

# Electronic Engineering with Business Management

EEngwBM

Information for modules taught in 2014-15.

All programmes and modules are reviewed annually and delivery in future years is subject to change.

## Certificate Level (Year 1)

### **BEng/MEng Elec Eng w Bus Man-LC**

All modules are compulsory

### **BEng/MEng**

**Year Credits:** 120

**Total Credits:** 360/480

<b>Compulsory</b>			
<b>Dept Code</b>	<b>Banner</b>	<b>Module Title</b>	<b>Credits</b>
			<b>Semester</b>
EE1A	0419509	Digital Logic and Microprocessor Systems	20
EE1B	0419502	Circuits, Devices and Fields	20
EE1D	0417022	Techniques of Analysis and Modelling	20
EE1E	0419503	C Programming and Algorithmic Problem Solving	20
0702720	0702720	Introduction to Economics	10
0714505	0714505	Introduction to Financial Analysis	10
0714507	0714507	Business Organisation and Management	10
0727081	0727081	Introduction to Marketing	10

### **Progress Requirements**

In order to proceed to the second year of study students are required to have passed: a) at least 100 credits. b) all modules that are pre-requisites for the modules in their second year. (i.e. EE1A, EE1B, EE1D and EE1E).

N.B. As part of the induction process you are also required to attend the first two scheduled IT lab sessions and to complete the introductory lab project at the start of the first semester.

# EE1A Digital Logic and Microprocessor Systems

20 Credits  
Semester 1+2  
Compulsory

**Description:** (EE1A1) Students are introduced to the theory and practice of logic, digital circuit design and digital representation of information. (EE1A2) Students are introduced to the design of sequential logic circuits and to the principles of linear sequential systems. Students are introduced to assembler programming and microprocessor interfacing using the PIC range of microcontrollers.

**Assessment:** 75% **EE1A Exam**

*3 hour exam in May/June, answer 4 questions from 6*

25% **Assessed Laboratories**

**Objectives:** EE1A1

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

- Perform manipulations of Boolean logic expressions
- Use Karnaugh maps to transform boolean expressions to a logic circuit
- Design, build and test combinational logic circuits
- Use 2's complement arithmetic
- Describe and apply the behaviour of flip flops and latches.

EE1A2

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

- Design and build simple Arithmetic Logic Units
- Write simple assembler language programs
- Interface a microcontroller to the real world
- Explain the principles of operation of the main building blocks of a computer.

**Pre-Requisites:** None

**Co-Requisites:** None

**Prohib Combs** None

# EE1B Circuits, Devices and Fields

20 Credits  
Semester 1+2  
Compulsory

**Description:** (EE1B1) Students are introduced to the physics of conduction in solids and the effects of electric fields. The terminal characteristics of basic devices are derived from first principles. The behaviour of nonlinear semiconductor devices is introduced. The underlying physical mechanisms are discussed quantitatively.  
(EE1B2) The principles of AC and DC operation of circuits are examined. Students learn the theory and practice of analogue circuit design using op-amps and discrete transistors.

**Assessment:** **85% EE1B Exam**

*3 hour exam in May/June, answer 4 questions from 6*

**15% Coursework**

**Objectives:** EE1B1

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

- Calculate the electric field and potential around a charge distribution for simple geometries.
- Derive the resistance and capacitance of simple structures.
- Describe the mechanism of conduction in solids, and perform calculations on the conductivity of materials.
- Describe physically the dc basic behaviour of diodes, MOSFETs and BJTs.

EE1B2

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

- Use Kirchoff's laws to solve simple linear circuits, using mesh and nodal analysis
- Use Kirchoff's laws to solve circuits at sinusoidal steady state
- Apply Thevenin's and Norton's theorems to simple linear circuits.
- Design and build a range of different types of amplifier circuit using op amps, including inverting, non-inverting, summing amplifiers, and differencing amplifiers, and differentiator and integrator circuits
- Design simple amplifiers based on BJTs and FETs.
- Use a circuit simulation CAD package to design simple linear circuits.

**Pre-Requisites:** None

**Co-Requisites:** None

**Prohib Combs** None

# EE1D Techniques of Analysis and Modelling

**Description:** (EE1D1) Students are introduced to the application of mathematical techniques to engineering problems. The application examples are reinforced by problem solving classes. (EE1D2) Students' knowledge and skills in the application of differentiation and integration are extended. Students are introduced to the principles and practice of the construction and solution of ordinary differential equations. Partial derivatives are introduced, and applied to functions of two variables. The application of differential equation techniques to a range of important engineering problems is introduced. 9 hours of tutorials will be available with marks being given for attendance. Tutorial work will be handed to be marked and an effort mark given.

**Assessment:** **75%** **EE1D Exam**  
*3 hour exam in May/June, answer 4 questions from 6*  
**20%** **Class Tests**  
**5%** **Tutorials**

**Objectives:** EE1D1

On successful completion of the module, students will be able to formulate and solve problems in

- circuit theory,
- computer graphics,
- basic mechanics and
- signals & systems

using the following techniques

- the algebra of matrices and determinants;
- complex numbers;

EE1D2

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

- Recognise standard forms of ordinary differential equations of first and second order, and solve them by appropriate techniques;
- Differentiate and integrate standard functional forms;
- Construct Taylor series
- Calculate partial derivatives
- Derive the equations corresponding to a range of important engineering situations. Solve these equations, and interpret the solutions.

**Pre-Requisites:** None

**Co-Requisites:** None

**Prohib Combs** None

# EE1E C Programming and Algorithmic Problem Solving

20 Credits  
Semester 1+2  
Compulsory

**Description:** (EE1E1) Students are introduced to the functional behaviour of digital computer systems. The course covers basic concepts of computer logic and architecture, algorithmic problem solving, programming structure, control and data organisation. The requirements for procedural programming languages are explained through the introduction of the syntax and semantics of the C programming language. (EE1E2) Students explore in further depth the advanced concepts of the C programming language, and are introduced to basic algorithmic decomposition and design

**Assessment:**

10%	<b>EE1E1 Lab sheets 4 &amp; 5</b>
10%	<b>EE1E1 Lab sheets 6 &amp; 7</b>
20%	<b>EE1E2 Lab exercise 4 &amp; 5</b>
20%	<b>EE1E2 Assignment</b>
20%	<b>EE1E1 Class Test</b>
20%	<b>EE1E2 Class Test</b>

**Objectives:**

**EE1E1**  
On successful completion of this module, the student will be able to:

- Describe the basic operation of a computer and understand the basic concepts of computer programming languages
- Design and test computer programs, using the basic constructs of the ANSI C programming language
- Understand elementary numerical methods (e.g. precision & errors) and their relationship to programming

**EE1E2**  
On successful completion of this module, the student will be able to

- Apply more advanced C programming concepts such as pointers and dynamic memory allocation
- Understand and apply the principles of algorithmic decomposition and design
- Develop high-quality software written in the C programming language

**Pre-Requisites:** None

**Co-Requisites:** None

**Prohib Combs** None

# Introduction to Economics

10 Credits  
Semester 2  
Compulsory

**Description:** The aim of the module is to provide a thorough grounding in microeconomics.

**Assessment:**

25%	<b>Class Test</b>
75%	<b>Exam</b>

**Objectives:** S1 Knowledge and understanding of commercial and economic context of engineering processes.

**Pre-Requisites:**

**Co-Requisites:**

**Prohib Combs**

## Introduction to Financial Analysis

10 Credits  
Semester 1  
Compulsory

**Description:** The aim of the module is to introduce financial analysis techniques related to the appraisal of company financial performance.

**Assessment:** 25% **Class Test**  
75% **Exam**

**Objectives:** S1 Knowledge and understanding of commercial and economic context of engineering processes.  
D3 Identify and manage cost drivers.

**Pre-Requisites:**

**Co-Requisites:**

**Prohib Combs**

## Business Organisation and Management

10 Credits  
Semester 1  
Compulsory

**Description:** The aim of the module is to acquaint students with the theory and practice of managing organisations.

**Assessment:** 25% **Essay**  
75% **Exam**

**Objectives:** S1 Knowledge and understanding of commercial and economic context of engineering processes

S5 Understanding of the need for a high level of professional and ethical conduct in engineering

P4 Understanding use of technical literature and other information sources

P5 Awareness of nature of intellectual property and contractual issues

**Pre-Requisites:**

**Co-Requisites:**

**Prohib Combs**

# Introduction to Marketing

10 Credits  
Semester 1  
Compulsory

**Description:** This course will examine the fundamental principles of marketing and illustrates why marketing is not just an isolated organisational function. In today's world technology and the increased power of the consumer have changed the way in which organisations have to market their goods and services. Equally, the global nature of our society means that many organisations must engage in marketing around the world during a turbulent economy. We will explore how organisations can manage profitable customer relationships. As consumers we engage with marketing on a daily basis whether it is trying to decide on Starbucks or Costa for a coffee or deciding to buy a car. We look at the key principles of marketing to establish marketing's key components.

**Assessment:** 1 x 3000 word report based assignment.

**Objectives:** By the end of the module students should be able to:

- Demonstrate knowledge and understanding of the fundamental principles of marketing;
- Evaluate the importance of the customer in the marketplace;
- Identify and interpret the trends that are changing the marketing landscape;
- Demonstrate knowledge and understanding of the global environmental issues that affect the marketplace;
- Demonstrate understanding of the customer decision making process and evaluate how the digital age is affecting the customer and the organization;
- Explain and appraise the product life cycle.

**Pre-Requisites:**

**Co-Requisites:**

**Prohib Combs**

## Intermediate Level (Year 2)

### **BEng/MEng Elec Eng w Bus Man-LI**

All modules are compulsory

### **BEng/MEng**

**Year Credits:** 120

**Total Credits:** 360/480

#### **Compulsory**

<b>Dept Code</b>	<b>Banner</b>	<b>Module Title</b>	<b>Credits</b>	<b>Semester</b>
EE2A	0419504	Digital Systems and Embedded Computing	20	1+2
EE2B	0419505	Electronic Circuits, Devices and Electromagnetics	20	1+2
EE2D1	0417024	Fundamentals of Signals and Systems	10	1
EE2D2	0413812	Communication Systems	10	2
EE2G	0424091	Project Management and Professional Practice	20	1+2
0702662	0702662	Introduction to Marketing	10	1
0703059	0703059	Human Resource Management	10	2
0714508	0714508	Financial Decision Making	10	1
0720327	0720327	Global Marketing	10	2
TBA		International Economy	10	1

#### **Progress Requirements**

In order to proceed to BEng 3 students are required to have:

- a) attempted all pre-requisite modules (i.e. EE2A, EE2B and EE2D1);
- b) passed at least 100 credits at level 2; and
- c) passed at least 200 credits overall.

To proceed to MEng 3 students must pass 220 credits over all, including all pre-requisite modules, and have a second year average of at least 60%.

#### **Transfer Opportunities**

None.

# EE2A Digital Systems and Embedded Computing

20 Credits  
Semester 1+2  
Compulsory

**Description:** (EE2A1) The module aims to provide an in-depth understanding of the design and implementation of finite state machines and an introduction to the use of C programming for embedded computing. (EE2A2) Students deepen their understanding of the design of synchronous and asynchronous digital systems, and undertake a series of case studies using programmable logic devices. Students deepen their understanding of embedded microcontrollers and communication protocols used by computers.

**Assessment:** 75% **EE2A Exam**

*2 hour exam in May/June, answer 3 questions from 4*

25% **Assessed Laboratories**

**Objectives:** (EE2A1)

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

- Design synchronous finite state machines.
- Implement synchronous finite state machine using a programmable logic device.
- Write programs for embedded microcontrollers, and interface the microcontroller to support circuitry.

(EE2A2)

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

- Design and implement complex synchronous and asynchronous digital systems
- Design interfacing circuitry for communication between microprocessors and peripherals.
- Write C programmes for embedded microcontrollers that control peripheral hardware.

**Pre-Requisites:** EE1A & EE1E

**Co-Requisites:** None

**Prohib Combs** None

# EE2B Electronic Circuits, Devices and Electromagnetics

20 Credits  
Semester 1+2  
Compulsory

**Description:** (EE2B1) Students deepen their understanding of electronic circuits, with a more in-depth consideration of linear circuits (in particular the most important amplifier configurations), examination of non-ideal effects, and consideration of nonlinear circuits. Students deepen their understanding of the behaviour of solid state electronic devices.  
(EE2B2) Students deepen their understanding of electrostatics and magnetostatics, and are introduced to electromagnetics. The behaviour of time varying signals along transmission lines is introduced, and important applications are considered.

**Assessment:** 85% **Exams**

*1.5 hour exam in May/June, answer 2 questions from 3*

*1.5 hour exam in May/June, answer 2 questions from 3*

15% **Assessed Laboratories**

**Objectives:** (EE2B1)

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

- Design circuits based on the common emitter bipolar transistor amplifier.
- Design circuits based on the differential amplifier.
- Calculate the frequency response of an op-amp amplifier in a variety of configurations.
- Design a comparator circuit
- Derive the current-voltage characteristics of a semiconductor diode from first principles.
- Use Gauss' law and Poisson's equation to determine the spatial dependence of field and potential within depletion layers.
- Derive the current-voltage characteristic of short channel MOSFETs

(EE2B2)

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

Formulate and solve equations relating to

- the electric field around a charge distribution
- the magnetic field around a current density distribution
- propagation of electromagnetic fields in free space
- the electromagnetic field within a transmission line

Use Smith charts to carry out designs of high frequency circuits

**Pre-Requisites:** EE1B & EE1D

**Co-Requisites:** None

**Prohib Combs** None

# EE2D1 Fundamentals of Signals and Systems

10 Credits  
Semester 1  
Compulsory

**Description:** The aim of the modules is to provide an understanding and computational experience in use of the relevant mathematics necessary for analysis of signals and systems. Students' learning is reinforced by problem solving classes and MATLAB computer laboratories. The module is a corequisite for second semester control and communication modules.

**Assessment:** **80% EE2D1 Exam**  
*1.5 hour exam in May/June, answer 2 questions from 3*  
**20% Coursework Assignment**

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

- Understand the application and uses of the Fourier Series and Fourier Transform;
- Understand the application and uses of the Laplace Transform to solve ordinary and partial differential equations in the s-domain;
- Understand the application and uses of the z-Transforms to solve difference equations in the z-domain;
- Apply concepts of statistics and probability to acquired signals.

**Pre-Requisites:** EE1D

**Co-Requisites:** None

**Prohib Combs** None

# EE2D2 Communication Systems

10 Credits  
Semester 2  
Compulsory

**Description:** The main features of communication systems are examined in detail. Students are introduced to the key issues in filter design. Different modulation schemes are contrasted. The role of noise is examined.

**Assessment:** **80% EE2D2 Exam**  
*1.5 hour exam in May/June, answer 2 questions from 3*  
**20% Coursework Assignment**

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

- Explain the operation of telephone switching systems and perform traffic calculations
- Apply Shannon's theory to calculate channel capacity
- Estimate the effect of noise on digital signals.
- Explain the functions of regenerators and eye diagrams.
- Explain and perform calculations on matched filtering.
- Explain and perform calculations on sampling and quantisation.
- Design passive filters.
- Relate modulated signals to their baseband counterparts, both in the time and frequency domains.
- Explain the noise model for narrowband signals, and use it in calculations.

**Pre-Requisites:** EE1D & EE2D1

**Co-Requisites:** None

**Prohib Combs** None

# EE2G Project Management and Professional Practice

20 Credits  
Semester 1+2  
Compulsory

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<b>Description:</b>	In the first half of the module, students are given an introduction to: the systems engineering process and how it can be applied to a variety of real world situations; the management skills necessary to facilitate the development of complex systems on time and within budget; how to recognise and manage risk and uncertainty. The key issues are examined for various strategies for implementation of sub-modules - analogue hardware, digital hardware, mechanical hardware, software. Limitations and imperfections of each approach, and sources of instability and catastrophic failure are considered. Method of design and modelling system elements and their interaction are considered. In the second half of the module, students carry out a major group assignment that utilises the systems engineering approach to the design of a complete product.		
<b>Assessment:</b>	50% EE2G1 Coursework 50% EE2G2 Coursework		
<b>Objectives:</b>	On successful completion of this module, the student will be able to: <ul style="list-style-type: none"><li>Describe the key concepts of the systems engineering approach and understand how to function as project team members under modern project management techniques.</li><li>Identify reasons for success or failure of systems engineering case studies</li><li>Plan a project, with consideration of all aspects of the product life cycle</li><li>Identify health and safety requirements and ethical and social issues related to engineering projects</li><li>Evaluate the trade-offs between competing technologies for sub-system implementation</li><li>Integrate software, electronic hardware and mechanical hardware into integrated systems and carry out and properly document an engineering project</li></ul>		
<b>Pre-Requisites:</b>	None	<b>Co-Requisites:</b> None	<b>Prohib Combs</b> None

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# Human Resource Management

10 Credits  
Semester 2  
Compulsory

<b>Description:</b>	Processes of planning for acquiring and utilising human resources in organisations.	
<b>Assessment:</b>	70% Exam 30% Class Test	
<b>Objectives:</b>	By the end of the module the student should be able to: <ul style="list-style-type: none"><li>Understand the issues relating to the management of people.</li></ul>	
<b>Pre-Requisites:</b>	<b>Co-Requisites:</b>	<b>Prohib Combs</b>

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## Financial Decision Making

10 Credits  
Semester 1  
Compulsory

**Description:** Examines investment projects using discounting methods under the conditions of certainty and risk using both traditional and portfolio methods. Demonstrates how to calculate and use cost of capital for geared companies, and how to evaluate leasing projects.

**Assessment:** 25% **Essay**

75% **Exam**

**Objectives:** By the end of the module the student will be able to:

- evaluate investment decisions using discounted cash flow methods under the assumption of certainty;
- apply traditional and portfolio approaches to incorporate risk in investment decisions;
- calculate and make use of the appropriate costs of capital for all equity-financed and geared companies.

**Pre-Requisites:**

**Co-Requisites:**

**Prohib Combs**

## Global Marketing

10 Credits  
Semester 2  
Compulsory

**Description:** The module aims to provide an introduction to the issues involved with global marketing management, and to critically analyse business topics and develop their own informed views.

**Assessment:** 25% **Coursework**

75% **Coursework**

**Objectives:** By the end of the module the student should have:

- S1m The ability to make general evaluations of commercial risks through some understanding of the basis of such risks
- S2m Extensive knowledge and understanding of management and business practices, and their limitations, and how these may be applied appropriately to strategic and tactical issues.

**Pre-Requisites:**

**Co-Requisites:**

**Prohib Combs**

## TBA International Economy

10 Credits  
Semester 1  
Compulsory

**Description:** National income accounting. Macroeconomic theory. Theory of monetary and fiscal policy. Exchange rate regimes. Purchasing power parity and interest rate parity. European monetary union.

**Assessment:** 2 hr written examination (75%) class test (25%)

**Objectives:** On completion of this linked module the student will be able to: understand modern macroeconomics; understand how various macroeconomic developments, shocks and policies might be expected to affect the economic environment in an open economy.

**Pre-Requisites:**

**Co-Requisites:**

**Prohib Combs**

# Higher Level (Year 3)

## **BEng Elec Eng w Bus Man-LH**

Choose 20 credits from the section Options 1

**BEng**

**Year Credits:** 120

**Total Credits:** 360

### **Compulsory**

<b>Dept Code</b>	<b>Banner</b>	<b>Module Title</b>	<b>Credits</b>	<b>Semester</b>
EE3A1	0415652	Computer Hardware and Digital Design	10	1
EE3B1	0415653	Analogue Electronics	10	1
EE3P	0402279	Individual Project	40	1+2
0714511	0714511	Supply Chain Management	10	1
0714512	0714512	Corporate Finance	10	2
0727083	0727083	Strategic Management	10	1
0727166	0727166	Innovation Management	10	2

### **Options 1**

<b>Dept Code</b>	<b>Banner</b>	<b>Module Title</b>	<b>Credits</b>	<b>Semester</b>
EE3A2	0422735	Computer Networking	10	2
EE3B2	0401839	Future and Emerging Device Technologies	10	2
EE3B3	0427422	Communication Electromagnetics	10	1
EE3D2	0422734	Advanced Communication Systems	10	2
EE3J2	0422739	Data Mining	10	2
EE3K1	0422736	Interactive 3D Simulation	10	1
EE3N1	0422737	Signal Analysis and Signal Processing	10	1
EE3N2	0415661	Digital Signal Processing	10	2

**MEng Elec Eng w Bus Man-LH**

Choose 30 credits from the section Options 1

**MEng****Year Credits:** 120**Total Credits:** 480**Compulsory**

<b>Dept Code</b>	<b>Banner</b>	<b>Module Title</b>	<b>Credits</b>	<b>Semester</b>
EE3A1	0415652	Computer Hardware and Digital Design	10	1
EE3B1	0415653	Analogue Electronics	10	1
EE3GP	0401859	Group Design Project	30	1+2
0714511	0714511	Supply Chain Management	10	1
0714512	0714512	Corporate Finance	10	2
0727083	0727083	Strategic Management	10	1
0727166	0727166	Innovation Management	10	2

**Options 1**

<b>Dept Code</b>	<b>Banner</b>	<b>Module Title</b>	<b>Credits</b>	<b>Semester</b>
EE3A2	0422735	Computer Networking	10	2
EE3B2	0401839	Future and Emerging Device Technologies	10	2
EE3B3	0427422	Communication Electromagnetics	10	1
EE3D2	0422734	Advanced Communication Systems	10	2
EE3J2	0422739	Data Mining	10	2
EE3K1	0422736	Interactive 3D Simulation	10	1
EE3N1	0422737	Signal Analysis and Signal Processing	10	1
EE3N2	0415661	Digital Signal Processing	10	2

# EE3A1 Computer Hardware and Digital Design

10 Credits  
Semester 1  
Compulsory

<b>Description:</b>	Students deepen their knowledge of design methods digital systems and are introduced to Hardware Description Languages and automatic synthesis. Implementation styles (e.g. ASIC, FPGA) are introduced. The principle functional units of a modern computer system are designed. The principles of computer arithmetic and the IEEE 754 standard are introduced.
<b>Assessment:</b>	<b>75% EE3A1 Exam</b> <i>1.5 hour exam in May/June, answer 2 questions from 3</i> <b>25% EE3A1 Coursework Assignment</b>
<b>Objectives:</b>	<p>On completion of this module, students should be able to:</p> <ul style="list-style-type: none"> <li>• Design, model and synthesise simple systems using VHDL</li> <li>• Explain the key features of modern microprocessor design (e.g. superscalar, super-pipelining, out-of-order execution, VLIW, RISC versus CISC), and how they impact on processor performance</li> <li>• Explain the architecture of a modern computer, identify issues affecting performance, and perform quantitative analyses on performance limits imposed by bus and memory hierarchy design</li> <li>• Perform calculations on modern pipelined microprocessors in terms of instruction throughput</li> <li>• Use testability enhancement techniques</li> <li>• Generate test vectors, using Boolean differences and path sensitization methods.</li> </ul>

**Pre-Requisites:** EE2A

**Co-Requisites:** None

**Prohib Combs** None

# EE3A2 Computer Networking

10 Credits  
Semester 2  
Options 1

<b>Description:</b>	Students are introduced to the major concepts of modern computer networks and the technologies underlying them. Network layer models, internet protocols and packet routing are studied. Fundamental concepts of cryptography and error control for secure and robust communication are also studied, along with more practical networking aspects, such as, network security and monitoring.
<b>Assessment:</b>	<b>100% EE3A2 Exam</b> <i>2 hour exam in May/June, answer 3 questions from 4</i>
<b>Objectives:</b>	<p>On successful completion of this module, the student should be able to:</p> <ul style="list-style-type: none"> <li>• Demonstrate an understanding of the computer networking fundamentals</li> <li>• Analyse the operation of local area networks and in particular Ethernet networks</li> <li>• Analyse the architecture, routing and addressing issues in IP networks and the Internet</li> <li>• Have a qualitative understanding of the operation of transport layer protocols in TCP/IP</li> <li>• Assess the problems associated with robust and secure communications across computer networks</li> <li>• Perform calculations for selected error control and cryptographic algorithms</li> <li>• Perform simple calculations characterising the operation of queuing systems</li> </ul>

**Pre-Requisites:** None

**Co-Requisites:** None

**Prohib Combs** None

## EE3B1 Analogue Electronics

10 Credits  
Semester 1  
Compulsory

**Description:** Power amplifier circuits are introduced. Class A, B and AB amplifiers are studied in detail along with the related issues of efficiency, power dissipation and heat sinking requirements. High frequency performance of transistors is studied. The resulting effects on the common-emitter amplifier and measures to counter them are explored. Sources of noise in electronic circuits are introduced. Concepts of noise figure, noise temperature and the design of low-noise amplifiers are studied. The design of active RC filters is introduced.

**Assessment:** **100% EE3B1 Exam**

*2 hour exam in May/June, answer 3 questions from 4*

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

- Design and analyse class A, B and AB power amplifier circuits.
- Design and analyse common-emitter and cascode amplifiers in terms of their frequency response.
- Design low noise amplifiers and calculate the noise figure of a common-emitter amplifier.
- Design and analyse active RC filter circuits.

**Pre-Requisites:** EE2B

**Co-Requisites:** None

**Prohib Combs** None

## EE3B2 Future and Emerging Device Technologies

10 Credits  
Semester 2  
Options 1

**Description:** Scaling of semiconductor devices is discussed with reference to Technology Roadmaps. The potential roadblocks to the future scaling of MOS transistors are outlined. Future and emerging devices such as single electron tunnelling transistors, intramolecular nanoelectronic devices, and carbon-based devices are described. Techniques for fabricating nanoelectronic circuits, including extreme UV and x-ray lithography are described. Future circuits and systems are introduced through the 'System on a chip' that integrates devices such as optical waveguides, modulators and detectors and molecular electronics. Carbon-based electronic technologies such as flat screen displays and organic computers are also covered. The module concludes with a look at the key technology drivers and markets.

**Assessment:** **100% EE3B2 Exam**

*2 hour exam in May/June, answer 3 questions from 4*

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

- Calculate the current-voltage behaviour of short channel MOSFETs
- Calculate sub-threshold currents in MOSFETs
- Perform scaling calculations, and comment on their trustworthiness
- Calculate the limitations on devices imposed by fundamental physics
- Analyse a wide range of emerging device technologies in terms of their ability to supplant or augment present-day silicon technology for electronics application.

**Pre-Requisites:** EE2B

**Co-Requisites:** None

**Prohib Combs** None

## EE3B3 Communication Electromagnetics

10 Credits  
Semester 1  
Options 1

<b>Description:</b>	RF & Microwave Communicaton link components. An introduction to Noise temperature, noise factor and sources of noise. Discussion of microwave links based on Link budget.
	Basic theory of antennas, their properties and behaviour. Microstrip antennas. Mobile phone antennas. Array antennas for smart/adaptive communications and radar. Plane wave propagation and polarisation. Interaction of plane waves with dielectric and metallic boundaries
	Transmission Lines as an extension to normal wire conductors. Reasons for using transmission line techniques. Coaxial lines, microstrip lines, and their use in microwave circuits. Reflections, VSWR, reflection coefficient and matching.
	Introduction to Electromagnetic Compatibility. Near field effects and interference. Screening/shielding. Radiated emission models. Capacitive/inductive coupling and crosstalk.
	Microwave measurement systems and associated errors – lab demonstration. Introduction to Microwave CAD package for visualisation and self study.
<b>Assessment:</b>	70% by 1½ hour examination in May/June, answer 2 questions out of 3; 30% by coursework
<b>Objectives:</b>	<p>By the end of the module students should be able to:</p> <ul style="list-style-type: none"> <li>• Demonstrate understanding of the basic properties of radiated electromagnetic waves and antennas.</li> <li>• Manipulate the interactions of transmission line circuit components and antennas.</li> <li>• Perform a detailed analysis and describe the measurement process of antennas and high frequency circuits used in communications systems.</li> <li>• Demonstrate understanding of the basics of electromagnetic compatibility and interference, and provide solutions for screening and shielding.</li> </ul>

**Pre-Requisites:** EE2B2

**Co-Requisites:**

**Prohib Combs**

## EE3D2 Advanced Communication Systems

10 Credits  
Semester 2  
Options 1

<b>Description:</b>	The module develops students' understanding of digital communication systems, including base band signals, methods of modulation/demodulation and analysis of wireless systems.
<b>Assessment:</b>	<b>100% EE3D2 Exam</b> <i>2 hour exam in May/June, answer 3 questions from 4</i>
<b>Objectives:</b>	<p>On completing the course, students should be able to:</p> <ul style="list-style-type: none"> <li>• Describe digital base-band and pass-band signals and modulation - demodulation methods and technique</li> <li>• Understand the basic principles behind communications, and specifically wireless systems</li> <li>• Analyse the major parameters and architectures of modern communication systems</li> </ul>
<b>Pre-Requisites:</b>	EE2D1 and EE2D2
<b>Co-Requisites:</b>	None
<b>Prohib Combs</b>	None

## EE3J2 Data Mining

10 Credits  
Semester 2  
Options 1

<b>Description:</b>	Data mining is concerned with computational techniques for data analysis, to extract relevant information or discover underlying structure. The data is high dimensional and too vast for manual analysis. The first part of the course concentrates on text and presents the principles which underpin current text search engines. The second part is concerned with generic techniques for analysing and discovering the underlying structure of general abstract data sets.
<b>Assessment:</b>	<b>100% EE3J2 Exam</b> <i>2 hour exam in May/June, answer 3 questions from 4</i>
<b>Objectives:</b>	On completion of this module, students should be able to: <ul style="list-style-type: none"><li>• Construct a basic text-based search engine, including:<ul style="list-style-type: none"><li>• Text normalization: stop-word removal, stemming</li><li>• Implementation of a Document Index</li><li>• Calculation of Term-Frequency, Inverse Document Frequency similarity between queries and documents</li></ul></li><li>• Understand the basic principle of Latent Semantic Analysis</li><li>• Understand the use of synonyms, hyponyms and hypernyms in information retrieval</li><li>• Understand the goals of data mining</li><li>• Implement maximum likelihood estimation of Gaussian PDF and Gaussian Mixture PDF parameters for a given data set</li><li>• Understand the basic principle of Principle Components Analysis</li><li>• Understand and apply agglomerative, divisive and k-means clustering algorithms</li><li>• Understand and apply sequence matching techniques based on dynamic programming</li><li>• Understand the basic principles of Artificial Neural Networks</li></ul>

**Pre-Requisites:** None

**Co-Requisites:** None

**Prohib Combs** None

## EE3K1 Interactive 3D Simulation

10 Credits  
Semester 1  
Options 1

<b>Description:</b>	This module provides a framework for the development of interactive systems and key human-centred design issues with regard to their use and application. Students will acquire the skills necessary to develop interactive 3D games, including 3D modelling and integration with an appropriate, professional real-time engine. The module also addresses interactive technologies and human factors issues associated with VR, Synthetic and Games-Based Environments.
<b>Assessment:</b>	<b>5% EE3K1 Workplan Presentation</b> <b>35% EE3K1 Group Report</b> <b>60% EE3K1 Group Presentation</b>
<b>Objectives:</b>	On successful completion of this module, the student should be able to: <ul style="list-style-type: none"><li>• Understand the pitfalls of "technology push" when considering the application of novel interface devices to real-life applications</li><li>• Create an interactive 3D scenario using an appropriate 3D modelling toolkit and games engine.</li></ul>

**Pre-Requisites:** None

**Co-Requisites:** None

**Prohib Combs** None

# EE3N1 Signal Analysis and Signal Processing

10 Credits  
Semester 1  
Options 1

**Description:** Students are introduced to spectral analysis, convolution, time-invariant and distortionless systems, and matched filtering including chirp filters.

**Assessment:** **100% EE3N1 Exam**

*2 hour exam in May/June, answer 3 questions from 4*

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

- Describe continuous signals as time waveforms or frequency spectra
- Transform signals from one representation to another
- Know and use the Fourier transform theorems
- Apply spectrum analysis, convolution and correlation processes
- Find the power spectra of random signals
- Describe the behaviour of linear time invariant systems
- Understand the nature of a distortionless system
- Understand the features of matched filtering
- Perform calculations on chirp signals and filters

**Pre-Requisites:** EE2D1 & EE2D2

**Co-Requisites:** None

**Prohib Combs** None

# EE3N2 Digital Signal Processing

10 Credits  
Semester 2  
Options 1

**Description:** Engineering application of discrete Fourier transform , FFT, z-transform, FIR and IIR digital filters are introduced to students. The application examples are reinforced by problem solving classes.

**Assessment:** **100% EE3N2 Exam**

*2 hour exam in May/June, answer 3 questions from 4*

**Objectives:** On successful completion of the module, students will be able to:

- Explain and quantify the application of both discrete Fourier transform and z transform
- Design digital FIR and IIR filters.
- Critically appraise the relative merits of LC, IIR and FIR filters for diverse applications.

**Pre-Requisites:** EE2D1 & EE3N1

**Co-Requisites:** None

**Prohib Combs** None

# EE3GP Group Design Project

30 Credits  
Semester 1+2  
Compulsory  
(MEng only)

**Description:** A technical specification is issued to groups of students. These groups then decide on their technical and managerial approach to the task. The groups are assessed on technical merit, added-value, end-product and demonstrable group working skills developed during the project.

**Assessment:**

<b>5%</b>	<b>First Demonstration</b>
<b>5%</b>	<b>Interim Group Report</b>
<b>20%</b>	<b>Second Demonstration</b>
<b>67.5%</b>	<b>Final Group Report</b>
<b>2.5%</b>	<b>Poster Session</b>

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

- Study a problem independently and as a group
- Work as a productive member of a team
- Gather, organise and distil information from various sources, summarise the information succinctly, and draw general conclusions;
- Exercise initiative and independence in the planning and execution of a project, and manage time and resources competently
- Design a solution to an engineering problem, which will include one or more of the following:
  - Construction and testing of hardware or software solutions
  - Simulation/modelling and testing
  - Analysis and inference
- Critically appraise results, and present the essential features and conclusions clearly and coherently in both written and oral forms.

An excellent student will additionally be able to

- Design an innovative solution, informed by the forefront of knowledge, to a new engineering problem

**Pre-Requisites:** None

**Co-Requisites:** None

**Prohib Combs** None

## EE3P Individual Project

40 Credits  
Semester 1+2  
Compulsory  
(BEng only)

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<b>Description:</b>	Students negotiate a project title and specification with their supervisor. After an initial period of background work, they carry out the necessary design and practical work to complete their project
<b>Assessment:</b>	<p><b>9.5% First Bench Inspection</b></p> <p><b>0.5% Second Stage Project Specification</b></p> <p><b>19% Second Bench Inspection</b></p> <p><b>70% Final Report</b></p> <p><b>1% Poster Presentation</b></p>
<b>Objectives:</b>	<p>On completion of this module, students should be able to:</p> <ul style="list-style-type: none"> <li>• Study a problem independently</li> <li>• Gather, organise and distil information from various sources, summarise the information succinctly, and draw general conclusions;</li> <li>• Exercise initiative and independence in the planning and execution of a project, and manage time and resources competently</li> <li>• Design a solution to an engineering problem, which will include one or more of the following: <ul style="list-style-type: none"> <li>• Construction and testing of hardware or software solutions</li> <li>• Simulation/modelling and testing</li> <li>• Analysis and inference</li> </ul> </li> <li>• Critically appraise results, and present the essential features and conclusions clearly and coherently in both written and oral forms.</li> </ul> <p>An excellent student will additionally be able to</p> <ul style="list-style-type: none"> <li>• Design an innovative solution, informed by the forefront of knowledge, to a new engineering problem</li> </ul>
<b>Pre-Requisites:</b>	None
<b>Co-Requisites:</b>	None
<b>Prohib Combs</b>	None

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## Supply Chain Management

10 Credits  
Semester 1  
Compulsory

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<b>Description:</b>	The aim of the module is to develop students' understanding of how critical tasks in supply chain management are organised and undertaken in an effective manner.
<b>Assessment:</b>	<b>100% Essay</b>
<b>Objectives:</b>	<ul style="list-style-type: none"> <li>• S1 Knowledge and understanding of commercial and economic context of engineering processes</li> <li>• S5 Understanding of the need for a high level of professional and ethical conduct in engineering</li> <li>• P3 Understanding of contexts in which engineering knowledge can be applied (e.g. operations and management, technology, development, etc)</li> <li>• P5 Awareness of nature of intellectual property and contractual issues</li> </ul>
<b>Pre-Requisites:</b>	
<b>Co-Requisites:</b>	
<b>Prohib Combs</b>	

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# Corporate Finance

10 Credits  
Semester 2  
Compulsory

**Description:** The aim of the module is to enable students to understand and apply aspects of corporate finance, especially on how technical methods can be applied.

**Assessment:** 25% Coursework  
75% Exam

**Objectives:**

- D3 Identify and manage cost drivers
- S4 Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues.
- S5 Understanding of the need for a high level of professional and ethical conduct in engineering.
- P4 Understanding use of technical literature and other information sources.
- P5 Awareness of nature of intellectual property and contractual issues.
- P6 Understanding of appropriate codes of practice and industry standards

**Pre-Requisites:**

**Co-Requisites:**

**Prohib Combs**

# Strategic Management

10 Credits  
Semester 1  
Compulsory

**Description:** This module seeks to provide an understanding of various approaches to strategic management analysis and to develop the students' personal skills in gathering and analysing disparate data, evaluating corporate strategies and convincing others of the value of their proposed strategy.

The module will focus on both the manufacturing and service sectors and may cover key areas such as:

The analysis and formulation of long run strategies of business organisations; Evaluation of the resulting corporate strategies; Convincing others of the value of the proposed strategies; The perspectives of higher levels of management (as opposed to the management of particular business functions).

**Assessment:** 3 hr examination 75%, 1 written case study report 25%.

**Objectives:** By the end of the module students should be able to:

- Demonstrate knowledge and understanding of strategic management concepts and principles and their application across a range of companies and sectors;
- Demonstrate knowledge and understanding of strategic management concepts and principles and their application across a range of companies and sectors;
- Identify strategic issues in complex organisations and design and evaluate appropriate solutions to address them;
- Understand and critically evaluate the sources of competitive advantage or disadvantage for particular businesses and propose initiatives to strengthen or develop a firm's competitive advantage.

**Pre-Requisites:**

**Co-Requisites:**

**Prohib Combs**

# Innovation Management

10 Credits  
Semester 2  
Compulsory

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<b>Description:</b>	<p>This module is intended to provide students with a critical awareness of major issues associated with Innovation Management. The module may cover areas such as: The definitions of innovation management; How organisations can develop robust innovation processes; How innovation management relates to strategy and organisational performance; How innovation management is related to technology development and Intellectual Property; How Innovation Management links to entrepreneurship and government policy initiatives and outcomes; How organisational barriers to innovation arise and how to overcome them; How the development of networks can facilitate innovation in large organisations</p> <p>Through the course of this module participants will explore some of the key Innovation Management frameworks and models, how they can be applied within a range of organisations and to what effect.</p>
<b>Assessment:</b>	Group presentation (20%); Individual assignment (4000 words) (80%)
<b>Objectives:</b>	<p>By the end of the module students should be able to:</p> <ul style="list-style-type: none"><li>• Demonstrate comprehensive knowledge and understanding of innovation management in the context of the competitive environment of large organisations;</li><li>• Understand the different theoretical approaches and models that underpin innovation management and outcomes and be able to critical evaluate such theories;</li><li>• Critically analyse the innovation management practices of a range of large organisations, identifying both successful approaches and barriers to innovation;</li><li>• Demonstrate a critical awareness of the importance of opportunity recognition and evaluation processes involved in developing innovation within large organisations;</li><li>• Demonstrate a critical awareness of the importance of technology, intellectual property and networks in facilitating innovation within large organisations;</li><li>• Demonstrate skills in verbal and written communication, team working, and critical analysis.</li></ul>

**Pre-Requisites:****Co-Requisites:****Prohib Combs**

# Masters Level (Year 4)

## **MEng Elec Eng w Bus Man-LM**

Choose 30 credits from the section Options 1.

**MEng**

**Year Credits:** 120

**Total Credits:** 480

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### **Compulsory**

<b>Dept Code</b>	<b>Banner</b>	<b>Module Title</b>	<b>Credits</b>	<b>Semester</b>
EE4G	0406217	Digital Design	10	1
EE4P(B)	0420511	Individual Project for Bus Man Students	40	1+2
0706130	0706130	International and Industrial Economics	20	1+2
0725280	0725280	Small Business & Entrepreneurship	20	1+2

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### **Options 1**

<b>Dept Code</b>	<b>Banner</b>	<b>Module Title</b>	<b>Credits</b>	<b>Semester</b>
EE4B	0424082	Communications Signal Processing	10	1
EE4D	0424083	Electromagnetics, Antennas and Propagation	20	2
EE4F	0420583	Electrical Energy Conversion Systems	10	1
EE4H	0406218	Computer Vision	10	2
EE4K	0421898	Intelligent Systems	10	2
EE4L	0422750	Computer and Communication Networks	10	2
EE4N	0424097	Satellite, Mobile and Optical Communications	20	2
EE4R	0406224	Spoken Language Processing	10	2
EE4T1	0424095	RF and Microwave Principles	10	1
EE4T2	0422751	RF & Microwave Engineering	10	2
EE4U	0426702	Human Factors and Interactive System Design	20	1

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## **EE4B Communications Signal Processing**

10 Credits  
Semester 1  
Options 1

**Description:** The module provides an introduction to random signals analysis and its role in communications signal processing, and digital communication systems optimisation. The module then analyses the process involved in digital communications, mobile communications channels and the relevant signal processing techniques. The particular emphasis is on the signal processing of GSM and CDMA communications that is the key technology behind 3G systems.

**Assessment:** **100% EE4B Exam**

**Objectives:** By the end of the module students should be able to:

- apply statistical signal processing methods and classical statistical theory to communication system analysis;
- analyse a communication system performance for a given system configuration and parameters;
- synthesise the structure and parameters of a communication system for a specified performance.

**Pre-Requisites:** EE3D2

**Co-Requisites:**

**Prohib Combs**

# EE4D Electromagnetics, Antennas and Propagation

20 Credits  
Semester 2  
Options 1

## Description:

The aims of this course are to:  
Review mathematical and statistical techniques that support the theory of electromagnetics and propagation studied in the remainder of the module.  
Make students aware of analytical methods for the solution of electromagnetics problems.  
Give students an understanding and awareness of computer aided design in electromagnetics.  
Describe the fundamental principles of a number of components where electromagnetic analysis is required.  
Understand the basic principles of antenna operation, analysis and design.  
Understand the physics of radiowave propagation at a number of frequency bands and environment

Students taking this module must have an understanding of basic electromagnetism (the magnetic field of a solenoid and wire, Lenz's Law etc), differential and integral calculus.

## Assessment:

**100% EE4D Exam**

## Objectives:

By the end of the module students should be able to:

- Solve problems using special functions, partial differential equations, and vector calculus using analytical and numerical techniques.
- Choose suitable electromagnetic based tools for the analysis of components.
- Use electromagnetic CAD tools.
- Demonstrate an understanding of the basic principles behind electromagnetic analysis.
- Describe the operation of and perform design calculations on selected electromagnetic systems.
- Analyse simple antennas and quantify their properties.
- Perform simple path loss calculations for a range of radiowave propagation problems.

**Pre-Requisites:** None

**Co-Requisites:** None

**Prohib Combs** None

# EE4F Electrical Energy Conversion Systems

10 Credits  
Semester 1  
Options 1

**Description:** Electrical energy systems integration is discussed. A detailed description of power electronic converters and inverters will be given. This will include a treatment of PWM strategies for converters and invertors, including diode and controlled converters. Interfacing devices to complex systems will be discussed with reference to hybrid vehicles and renewable energy generation. An overview of emerging energy devices will be given and will include; fuel cells, battery systems, super-capacitors, flywheels and magnetic storage.

**Assessment:** **100% EE4F Exam**

*2 hour exam in May/June, answer 3 questions from 4*

**Objectives:** After completing this module, students should be able to:

- Sketch waveforms for and explain the operation of combinations of six-pulse converters, including overlap and load regulation in twelve-pulse converters and control of circulating current in back-to-back converters.
- Describe the principles of pulse-width modulation using a generic strategy based on volt-second equivalents, calculate depth of modulation and minimum pulse widths, undertake complex Fourier analysis of waveforms.
- Explain the application of PWM techniques in inverters and reversible converters
- Explain the operation of energy devices including analysing the performance characteristics
- Perform system design and integration of hybrid devices
- Explain and analyse the methods used for renewable energy grid connection

**Pre-Requisites:** EE3C1

**Co-Requisites:**

**Prohib Combs**

# EE4G Digital Design

10 Credits  
Semester 1  
Compulsory

**Description:** This module builds on the material of EE3A1 to deepen students' knowledge and understanding of the design of large-scale digital projects using VHDL for FPGA and ASIC implementation. The hierarchy of design abstraction and the process of top down design are overviewed. Advanced concepts and methods of VHDL are surveyed. The process of synthesis is introduced, and the synthesisable subset of VHDL is considered. FPGA architectures are investigated, and the required tools for partition, placement and routing are examined. Issues involved in FPGA based implementations of advanced digital designs are illustrated by practical laboratories and an assignment.

**Assessment:** **100% Coursework Assignment**

**Objectives:** On completing the course, students should be able to:

- Perform designs of complex logic systems using VHDL
- Produce synthesisable VHDL for the custom digital circuitry of an embedded system
- Produce designs with testability enhancement
- Design fast arithmetic circuits

**Pre-Requisites:** EE3A1

**Co-Requisites:**

**Prohib Combs**

## EE4H Computer Vision

10 Credits  
Semester 2  
Options 1

<b>Description:</b>	<p>This module is designed to provide an introduction to the theory and application of key issues in image interpretation.</p> <p>Students will learn about methods for enhancing and interpreting both still and video images, methods of evaluation and tools for building image interpretation programmes</p> <p>Students will be required to analyse selected research.</p>
<b>Assessment:</b>	<p><b>33.33% EE4H Demonstration 1</b></p> <p><b>33.33% EE4H Demonstration 2</b></p> <p><b>33.33% EE4H Assignment</b></p>
<b>Objectives:</b>	<p>On completing the course, students should:</p> <ul style="list-style-type: none"> <li>• Analyse academic papers on computer vision.</li> <li>• Apply and implement image enhancement algorithm.</li> <li>• Apply and implement binary and grey-level mathematical morphology algorithms.</li> <li>• Implement algorithms for identifying the boundary of objects in an image.</li> <li>• Apply motion estimation algorithms.</li> <li>• Develop model-based image interpretation strategies</li> <li>• Solve practical image interpretation problems</li> </ul>

**Pre-Requisites:** None**Co-Requisites:** None**Prohib Combs** None

## EE4K Intelligent Systems

10 Credits  
Semester 2  
Options 1

<b>Description:</b>	Modelling of nonlinear and uncertain systems by using fuzzy, neural and fuzzy-neural approximators are examined and applications of these approximators to the synthesis of learning control algorithms are presented. Approaches to intelligent control system design are presented. An emphasis is placed on efficient integration of qualitative and quantitative knowledge in order to handle uncertainty and complexity of system dynamics. The design approaches and solutions are illustrated by a number of real life applications. A MATLAB-SIMULINK based assignment gives practice in selecting and using these techniques.
<b>Assessment:</b>	<p><b>65% EE4K Exam</b>  <i>2 hour exam in May/June, answer 3 questions from 4</i></p> <p><b>35% Coursework Assignment</b></p>
<b>Objectives:</b>	<p>After completion of this module, students should be able to:</p> <ul style="list-style-type: none"> <li>• Model nonlinear systems based on data records by using static and dynamic neural networks,</li> <li>• Integrate qualitative knowledge expressed in the form of heuristic rules and quantitative knowledge to design models of nonlinear systems by using fuzzy-neural networks,</li> <li>• Design learning neural and fuzzy controllers for uncertain plants,</li> <li>• Design a fast prototyping fuzzy PI controller for a nonlinear and uncertain SISO plant,</li> <li>• Design a multiregional controller for a nonlinear plant,</li> <li>• Overcome the drawbacks of a classic controller operating at a specific site by introducing a supervisory controller based on existing operational experience at a plant site,</li> <li>• Synthesise on-line identification algorithms with neural and fuzzy approximators based on real time data structured over moving measurement window.</li> </ul>

**Pre-Requisites:** EE2D1 and EE2C2**Co-Requisites:****Prohib Combs**

# EE4L Computer and Communication Networks

10 Credits  
Semester 2  
Options 1

**Description:** This module will begin by reviewing basic notions of layered architectures in data networks. A brief introduction to queuing theory will also be given. This will be followed by lectures on a small number (2-3 typically) of advanced networking topics from an extensive list that includes: Wireless networks, sensor networks, multicasting, QoS and queuing, network overlays, VoIP and real-time transport protocols, network security, network measurements and the large-scale structure of the Internet, etc.

**Assessment:** 90% EE4L Exam

10% EE4L Presentation

**Objectives:**

- Demonstrate knowledge of distributed systems principles and algorithms pertinent to networks.
- Critically assess the merits and drawbacks of state of the art networking technologies and proposals for future systems.
- Perform basic calculations to calculate metrics commonly used to characterise networks and be able to interpret the results.
- Be able to perform reasoned critiques of state of the art research publications in the field of networks.

**Pre-Requisites:** EE3A2

**Co-Requisites:**

**Prohib Combs**

# EE4N Satellite, Mobile and Optical Communications

20 Credits  
Semester 2  
Options 1

**Description:** The aims of this course are:

- To introduce and overview the wide range of current personal and mobile, satellite and optical communication systems.
- To describe the propagation environment involved in such systems and to explain methods of characterisation.
- To explain typical modulation, coding and multiplexing methods.
- To describe the system and network aspects of typical mobile systems.
- To introduce optical fibres, laser diodes and Photo-detectors.
- To discuss in detail: optical transmitters; optical receivers; and optical fibre communication systems in particular coherent fibre communications and wavelength division multiplexing systems

**Assessment:** 100% EE4N Exam

**Objectives:** By the end of the module students should be able to:

- Discuss the design and configuration of satellite and mobile communication systems to meet specific requirements.
- Discuss appropriate measures to overcome the problems caused by different propagation environments.
- Calculate figures of merit for basestations, earth stations, satellite transponders and mobile units and use these in assessing link budgets.
- Perform quantitative design on optical fibre systems.
- Describe roles of optical transmitter, fibre and receiver in an optical fibre communication system.
- Design both conventional and coherent optical fibre communication systems.
- Critically appraise the relative merits of satellite, cellular and optical fibre communication systems for diverse applications.
- Calculate figures of merit for basestations, earth stations, satellite transponders and mobile units and use these in assessing link budgets.

**Pre-Requisites:** None

**Co-Requisites:** None

**Prohib Combs** None

# EE4R Spoken Language Processing

10 Credits  
Semester 2  
Options 1

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<b>Description:</b>	The aim of the module is to provide an understanding of the scope, principles, capabilities and applications of speech and language processing. Students will learn about basic principles of human speech production and perception and methods for processing of speech signals. Students will learn in-depth about automatic speech recognition, in particular, the employment of hidden Markov models for modelling of time-varying signals, such as speech, principles of language modelling and strategies for dealing with noise.				
<b>Assessment:</b>	<b>90% EE4R Exam</b> <b>10% Coursework Assignment</b>				
<b>Objectives:</b>	On successful completion of this module the student will <ul style="list-style-type: none"> <li>• Demonstrate an appreciation of the full range of spoken language technologies.</li> <li>• Explain the basic principles of human speech production and perception and use the language of elementary phonetics.</li> <li>• Demonstrate an understanding of the different modelling assumptions which are used in speech recognition and language processing and an awareness of their strengths and weaknesses in the context of spoken language processing.</li> <li>• Demonstrate an in-depth understanding of automatic speech recognition using Hidden Markov models, principles of language modelling and strategies for dealing with noise.</li> <li>• Apply their understanding of the capabilities of spoken language processing systems and trade-off different capabilities in order to meet application requirements.</li> <li>• Demonstrate an understanding of the multimodal aspect of spoken language.</li> <li>• Explain the range of potential applications of spoken language processing.</li> </ul>				
<b>Pre-Requisites:</b>	None	<b>Co-Requisites:</b>	None	<b>Prohib Combs</b>	None

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# EE4T1 RF and Microwave Principles

10 Credits  
Semester 1  
Options 1

<b>Description:</b>	The module covers the principles of RF and microwave engineering that underpin the design of analogue front end elements of communication systems. Computer simulation of passive and linear active microwave circuits is also introduced through laboratory sessions.				
<b>Assessment:</b>	<b>75% EE4T1 Exam</b> <b>25% Coursework Assignment</b>				
<b>Objectives:</b>	On completing the module, students should be able to: <ul style="list-style-type: none"> <li>• interpret the scattering parameters of microwave and RF components;</li> <li>• explain the operation of and carry out first order design calculations on some passive and linear active components, such as transmission lines, filters, couplers and amplifiers;</li> <li>• use a representative commercial microwave circuit simulation tool to simulate some basic microwave components and be aware of the limitations</li> </ul>				
<b>Pre-Requisites:</b>	None	<b>Co-Requisites:</b>	None	<b>Prohib Combs</b>	None

## EE4T2 RF & Microwave Engineering

10 Credits  
Semester 2  
Options 1

**Description:** Methods of analysing both active and passive circuits will be developed, based on s-parameters and ABCD parameters. CAD techniques for RF and microwave circuits will be introduced and the capabilities and characteristics of field solvers and circuit simulators will be studied. Linear, non linear and noisy circuits will be analysed using circuit simulation CAD. CAD based tuners and optimisers will be introduced and their advantages and disadvantages will be discussed.

**Assessment:** 100% EE4T2 Exam

**Objectives:** By the end of the module students should be able to:

- Explain the operation of a wide range of active and passive RF and microwave components, including advanced filters, linear and non-linear amplifiers, mixers, modulators and control components
- Apply appropriate methods to the analysis or synthesis of some representative components
- Summarise the advantages and disadvantages of different analysis and synthesis tools

**Pre-Requisites:** None

**Co-Requisites:** EE4T1

**Prohib Combs** None

## EE4U Human Factors and Interactive System Design

20 Credits  
Semester 1  
Options 1

**Description:** Aims:  
To provide an overview of fundamental principles and practices of human-centred design of interactive systems;  
To explain the theoretical principles of human-computer interaction;  
To analyse the basic physiological, psychological and social factors that influence human-computer interaction;  
Graphical design for interaction;  
Usability evaluation and analysis

**Assessment:** 100% coursework

**Objectives:** By the end of the module students should be able to:

- Describe and assess the range of human factors issues central to the design and development, selection and evaluation of interactive technologies and computer interfaces
- Qualitatively evaluate the importance of human factors approaches and techniques at different stages of interactive system and product life cycles (Human Factors Integration)
- Describe and assess the basic cognitive factors and interaction design issues that influence human-computer interaction and interactive systems design
- Apply basic Human Factors principles of human-computer interaction to the design of user interfaces and interactive technologies
- Evaluate and redesign a user interface
- Critically evaluate two or three contemporary commercial-off-the-shelf interactive technologies identified from online sources
- Undertake basic task analysis exercises and assess key human-centred design issues such as human performance (strengths and limitations), mental workload assessment, situational awareness, error analysis, cognitive walkthrough, etc.

**Pre-Requisites:** None

**Co-Requisites:** None

**Prohib Combs** None

# EE4P(B) Individual Project for Bus Man Students

40 Credits  
Semester 1+2  
Compulsory

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<b>Description:</b>	Students negotiate a project title and specification with their supervisor. After an initial period of background work, they carry out the necessary design and practical work to complete their project.												
<b>Assessment:</b>	<table><tr><td>5%</td><td><b>EE4P First Report</b></td></tr><tr><td>5%</td><td><b>EE4P Technical Presentation</b></td></tr><tr><td>5%</td><td><b>EE4P Second Report</b></td></tr><tr><td>14%</td><td><b>EE4P Bench Inspection</b></td></tr><tr><td>70%</td><td><b>EE4P Final Report</b></td></tr><tr><td>1%</td><td><b>EE4P Poster Presentation</b></td></tr></table>	5%	<b>EE4P First Report</b>	5%	<b>EE4P Technical Presentation</b>	5%	<b>EE4P Second Report</b>	14%	<b>EE4P Bench Inspection</b>	70%	<b>EE4P Final Report</b>	1%	<b>EE4P Poster Presentation</b>
5%	<b>EE4P First Report</b>												
5%	<b>EE4P Technical Presentation</b>												
5%	<b>EE4P Second Report</b>												
14%	<b>EE4P Bench Inspection</b>												
70%	<b>EE4P Final Report</b>												
1%	<b>EE4P Poster Presentation</b>												
<b>Objectives:</b>	On completion of this module, students should be able to: <ul style="list-style-type: none"><li>• Study a problem independently</li><li>• Gather, organise and distil information from various sources, summarise the information succinctly, and draw general conclusions from fragmentary or conflicting data;</li><li>• Demonstrate awareness of new and emerging technologies</li><li>• Exercise initiative and independence in the planning and execution of a project, and manage time and resources competently</li><li>• Design an innovative solution, informed by the forefront of knowledge, to a new engineering problem, which will include one or more of the following:<ul style="list-style-type: none"><li>• Construction and testing of hardware or software solutions</li><li>• Simulation/modelling and testing</li><li>• Analysis and inference</li><li>• Critically appraise results, and present the essential features and conclusions clearly and coherently in both written and oral forms.</li><li>• Evaluate the limitations of a solution, suggest how it might be improved, and under what circumstances it is likely to fail.</li></ul></li></ul>												

**Pre-Requisites:**

**Co-Requisites:**

**Prohib Combs**

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# International and Industrial Economics

20 Credits  
Semester 1+2  
Compulsory

**Description:** The aim of the module is to enhance students understanding of the economics of firms, the organisation of productive activity and the interplay between public policy, firms and industries.

**Assessment:** **12.5% Essay**  
**12.5% Essay**  
**75% Exam**

**Objectives:** By the end of the module the students should have:

- S1m The ability to make general evaluations of commercial risks through some understanding of the basis of such risks
- S2m Extensive knowledge and understanding of management and business practices, and their limitations, and how these may be applied appropriately to strategic and tactical issues.
- S4 Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk) issues.
- S5 Understanding of the need for a high level of professional and ethical conduct in engineering

**Pre-Requisites:**

**Co-Requisites:**

**Prohib Combs**

# Small Business & Entrepreneurship

20 Credits  
Semester 1+2  
Compulsory

**Description:** The aim of this module is to provide a solid conceptual and analytical understanding of small business and entrepreneurship. Lectures and small group teaching will allow students to discuss and critically evaluate key theories and understandings of small businesses and entrepreneurial firms. The module is split across two semesters. In the first semester, the focus is on the entrepreneurial development of new firms and in the second semester, the focus shifts to analytically developing understandings of business growth and wider issues in entrepreneurship.

**Assessment:** 2 hour examination (60%) Individual written assignment, 1,000 words (20%) Group presentation (20%)

**Objectives:** By the end of the module students should be able to:

- demonstrate a comprehensive understanding of the differences between small and large businesses in terms of uncertainty, employment, innovation.
- explain the different conceptual approaches and models that underlie entrepreneurial processes and outcomes;
- critically analyse empirical data and key readings;
- critically evaluate evidence and identify its strategic implications for small business and entrepreneurship practice.

**Pre-Requisites:**

**Co-Requisites:**

**Prohib Combs**