# SEMESTER 2, 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 | BME200 | Introduction to Biomaterials | 5 | 2 | 2 | Continuous Assessment |

The course will discuss the complexity of biological systems and the imposing need to design and develop biomaterial-based therapies to address currently unmet clinical needs. The course will cover biomaterial fabrication methods and in vitro and in vivo assessment of thereof.

This course integrates the principles and methods of engineering, biology, biochemistry and clinical sciences towards the repair and regeneration of degenerative or injured tissues.

The course is designed to provide foundamental information on the complexity of living tissues and biomaterial-based strategies that will enable restoration of tissue functions that have been lost due to injuries or degenerative conditions.

Sources of raw materials for biomedical applications; design principles; nano- and micro-fabrication technologies; in vitro and in vivo analysis; clinical translation; and ethical issues related to biomaterials development will be discussed and analysed in detail.

Individual and group projects will be undertaken aiming to develop a therapeutic strategy for an unmet clinical need.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Biomedical Engineering | BME327 | Materials II | 5 | 2 | Spring | 2 hour exam |

Structure and classification of metals, elasticity, plasticity, dislocations, strain-hardening, alloying, recrystallisation, phase diagrams, heat treatment, metal forming, casting, forging, powder metallurgy, ferrous and non-ferrous metals and alloys, tensile and hardness measurements.
Classification and properties of polymers, polymer processing (extrusion, injection moulding, blow moulding, rotational moulding, thermoforming, compression moulding) and polymer rheology and failure.

This module develops a detailed understanding of the compositions and structures of metals and polymers and relates these characteristics to mechanical and physical performance. A wide range of metal and polymer processing techniques are reviewed; the influence of processing on function and performance is addressed.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Biomedical Engineering | BME403 | Medical Implant and Device Design | 5 | 2 | 2 | 2 hour exam |

This course integrates and applies the principlies of engineering to the analysis and design of medical implants and devices, incorporating biomechanics, materials science, anatomy and physiology.

Fundamentals of medical implant design; Design specifications of medical devices; Load sharing and stress analysis of orthopaedic implants; Wear and fatigue in orthopaedic implants (fracture fixators, total joint prostheses, surgical tools); Theory of metal plasticity; Analysis and prediction of fatigue failure; Analysis and design of stents and guidewires; Mechanical behaviour of Nitinol; Design of cochlear and middle ear implants; Design of mechanical bioreactors for tissue engineering applications; Design of spinal implants; Design of dental implants; Design of assistive and rehabilitative medical devices (wheelchair, prosthetic and orthotic devices); Biosensors; Mechanical testing of medical devices; Finite element analysis and design of stents; Mechanical behaviour of Nitinol.

# CIVIL ENGINEERING

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Civil Engineering | CE221 | Building systems | 5 | 2 | 2 | 2 hour exam |

The course is designed to introduce students to the basic principles of building with the aim of creating a sound fundamental knowledge that will be enlarged upon in subsequent years.

The subject matter covers the structure of the building team; planning and development acts, byelaws and building regulations; ground works, drainage and foundations, superstructures and stability; floor, wall and roof types; construction methods and the appropriate use of materials including steel, concrete, masonry and timber. Principles of building physics include heat and sound insulation, ventilation and light provision. Sanitary and other building services, architectural principles and internal and external finishes are also covered.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Civil Engineering | CE222 | Civil Engineering Materials & Design | 5 | 2 | 2 | 2 hour exam |

Coursework
Concrete Technology – Introduction; Cements; Aggregates; Properties of fresh and hardened concrete; Specification, testing and compliance; Durability; Site Practise; Mix Design
Concrete Laboratories

Working in groups, students must participate in 4 linked laboratory experiments relating to Concrete Technology. These involve:

1. The classification of fine, 10mm and 20mm single size aggregates by selecting and preparing test samples and conducting sieve analysis
2. Use of the results of the above to design a concrete mix of specified characteristic 28 day cube strength and consistence, batching and mixing the concrete, conducting three different consistence tests on the fresh concrete, casting and compacting a range of test specimens including cubes, cylinders and beams
3. Assessing 7-day density, cube strength, Schmidt hammer readings and USPV times
4. Assessing 28-day density, cube strength, modulus of elasticity, indirect tensile strength by both bending and cylinder splitting.
5. Timber Engineering and Design
6. Timber properties; Structural grading; Engineered wood products;
7. Basis of Structural Design; Introduction to Eurocodes; Limit states; Design of flexural members to EC5; Design of axially loaded members to EC5
8. Timber Laboratory
9. Testing of timber elements in flexure to EN408; Engineered wood products lab.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Civil Engineering | CE224 | Engineering Hydraulics I | 5 | 2 | 2 | 2 hour exam |

Lecture Content:
• Buoyancy and stability
• Theorems on conservation of mass, momentum and energy
• Flow measurement
• Forces exerted by moving fluids
• Energy losses in pipe flow
• Simple pipe flow systems (single, series, parallel, simple branching)
• Introduction to open channel flow

Laboratories:
The following six experiments are carried out in a hands-on manner by students working in small groups:
1. Examination and calibration of thin plate weirs.
2. Open channel flow, validation of Chezy and Manning formulae, calibration of C and n.

3. Laminar and turbulent pipe flow, hydraulic gradient, relation between hydraulic gradient and velocity, use of laminar flow to determine fluid viscosity.
4. Friction and form / shock losses in a small bore pipeline.
5. Force exerted by a jet of fluid on a plane or curved surface (Momentum Principle or Bulk Flow Eqn.).
6. Venturi section, conversion of pressure head to velocity head and vice versa, use and calibration of a Venturi section as a flow meter.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Civil Engineering | CE226 | Principles of Building | 10 | 2 | 2 | 2 hour exam |

The course is designed to introduce students to the basic principles of building with the aim of creating a sound fundamental knowledge that will be enlarged upon in subsequent years.

The subject matter covers the structure of the building team; planning and development acts, byelaws and building regulations; ground works, drainage and foundations, superstructures and stability; floor, wall and roof types; construction methods and the appropriate use of materials including steel, concrete, masonry and timber. Principles of building physics include heat and sound insulation, ventilation and light provision. Sanitary and other building services, architectural principles and internal and external finishes are also covered.

A requirement of this module is that students complete a community-based engineering project in groups of two or three. Each group researches one particular aspect of the building process that relates directly to a real need in the community. Several groups can work on a single community-based project, with each group researching a different aspect of the building process for that project. This is written up in the form of a professional report to a client, or as information for inclusion in a technical encyclopaedia, or as an article for communicating with the engineering community at large. Each member of the group must make a short oral presentation of the finding from their project using PowerPoint. If appropriate, students in subsequent years can further develop and advance the work completed by their colleagues.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Civil Engineering | CE334 | Construction Operations | 5 | 2 | Spring | 2 hour exam |

This course is designed to give the student an appreciation of all of the key stages involved in a construction project. The module is delivered by industry practitioners with different backgrounds - so the involvement of consultants, contractors, local authority engineers and architects is conveyed.

Topics include: contractual roles and relationships, contracts and contract documents, construction planning and control, health, safety and welfare in construction, disputes, claims and arbitration, budgeting, legal and planning environment, roles and responsibilities of contractor, consultant and local authority in construction, project supervision (projects carried out by contractor), safety in the construction sector, new forms of contract, Public Private Partnerships, public interaction

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Civil Engineering | CE337 | Introduction to Geomechanics | 5 | 2 | 2 | 2 hour exam |

This module provides an introduction to soil as an engineering material, and it includes some of the basic mechanics of soil behaviour. The context of soil behaviour is set by considering soil origin, mineralogy, phase relations, gradings and plasticity. The main mechanics components of the module are covered in six further sections: earthworks and compaction, effective stress, groundwater, permeability and seepage, 1-D consolidation, shear strength and lateral earth pressures.

Origin and mineralogy of soils, phase relations, gradings, plasticity, earthworks and compaction, effective stress, groundwater, permeability and seepage, 1-D consolidation and settlement, shear strength, lateral earth pressures and retaining walls

Laboratories:
Students must participate (in groups of 4 or less) in the following laboratory sessions:
(1) soil identification, classification, index properties and gradings,

(2) shear box test
(3) oedometer test
(4) dam seepage experiment

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Civil Engineering | CE344 | Transportation Systems and Infrastructure I | 5 | 2 | Spring | 2 hour exam |

This module introduces the planning, design and operation of Transport systems and related infrastructure. An initial focus is placed on Highway and Traffic Engineering with topics including highway design and traffic engineering. The module also covers Environmental Impact Assessments for infrastructural projects. Emphasis is also placed on the sustainable design with an introduction to concepts including the embodied carbon and carbon footprint (with an emphasis transport infrastructure).

1. Transport history, planning highways
2. Predicting future highway demand
3. Analyses of highway projects: Cost benefit analyses and environmental appraisal.
4. Design of highways and roads: sight distance, horizontal and vertical alignment, transition curves, design speeds, junctions, roundabouts
5. Pavements, pavement materials
6. Traffic systems Engineering
7. Energy & Transport: embodied energy in road materials, carbon emissions during construction of infrastructure
8. Environmental Impact Statements (assessments) for Infrastructural Projects

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Civil Engineering | CE469 | Hydrology and Water Resource Engineering | 5 | 2 | 2 | 2 hour exam |

This module introduces students to theory and practice of engineering hydrology and how these are applied to water resource engineering.

Physical and chemical properties of water
- Flow routing through reservoirs and lakes
- Unit Hydrograph
- Water quality in the natural environment
- Hydrological and energy cycles
- Hydrological frequency analysis
- Precipitation measurement
- Streamflow measurement
- Hydrometric data, flow duration curves, mean daily flows, waterbalance and water resources
- Climate change
- Evaporation and evaporation measurement
- Groundwater – hydrogeology

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Civil Engineering | CE472 | Structural Analysis | **5** | **2** | **2** | **2 hour exam** |

This module follows on from the structures modules in 3rd year and the students receive additional lectures on moment distribution in addition to the stiffness method, the concepts associated with shear walls and a brief introduction to the finite element method. Students will also be required to carry out a number of laboratory assignments that are used to illustrate the theoretical concepts from the coursework.

Lectures:
1. Moment distribution – this section presents the background and application of the moment distribution method for both non-sway and sway induced deformations.
2. Stiffness matrix method – stiffness method introduced and the stiffness matrix for plane frames developed. Several applications of the method are presented for various configurations of plane frames
3. Shear wall analysis – the theory and analysis of shear walls is presented in this section. The applications of the theory to important structural elements are presented.

4. Finite element methods – fundamental principles. Some simple examples. Interpretation of results.
Laboratory
Students work in groups to carry out four 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.
- Experiments on a shear web with strain gauge rosettes.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Civil Engineering | CE475 | Sustainable Energy and Energy in Buildings | 5 | 2 | 2 | 2 hour exam |

This module comprises two sections. Section A introduces students to sustainable energy resources, e.g. solar, wind and hydro, looking primarily at how the available resource can quantified and how it can be harnessed. Section B introduces students to energy use in buildings required to support the effective provision and maintenence of thermal, visual and acoustic comfort.

Section A - Sustainable Energy:
This section of the subject is an introduction to sustainable energy. The course covers various sustainable energy resources, including wind, solar, hydropower and geothermal from the point of view of quantification of the available resource, the energy conversion technologies used to harness them and the environmental impacts resulting from their use. World and national energy usage patterns are also examined as is the sustainability of tradional fuel supplies, e.g. fossil and nuclear fuels.

Section B- Energy in Buildings:
This section is an introduction to energy systems in buildings. The course describes the inter-relationships between building physics, human occupant behaviour and energy systems required to support the efective provision and maintenance of thermal, visual and acoustic comfort. Optimum states of comfort are defined including the necessary physical measurement and control infrastructure. Systematic procedures for the analysis of thermal comfort metrics and design principles of sustainable and smart buildings including conventional and renewable energy systems are presented. The content delivered in Section B is structured to consist of lectures in parallell with a laboratory element that provides the incremental development of energy simulation models that addresses the content in the lecture part of Section B utilising real world buildings including a number of buildings on the NUI Galway campus.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Civil Engineering | CE477 | Theoretical and Applied Geomechanics | **10** | **2** | **2** | **2 hour exam** |

This module supplements the introductory geomechanics material in 3rd year with additional theoretical content in the areas of seepage, consolidation, shear strength and lateral earth pressures. Shear strength and consolidation are unified under a new stress path and critical state theory framework. Additional material covered includes the design of shallow and deep foundations to EC7, slopes and retaining walls. In situ testing is also covered.

Lectures:
Seepage in anisotropic and layered soils, 1-D Consolidation and applications (surcharging, vertical drains), shear strength, stress paths and critical state soil mechanics, slope stability, bearing capacity of deep and shallow foundations, stresses and displacements, retaining walls, in-situ testing, introduction to geo-environmental engineering

Laboratory:
1. Examine time-settlement characteristics of a soil in an oedometer
2. Carry out a consolidated drained triaxial test on a sand
3. Carry out an unconsolidated undrained triaxial compression test on a clay.

# INFORMATION TECHNOLOGY

| Discipline | Course Code | Module Title | ECTS Credits | Taught in Semester | Examined in Semester | Duration of exam (hours) |
|---|---|---|---|---|---|---|
| Information Technology | CT112 | Programming and Logical Foundations II | 5 | 2 | 2 | 2 |

This course further develops the students' study of computer programming in a high-level language, i.e. Python. It covers some more advanced programming concepts and applies the students' knowledge to more complex problem sets.

| Discipline | Course | Module Title | ECTS | Taught in Semester | Examined in Semester | Duration of exam (hours) |
|---|---|---|---|---|---|---|
| Information Technology | CT243 | Data Structures | 5 | 2 | 2 | 2 hour exam & assignment |

More advanced programming development. Fundamental data structures: lists, stacks, queues and trees. Efficiency analysis. File handling and processing. Hash tables. Practical program development using these data structures and algorithms.

| Discipline | Course | Module Title | ECTS | Taught in Semester | Examined in Semester | Duration of exam (hours) |
|---|---|---|---|---|---|---|
| Information Technology | CT244 | Information Systems II | 5 | 2 | 2 | 2 hour exam & assignment |

Web based information: history of the internet, other issues, current trends. Web based information retrieval and web search engines. Collaborative retrieval and filtering. Social information systems. Practical application development. Other issues.

| Discipline | Course | Module Title | ECTS | Taught in Semester | Examined in Semester | Duration of exam (hours) |
|---|---|---|---|---|---|---|
| Information Technology | CT245 | Technological Frameworks II | 5 | 2 | 2 | 2 hour exam & assignment |

This course examines modern digital communications, both how they work and how they are applied. Students should gain an understanding of the technical operation of telecommunications, and appreciation of the work carried out by the network administrator of a local area network. On a broader scale, they take a critical view of the role of the internet in our lives. They also research network security issues.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Information Technology | CT248 | Introduction to Modelling | 5 | 2 | 2 | 2 hour exam |

Introduction to Matlab: Data input & output, Manipulating Matrices, Data Visualisation, Programming constructs, Matlab functions and scripts, Introduction to Matlab OO classes. Introduction to Simulink, Basic Model Design &

Implementation, Modelling Dynamic Control Systems, Strong emphasis on Energy Systems Case Studies both in lectures and associated labwork.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Information Technology | CT420 | Real Time Systems | 5 | 2 | 2 | 2 hour exam |

Real-time operating systems: Multi-tasking; co-ordination – semaphores, mutexes and signals; process message passing and task communication; concurrency; real-time scheduling; real-time system design; Petri nets; Standards POSIX; Operating systems QNX; developing real-time systems; debugging and testing real-time systems; verification of real-time system performance.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Information Technology | CT436 | Advanced Professional Skills | 5 | 2 | 2 | Continuous Assessment |

Developing good interpersonal and group skills whilst examining the role of professional software engineers in society. A primary objective is to integrate and expand upon IT and Business skills. Support is provided in the areas of creativity and innovation, funding and planning. The module also examines ethical issues and the social impact of computing, with an emphasis on the responsibilities of the professional software engineer in maintaining good practice in systems development.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Information Technology | CT437 | Computer Security and Forensic Computing | 5 | 2 | 2 | 2 hour exam |

Computer security. Risk assessment. Policies, procedures. Audit. Incident handeling. Intrusion detection. Honeynets. Firewalls. Filters. Phishing. Cryptogtraphy. Steganography. Information visualisation. Computer forensics and computer crime. Evidence: acquiring, analysing, reporting. Forensic toolkits.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Information Technology | CT475 | Machine Learning and Data Mining | 5 | 2 | 2 | 2 hour exam |

Machine Learning is concerned with developing algorithms that improve their performance over time, as they are exposed to new data. Data mining is concerned with the related task of extracting interesting information from large, unstructured data sources. This module introduces learners to the different categories of machine learning task and limportant agorithms for tackling them. The learners get practice in selecting and applying these algorithms in practical data mining problems, evaluating.

Definitions of Machine Learning, Data Mining and the relationship between them; the CRISP Data Mining process model; major tasks including classification, regression, clustering, association learning, feature selection, and reinforcement learning; algorithms for these tasks including decision tree learning, instance-based learning, probabilistic learning, support vector machines, neural networks, association rule mining, and Q-learning; open-source software tools for data mining; practical applications such as object recognition, healthcare data analysis, and text mining to identify spam email; ethical issues and emerging trends in data mining and machine learning.

| Discipline | Course | Module Title | ECTS | Taught in Semester | Examined in Semester | Duration of exam (hours) |
|---|---|---|---|---|---|---|
| Information Technology | CT866+ | Networks and Computer Communication | 5 | 2 | 2 | 2 hour exam & assignment |

Basic data communication. Transmission. Protocols. Networking. Distributed Systems.

+These modules are options chosen by NUI Galway undergraduates. Some of these options may not be available in any particular year.

# ELECTRICAL & ELECTRONIC ENGINEERING

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Electronic Engineering | EE219 | Analogue Systems Design I | 5 | 2 | 2 | 2 hour exam |

Introduction to semiconductor physics, diodes, real characteristics; Diode-Reactive Circuits; Bipolar Junction Transistor, Biasing; Common Emitter Amplifier, Box Model, Emitter Follower (The Common Collector Amplifier), Improved BJT AC Models; Field Effect Transistor, JFET, MOSFET, AC behaviour and applications; Operational Amplifier, Operational Amplifier Circuits, Frequency Response, Active Filters, amplifier applications.

Introduction to semiconductor physics, diodes, real characteristics; Diode-Reactive Circuits; Bipolar Junction Transistor, Biasing; Common Emitter Amplifier, Box Model, Emitter Follower (The Common Collector Amplifier), Improved BJT AC Models; Field Effect Transistor, JFET, MOSFET, AC behaviour and applications; Operational Amplifier, Operational Amplifier Circuits, Frequency Response, Active Filters, amplifier applications

Laboratories:

ASD1-1 BJT – linear biasing and common emitter amplifier
ASD1-2 JFET circuits and drain characteristics
ASD1-3 Enhancement mode MOSFET
ASD1-4 Op-Amp non-inverting amplifier configuration
ASD1-5 Op-Amp frequency response

Assignments: Circuit simulations using SPICE, MultiSim or CircuitLab

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Electronic Engineering | EE220 | Digital Systems I | 5 | 2 | 2 | 2 hour exam |

This module covers the fundamentals of digital design using discrete gates. Students design simple combinational logic circuits, and incrementally build towards the design of sequential systems. Students also incorporate the electrical behaviour of digital logic circuitry into their designs.

Binary codes, error detection and correction. Combinational logic design, system design using medium-scale integration devices. Sequential system design, state machines. Electrical behaviour of logic circuits, timing, power dissipation. Computer number systems, data formats, data structures,

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Electronic Engineering | EE224 | Microprocessor Systems Engineering | 5 | 2 | 2 | 2 hour exam |

This module covers the fundamentals of computer architectures, and embedded systems design. The students learn to program an embedded system and learn how to interface to analogue and digital peripherals. The students work in groups on a project involving an embedded system for a practical application.

Computer systems, peripherals, computer internals, storage and I/O devices, data communications, networking, operating systems. Introduction to assembly and high level language programming. Interrupts, timers, serial communications. Interfacing to LCD/Keypad. ADC/DAC, sensor applications

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Electronic Engineering | EE232 | Fundamentals of Electromagnetic Theory | 5 | 2 | Spring | 2 hour exam |

The module should provide you with an understanding of the physics embodied in Maxwell's equations and teach you how to solve them in a number of situations. The module also prepares you for future modules on electromagnetism in the third and fourth years.
By the end of the module you should understand the significance of all the various quantities which appear in Maxwell's equations and those derived from them like the Poynting vector and refractive index.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Electronic Engineering | EE342 | Analogue Systems Design II | 5 | 2 | Spring | 2 hour exam |

This module introduces you to more complex aspects of analog systems design. We consider multi-stage amplifiers and a range of non-linear circuits. An introduction to the Miller effect and high-frequency transistor circuit design is also given.

(1) analyze and design a range of non-linear single transistor circuits
(2) analyze and design two-stage transistor amplifiers and differential amplifiers
(3) determine the theoretical and practical energy efficiency of various classes of transistor amplifier
(4) explain the advantages of a differential transistor amplifier over a conventional common-emitter transistor amplifier
(5) analyze and design three-stage amplifiers with a current gain stage
(6) analyze and design a range of non-linear op-amp circuits for analog computation
(7) analyze and design Schmitt Trigger circuits with hysterisis
(8) design astable oscillators using transistors or op-amps
(9) design class B and AB transistor amplifiers to meet various performance criteria
(10) explain the Miller effect and how it affects high-frequency transistor circuits
(11) explain the theory and advantages of cascode amplifier configuration for high-frequency amplifiers and filters; design a basic cascode amplifier
(12) analyze and design high-performance filters using op-amps
(13) analyze and design logarithmic and exponential amplifiers
(14) analyze and explain the basic 741 op-amp circuitry at a transistor amplifier level
(15) explain and analyze various op-amp circuits that provide negative impedance or convert capacitative circuits into inductive components

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Electronic Engineering | EE343 | Communication Signals and Systems | 5 | 2 | Spring | 2 hour exam |

This modules provides a detailed examination of topics relating to communication signals and systems such as: Transport layer protocols, UDP, TCP, Local area networking, network topologies, medium access control, inter- and intra-LAN connectivity, satellite networking technology, DCME technology, Amplitude Modulation (AM), Frequency Modulation (FM), digital modulation.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Electronic Engineering | EE347 | Embedded Systems Applications | 5 | 2 | Spring | 2 hour exam |

This module introduces you to POSIX based systems; concepts of data-sharing and multi-tasking systems; various embedded systems architectures; round robin, priority queue-based and real-time operating systems; programming concepts used in embedded systems are introduced and explained; common design flaws are explained and demonstrated; the role of interrupts and a range of hardware/software issues are also explored.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Electronic Engineering | EE348 | Engineering Electromagnetics | 5 | 2 | Spring | 2 hour exam |

This is a mid-level course in Engineering ElectroMagnetics. It replaces the former module Electromagnetics & Instrumentation. The module should provide you with an understanding of how EM Fields generate Electromagnetic Waves; a range of wave phenomena will be covered including Transmission Line Theory, Travelling and Guided EM Waves, Reflection, Refraction and Polarization of EM Waves, Antennas, Microwave Systems and EM Interference (EMI).

1. explain the physical meanings of the differential equations for electrostatic and magnetostatic fields
2. calculate the electric field from the stationary charge distributions and magnetic fields from steady current distributions
3. solve simple electrostatic boundary value problems
4. describe and use simple models of electric and magnetic field interactions with materials
5. explain the concept of electromotive force
6. write down Maxwell's equations and explain their physical meanings
7. analyze how energy and momentum is stored and transported in an electromagnetic field
8. analyze the propagation, reflection and transmission of plane waves
9. analyze propagation in simple types of waveguides
10. use Maxwell's equations to analyze the electromagnetic fields generated by given dynamic charge/current distributions
11. calculate the radiation fields from simple types of antennas and antenna systems
12. use s-parameters to analyze a range of EM systems

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Electronic Engineering | EE349 | Exercise Prescription & Programming | 5 | 2 | Spring | 2 hour exam |

This module focuses on the benefits of exercise. It will explore the principles and rationale for safe and effective exercise for different populations.

Methods of assessment, exercise prescription, and programmes of exercise will be discussed in accordance with the American Council on Exercise (ACE) guidelines. Course material will be available online in blackboard.

1. Recognise the benefits of exercise activity for persons
2. Perform graded exercise testing
3. Select appropriate exercise activities according to recognised American Council on Exercise (ACE) guidelines
4. Apply the principles of exercise programming to enhance quality of life

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Electronic Engineering | EE351 | Kinesiology of Human Movement | 5 | 2 | Spring | 2 hour exam |

This course focuses on the science of human movement and the electronic instrumentation used to measure different aspects of human movement both health and pathological. Learners will investigate the different aspects of the human gait cycle, temporal parameters of gait, electromyography, use of accelerometrt in human movement studies and FES. This course will feature a combination of theoretical and practical laboratory activities. Course material will be available online in blackboard.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Electronic Engineering | EE354 | Power, Machines & Control | 5 | 2 | Spring | 2 hour exam |

Topics in power & machines include AC induction machines, synchronous & fractional horsepower motors and an introduction to power quality issues & measures.
Control material is focussed on digital control systems; including z-plane representation, frequency folding effects and digital emulation techniques.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Electronic Engineering | EE356 | Sports & Exercise Psychology | 5 | 2 | Spring | 2 hour exam |

This module will explore the psychological aspects underlining sports and exercise performance, health and rehabilitation. It will examine factors that affect individual behaviour, participation, and adherence to exercise as well

as the mental aspects of sports performance. The module features a combination of theoretical and practical components.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Electronic Engineering | EE441 | Advanced RF Engineering Electromagnetics | 5 | 2 | 2 | 2 hour exam |

Advanced Antenna Theory: Hertzian Dipole; Small Loop Antennas; Half-Wave Dipole; Image Theory.Antenna Arrays: Pair of Hertzian Dipoles; N-Element Arrays; Parasitic Arrays; Friis Transmission Equation; Polarization Effects and Receiver Matching; Radar Techniques.Antennae for Wireless Communications: Parabolic Reflectors; Patch Antennae; slot Antennae; Folded Dipole Antennae.Microwave Engineering: Scattering Parameters; Couplers and Dividers; Filters: Amplifiers; Receiver Design; Oscillators.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Electronic Engineering | EE442 | Advanced Power Electronics | 5 | 2 | 2 | 2 hour exam |

Review of AC/DC and DC/DC converters, 3-phase inverters, motor drives, high frequency magnetic design, power semiconductors & applications, power electronics for computing loads, power electronics for renewable energy systems.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Electronic Engineering | EE444 | Communications and Signal Processing Applications | 5 | 2 | 2 | 2 hour exam |

This module covers a range of applications of Digital Signal Processing (DSP) and communications technology, including: multirate DSP, speech processing, adaptive filters, biomedical signal processing, Quality of Service (QoS) and other advanced IP networking topics, Voice and Multimedia over packet, Security infrastructure and algorithms, application of mobile phone based sensing.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Electronic Engineering | EE450 | Power Systems | 5 | 2 | 2 | 2 hour exam |

Sources of energy, renewable energy systems. Three-phase transformers. Transmission lines. Power and load flow. Symmetrical components and unsymmetrical faults. System protection. Synchronous generators, transient analysis and stability.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Electronic Engineering | EE452 | System on Chip Design II | 5 | 2 | 2 | 2 hour exam |

Single cycle computer architecture. Programming considerations. Computer arithmetic. Hardware co-processor acceleration. Interrupt handling, Pipelining. Embedded processor systems and applications.
Related Electronic Design Automation (EDA) tools. Digital systems and reconfigurable System on Chip (SoC) case studies. Design project.

# ENERGY SYSTEMS ENGINEERING

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Energy Systems | EG224 | Energy Systems Engineering | 5 | 2 | 2 | 2 hour exam |

This module introduces the contextual drivers behind the importance of energy in today's world. Energy end uses in buildings, transportation and industry are explored, with the role of energy efficiency emphasised. Energy resources such as fossil fuels, nuclear and renewables are studied. Students will work in groups to develop international case studies for sustainable energy development. Students will also complete a Community-based engineering group design project.

# MECHANICAL ENGINEERING

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Mechanical Engineering | IE319 | Operations Strategy | 5 | 2 | 2 | 2 hour exam |

Case studies form an integral part of this course and student participation in class discussions is important. The objective of this course is to provide students with a theoretical background in Operations Strategy including to:

1. Understand and appreciate the role of Operations and Production Management as a competitive weapon
2. Identify the long term benefits of manufacturing in the areas of quality, flexibility, market response and customer satisfaction;
3. Appreciate product/process decisions;
4. Incorporate the management of technology
5. Understand productivity and its measurement in modern manufacturing and service industries.
6. Identify components of operations strategy;
7. Use analytical techniques;
8. Undertake the writings of Hayes, Meredith, Porter, Schroeder, Skinner and Wheelwright and Case Studies

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Mechanical Engineering | IE332 | Quality Management | 5 | 2 | 2 | 2 hour exam |

Quality assurance. Quality management systems, documentation, audits, standards(ISO etc). Total Quality Management, human resource issues, sourcing policy and supplier management. Quality costs. Problem solving tools and quality improvement. Quality Function Deployment.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Mechanical Engineering | IE345 | Logistics and Transportation | 5 | 2 | 2 | 2 hour exam |

The Business Logistics course will equip students with a solid foundation in logistics basics. It illustrates that logistics is a major component of the supply chain process covering all the bases of logistics including technology, customer service, packaging, transportation, warehousing, inventory, procurement, controls, systems analysis, international issues, social responsibility etc. The course includes real-world examples and cases are based on real business situations and include both national international challenges.
Specific objectives include:

To develop an understanding of the state of the art strategic management thinking as it applies to firms with global operations. To develop a capacity for analysing logistics problems on a functional, business, and company-wide basis. To develop an awareness of the organisational structures used in logistics and their strengths and weaknesses of those structures. To develop an understanding of the key criteria utilised in multi-national location site selection, global scale facilities configurations, and international sourcing networks development. To become acquainted with some of the realities of running different types of production/distribution firms.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Mechanical Engineering | ME221 | Fundamentals of Operations Engineering | 5 | 2 | 2 | 2 hour exam |

Introduction to operations engineering, design of products & services, lean and JIT manufacturing systems, facility design & layout, human resources in engineering, forecasting, capacity planning and aggregate production planning, inventory management, enterprise resource planning, scheduling, project planning/control and quality planning and control.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Mechanical Engineering | ME304 | Mechanical Analysis And Design | 5 | 2 | Spring | 2 hour exam |

Application of mathematics, materials sciences, and engineering mechanics to problems in the analysis and design of mechanical elements; considers product specification, manufacturing methods, safety and economic factors. Detailed design of a selection of machine components based on analytical solutions, empirical techniques and test results. Introduction to the use of the computer in engineering design.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Mechanical Engineering | ME322 | Thermodynamics and Heat Transfer | 5 | 2 | Spring | 2 hour exam |

Introduction to energy, heat and work. Thermodynamic properties of solids, liquids, ideal gases and phase change substances. The First Law of Thermodynamics. Applications to closed systems and control volumes. The Second Law of Thermodynamics, entropy and exergy. Isentropic efficiency.
Introduction to power and refrigeration – the basic Rankine, Otto and vapour-compression cycles.
Introduction to conduction, convection and radiation. Biological energy conversion, thermoregulation, perioperative hypothermia, thermodilution cardiac output monitoring. One-dimensional conduction, extended surfaces, conduction with generation. Three-dimensional conduction, the heat diffusion equation, the Pennes bioheat equation. Hyperthermic therapy devices.

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Mechanical Engineering | ME426 | Turbomachines and Advanced Fluid Dynamics | 5 | 2 | 2 | 2 hour exam |

Fluid dynamics of turbomachinery. Classification, system characteristics, dimensionless parameters and scaling laws, energy and angular momentum aspects, incompressible flow turbomachines (pumps, fans, turbines), compressible flow turbomachines (compressors, turbines).

| Discipline | Module Code | Module Title | ECTS | Taught in Semester | Examined in Semester | Examination Arrangements |
|---|---|---|---|---|---|---|
| Mechanical Engineering | ME429 | Polymer Engineering | 5 | 2 | 2 | |

Designing with polymers, viscoelastic phenomena, mathematical models for viscoelaticity, fracture, fatigue and failure of polymers, polymer rheology, analysis of polymer processing, introduction to polymer composites

This module analyses the mechanical and processing behaviour of polymers (plastics), from short-term properties (stiffness, strength, fracture strength) to long-term, time-dependent properties (creep, stress-relaxation), as well as helping the student to develop an understanding of the effect of adding fibre reinforcement to create polymer composites. Melt processing of polymers is also examined and their important flow parameters investigated