular shafts, thin tubular sections, open sections; Beam Bending: basic equations, combined bending and direct stress, unsymmetrical bending, bending of composite beams
Deflection of Beams: deflection equations, differential equation solution, moment area method; Transverse Shear in Beams: shear stress expression, different cross section configurations, shear centre; Stress-Strain Transformation: analysis of stress and strain, Mohr circle of stress/strain, principal moments of inertia, strain gauges; Energy Considerations: strain energy, axial, bending, shear, torsion; Inelastic Problems: fundamentals of plastic behaviour, torsion beyond the yield point, plastic hinge; Elastic Instability: Various end conditions; Eigenvalue Problems; Beam-Column behavior; Vibrations: Single degree of freedom structures; Vibrations of beams and shafts;

Computational Analysis
Use of a structural analysis package to analyse a number of continuous beam and frame problems

Laboratory Experiments
Students work in groups to carry out three experiments on both model and full scale structures. These experiments are:
- Plastic collapse of portal frames.
- Vibrations of a simply supported beam.
- Tests on reinforced concrete model beams.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Civil Engineering	CE341	Structural Engineering Design	10	1	1	2 x 2 hour exam

This module will focus on design of Concrete and Steel Structures by studying the following: Introduction to allowable stress design and limit states design philosophies. Overview of modern LSD steel and concrete codes, principally Eurocodes 2 and 3. Design simple steel structural members including ties, struts, beams, connections, truss roofing systems.Design one-way reinforced concrete spanning slabs, singly and doubly reinforced concrete beams, columns and pad foundations.

Design of Concrete and Steel Structures
Identify appropriate code clauses to apply to various design problems. Study the behaviour and design of steel ties, including eccentric loading. Local buckling behaviour and the classification of steel sections. Behaviour and design of steel beams and columns, including design transition curves, initially crooked members and residual stresses. Behaviour and design of connections.
Stress analysis of reinforced concrete cross-sections. Design and detail reinforced concret one-way spanning slabs, singly and doubly reinforced beams, columns (braced, short), pad foundations. Produce reinforced concrete drawings and bar schedules.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Civil Engineering	CE341	Structural Engineering Design	15	Full year	1 & Spring	2 hour exam

This module will focus on design of Concrete and Steel Structures by studying the following: Introduction to allowable stress design and limit states design philosophies. Overview of modern LSD steel and concrete codes, principally Eurocodes 2 and 3. Design simple steel structural members including ties, struts, beams, connections, truss roofing systems.Design one-way reinforced concrete spanning slabs, singly and doubly reinforced concrete beams, columns and pad foundations.

Design of Concrete and Steel Structures
Identify appropriate code clauses to apply to various design problems. Study the behaviour and design of steel ties, including eccentric loading. Local buckling behaviour and the classification of steel sections. Behaviour and design of steel beams and columns, including design transition curves, initially crooked members and residual stresses. Behaviour and design of connections.
Stress analysis of reinforced concrete cross-sections. Design and detail reinforced concret one-way spanning slabs, singly and doubly reinforced beams, columns (braced, short), pad foundations. Produce reinforced concrete drawings and bar schedules.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Civil Engineering	CE342	Structures I	5	1	1	2 hour exam

This module represents a continuation of the Strength of Materials module from 2nd year. The students are exposed to a number of structural analysis techniques for common Civil Engineering structures. They will aslo use a structural analysis package to analyse relevant structures.

Theory of Structures
Structural Form; Qualitative Structural Analysis; Computer-based Structural Analysis; Moment Distribution Method; Principle of Virtual Work;
Approximate methods of analysis applied to frames. Analysis of multi-storey frames by division into free bodies and use of the inflection points, from where analysis by equilibrium can proceed; Analysis of statically indeterminate trusses by approximate methods; Defining the duality of structural analysis: structural approach and flexibility approach. Study of a propped cantilever to enable the flexibility and stiffness methods to be compared. Implementation of the flexibility method and application to frames and trusses to calculate internal forces and deflections; Construction of influence lines for beams, parabolic arches and trusses; Proof of several theorems on influence lines. Application of moment distribution to a variety of frames.

Mechanics of Solids
Properties of Area: moment of inertia, parallel axis theorem, product of inertia; Torsion: basic equations, varying cross section, rectangular shafts, thin tubular sections, open sections; Beam Bending: basic equations, combined bending and direct stress, unsymmetrical bending, bending of composite beams
Deflection of Beams: deflection equations, differential equation solution, moment area method; Transverse Shear in Beams: shear stress expression, different cross section configurations, shear centre; Stress-Strain Transformation: analysis of stress and strain, Mohr circle of stress/strain, principal moments of inertia, strain gauges; Energy Considerations: strain energy, axial, bending, shear, torsion; Inelastic Problems: fundamentals of plastic behaviour, torsion beyond the yield point, plastic hinge; Elastic Instability: Various end conditions; Eigenvalue Problems; Beam-Column behavior; Vibrations: Single degree of freedom structures; Vibrations of beams and shafts;

Computational Analysis
Use of a structural analysis package to analyse a number of continuous beam and frame problems

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Civil Engineering	CE461	Civil Engineering Project	10	Full year	2	Continuous Assessment

This is the major project that is completed by students in the final year of their undergraduate programme. Projects are generally conducted in pairs although there may be some instances of individual projects. The project is defined at the start of the academic year on some Civil Engineering topic and students have the full academic year to complete. Students also complete a number of other communications based assignments.

Each student is required to carry out an engineering project on a particular engineering topic of their choice. The student is required to submit a technical engineering report detailing the background and aims of the project, the work

carried out as part of the project and the findings of this work including discussion and conclusions. Each student is also required to give an oral presentation on their project during which they must also field technical questions on their work from members of staff.
It should be noted that students may carry out an individual project or may work with a second student and carry out a joint project.
Communications/Professional Engineer
The students will receive guest lectures on aspects of the engineer in society with are deemed to be important to the students as they develop into professional engineers. The topics include (i) Health and safety, (ii) Engineering ethics (as set out by Engineers Ireland), (iii) Freedom of information and plagiarism, (iv) Effective leadership and teamwork and (v) The engineer as expert witness. Students are required to complete reflective essays on leadership and teamwork, ethics, the engineer as expert witness and overseas technical aid. In addition, they have to complete an on-line exam which assesses their ability to identify instances of plagiarism.
Students are also required to prepare written and oral presentations on their work placement that they complete at the end of 3rd year.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Civil Engineering	CE462	Coastal and offshore Engineering	5	1	1	2 hour exam

Wavemaker theory: mathematical model to simulate the creation of waves in a wave flume: progressive and evanescent.

Tidal dynamics oceanic and local
Properties of ocean and coastal waves: length, celerity, water particle orbits, dynamic pressure, shoaling, refraction, breaking, and diffraction. Ports and harbours. Evaluate the wave forces on a seawall due to breaking- or non-breaking waves. Design a breakwater. Estuarine processes. Sediment transport, coastal protection.

Properties of ocean and coastal waves: length, celerity, water particle orbits, dynamic pressure, shoaling, refraction, breaking, and diffraction. Ports and harbours. Evaluate the wave forces on a seawall due to breaking- or non-breaking waves. Design a breakwater. Estuarine processes. Beach processes, sediment transport, coastal protection. Tidal dynamics.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Civil Engineering	CE464	Design of Sustainable Environmental Systems I	5	1	1	2 hour exam

This module introduces the theory supporting, design, maintenance and operation of waste and wastewater treatment systems. Topics covered will include wastewater and waste composition and characteristics, design of treatment facilities, energy efficiency and production, control and monitoring techniques that are used in these systems and current state of the art. The module discusses the engineers responsibility to the public and the environment when designing and operating such faiclities.

In this module the theory behind the design of waste, wastewater and sludge treatment systems is discussed. Particular attention is focused on activated sludge and biofilm-based wastewater treatment systems, nutrient removal from wastewaters, biotechnologies for waste treatment, and thermal treatment technologies for waste treatment. Energy efficiency and recovery are discussed as is the engineer's role to society and the environment when designing and operating such facilities. The module is examined through written exams and project/essay work.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Civil Engineering	CE471	Project Management	5	1	1	2 hour exam

The module content includes: Project and project management characteristics; Stakeholders; Management and organisational concepts; Project life-cycle and its characteristics; Project financing, mechanisms for project financing and measures of project profitability; Project planning; Project delivery/procurement systems; Networks, planning, scheduling and resource allocation; Computer based network analysis; Estimating; Project monitoring and control; Project changes, claims & disputes; Quality.

Project and project management characteristics;
•Project stakeholders;
• Management and organisational concepts;

- Project life-cycle and its characteristics;
- Project financing, mechanisms for project financing and measures of project profitability;
- Project planning;
- Project delivery/procurement systems;
- Organisation structure diagrams;
- Networks, planning, scheduling and resource allocation;
- Computer based network analysis;
- Estimating;
- Project monitoring and control;
- Project changes, claims and disputes;
- Classification and distribution of costs;
- Quality.

INFORMATION TECHNOLOGY

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Information Technology	CT101	Computing Systems	10	Full year	2	2 hour exam

Computing Systems

The course is an introductory presentation of computing systems architecture and components: software, hardware and data that is being manipulated.

Data representation in computing systems (numbes, audio, graphics, video); Introduction to Computing Systems Organization (CPU, Memory, Buses, I/O Devices); Introduction to Operating Systems; Introduction to Data Communications; Introduction to Networking; Introduction to Electronic Circuits; Digital logic fundamentals (CLC and FSM design); Principles of operation for main computing systems elements: CPU, Memory Subsystem (Primary and Secondary), I/O Subsystem and Devices;

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Information Technology	CT102	Algorithms and Information Systems	10	Full year	2	2 hour exam

Algorithms & Information Systems
An introduction to algorithms, data structures and information systems
Fundamentals of Data, Evaluation and Control
Fundamentals of Problem Solving
Data Structures
Algorithms for searching
Algorithms for sorting
"Big Oh" notation
Algorithms for compression
Finite state machines
Information systems
Database systems
Social networks
Logic and Sets
Functions and relations
Google's page rank algorithm

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Information Technology	CT103	Programming	10	Full year	2	2 hour exam

Programming

Program Design and Flowcharting; Data input / output and formatting; Mathematical library functions; Relational and Conditional Operators; Arrays and Strings; While and For loops; Functions; Use of the Debugger; Functions; Data Structures; Referencing by address and Pointers; File input and output;
Dynamical Memory Allocation

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Information Technology	CT108	Next Generation Technologies	10	Full year	2	2 hour exam

Next Generation Technologies I

This is an introductory course into energy, environmental, medical informatics, digital media and Arts in Action.

Introduction to Next-Generation Technologies including Digital Media and Gaming, Multimedia Web Development, Medical Informatics Informatics, Energy & Environmental Informatics, Computational Informatics and Enterprise Systems.

The primary goal is to engage the students in software development at an early stage by using a team-based, problem-based learning approach focused on these thematic areas. Students will work on medium-sized group-based problems in these diverse domains that are specifically aimed at strengthening their grasp of context, core concepts as well as programming and algorithm development. Students will participate on the College of Engineering and Informatics Arts in Action Programme, and thereby gain an appreciation for the role of performance arts and sound creation on the software development process

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Information Technology	CT113	Computing Systems and Applications	5	Full year	2	c/a

This is a foundation course for further studies in IT, and covers most of the relevant topics at an introductory level. There is a fundamental overview of the hardware components of a standard computer system, introduction to the functions of the operating system, issues of security and internet/networks fundamentals. The course complements a thorough understanding of many package applications related to text editing, graphics creation and manipulation and some concepts in client-server implementations by requiring the students to develop a webpage/website over the duration of the module's implementation which will encapsulate and illustrate many key concepts in computer systems and applications.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Information Technology	CT213	Computer Systems & Organization	5	1	1	2 hour exam

Computer Systems and Organisation

Computer Systems History and Architecture Development; Von Neumann machine; memory systems; storage media; virtual and cache memory; interrupts; concurrency and pipelining; processes; scheduling; critical regions and synchronisation; file systems and management; distributed operating systems and parallel processing; case studies; UNIX, MSDOS and Windows NT.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Information Technology	CT216	Software Engineering I	10	Full year	2	2 hour exam

Software Engineering 1

Introduction to Software Engineering. Structured Programming and Structured Design. Modularity: The Structure Chart and Module Specification Methods. Quality Module Design: Coupling, Cohesion and Factoring. Structured Analysis: Data Flow Diagrams, Event Partitioning, Functional Decomposition. Transaction and Transform Analysis. Real time design issues in software development. State Transition diagrams and Petri Nets. Introduction to Formal Methods and Formal Design Specifications using the Z notation

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Information Technology	CT229	Programming II	10	Full year	2	2 hour exam

Programming II
Techniques to analyse algorithms. Abstract Data Types. Modularity. Queues. Stacks. Lists. Arrays. Sorting Techniques: Bubble, Selection, Insertion, Quick, Merge and Shell. Searching: Linear and Binary. Trees: Binary trees, Tree Algorithms, depth first, breadth-first searching. Balanced Trees, AVL Trees. Hashing. Priority queues and heaps. Introduction to Graphs.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements

Information Technology	CT230	Database Systems I	5	1	1	2 hour exam

Indexing Techniques: Primary, Secondary, Clustering, B Trees, B+ Trees, Hashing (Extendible, Dynamic, Linear). Database Architectures and Data Models: Network, Hierarchical, Relational, Object-Oriented. Relational Model: Relations, Relational operators, Integrity constraints. Relational Algebra and SQL: Relational operators, Query Optimisation, DDL, DML,DCL. Extended Relational Model.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Information Technology	CT231	Professional Skills I	5	Full year	2	Continuous Assessment

Effective communication and presentation skills for a work environment. Preparation: defining the purpose, identifying the context, identifying the content, structuring the process, planning for time. Presentation skills for a software developer: code walkthroughs, peer reviews. Students will also be assessed by continuous assessment, including a sizeable project presentation.

Course Code	Module Title	ECTS Credits	Taught in Semester	Examined in Semester	Duration of exam (hours)
CT240	Programming - Algorithms	5	1	1	Laboratory-based exam

Introduction to Visual Basic programming. Basic program structures, loops, conditions and expressions. Designing a visual interface. An introduction to Visual programming – simple visual elements.

Course Code	Module Title	ECTS Credits	Taught in Semester	Examined in Semester	Duration of exam (hours)
CT241	Information Systems I	5	1	1	2 hour exam & assignment

Introduction to information systems: Databases. File systems: organisation, processing, indexing techniques. Database systems: architectures, overview of models. Relational database concepts and development: entities, entity relationships, normalisation.

Course Code	Module Title	ECTS Credits	Taught in Semester	Examined in Semester	Duration of exam (hours)
CT242	Technological Frameworks I	5	1	1	2 hour exam & assignment

Introduction to Visual Basic programming. Basic program structures, loops, conditions and expressions. Designing a visual interface. An introduction to Visual programming – simple visual elements.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Information Technology	CT303	Networks and Communications	10	Full year	Spring	2 hour exam

ISO / OSI Reference Model. Basic Data Communications, Physical Layer. Data Link Layer, Example Protocols. LAN Technology Standards, Virtual LANs. Network Layer, Internet Protocol, ATM. Transport Layer, TCP and UDP. Use of Higher OSI Layers. Client /Server Architectures. Network Programming using Sockets API.

Course Code	Module Title	ECTS Credits	Taught in Semester	Examined in Semester	Duration of exam (hours)
CT317	Systems Approach	5	1	1	2 hour exam & assignment

This course examines the nature of systems thinking, and how the systems approach can be used to avoid the pitfalls of reductionist thinking. Topics covered include: Problem Solving, Systems Methodologies, Systems Dynamics, Total Systems Intervention, Interactive Planning, and Soft Systems Methodology.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Information Technology	CT318	Human Computer Interaction	5	1	1	2 hour exam

Effective techniques to the gathering of systems requirements. HCI as a key component of the SDLC. Model user and task components of system projects. System interaction design patterns. User Interface Design and programming tools to the design of interfaces with many applicable domains. Assess the interfaces/interaction patterns of existing systems. Prioritise varied and conflicting design criteria as part of the systems development task.

Course Code	Module Title	ECTS Credits	Taught in Semester	Examined in Semester	Duration of exam (hours)
CT319	Artificial Intelligence	5	1	1	2 hour exam & assignment

This course includes an introduction to Artificial Intelligence. It looks at AI as applied to image processing, knowledge representation and inference, problem solving and search, and expert systems.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Information Technology	CT326	Programming III	10	Full year	Spring	2 hour exam

Fundamentals of OO Analysis and Design. Encapsulation, Inheritance, Polymorphism. Function Overloading. Constructor Functions, Overloading Constructors. Controlling Fonts. String Classes. HTML Applet Attributes. Graphics. Event Handling.Exception Handling. Multithreaded Programming and Synchronisation. Abstract Classes and Interfaces. Packages. Input /Output Streams and Object Serialisation, Customising Serialisation. Random File Access. Socket Classes. Applet Security. Large Scale Design, Open / Closed Principle, Dependency Inversion Principle. Design Patterns, Observer Pattern, Abstract Factory Pattern. Component Design and Testing. Software Reflection. Collections Framework, Interfaces, Implementation Classes and Algorithms.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Information Technology	CT331	Programming Paradigms	5	1	1	2 hour exam

Introduction to programming paradigms. Formal language. Chomsky hierarchy. Finite Automata. Push down automata. Interpreters. Compilers. Compiler structure. Scanning. Parsing. Language abstractions. Data Abstraction. Control Abstraction. Subprograms. Procedural Model. Functional programming. Logic Programming. Object oriented programming. Visual programming. Database programming. Parallel programming.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Information Technology	CT332	Database Systems II	10	Full year	Spring	2 hour exam

Database Design: ER Modeling, EER modeling, mapping to relational schema. Normalisation - 1st, 2nd, 3rd, BCNF. Design Issues Choice of keys, denormalisation, indexing strategies. Concurrency Control Lost Update, Temporary Update, Incorrect Summary Problems Locking Mechanisms, Binary Locks, Shared and Exclusive Locks, 2 Phase Locking Protocol, Timestamping approaches. Multiversion approaches. Recovery Mechanism Motivations, Transactions, System Log, Commit Points, Checkpoints, Immediate & Deferred Update Protocols. Shadow paging. Distributed Databases Introduction, Fragmentation policies, Distributed Database Architectures, Distributed Query Execution and Optimisation, Distributed Recovery, Distributed Concurrency Control Object-Oriented Databases Mapping EER models to Object Oriented Schemas. OQL.

Course Code	Module Title	ECTS Credits	Taught in Semester	Examined in Semester	Duration of exam (hours)
CT335	Object Oriented Programming	5	1	1	2 hour exam & assignment

Introduction: objects, classes, flow control, data structures using Java. OO Design Principles. Exception Handling. Input and Output. Graphical Programming, Event Model. Applets. Introduction to Multithreading & Network Programming. Java Beans. RMI. Java and Security. Discussion on OO design and implementations in the Java and Python environments.

Course Code	Module Title	ECTS Credits	Taught in Semester	Examined in Semester	Duration of exam (hours)
CT336	Graphics and Image Processing	5	1	1	2 hour exam & assignment

This course deals with the automatic and semi-automatic improvement and interpretation of digital images. Includes: the capture and storage of digital images; file formats; basic digital techniques such as convolution, thresholding, and histogram manipulation; image enhancement; geometric manipulations and their applications, for example to image rectification; the automatic identification and extraction of objects of interest; the design and development of measurement and classification systems; applications and case studies from various domains: industrial; the biological & medical sciences; remote sensing.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Information Technology	CT338	Software Engineering & Project Management	10	Full year	Spring	2 hour exam

The Software Development Life Cycle. Waterfall, prototype and spiral models of software product development. Object-Oriented analysis and design. Detailed instruction in one particular object-oriented methodology. CASE tool. Introduction to software testing: Black and White Box approaches. Complexity and metrics analysis. Transaction Flow Testing. Logic-Based Testing. The V-model of software development. The practice of project management, Group based exercises in project management.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Information Technology	CT360	Next Generation Technologies III	10	Full year	Spring	2 hour exam

More advanced coverage of Next Generation Technology topics including: Digital Media and Games Development. Medical and Bioinformatics. Acquisition of Biosignals, Lossy and Lossless Data Compression Techniques, Analysis and Classification of Biosignals. Biostatistical Methods. Energy Informatics. Computational Informatics. Enterprise Systems.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Information Technology	CT404	Graphics & Image Process	5	1	1	2 hour exam

Transformations. Projections. Rendering Standards. Edge detection. Shape contours. Segmentation. Object recognition. Industrial applications.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Information Technology	CT414	Distributed Systems & Co Operative Computing	5	1	1	2 hour exam

Introduction. Distributed Systems. Enabling Technology. High-Bandwidth Networks. Distributed Systems. ANSA/ISA Architecture. Open Distributed Processing. Distributed Application Platforms. Transparency. Reliability. Computer-Supported Co-operative Work. Human-Computer Interaction. Human-Interaction. Groupware. Multimedia. Hypertext. Security. Asynchronous Groupware. E-mail. Structured Messages. Co-operative Hypertext Systems. Synchronous Groupware. Seeheim Model. WYSISIS. Multi-user Interfaces. Group-Enabled Applications. Shared Window Systems. Desktop Conferencing. Compter-Supported Meetings. Media Spaces. Telework. Telepresence. Commercial Groupware examples. Research Trends

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Information Technology	CT417	Software Engineering III	5	1	1	2 hour exam

Software Project Management. Metrics and Behaviour. Measuring software projects. Project costings and projections. Software Quality Assurance: ISO and CMM Model. Object-oriented Analysis and Design. Methodology review, detailed instruction in one particular object-oriented methodology. Software Engineering: The Past, Present and Future.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Information Technology	CT421	Artificial Intelligence	5	1	1	2 hour exam

AI History and Applications. Predicate Calculus, Search Strategies, Production Systems. Review of primary languages; Prolog and LISP. Rule-Bases Expert Systems, Knowledge Representation and Natural Language. Review of Automated Reasoing. Machine Learning and Advanced AI Techniques.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Information Technology	CT422	Modern Information Management	5	1	1	2 hour exam

Data Mining, Data Warehousing, Data Mining, Data Warehousing Retrieval, Filtering, Extraction, Classification. Text Retrieval. Text Retrieval Models: Boolean, Statistical, Linguistic. Lexical Analysis, Stemming Algorithms Vector Space Model, Latent Semantic Indexing, Semantic Networks, Connectionist approaches. Multi-Media Retrieval. Evaluation: Precision/Recall Measures. Machine Learning, Relevance Feedback. Collaborative Retrieval.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Information Technology	CT423	Systems Theory	5	1	1	2 hour exam

The nature of systems thinking. The art of problem solving. The scientific method. System methodologies. Systems Dynamics. Soft systems methodology. Total systems intervention. Case studies.

ELECTRICAL & ELECTRONIC ENGINEERING

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Electrical & Electronic Engineering	EE230	Electrical Circuits & Systems	5	1	1	2 hour exam

Review of DC and AC circuit analysis. Transform networks and transient analysis. Transfer functions. Interpretation of pole-zero maps. Frequency response of linear systems. BODE plots and system identification. Block diagram analysis.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Electrical & Electronic Engineering	EE231	Electronic Instrumentation and Sensors	5	1	1	2 hour exam

Review of systems. Circuit analysis and theorems. Measurement and instrumentation. Sensors, actuators, transducers. Sensed quantities. Passive, active sensors. Resistors, capacitors, inductors as sensing elements. Practical sensor applications. Sensor characteristics. Frequency response. Noise and errors in measurements. Signal conditioning and filtering. Analogue and digital sensors. Analogue-digital conversion. Display of sensed values. Data acquisition and instrument control using a computer.

Review of systems: inputs, outputs, system blocks. Overview of electrical circuit analysis and theorems. Introduction to measurement and instrumentation systems. Sensors, actuators and transducers. Sensed quantities. Passive sensors and active sensors. Resistors, capacitors and inductors as sensing elements. Practical sensor applications (e.g. galvanometer, Wheatstone bridge). Sensor characteristics. Frequency response. Noise, interference and errors in measurements. Signal conditioning and filtering. Analogue and digital sensors. Analogue-to-digital conversion and digital-to-analogue conversion. Analogue and digital display of sensed values. Data acquisition and instrument control using a computer.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Electrical & Electronic Engineering	EE344	Communication Systems Engineering	5	1	1	2 hour exam

In this module, students will study how various elements of communication technology are used to deliver a variety of communication systems and networks. Topics studied include information compression, source coding, impact of noise on communication links, channel coding, OSI 7 layer model, taxonomy of transmission technologies, physical layer, line coding, data link layer protocols, networking layer, circuit and packet switched data networks, connectionless\connection oriented services, IP, ATM

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Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Electrical & Electronic Engineering	EE345	Digital Systems II	5	1	1	2 hour exam

MOS semiconductor integrated circuit technology. MOS digital logic building blocks. Mask layout, simulation. Area, power, timing and performance considerations.
Combinational and sequential component building blocks and description formats. Digital system structured design and documentation. intro to HDL (capture, testbenching, simulation, logic synthesis). Electronic Design Automation tools. FPGA technology. Design and implementation of modular digital system. Interfacing.

CMOS technology analysis and fabrication for common digital logic component building blocks. Design, HDL capture, simulation, logic synthesis, FPGA implementation and hardware test of medium complexity digital systems.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Electrical & Electronic Engineering	EE346	Electrical Power and Machines	5	1	1	2 hour exam

Laws of electromagnetism, magnetic circuits, magnetic materials
Transformers; equivalent circuits and transformer tests
DC generators & motors: equivalent circuits and tests, speed control
3-phase systems, per unit system
Introduction to induction motors

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Electrical & Electronic Engineering	EE352	Linear Control Systems	5	1	1	2 hour exam

This module includes lectures & laboratory classes on control systems modelling, analysis & design techniques. Methods include the Nyquist stability plot, the Nichols chart and the root-locus, along with an introduction to proportional, derivative, integral & PID controller design. Lab classes illustrate applications in DC motor position & speed control, simulated process control and feedback amplifier design.

Modelling of feedback control systems. Polar plots & Nyquist stability. Performance specifications. Root-Locus. M-circles and the Nichols chart. Analogue controller design: PID, phase-lead compensation. Practical examples of the implementation of control systems.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Electrical & Electronic Engineering	EE355	Project & Professional Studies	10	Full year	Spring	Continuous Assessment

All students are required to complete a group project to design and build a electrical\electronic\software system which addresses a specific problem identified and designed through interaction with partner community organisations. Project deliverables are supported by a series of lectures in communication skills, professionalism, ethics, health and safety, intellectual property, teamwork, continued professional development (CPD), many of which are delivered by guest speakers from industry.

All students are required to work in a project group to design and build a working prototype of an electrical\electronic\computer engineering systems which addresses a specific problem specification. This module will be completed by the student groups working on problems identified by community partner organisations. In addition to the technical elements of the project, all groups are also required to deliver a written report, poster presentation and oral presentation detailing the project work. Project deliverables are supported by a series of lectures in communication skills, professionalism, ethics, health and safety, intellectual property, teamwork, continued professional development (CPD), many of which are delivered by guest speakers from industry.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Electrical & Electronic Engineering	EE357	Signals and Communications	5	1	1	2 hour exam

This modules covers concepts and techniques for analysis and processing of signals, and system analysis and design, with particular emphasis on topics relevant to the study of communication systems.

Fourier series and Fourier transform. Analysis and design of signal processing systems, passive and active filters. Random signal analysis, energy and power spectral density. Sampling and quantization. Introduction to Digital Signal Processing.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Electrical & Electronic Engineering	EE443	BE Project	10	Full year	2	Continuous Assessment

Each student must complete an individual project in a relevant area of E&EE engineering under the supervision of an academic staff member.
The project is assessed using a number of project deliverables:

- Initial report (submitted after 1 month),
- Progress report (submitted at the start of Semester 2),
- Final project report,
- Oral project presentation,
- Q&A session following oral presentation,
- Project demonstration,
- Project notebook (maintained throughout project),
- Project web-page

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Electrical & Electronic Engineering	EE445	Digital Signal Processing	5	1	1	2 hour exam

This modules covers concepts and techniques for discrete-time analysis and processing of signals, and system analysis and design.

Discrete-time systems, time-domain analysis. The z-Transform. Frequency-domain analysis, the Fourier Transform. Digital filter structures and implementation. Spectral analysis and filtering with the DFT/FFT, practical and computational considerations. Digital filter design: IIR, FIR, window methods, use of analogue prototypes.

Laboratory Experiments:
DSP-1: Discrete-Time Signals and Systems
DSP-2: Frequency Response of Discrete-Time Systems
DSP-3: Digital Filter Design

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Electrical & Electronic Engineering	EE448	Power Electronics	5	1	1	2 hour exam

AC-DC conversion, phase controlled rectification.
DC-DC conversion; switch mode and quasi-resonant power supplies.
Power factor correction; active and passive.
Thermal design.
DC-AC conversion, PWM, bridge and resonant inverters.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Electrical & Electronic Engineering	EE451	System on Chip Design I	5	1	1	2 hour exam

Structured design workshop: design, HDL (capture, testbenching, simulation, logic synthesis), FPGA implementation and test of a modular, multi-component embedded digital system. Follows a structured design and documentation method, and applies related Electronic Design Automation (EDA) tools. Modules include: network and user I/O, synchronisation, finite state machines, handshaking, memory control, datapath handling, basic signal processing tasks.

Embedded FPGA System on Chip design and implementation.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Electrical & Electronic Engineering	EE453	Telecommunications Software Applications	5	1	1	2 hour exam

This module is designed to provide students with a detailed knowledge of the application of advanced software both within telecommunication networks and on user devices. Topics which will be examined include structure and operation of PSTN, intelligent network services, design and dimensioning of telephony networks, cellular network technologies, structure of cellular network, operations and services within cellular networks, user device app development, mobile phone based sensing

This module is designed to provide students with a detailed knowledge of the application of advanced software both within telecommunication networks and on user devices. Topics which will be examined include structure and operation of PSTN, intelligent network services, design and dimensioning of telephony networks, cellular network technologies, structure of cellular network, operations and services within cellular networks, user device app development, mobile phone based sensing
Laboratory session will include:
TSA-1 : Dimensioning of telephony network elements
TSA-2 : Introduction to Android application development
TSA-3 : Android apps: GPS sensor utilisation
TSA-4 : Accelerometer, battery and other sensors on Android platforms

ENERGY SYSTEMS ENGINEERING

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Energy	EG400	Advanced Energy Systems Engineering	5	1	1	Continuous Assessment

This module will introduce the fundamental engineering principles behind current and future energy technologies including combustion, gasification and electrochemistry, as well as economic analysis methods. These fundamentals will be combined with previously-acquired techniques to analyse complex energy systems such as conversion technologies (wind, solar, geothermal, waste-to-energy, CCS) and infrastructures (bioenergy, natural gas, hydrogen, water).

MECHANICAL ENGINEERING

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Mechanical Engineering	IE309	Operations Research	5	1	1	2 hour exam

1. Introduce students to the mathematical modelling approach to managerial decision making
2. Understand and appreciate the role of management science techniques in solving real life engineering and business problems
3. Adopt a scientific approach/philosophy to analyzing real life engineering management problems and generate optimal solutions
4. Have a sound base in the fundamentals of quantitative management science techniques and be able to apply these in problem solving
5. Develop students ability to analyse data in support of strategic decision making and contribute to decision making by advising management using the mathematical models introduced on this module

Mathematical modelling approach to managerial decision making
Linear programming
Sensitivity Analysis and scenario planning
Integer Programming
Transportation & Transhipment
Assignment
Network Flow Models
Multi-criteria Decision Making
Decision Analysis
Project Management, stakeholders, project evaluation and trade-offs, Tools for project managers
4-D and 7-S models and the project process

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Mechanical Engineering	IE446	Project Management	5	1	1	2 hour exam

This course focuses on the essential concepts and practical skills required for managing projects in dynamic environments. It aims to provide learners with a solid understanding of the fundamentals of project management and to equip them with effective tools that will empower them to meet their full potential in the area of project management thus enabling them to implement successful projects on time, within budget and to the highest possible standard.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Mechanical Engineering	IE447	Regulatory Affairs and Case Studies	10	Full year	2	2 hour exam

Product safety/liability legislation, medical device directive, FDA regulations & GMP, food safety & ISO22000, medical device risk assessment, machinery directive, SEVESO Directive, WEEE directive, social acountability standards, safety management and environmental management systems, relevant case studies.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Mechanical Engineering	IE450	Lean Systems	5	1	1	2 hour exam

Understanding business, value stream mapping, current state mapping, future state mapping, lean tools, lean balancing, lean layouts, action plans, lean problem solving, lean gaming, project work.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Mechanical Engineering	IE522	Safety and Risk Management	10	Full year	2	2 hour exam

Safety Management
Systems management of safety; safety principles, safety programmes, risk control, performance monitoring and evaluation. The system safety effort, life cycle phases and the system safety process. Legislative requirements, safety statements, accident prevention through system design, the process of task analysis, job safety analysis and system safety.

System Safety Analysis: Techniques and Methods
Preliminary hazard analysis, subsystem and system hazard analyses, operating and support hazard analysis, energy tree and barrier analysis, failure mode and effect analysis, functional hazard analysis, fault tree analysis, management oversight and risk tree, job safety analysis, reliability, fail safe and fail danger failures, high integrity protection systems, human reliability.

Safety Organization
Procedures for reducing the risk of injury and minimizing the consequences of dangerous occurrences, safety system organisation, first-aid and medical facilities, emergency use of protective equipment, fire and emergency drills, emergency planning.

The remaining lectures in this subject, primarily in the professional and practical aspects of the syllabus, will be given by various experts drawn from industry and state and semi- state bodies.

SectionII-SAFETYTECHNOLOGY

Safety Technology: Equipment
Mechanical hazards, non-mechanical hazards, risk assessment and machine design, guard design and construction, safety devices and interlocking, abrasive wheels, woodworking machines, automated machinery, pressure vessels, lifting machines, tools. CE marking.

Safety Technology: Systems
Maintenance, housekeeping, safe means of access and egress, safe place of work, transport. Safety management systems.

Construction Safety
Scaffolding, fall arrest systems, hazards specific to the construction industry. Responsibilities of project manager design stage and project manager construction stage.

Electrical Safety
Introduction to electrical systems, legislation and codes of practice, basic principles of electricity, static, A.C. and D.C. generation, transmission and distribution, fixed electrical installations, temporary electrical installations, electrical equipment for explosive, damp and corrosive atmospheres, electric shock, residual current circuit breakers, safety devices.

Chemical Safety
Chemical, radioactive, and biological emergencies, dust explosions, gas and vapor clouds, toxic waste storage, transport and disposal, transport of hazardous material, Seveso 11 Directive.

Fire Prevention, Fire Fighting, and Fire Escape
Current legal requirements, codes of practice, building regulations, identification of fire hazards in buildings, sources of ignition, factors affecting the spread of fire, smoke and toxic fumes, reduction of fire risk by design, effect of fire on buildings, finishes and furnishings, measures to reduce the risk of injury in a fire, fire detection and alarm systems, fire fighting equipment, means of escape, fire drills, human behaviour in fire situations.

Minimization of Consequences
Cost reduction due to injuries and damage. Investigation and analysis of hazardous incidents and near misses, principles of such investigations.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Mechanical Engineering	ME219	Design I	10	Full year	2	2 hour exam

This course has three sub-modules that provide the primary components of mechanical engineering design: (a) an introduction to the basic theory of mechanical components that are the core building blocks in mechanisms and machines and how they are modelled and analysed; (b) an introductory lecture and practical based course on workshop equipment and methods; (c) an intermediate level 3D CAD course providing instruction in the design and depiction of basic mechanisms and machines.

This module introduces students to design elements specific to mechanical engineering. In particular it exposes students to: mechanical components and elements and explains how they fundtion; how they are manufactured and assembled into usable configurations; how these mechanisms or machines may then be analysed kinematically and kinetically in order to evaluate displacements, speeds, accelerations and the accompanying forces; students also learn how to depict these components in professional standard drawings in 2D and 3D in plan, elevation, section and assembly views; the core elements of manufacturing basic components using standard workshop equipment and methods is also introduced. In summary the course provides the student with a grounding in design, analysis and CADD skills that are developed on in subsequent years.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Mechanical Engineering	ME220	Engineer in Society, Service Learning and Ethics	5	1	1	Continuous Assessment

This module is concerned with the role of the engineer in society, ethical behaviour of engineers, health and safety matters and developing a community awareness in students about how engineering can contribute directly to society. A key part of the module is the Community Awareness Initiatives Responsibly Directed by Engineers (CAIRDE) project culminating in a engineering community action poster presentation.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Mechanical Engineering	ME223	Thermodynamics & Fluid Mechanics	5	1	1	2 hour exam

Introduction to the fundamental aspects of thermofluid mechanics in engineering. Basic language, scope and applications; thermofluid systems, system boundaries; control volume concept; concepts of mass, momentum, heat, work, energy and entropy in thermofluid systems, control volumes & cycles; conservation laws; physical & thermodynamic properties, behaviours and models of substances; fluid forces, statics and dynamics; relating velocity & pressure; problem-solving techniques, applications.

This module introduces all engineering students to the essential fundamental aspects of thermofluids engineering. The module covers: physical and thermodynamic properties and models for fluids and solids; identification of systems and system boundaries; mass, momentum, energy and entropy storage and transfers; application of the laws of conservation of mass, momentum, energy and entropy to thermofluid systems and cycles; fluid statics and dynamics; problem-solving techniques.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Mechanical Engineering	ME301	Fluid Dynamics	5	1	1	2 hour exam

Governing differential equations of flow – continuity, momentum and energy; Navier-Stokes equation. Simplified concepts, stream function and potential flows. Dimensional analysis and similarity; dimensionless groups; modelling and experimental fluid mechanics. Laminar, transitional and turbulent flows; Reynolds number regimes in internal and external flows; the time-averaged equations. The speed of sound, acoustics and compressible flow regimes. Internal compressible flows; steady adiabatic and isentropic flows; effects of area changes; normal-shock waves; converging and diverging nozzle flows. Viscous flow in ducts; frictional pressure losses; component losses; diffusers; flow metering. Viscous external flows; boundary layers; external forces on immersed bodies – drag, lift. Idealised plane-flows; elemental solutions, superposition, images. Unsteady flows; vortex shedding, aeroacoustics and forcing; added mass.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Mechanical Engineering	ME347	Mechanical Vibrations	5	1	1	2 hour exam

Basics of vibrations, translational and rotational systems, equivalence of masses and springs, free vibration of undamped systems, critically-damped, under and over-damped systems, forced vibration of single DOF systems, theory of harmonic excitation, vibration isolation and vibration measurement, 2-DOF vibrational systems, multi-DOF systems, numerical methods, eigenvalues and eigenvectors, modal analysis, computational analysis of multi-DOF vibrational problems.

This module analyses the vibration of mechanical systems. Single and multi-degree of freedom mechanical systems are modelled in free and forced vibration, enabling the student to understand the concepts of harmonic vibration, viscous damping, resonance, natural frequencies, mode shapes and vibration measurement and suppression. Coursework is supplemented by laboratory experiments and computational modelling

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Mechanical Engineering	ME351	Design II	15	Full year	Spring	Continuous Assessment

Design II integrates core mechanical elements in an individual machine design project that goes from specification, detailed design and analysis to final working drawings. Typically designs include electric motor driven hoists, pumps, presses, etc. The course also incorporates: a taught 3D CADD module for design representation to BS8888 standards; a taught communications module to teach written and verbal project presentation skills to a professional standard.

This subject covers the fundamentals of engineering planning and decision making, the mathematical and analytical tools required, and the subject matter employed in using these tools. These fundamentals are applied to a variety of engineering design situations. Application of mathematics, materials sciences and engineering mechanics to problems in the analysis and design of mechanical elements; consideration of product specification, manufacturing methods, safety and economic factors. Detailed design of a selection of machine components is covered based on analytical solutions, empirical techniques and test results. The third year design project is used to integrate in one project a number of elements that the students have acquired through 1st, 2nd and 3rd year including: workshop practice, design, CADD, mechanics of solids, mechanical analysis and design, communication and report writing skills.

As part of this course an additional module in 3-D CADD is taught. This enables the student further develop their Design and Drafting skills from the 1st and 2nd Year CADD I & II courses. A detailed course outline for the 20 hours of lecture and practicals taken in the 1st semester of 3rd year is provided below.

The course requires the conceptual design of a functional machine. The ultimate aim of the project is that the student designs the machine to a professional level and in sufficient detail that it could be manufactured in a workshop as a prototype. The design should be presented primarily in 2D format and must obey all conventions in basic drawing techniques including sketching, projections & views; auxiliary views, section views, production drawings, dimensioning. All parts should be correctly toleranced in accordance with best practices. Assemblies for the machine, derivative parts list and component detailed drawings are required. Where possible the design should make use of standard library components – fasteners, bolts, circlips, bearings, gears, electric motors, pulleys, taper-locks, dowels, belts, etc. The allocation date is typically mid-Sept with a submission date in the 2nd Semester. Each student is required to do his or her work in as individual and as professional a manner as possible. Project parameters are varied so that in effect each student receives a different project reducing the opportunity for plagiarism and copying. Each design is submitted as drawings and a report. The report details the design procedure with clarification and justification of decisions made as well as containing all design calculations including dynamic and stress analysis. All texts must be done using MS Word. A complete project should be capable of being handed to a craftsman or workshop for fabrication, i.e., it should be self-explanatory and complete. Where material from another source is used e.g., a manual, journal, paper etc. this should be indicated in accordance with standard convention relating to references.

Students are required to present their projects key findings using powerpoint slides in a group setting. This requires them to practice skills taught in the Communications module of Design II. A question and answer session follows and introduces them to a typical design team environment where all aspects of one's work may be queried.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Mechanical Engineering	ME353	Quality Systems	5	1	1	2 hour exam

Quality management systems (e.g. ISO9001), Six sigma philosophy, basic statistical quality control, tools for quality improvement, process capability analysis, Kaizen, quality costs, quality auditing, key influences on quality (Deming, Juran, Ishakawa, Crosby etc), Quality in a regulated sector e.g. Medical Devices.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Mechanical Engineering	ME355	Mechanical Design I for Sports & Exercise	5	1	1	2 hour exam

This course has three sub-modules that provide the primary components of mechanical engineering design: (a) an introduction to the basic theory of mechanical components that are the core building blocks in mechanisms and machines and how they are modelled and analysed; (b) an introductory level 3D CAD course providing instruction in the design and depiction of basic mechanisms and machines.

This module introduces students to design elements specific to mechanical engineering. In particular it exposes students to: mechanical components and elements and explains how they fundtion; how they are manufactured and assembled into usable configurations; how these mechanisms or machines may then be analysed kinematically and kinetically in order to evaluate displacements, speeds, accelerations and the accompanying forces; students also learn how to depict these components in professional standard drawings in 2D and 3D in plan, elevation, section and assembly views. In summary the course provides the student with a grounding in design, analysis and CADD skills that are developed on in subsequent years.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Mechanical Engineering	ME402	Advanced Mechanical Analysis And Design	5	1	1	2 hour exam

Analytical methods applied to mechanical design; stress and strain analysis, linear and non-linear problems, constitutive laws, mathematical modelling of mechanical systems, system optimisation and reliability; multi-body contact. Applications to the design of beams, frames, pressure vessels, machine parts, thin plates and multi- body systems.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Mechanical Engineering	ME420	PEP Report & Project	15	Full year	2	Project

All PEP students are required to give a presentation on the work experience they have gained while on placement. The presentation is given when the student returns to the university and the audience consists of class members and academic staff. PEP students are also required to submit a written report in a format specified for them before going on placement.

Each student is assigned an individual project at the start of the academic year based on work done during industrial placement or topics assigned by staff members. Assessment is based on a comprehensive final report and oral presentation of the project results to the class and staff.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Mechanical Engineering	ME424	Energy Conversion	5	1	1	2 hour exam

Review of conduction and radiation heat transfer. Review of thermodynamics. Convection heat transfer – physical mechanisms, development and use of empirical correlations. Review of the Rankine cycle and modifications (regeneration and reheat). Review of air standard cycles. Heating, ventilation, air conditioning and refrigeration. Renewable energy technologies. Case study for integrated application of thermodynamics and heat transfer tools in design/analysis of complex energy technology (e.g. gas turbine engine, hybrid electric vehicle). Design/analysis project: each student will carry out a detailed analysis or design on a chosen energy technology, following the model of the above case study. Laboratory assignments: internal combustion engine, experiment in convection heat transfer, CFD computation of convective heat transfer.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Mechanical Engineering	ME425	Project	10	Full year	2	Project

Based at NUI Galway, this programme aims to provide the students with a specific research project, and to equip them with the skills necessary for their research career. On successful completion of this subject, the student will have demonstrated his/her ability to:
1) Give an academic level presentation on their research project outlining the research project background, a reflection of skills and knowledge acquired, a reflection on their contribution to the project.
2) Complete a significant engineering project that involves one or more of the following aspects: literature searching and understanding, design and analysis, experimental testing, mathematical modelling, biomaterials characterisation, product manufacture, process development.
3) Produce a comprehensive and substantial engineering project report, which describes project objectives, background, test methods, results, discussion and conclusion.
4) Give a presentation supported by the use of an overhead projector, at an early stage of the project. Produce a GANTT chart to support this early presentation.
5) Maintain a laboratory book throughout the project.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Mechanical Engineering	ME428	The Erasmus and International Student Project	10	1	1	Project

Based at NUI Galway, this module aims to provide the students with a specific research project, and to equip them with the skills necessary for their research career. On successful completion of this subject, the student will have demonstrated his/her ability to:

1) Give an academic level presentation on their research project outlining the research project background, a reflection of skills and knowledge acquired, a reflection on their contribution to the project.

2) Complete a significant engineering project that involves one or more of the following aspects: literature searching and understanding, design and analysis, experimental testing, mathematical modelling, biomaterials characterisation, product manufacture, process development.

3) Produce a comprehensive and substantial engineering project report, which describes project objectives, background, test methods, results, discussion and conclusion.

4) Give a presentation supported by the use of an overhead projector, at an early stage of the project. Produce a GANTT chart to support this early presentation.

5) Maintain a laboratory book throughout the project.

Discipline	Module Code	Module Title	ECTS	Taught in Semester	Examined in Semester	Examination Arrangements
Mechanical Engineering	ME431	Systems Reliability	5	1	1	2 hour exam

Reliability analysis. Probabilistic modelling. Analysis of reliability data. Reliability modelling, Reliability management. Markov models. High integrity protective systems. Monte Carlo Method. Maintenance modelling.