Dublin Institute of Technology

Pre-Requisite Modules code(s)	Co-Requisite Modules code(s)	ECTS Credits	Module Code	**Module Title**
Math 1301		5	MATH 2301	Mathematics 2

This Header should be repeated on each page of the Module

MATH 2301 – Mathematics 2

Module author: Colum Watt

Module Description:

This module introduces the learner to several transform methods which are of use in the solution of engineering problems (such as signals analysis). Necessary definitions are provided and standard, useful techniques, which build on the learner's previous exposure to one-variable calculus in Math 1301, are developed.

Module aim

This module aims to familiarise the learner with a range of transform techniques of use in the solution of problems of engineering interest (such as the Fourier analysis of both periodic and aperiodic signals) and to enable the learner to understand their uses in concurrent and later modules of the program.

Learning Outcomes:

On completion of this module, the learner will be able to:

(i) Calculate the Laplace transform of standard functions both from the definition and by using tables.
(ii) Select and use the appropriate shift theorems in finding inverse Laplace transforms
(iii) Select and combine the necessary Laplace transform techniques to solve second order ordinary differential equations
(iv) Calculate the Fourier series for standard periodic waveforms.
(v) Demonstrate their understanding of the Dirichlet conditions by using them to evaluate infinite series.
(vi) Calculate the Fourier transform of elementary functions from the definition.
(vii) Demonstrate their understanding of both the t-w duality and the Fourier integral representation theorems, by applying them to appropriate examples.
(viii) Compute the Z transform of elementary sequences both from the definition and by using tables.
(ix) Select and combine the necessary Z transform techniques to solve second order ordinary difference equations.
(x) Present their calculations and solutions in a manner that is readily intelligible.
(xi) Use computers as an aid to learning and as a tool in solving problems.
(xii) Approach more advanced aspects of transform methods.

Learning and Teaching Methods:

Lectures supported by problem solving sessions. In the problem solving sessions, students are encouraged to engage with the course content (whether individually or in groups).

Module content:

Fourier Series: Periodic functions, definition and examples of Fourier series, superposition, half-range expansions, Dirichlet conditions, complex form, Parseval's Theorem, applications.

Fourier Transform: Integral definition and calculation, properties and shift-theorems, even and odd Functions, t-w duality principle and its applications, inverse Fourier Transform, Fourier integral representation.

Laplace Transform: Integral definition and calculation, properties and shift-theorems, use of tables, inverse Laplace transform, application to solving differential equations, the Dirac delta and its use. Introduction to state-space for ordinary differential equations.

Z Transform: Calculation from definition, properties and shift theorems, use of tables, inverse Z transform, application to solving difference equations.

Module Assessment

Assessment of the lecture material is by written examination. The pass mark is 40%.

Essential Reading: Advanced Modern Engineering Mathematics 3ed, G. James, Prentice Hall (2004)

Supplemental Reading: Advanced Engineering Mathematics, K. A. Stroud , Palgrave (2003)

Advanced Engineering Mathematics 8ed, E. Kreyszig, Wiley, (1999)

MATLAB 5 For Engineers, A. Biran, M. Bremer, Addison-Wesley (1999)

Further Details:

Hours/week	Lectures	Tutorial / Laboratory
4	3	1

This module lasts for one semester and is assessed by a written examination at the end of the semester.

Date of Academic Council approval …………………………

Dublin Institute of Technology

Pre-Requisite Modules code(s)	Co-Requisite Modules code(s)	ECTS Credits	Module Code	**Module Title**
PHYS 1853		5	MECH 2601	Mechanics and Properties of Materials

This Header should be repeated on each page of the Module

MECH 2601 – Mechanics and Properties of Materials

Module author: Kevin Sullivan

Module Description:

This module introduces the student to a range of engineering materials, their properties and property modification to meet in-service requirements and also enables the student to assess loading and determine stress levels for some engineering applications.

Module aim

The aim of this module is to enable the student to relate to the broad environment of mechanical systems and devices and the proper utilisation of materials.

Learning Outcomes:

On completion of this module, the learner will be able to demonstrate ability at a basic level to include:

-Interpret and explain the elastic and plastic behaviour of engineering materials.
-Devise and use mathematical models of engineering systems and processes; e.g. free-body diagrams, fluid flow, pressure vessels, power transmission.
-Format a scientific statement of a mechanical engineering problem from an oral or written description using a structured problem-solving approach and coping with incomplete information.
-Specify an appropriate engineering material to meet specified loading conditions without exceeding safe stress levels.
-Determine the delivery head required for a pump; or size a power transmission shaft.
-Complete a laboratory based group mini project.

Learning and Teaching Methods:

The module will be delivered by lecture, laboratory and tutorial, supported by reading and self directed learning.

Module content:

Elements and molecules, the influence of atomic and molecular structure.
Chemical reactivity: fuels and combustion, polymerisation, ionisation (pH) and corrosion.
Elastic and plastic behaviour of aggregate materials.
Stress, strain and elastic constants. Safe working stress, strain gauges and their use in load and stress monitoring for applications such as pressure vessels. Torque, shear modulus and the design of shafts for power transmission; transmission by belt drives, gears and clutch.

Fluids, bulk modulus and viscosity; Reynold's number and fluid flow. The Benoulli equation and energy losses in pipeline flow.

Laws of solid friction. Simple machines and efficiency. Rotating mass systems, centrifugal force, stability, balancing. Simple harmonic motion, oscillating and reciprocating systems.

Module Assessment

Assessment is comprised of two components:

(1) Laboratory by continuous assessment accounts for 30% of the overall mark

(2) End of module written examination accounts for 70% of the overall mark.

The pass mark for each component and the module is 40%.

Essential Reading: Mechanical Science, W. Bolton, Blackwell Science 2001

Introduction to Engineering Materials, V.B. John, Pitman

Applied Mechanics, J. Hannah and M.J. Hillier, Pitman

Supplemental Reading:

Web references, journals and other:

Further Details: Duration	Hours/Week	Lectures	Tutorial	Laboratory
13 wks	4	2	1	2 (alt. weeks)

Date of Academic Council approval ………………………….

ELTR 2601 – Electronic systems

Module author: Paul Kiernan

Module Description:

This module teaches the analysis and design of digital electronic circuits.

Module aim

The aim of this module is to teach students how to analyse and design digital circuits. The module also aims to give the students an understanding of the structure and properties of digital logic families and programmable logic devices.

Learning Outcomes: On completion of this module, the learner will be able to:

1. Describe the operation and give the circuit layouts of TTL and CMOS gates;
2. Describe the properties of TTL and CMOS logic families;
3. Explain the operation of and derive waveform diagrams for sequential digital circuits;
4. Apply state design techniques to the analysis and design of digital circuits;
5. Illustrate the structure and characteristics of various programmable logic devices;
6. Illustrate the design of digital systems using programmable devices;
7. Carry out experiments in the design analysis and simulation of digital electronic circuits;
8. Present experimental findings through written reports.

Learning and Teaching Methods:

This module will be delivered a series of lectures and practical laboratory exercises.

Module content:

Logic Families
TTL, LSTTL, CMOS: structures and circuits; properties and operation.

Synchronous Systems
Sequential design and state diagrams. Analysis and design of synchronous counters. State reduction and Caldwell's merging procedure. Combination and sequence detectors.

Programmable Logic Devices
Programmable devices: structures and circuits. Design of combinational and sequential circuits using ROM, PLA, PAL, PLS, and FPGA

Laboratories
To be selected from the following:

Waveform analysis of synchronous counters. Design and implementation of synchronous counters with decoding.

Parallel loadable shift register. Investigation of MSI counters. Sequential circuit implementation using programmable devices. Combination and sequence detectors.

Module Assessment

The assessment of this module comprises of two components:

(1) formal examination of 2 hours duration comprising 70% of the module marks

(2) laboratory assessment comprising 30% of the module marks.

The pass mark for each component and the module is 40 %.

Essential Reading: Wakerly, John F., Digital Design: Principles and Practices (4th Edition), Prentice Hall, 2006.

Supplemental Reading: Floyd Thomas, Digital Fundamentals, (8th Edition), Prentice Hall 2003. Holdsworth B, Digital Logic Design, (3^{rd} Edition), Butterworth-Heinemann 1994.

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Further Details: The module will be delivered over one semester, 2 hours per week for lectures, 1 hour per week for tutorial, and 2 hours per week for laboratory. Students will be expected to spend 2 hours per week in additional study.

Date of Academic Council approval …………………………

Dublin Institute of Technology

Pre-Requisite Modules code(s)	Co-Requisite Modules code(s)	ECTS Credits	Module Code	**Module Title**
MATH 1301, ELEC1600		5	EESY 2601	Introduction to Electrical Energy Systems

EESY 2601 – Introduction to Electrical Energy Systems

Module authors: Jane Courtney, Michael Farrell.

Module Description:

This is an introductory module dealing with the area of electrical power systems and electromechanical energy conversion. The concept of electromechanical energy conversion and mechanical performance of common motors is analysed using torque–speed characteristics and rating plate information. The module introduces the concepts and techniques required for the analysis of three-phase power systems. The equivalent circuit technique is used in the performance analysis of single-phase transformers and machines.

Module aim:

The aim of this module is to give an overview of power system operation and to discuss electrical energy sources and their sustainability. The module will also introduce the concepts and techniques used in analysing the performance of three-phase power systems, electromechanical energy conversion, induction machine and single-phase transformers.

Learning Outcomes:

On completion of this module, the learner will be able to:

- Describe the roles played by generation, transmission, distribution and utilisation of modern electricity energy systems;
- Demonstrate an awareness of the sources of electrical energy and their sustainability;
- Describe the construction and operation of simple electrical machines and use nameplate data and equivalent circuits to determine electrical and mechanical performance;
- Apply phasor techniques to the analysis of three-phase circuits to determine voltage, current and power;
- Apply complex power theory to the analysis of simple power networks;
- Perform passive power factor correction on simple power systems;
- Describe and analyse magnetic circuits;
- Describe the construction, operation and equivalent circuit of a single-phase transformer to determine its performance.

Laboratory learning outcomes:

- Select and use appropriate instrumentation for laboratory exercises.
- Be able to interpret and connect circuits in accordance with circuit diagrams.
- Identify sources of experimental error
- Record data, plot and interpret graphs
- Use appropriate theory to explain results
- Interpret and comment on experimental results
- Write and maintain a record of lab work in a laboratory logbook
- Write and present a formal report on experimental work
- Plan and conduct the experimental work as part of a team
- To be able to work in accordance with Health and safety regulations in an Electrical Engineering lab

Learning and Teaching Methods:

A combination lectures, labs, tutorial, case study/assignment and problem-solving exercises.

Dublin Institute of Technology

Pre-Requisite Modules code(s)	Co-Requisite Modules code(s)	ECTS Credits	Module Code	**Module Title**
MATH 1301, ELEC1600		5	EESY 2601	Introduction to Electrical Energy Systems

Module content:

Introduction to Power Systems:
Single-line diagram description of a power network. Description of Thermal and Hydro generation stations. Sources of electrical energy and their long-term availability and sustainability.

Machines: construction and principles of various common machines. Voltage and torque equations. Equivalent circuit models. Power flow. T/N characteristics of motors. Interpretation of nameplate data. Speed control. Rotating field and torque production in a three-phase induction motor. Applications of machines.

Magnetic Circuits: introduction to magnetic quantities: mmf, flux, flux density, magnetic field intensity and reluctance. B-H curves. Magnetic core losses. Electric circuit analogies. Equivalent circuits of simple magnetic devices. Analysis of simple magnetic circuits.

Transformers: construction and principles of a single-phase transformer. Equivalent circuit. Open and short-circuit tests. Efficiency. Applications in power systems.

Elementary Power Systems: AC power analysis. Real and reactive power calculation and measurement. Analysis of balanced 3-phase systems. Analysis of three-phase star and delta connected loads. Advantages of three-phase power distribution. The per-unit system. Power factor correction.

Examples of laboratory work to support this course:

- Open-circuit characteristics of a DC machine;
- Efficiency of a DC generator;
- Torque-speed characteristics of a DC motor;
- Torque-speed characteristics of an induction motor;
- Analysis of a single-phase transformer;
- Three-phase system analysis.

Module Assessment:

Assessment is via 2 components:

1) Coursework: accounts for 40% of the overall module mark, this component consists of two elements:
- Laboratory: accounts for 25% of the overall mark and which is continuously assessed throughout the Module.
- Task: an in-class assessment or assignment which accounts for 15% of the overall module mark.

2) Written examination: accounts for 60% of the overall module mark; held at the end of the Module

The pass mark for each of the 2 components and the module is 40%.

Essential Reading: Theodore Wildi, 2006, Electrical Machines, Drives and Power Systems: International Edition, 6th Ed., Prentice Hall, ISBN: 0131969188.

Supplemental Reading: Edward Hughes, 2005, Electrical and Electronic Technology, 9th Ed., Prentice Hall, ISBN: 0131143972.

Web reference: http://www.ibiblio.org/obp/electricCircuits/

Further Details:

This module will be delivered in one 12 weeks semester with:
- 3 hours per week lecture/tutorial time
- 2 hours per fortnight laboratory time

Date of Academic Council approval ………………………….

Dublin Institute of Technology

Pre-Requisite Modules code(s)	Co-Requisite Modules code(s)	ECTS Credits	Module Code	**Module Title**
	None	5	SSYS 2601	Signals and Systems

SSSY 2601 – Signals and Systems

Module author: Colm Murray BSc. (Eng.) MIEng. CEng. M.I.E.I.
Dermot Breen BSc. (Eng.) MEng. CEng. M.I.E.I.
School of Control Systems and Electrical Engineering

Module description:

This module covers the theory and analysis of signals and systems. The module is split between theory, problem solving and analysis and the use of software simulation.

Module aim:

The aim of this module is to develop the student's knowledge, practical, research and communication skills in signals and systems theory and analysis.

Learning outcomes:

On completion of this module, the learner will be able to:

Classify and describe mathematical models of signals and systems .

Derive mathematical models of systems for analysis purposes .

Apply system response methods such as convolution and solution of differential system equations.

Describe and apply frequency response methods to the solution of problems and analysis of signals and systems.

Describe and apply Laplace transform methods to the solution of problems and analysis of signals and systems.

Describe and apply z-transform methods to the solution of problems and analysis of signals and systems.

Use software simulation and analysis tools in the solution of problems and analysis of signals and systems

Communicate signals and systems theory, concepts, ideas and analysis through software simulation and analysis exercises and assignments.

Communicate signals and systems theory, concepts, ideas and analysis orally and through written work.

Learning and Teaching Methods:

Lectures, problem solving and analysis exercises.

Laboratory based experiments and project work using software simulation.

Dublin Institute of Technology

Pre-Requisite Modules code(s)	Co-Requisite Modules code(s)	ECTS Credits	Module Code	**Module Title**
	None	5	SSYS 2601	Signals and Systems

Module content:

Lecture based material:

Introduction to signals and systems Continuous and discrete signals, basic operations on signals, even and odd signals, periodicity, basic signals such as exponential, sinusoidal, complex exponential, the unit step and unit impulse. The system model concept, classification of systems such as continuous/discrete, linear/non-linear, time invariant/time varying , instantaneous/non-instantaneous, causal/non-causal and stable/ unstable systems.

*System model and system response: D*erivation of system models (continuous systems), discrete representation of a continuous system, application to first order system, Use of the impulse as a basic signal, discrete signal representation, representation of a continuous signal, convolution (summation formulae and integral formulae), solution of the system differential equation zero-input and zero-state responses, first and second order systems step response concept.

Frequency response methods: Response of a continuous system to a sinusoidal input, frequency response function, use of reactance methods, general plot for a first order system, general plot for a second order system, bode plots. Fourier series representation of continuous signals, effect of symmetries, power representation in the Fourier series. Fourier transform for continuous systems, elementary properties of the Fourier transform, signal energy-power signals, system response in terms of Fourier transform

Laplace transform methods (complex frequency domain): Laplace transform derivation and is properties, application to system analysis, response via the differential equation, the system transfer function, step response analysis of first and second order systems. Representation on the complex plane poles and zeros, interpretation of system response via pole positions. Frequency response from pole-zero diagram.

Z-transform and difference equation methods: General form of the difference equation, implementation of the difference equation, sampling and the z-transform, evaluation of the z-transform, shifting theorem, inversion of the z-transform, use of the z-transform in the solution of difference equations, pole-zero representation for discrete systems. Frequency response of discrete systems.

Laboratory based material:

Exercises and projects using software simulation and analysis tools will reflect the lecture based material and will include exercises on

Modelling of signals and systems in the continuous and discrete domains.

Investigation of signals and systems software simulation in the frequency, Laplace (complex frequency) and z domains.

Investigation of system response and stability analysis in the frequency, Lapalce (complex frequency) and z domains

Investigation of software simulation methods in analysing and solving signals and systems problems.

Dublin Institute of Technology

Pre-Requisite Modules code(s)	Co-Requisite Modules code(s)	ECTS Credits	Module Code	**Module Title**
	None	5	SSYS 2601	Signals and Systems

Module Assessment

Module assessment comprises of two components:

1 Continuous assessment of the laboratory activity (weighting 40%). Assessment will be based on achievement of exercise objectives, quality of work, assignments and oral examination.
2 End of module written 2 hour examination (weighting 60%) (weeks 14/15)

The pass mark for each component and the module is 40%

Essential Reading:

Balmer Leslie. (1997), Signals and Systems An Introduction Second Edition, Pearson Prentice Hall I
ISBN 0-13-495672-9

Supplemental Reading:

Meade M.L. and Dillon C.R. (1991), Signals and Systems, Models and Behaviour, Chapman and Hall
ISBN 0 4124 0110 x

Bird J.O. (2001) Electrical Circuit Theory and Technology, Newnes ISBN 0 7506 4989 5

Web references, journals and other

DIT library , **http://www.dit.ie/DIT/library/index.html**

John Hopkins University, Signals Systems and Control Java applets **http://www.jhu.edu/~signals/**

Signal and Systems by Richard Baraniuk, **http://cnx.rice.edu/content/col10064/latest/**

(Web sites last accessed October 2005)

Further Details:

This module will be delivered over one semester

2 hours per week lecture
2 hours per week laboratory/tutorial

Date of Academic Council approval ....

COMP 2601 – Computer Architecture 1

Module author:
Tom Scarff

Module Description:
This module introduces microcomputer systems, and provides the student with detailed knowledge of the structure and operation of microcomputers, memory and input/output interfacing. It also provides the ability to design, assemble, compile and debug microcomputer programmes.

Module aim:
The aim of this module is to provide the students with an understanding of the architecture and organization of basic 8-bit microcomputer systems and the ability to programme these systems

Learning Outcomes:
On completion of this module, the learner will be able to:

- Describe and explain the operation of microcomputers;
- Describe and explain microprocessor internal organization, memory and input/output interfacing;
- Design, assemble and debug assembly language routines to control and interface microcomputers;
- Design, compile and debug C language routines to control and interface microcomputers.

Learning and Teaching Methods:
This module will be delivered as a series of lectures and practical laboratory sessions.

Module content:
- Von Neumann and Harvard computer architecture;
- The bus-structured computer system: CPU, memory and input/output ports;
- Arithmetic Logic Unit (ALU) and Accumulator;
- Architecture of an 8-bit microprocessor. dedicated and general-purpose registers;
- Assembly language programming;
- Address bus decoding, the memory map;
- C compiler extensions for microcontrollers.
- Memory-mapped and isolated Input/Output;
- Semiconductor memory devices;
- Interface adapters: General-purpose parallel and serial Input/Output;
- The stack;
- Interrupt mechanisms and organization.

Laboratory Programme:

- Simple assembly language/machine code programs to familiarize the student with a range of instruction types and addressing modes;
- Exercises involving the use of an integrated development environment to develop, trace and debug more sophisticated assembly and C language programs;
- Exercises involving the use of input/output adapters to interface to simple devices e.g. switches, seven-segment displays, Analogue-to-Digital and Digital-to-Analogue converters.

Module Assessment:

Students' performance in reaching the learning outcomes for this module will be assessed by a combination of continuous assessment in the laboratory exercises and a written examination at the end of the module. The written examination will be 2 hours long, and students will be required to attempt all 3 questions on the examination paper. The continuous assessment will be as defined in the general laboratory assessment regulations of the School of Electronic and Coommunications Engineering, with marks assigned for each laboratory session and for each report requested.

In calculating the final grade for the module, continuous assessment will be given a weighting of 30% and the written examination a weighting of 70%.

The pass mark in each component and the module is 40%

Essential reading:

- Wray, Greenfield and Bannatyne, *Using microprocessors and microcomputers, The Motorola Family*. 4th ed., Prentice Hall, 1999.

Supplemental reading:

- A. S. Tannenbaum, *Structured Computer Organization*. 4th ed., Prentice Hall, 1999.
- John B. Peatman, *Design with PIC Microcontrollers*, Prentice Hall, 1998, ISBN 0-13-759259-0.

Web references, journals and other:

- Microchip website at http://www.microchip.com/

Further Details:

This module will be delivered in one semester, as a series of lectures and practical laboratory exercises. Laboratory exercises will be closely coordinated with the lectures, and will provide practical demonstrations and exploration of the of the material being covered in lectures. The total contact will be 2 hours per week of lectures and 2 hours per week of practical laboratory work. Students will be expected to spend 4 hours per week in additional study.

Date of Academic Council approval ……………………………

Dublin Institute of Technology

Pre-Requisite Modules code(s)	Co-Requisite Modules code(s)	ECTS Credits	Module Code	**Module Title**
Math 1301, Math 2301		5	MATH 2302	Mathematics 3

This Header should be repeated on each page of the Module

MATH 2302 – Mathematics 3

Module author: Colum Watt

Module Description:

This module introduces the learner to calculus of several variables and to statistical methods. Necessary definitions are provided and standard, useful techniques, which build on the learner's previous exposure to one-variable calculus in Math 1301, are developed.

Module aim

This module aims (a) to familiarise the learners with a range of techniques in the calculus of several variables which are of use in the solution of problems of engineering interest, (b) to introduce and develop probabilistic and statistical methods for application to engineering problems, and (c) to enable the learner to understand the uses of both in other modules of the program.

Learning Outcomes:

On completion of this module, the learner will be able to:

(i) Use the chain rule to calculate partial and directional derivatives.
(ii) Recognise where particular methods are applicable and apply them in solving problems of engineering interest.
(iii) Reproduce the definitions of gradient, divergence and curl, and compute them in specific cases.
(iv) Calculate elementary line integrals.
(v) Calculate probabilities using the basic laws and distributions.
(vi) Classify, analyse and interpret statistical data.
(vii) Apply the method of least squares to obtain best fit curves.
(viii) Determine confidence intervals when using the normal or chi-squared distribution.
(ix) Present their calculations and solutions in a readily intelligible manner.
(x) Use computers as an aid to learning and as a tool in solving problems.
(xi) Pursue more advanced aspects of Fourier analysis and Calculus.

Learning and Teaching Methods:

Lectures supported by problem solving sessions. In the problem solving sessions, students are encouraged to engage with the course content (whether individually or in groups).

Module content:

Calculus of Several Variables: Partial derivatives, chain rule, directional derivatives, local max/min, Lagrange multipliers.

Vector Calculus: Introduction to gradient, divergence and curl. Line integrals.

Probability and Statistics: Laws of probability, independence, conditional probability, moment generating functions. Discrete and continuous random variables. Binomial, Poisson, normal and chi-squared distributions. Regression and correlation analysis.

Dublin Institute of Technology

Pre-Requisite Modules code(s)	Co-Requisite Modules code(s)	ECTS Credits	Module Code	**Module Title**
Math 1301, Math 2301		5	MATH 2302	Mathematics 3

This Header should be repeated on each page of the Module

Module Assessment

Assessment of the lecture material is by written examination. The module pass mark is 40%

Essential Reading:

Calculus 8ed, H. Anton, Wiley (2005)

Applied Statistics for Engineers and Scientists, D.M. Levine, P.P. Ramsey & R.K. Smidt, Prentice Hall, (2001)

Supplemental Reading:

Advanced Modern Engineering Mathematics 3ed, G. James, Prentice Hall (2004)

Advanced Engineering Mathematics, K. A. Stroud , Palgrave (2003)

Advanced Engineering Mathematics 8ed, E. Kreyszig, Wiley, (1999)

Further Details:

Hours/week	Lectures	Tutorial / Laboratory
4	3	1

This module lasts for one semester and is assessed by a written examination at the end of the semester.

Date of Academic Council approval …………………………

Dublin Institute of Technology

Pre-Requisite Modules code(s)	Co-Requisite Modules code(s)	ECTS Credits	Module Code	**Module Title**
		5	ELTR 2603	Solid State Electronics

This Header should be repeated on each page of the Module

ELTR 2603 – Solid State Electronics

Module author: Kevin Berwick, Paul Kiernan, Domnick Nardone.

Module Description:
This module is an introduction to the concepts required to describe the operation of semiconductor devices.

Module aim
The aim of this module is to introduce the student to the fundamentals of Solid State Electronics and to apply these principles to the analysis of semiconductor devices.

Learning Outcomes: On completion of this module, the learner will be able to:

1. Explain the concept of energy bands and the difference between Metals, Semiconductors and Insulators.
2. Explain the concepts of direct and indirect bandgaps and the operation of electronic and optical devices.
3. Describe and derive the physics of charge carriers in solids and use this theory to solve device problems.
4. Use software simulation and analysis tools to predict the operation of semiconductor devices.
5. Present experimental findings through written reports

Learning and Teaching Methods:

This module will be delivered a series of lectures, tutorials and practical laboratory exercises.

Module content:
Crystal Structure, Bonds and Energy Bands in Solids, Metals, Semiconductors and Insulators, Direct and indirect semiconductors, Charge carriers and doping, Intrinsic and extrinsic material, Carrier concentrations, The Fermi level, Drift velocity, Diffusion currents, Excess carriers in semiconductors, p-n Junctions, Light emitting diodes, Bipolar transistors, MOSFETs, Device models, Device fabrication, Lasers

Laboratories
Simulation exercises will use the following resources

Educational applets at http://jas.eng.buffalo.edu/index.html
Microwind http://www.microwind.org
PSPICE

Laboratories to include a selection from the following

The Haynes Schockley experiment
p-n junction at equilibrium
The p-n junction under applied bias
BJT simulation
MOSFET static and dynamic simulation
MOSFET layout using the MicroWind Layout Editor
Device fabrication applet, the p-n junction, MOSFET and CMOS Inverter
PSPICE simulation of CMOS Inverter

Module Assessment:

The assessment of this module comprises two parts: (1) formal examination of 2 hours duration comprising 70% of the module marks; and (2) laboratory assessment comprising 30% of the module marks.

Essential Reading:

Ben Streetman , Sanjay Banerjee, Solid State Electronic Devices (6th Edition), Prentice Hall, 2005

Supplemental Reading:

An Introduction to Semiconductor Devices, 1/E, Donald Neamen, Mc Graw Hill, 2006

Analysis and Design of Analog Integrated Circuits, Gray, Hurst, Lewis and Meyer, 4/E, Wiley, 2001

Semiconductor Physics And Devices, 3/E, Donald Neamen, Mc Graw Hill, 2003

Digital Integrated Circuits, 2/E, Jan M. Rabaey, Prentice Hall, 2003.

Introduction to Semiconductor Materials and Devices, M. S. Tyagi, Wiley, 1991

Further Details: The module will be delivered over one semester, 2 hours per week for lectures, 1 hour per week for tutorials, and 2 hours per week for laboratory on alternate weeks. Students will be expected to spend 3 hours per week in additional study.

Date of Academic Council approval ………………………….

Dublin Institute of Technology

Pre-Requisite Modules code(s)	Co-Requisite Modules code(s)	ECTS Credits	Module Code	**Module Title**
		5	REES 2602	Regulatory Environment & Engineer in Society

This Header should be repeated on each page of the Module

REES 2602 - Regulatory Environment & The Engineer in Society

Module author: Kevin Sullivan, Michael Farrell

Module Description:

This module seeks by dialogue and discussion to establish the place and functions of Engineers in society by consideration of the social impact of engineering/technology and to raise the awareness of the need to operate within a regulatory framework.

Module aim

The aim of this module is to provide engineering students with a broad perspective of both the nature of engineering as a profession and the role and responsibilities of an engineer in society. In addition the module develops an awareness of the codes of practice, standards and statutory regulations associated with the practice of Electrical/Electronic Engineering.

Learning Outcomes:

On completion of this module, the student will be able to:

-Demonstrate an understanding of the Engineer's responsibility in the performance of his/her duties at the interface of Technology, Society and the Environment.
- Demonstrate an ability to recognise and assess specific ethical and social issues as they arise.
-Devise and implement safe conditions for those who must interact with the "workplace" in accordance with good practice and statutory obligations.
-Demonstrate an understanding of the issues, technologies and methodologies associated with forecasting, prediction and planning for the future needs of Society in respect of Energy, new technology, inventions and products.
-Describe the role played by national and international standardisation bodies
-Describe the scope of the Wiring Rules and apply them in the design of distribution circuits
-Explain the need for earthing of installations and describe the main earthing systems
-Explain the testing and certification procedures for a completed installation.
-Explain the role of an expert witness

Learning and Teaching Methods:

The module is delivered as a series of lectures and case studies using both DIT lecturers and invited lecturers from the Engineering profession and elsewhere as appropriate.

Module content:

<u>Historical Development of Engineering</u>
Engineering prior to the 18th Century. The renaissance engineer; the 19th century and the emergence of engineering specialisation. Electro-chemical and electro-magnetic discoveries. The generation and use of electrical power: electrical traction. The development of telegraphy and the telephone. The birth of electronic devices. The development of radio and broadcasting. Developments in computers and communications and their convergence.

<u>Professional Ethics</u>
Definition of ethics and ethical conduct; fundamental issues. Awareness of responsibility to oneself, colleagues, clients, employers and society. Ethical issues: conflict of interest problems, whistle blowing. Exercises in ethical reasoning. Unethical conduct. Codes of ethics for engineering in Ireland and abroad.

Dublin Institute of Technology

Pre-Requisite Modules code(s)	Co-Requisite Modules code(s)	ECTS Credits	Module Code	**Module Title**
		5	REES 2602	Regulatory Environment & Engineer in Society

This Header should be repeated on each page of the Module

Engineering as a Profession

The development of the engineering profession and specialisation. Professional societies; grades of membership, the chartered engineer. Codes of conduct; misconduct. Careers and career structures in engineering; continuing professional development and lifelong learning. Engineering education and the profession in the EC and elsewhere.

Social Issues

What is an engineer's responsibility to society? Health and safety issues; overview of the law and regulatory standards; toxic materials and industrial diseases; industrial accidents; causes and prevention.
Risk: Societal risk, risk assessment; EU directives on risk assessment.

Energy and the Environment

Energy: Traditional energy sources; Alternative and renewable energy sources. The utilisation of energy, energy efficient processes, transport and buildings. Engineering and the environment; pollution and its effects; global warming. Waster management: recycling technologies; National and international targets for waste recovery.

Predicting Change

The need to predict change and the future. Global trends and changing societies; equal access to technologies. Predicting the future: Projection and extrapolation, the role of modelling and simulation. Technological convergence and physical limitations as predictors. Lessons from the past; unexpected problems and their consequences. Product development; product lifecycles; unwanted products. The future of computing and communications.

Standards & Codes of Practice

National, European and International Standardisation Bodies. ETCI and it role. EU Directives (e.g. Waste Electrical and Electrical Equipment, LV Directive) and their implications. National Wiring Rules. Electrical Safety – Earthing Practice, Protective Devices. Distribution circuit design. Requirements for testing and certification of installations . Codes of Practice and Guides. Forensic investigations, the Expert Witness and the law.

Module Assessment

Assessment comprises of two components:
1) Course-work assignments, which account for 50% of the module mark

2) A 2-hour, end-of module written examination, which accounts for 50% of the module mark.

The pass mark for each component and the module is 40%.

Essential Reading: Engineers and their profession, John D. Kemper. Published by Saunders College Publishing, 4th Edition 1990

Supplemental Reading: A history of electrical engineering, Percy Dunsheath, Published by Faber, 1969.

Social, Ethical and Policy implications of Engineering, Joseph R. Herkert, Published by the IEEE, 1st Edition 1999.

Given the diverse and topical nature of many of the issues considered in the programme, additional reading material will be made available through class handouts.

Web references, journals and other:

Further Details:

The module is delivered in one semester, 4 lectures per week.

Date of Academic Council approval …………………………

ELTR2602 - Analogue Electronics

Module author: Paul Kiernan

Module Description:

This module teaches the analysis and design of analogue electronic circuits.

Module aim

The aim of this module is to teach students to analyse and design analogue electronic circuits. The module also aims to give the students an understanding of the theory and operation of circuits used in analogue integrated circuits.

Learning Outcomes: On completion of this module, the learner will be able to:

1. Design and give the circuit diagrams for a range of operational amplifier-based circuits, including oscillators;

2. Analyse and explain the operation of various operational amplifier based circuits;

3. Describe operational amplifier imperfections and analyse the effects that these imperfections have on the performance of operational amplifier circuits;

4. Derive and evaluate expressions for the electronic characteristics of analogue circuits;

5. Illustrate the equations and circuit diagrams for transistor models and analyse these models under various operating conditions;

6. Analyse and describe the operation of the Darlington amplifier, differential amplifiers, active biasing circuits and basic current sources;

7. Carry out experiments in the design, analysis and simulation of analogue electronic circuits;

8.Present experimental findings through written reports.

Learning and Teaching Methods:

This module will be delivered a series of lectures and practical laboratory exercises.

Module content:

Operational Amplifiers

Analogue signal processing circuits: Inverting amplifier; Non-inverting amplifier; Integrator, Differentiator; Instrumentation amplifier; Summing and Differencing amplifier. Oscillator circuits: Wien bridge; RC relaxation; Phase shift. Effect of negative feedback in operational amplifier circuits. Operational amplifier limitations: bias currents; offset voltages; frequency response; drift; slew rate. Effect of limitations on operational amplifier circuits. Use of Laplace transform to determine error outputs. Stability and frequency compensation.

Direct Coupled Design

Transistor models. Amplifiers. Biasing techniques in amplifiers. BJT current sources and current mirrors. Emitter coupled differential amplifiers: Basic differential and common mode operation; D.C. analysis, common mode and differential mode gain; CMRR; transfer characteristics. Darlington amplifier.

Laboratories
To be selected from the following:

Operational amplifier circuits: . Frequency and time domain analysis. integrator and differentiator circuits. Differencing amplifier and the 3 op-amp instrumentation amplifier. Measurement of operational amplifier limitations and comparison of various operational amplifiers. Oscillator circuits: Self starting Wien bridge; RC relaxation; Phase shift. Differential amplifier: difference and common mode gain, CMRR. BJT current mirror

Module Assessment:

The assessment of this module comprises two parts:

(1) formal examination of 2 hours duration comprising 70% of the module marks; and

(2) laboratory assessment comprising 30% of the module marks.
The pass mark for each component and the module is 40%.

Essential Reading: Microelectronic Circuits, A.S. Sedra and K.C. Smith, 5th Edition (2004), Oxford University Press

Supplemental Reading: Microelectronics, J. Millman and A. Grabel, 2nd Edition (1987), McGraw Hill.
Floyd, T Electronic Devices (6th edition), Prentice Hall 2002.

Further Details: The module will be delivered over one semester, 2 hours per week for lectures, 1 hour per week for tutorial, and 2 hours per week for laboratory on alternate weeks. Students will be expected to spend 3 hours per week in additional study.

Date of Academic Council approval ………………………….

CONT 2602 – Introduction To Control Engineering

Module author: Department of Control Engineering Staff

Module Description:

This module is an introductory module. The module is composed of two portions: ***Control Engineering*** and ***Automation***. The **Control Engineering** portion of the module covers basic concepts in feedback and control, with particular reference to design in the time domain. On completion of the module, the learner should be able to explain concepts, perform calculations and solve problems. They should be able to perform experiments, collect data, analyse data and present results. The **Automation** portion of the module concentrates on the implementation of safe control of processes using industrial computers. On this module, 32 contact hours are devoted to Control Engineering and 16 contact hours are devoted to Automation.

Module aim

The aim of the **Control Engineering** portion of the module is to allow the student to develop an understanding of, and carry out practical work using, fundamental concepts in feedback and control. The aim of the **Automation** portion of the module is to implement safe control of a simple process using a computer, with analysis of all possible failure modes.

Learning Outcomes:

On successful completion of this module, the learner will be able to

Control Engineering

1. Use the mathematics and software tools required for a control engineer.
2. Model simple industrial control systems.
3. Analyse first and second order models in detail.
4. Explain feedback ideas and some applications.
5. Discuss design specifications based on system time responses.
6. Evaluate system stability based on the poles and zeroes of a system model.
7. Design a PID controller using elementary manual tuning methods.
8. Recall how to model systems in state-space form.
9. Explain introductory concepts in frequency domain analysis.

Automation

10. Demonstrate an ability to qualify the installation of a control system.
11. Develop and design simple control programs.
12. Implement a simple fault finding exercise on a basic control system.
13. Explain and predict the fail-safe operation and structure of a computerised industrial control system.
14. Design and implementation of a fail-safe simple automation control system.
15. Correctly use timers and counters to control production processes.

Learning and Teaching Methods:

Control Engineering: Lectures, tutorials (problem solving exercises), laboratory activities, computer based learning, case studies, self-directed learning, web-based resources. Formal teaching contact takes place in the lecture room and laboratory; the learning model requires that formal teaching takes place in 2-hour blocks, with the lecture room and laboratory simultaneously available for that period.
Automation: Lectures, problem solving exercises, laboratory activities, case studies, self-directed learning, presentation of automation solutions, open discussions on software control solutions, and web-based resources.

Proposed Module content: The **Control Engineering Syllabus** is detailed below. Lectures and laboratories in this part of the module are integrated; MATLAB/SIMULINK is the tool used to facilitate this.

1. Introduction: Examples of where control engineering is used e.g. wind turbine systems, wastewater treatment plant control, flight control systems, industrial heaters.
2. Tools for the control engineer: Revision of complex number manipulations, Laplace transform issues, linearity, frequency content of signals.
3. Software toolkit: MATLAB: Introduction. Starting MATLAB. Basic operations. Transfer functions in MATLAB. M-files and functions. SISO design tool: ***rltool***.
4. Software toolkit: SIMULINK: Using SIMULINK for analysis. SIMULINK model of a house heating control system. Building a SIMULINK model. Case study: Development and analysis of the house heating model.
5. Modelling for control engineering: Signals, systems and block diagrams. Actuator-Process-Transducer structure. Modelling applications – liquid level, mechanical vibration system, conveying system.
6. System responses: Test signals. First order and second order systems. Time delays. Using SIMULINK to determine responses.
7. Feedback: Open and closed loop systems. Introducing feedback. Practical closed loop control systems. Block diagram manipulation.
8. Design specifications based on system time response: Steady state and transient behaviour. Steady state performance. Steady-state errors. Transient performance. Specifications for disturbance rejection.
9. Poles, zeroes and system stability: Poles, zeroes and the s-plane. The relation between system parameters and poles and zeroes. Pole positions and the time response. How zeroes arise. Open and closed loop system poles and zeroes. Bounded signals. System stability. Use of the Routh criterion.
10. PID control: Proportional (P) control. Integral (I) control. Derivative (D) control. PD control. Textbook and parallel PID controllers. Procedures for tuning P, PI and PID controllers: manual, pole placement. Discrete PID implementation.
11. Introduction to state-space analysis: Translating single-input, single output linear time-invariant first order differential equations to transfer function form to ABCD state-space form.
12. Introduction to frequency domain analysis: Sinusoidal signals – magnitude and phase. Logarithmic frequency scales. Presentation of gain and phase information – Bode plot.

The Automation syllabus is detailed below.

1. Structure of Automation computer
2. Operation cycle of Automation computer with fail-safe ability
3. Wiring of a control systems and safety issues.
4. Basic software control elements. Discrete control elements in automation, I/O, bits, pulses, Set and reset
5. Timers counters, Latched and un-Latched devices, power fail memory devices.
6. Simple control programs and algorithms.

Module Assessment

The learning outcomes will be assessed in the following manner:

1. End of module closed-book examination - 50% of module mark.
2. Assessment of problem solving exercises in a learning journal (control engineering) - 10% of module mark.
3. Assessment of laboratory work by observation of individual student performance in the laboratory and assessment of a laboratory learning journal (control engineering) - 15% of module mark.
4. Assessment of laboratory work by observation of individual student performance in the laboratory and assessment of the fully commented program listings developed as solutions to laboratory and self-learning tasks (automation) - 25% of module mark.

Essential Reading:

Wilkie, J., Johnson, M. and Katebi, R. (2002). ***Control Engineering: an introductory course***, Palgrave, U.K.

Automation Booklet and Laboratory sheets provided by David Berber

Supplemental Reading: None, as this is an introductory course.

Web references, journals and other: Some use will be made of web-based materials. Examples include:
http://www.mathworks.com - MATLAB/SIMULINK website
http://sysdyn.clexchange.org/road-maps/rm-toc.html - a guide to learning system dynamics;
http://www.jhu.edu/~signals/explore/index.html (exploring the s-plane);
http://vlab.ee.nus.edu.sg/vlab/control (manual control);
http://eweb.chemeng.ed.ac.uk/courses/control/course/map/index.html (Sub-sections: Introduction to control and Controller tuning);
http://www.cheric.org/education/control (Open loop response in the time and frequency domains; Effects of poles and zeroes on the open loop system response);
http://www.jhu.edu/~signals/arcade2/indexarcade2.htm (sketching out Bode plots).
All websites accessed 24 October 2005.

Further Details:

The module will be delivered over one semester, 2 hours per week for lectures, 1 hour per week for tutorials, and 2 hours per week for laboratory.

Date of Academic Council approval ………………………….

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Pre-Requisite Modules code(s)	Co-Requisite Modules code(s)	ECTS Credits	Module Code	**Module Title**
	None	5	COMM 2602	Communications Networks 1

COMM 2602 – Communications Networks 1

Module author:
Bertrand Faust

Module Description:
This module is an introduction to the concepts and technologies of communications networks.

Module aim:
The aim of this module is to provide the students with a basic knowledge of communications networks, focussing on Local Area Networking and Internetworking.

Learning Outcomes:
On completion of this module, the learner will be able to:

1. Use the concepts and terminology of computer networks, to describe the operation of common networking technologies in the context of local area networking,
2. Describe functions performed by protocols in data link and network layers and the operation of common network protocols,
3. Configure, build, and test a simple computer network,
4. Analyse network traffic using a Network Protocol Analyser,
5. Select flow control mechanisms and parameters,
6. Define or select IP addresses to configure network nodes,
7. Apply routing mechanisms and analyse routing information,
8. Apply error detection and correction methods used in data networks.

Learning and Teaching Methods:
This module will be delivered as a series of lectures supported by laboratory exercises.

Module content:
- Networks & Networking Functions: topologies, nodes, links, transmission media & their characteristics, switching, packet switching/circuit switching, datagram/virtual circuits, signalling, routing,
- Services & Networks Classification: data, telephony, LAN, MAN, WAN, Public operator network, enterprise network, shared medium/switched networks,
- Introduction to Protocols: layered models (OSI, TCP/IP); generic functions such as delineation, error control, flow control, access control, addressing. Standards such as HDLC.
- Network Technologies (LAN): Ethernet and associated technologies such as , Hubs, Bridges, LAN Switches, Spanning Tree Protocol, VLANs..
- Internetwork Technologies: IP and associated protocols such as ICMP, ARP - IP addressing, CIDR, Subnetting, associated functions such as NAT, DHCP,..
- Routing: distance vector routing, RIP.

Laboratory work
- Examination of network traffic associated with different protocols using a network protocol analyser
- Set up and configuration of simple networks using components such as PCs, Hubs, Switches, Routers..
- Modelling of different basic network configurations for performance analysis using OPNET

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Pre-Requisite Modules code(s)	Co-Requisite Modules code(s)	ECTS Credits	Module Code	**Module Title**
	None	5	COMM 2602	Communications Networks 1

Module Assessment:

Students' performance in reaching the learning outcomes for this module will be assessed by

(1) Laboratory work and assignments throughout the module, accounting for 30% of the overall mark .

(2) Written examination at the end of the Module, accounting for 70% of the overall module mark

Learning Outcomes 3 & 4 are essentially assessed during laboratory work.

Learning Outcomes 1, 2 & 5 to 8 are essentially assessed through written examinations.

Essential reading:

- William Stallings, *Data and Computer Communications*, Prentice Hall, 7th ed., 2004

Supplemental reading:

- Larry Peterson & Bruce Davie, *Computer Networks: a Systems Approach*, Morgan-Kaufmann,3rd ed.,2003

Further Details:

Duration of module: 13 weeks

Contact Hours: 4 hrs every week = lectures 2 hrs, laboratory 2 hrs

Self Study: 4 hrs every week

Date of Academic Council approval ……………………………..