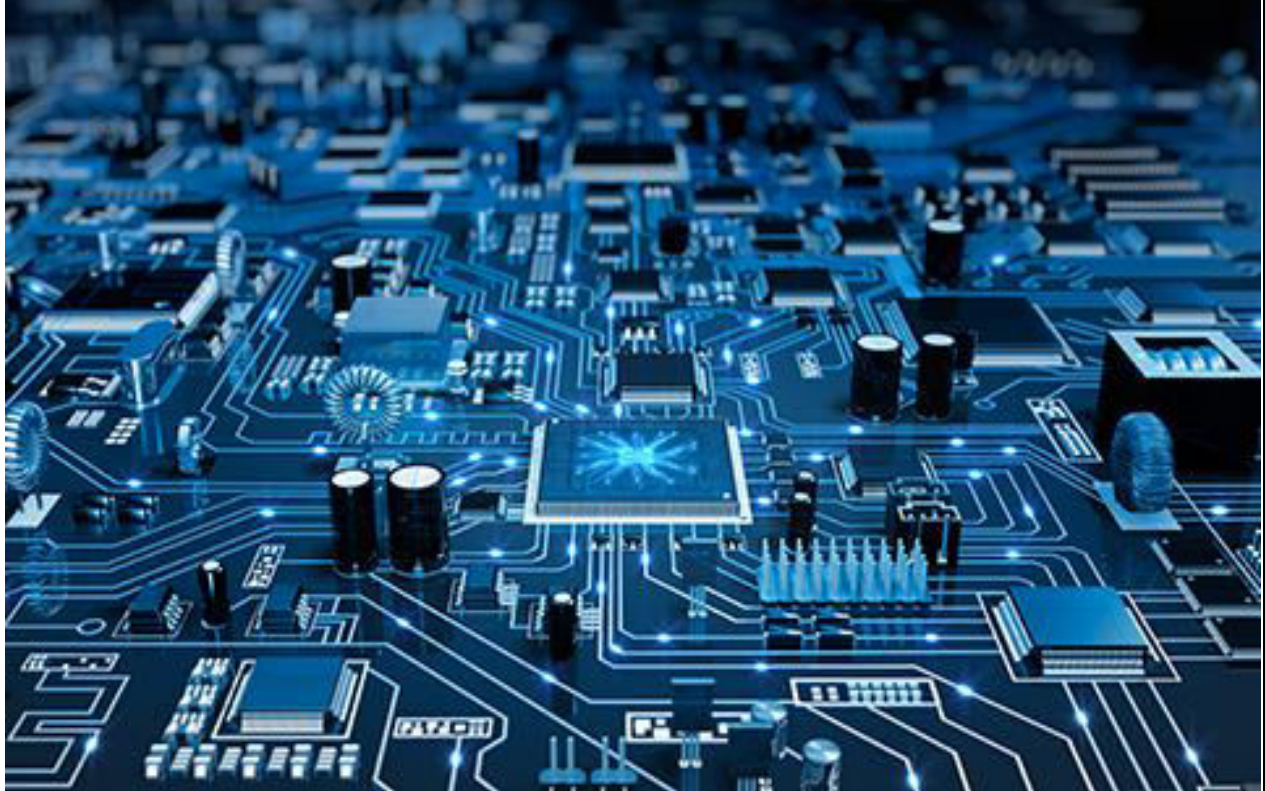




HIGHER DIPLOMA IN ELECTRONICS



ELECTRONICS ENGINEERING

Electronic Engineering education has entered a transitional phase because the technology is changing every day. The diversity of Electronics education is also increasing underscoring its multi-disciplinary nature. All the areas of the electrical and electronic engineering are growing rapidly and new fascinating disciplines of this subject are being created.

Thus role of and Electronic Engineer has changed significantly. Employers demand an Engineer with excellent communication skills along with skills of multi-disciplinary engineering.

Keeping this in mind, the curriculum of the Electronics has been designed. The main focus of the Electronics curriculum is on four major areas- power and energy, electronics, communication and computer in the undergraduate curricula.

A student is expected to specialize in one of these groups without compromising the fundamental knowledge in Electronics. Courses in basic

science, mathematics, relevant branch of Engineering including laboratory experience in the use of modern equipment for measurement and design. Technical Elective coursework that encourages individual interests and provides the opportunity to gain further knowledge in multiple disciplines facilitates the development of problem solving, teamwork, and engineering design skills with the aid of tools, such as, the computer.

Our specifically targeted curriculum will prepare graduates to compete in the high-tech job market on a global scale. In addition to the foreign job opportunities, graduates can avail job opportunities at home, both in public and private sector in the diversified areas, such as, Electrical Power Generation, Transmission and Distribution, Telecommunication Industry, Wireless and Mobile Telecommunication Companies, Satellite Communication Systems, Integrated Circuit (IC) Design, Satellite Television Channels, Switching Systems, Networking, Consumer Electronics Manufacturer, Process Industries, Textile Industries, Computer Industry, Design Firms of Embedded System, Microprocessor and Microcontroller based Systems etc.

Outcomes

The aims of the programme are:

- To provide you with the knowledge and skills relevant to a career as a professional engineer who can work effectively with current and future electrical and electronic engineering design, development and implementation methods
- To support you in understanding the innovative and pioneering approaches in this field and to be able to apply them to the solution of real-world problems to develop new products and technologies
- To help you acquire the knowledge and skills required to perform a variety of graduate level professional roles within electrical, electronic, control and communications engineering, including management roles.

RITHS HIGHER DIPLOMA IN ELECTRONICS

CORE SUBJECTS		
Course Code	Subject	Credit
HDME1	ENGINEERING MATHEMATICS -1	15
HDME2	MATERIALS FOR ELECTRICAL AND ELECTRONICS ENGINEERING	15
HDME3	ENGINEERING PROFESSIONAL SKILLS	15
HDME4	PRACTICAL AND EXPERIMENTAL SKILLS	15
HDME5	OPERATIONAL AMPLIFIERS	15
HDME6	ELECTRICAL CIRCUITS	15
HDME7	PROFESSIONAL DEVELOPMENT FOR ENGINEERS	15
HDME8	ANALOGUE ELECTRONICS	15
HDME9	ENGINEERING MATHEMATICS 2	15
HDME10	CONTROL AND INSTRUMENTATION	15
HDME11	DIGITAL AND EMBEDDED ELECTRONICS	15
HDME12	POWER SYSTEMS	15
HDME13	COMMUNICATION AND ELECTROMAGNETIC WAVES	15
HDME14	HARDWARE SYSTEMS AND CONTROL	15
HDME15	OPTICAL FIBRE COMMUNICATION SYSTEM	15
HDME16	MICROPROCESSOR SYSTEMS	15
HDME17	INDIVIDUAL PROJECT	25
ELECTIVE SUBJECTS (Any one Module from the following)		
HDMEE1	PROGRAMMING FOR ENGINEERS	15
HDMEE2	COMBINATION AND SEQUENTIAL LOGIC	15
HDMEE3	APPLIED ENGINEERING PRACTICE	15
HDMEE4	INTRODUCTION TO MECHATRONICS	15

HDMEE5	ENGINEERING OPERATIONS MANAGEMENT	15
HDMEE6	QUALITY ENGINEERING	15

HDE1 - ENGINEERING MATHEMATICS-1

Aims

This course aims to provide students with an understanding of, and competence in the use of, mathematical techniques that are relevant to the solution of engineering problems. It will also give students a firm foundation from which to develop solutions to a wider and deeper range of engineering problems that they will encounter throughout their undergraduate engineering programme of study.

Learning outcomes

On successful completion of this course a student will be able to:

- 1 Demonstrate an understanding of relevant mathematical concepts
- 2 Interpret and use relevant mathematical notation and terminology
- 3 Manipulate mathematical expressions and equations appropriate to the level and context
- 4 Carry out relevant mathematical calculations in the solutions to engineering problems
- 5 Apply the mathematical techniques to the solution of engineering problems encountered using appropriate mathematical software tools.

Indicative content

The topics listed under the indicative content below are the underpinning areas of knowledge and understanding that would be obtained from the course delivery.

Foundations of Engineering Mathematics

- Arithmetic: types of numbers, fractions, decimal numbers, powers, number systems, review of basic algebra, trigonometry, and logarithms;
- Introduction to algebra: algebraic expressions, powers as related to logarithms, rules of logarithms, multiplication / division / factorisation of

algebraic expressions;

- Expressions and equations: evaluating expressions, independent variables, transposition of formulas, polynomial equations;
- Functions, graphs, data presentation: Cartesian and polar co-ordinates / axes, use of software tools for plotting graphs and charts;
- Simultaneous linear equations: solution of simultaneous linear equations with two unknowns (by substitution and by equating coefficients);
- Differentiation: small increments and rates of change, critical values, partial differentiation;
- Integration: calculation of areas and volumes, multiple integration;
- Complex numbers: Cartesian, polar and exponential forms, Argand diagrams, complex arithmetic;
- Matrices and determinants: matrix algebra, determinants, solving a set of linear equations using matrices and determinants;
- Vectors: vectors in two and three dimensions, vector algebra;
- Differential equations: solution of first-order differential equations by separation of variables, and by the use of an integrating factor, solution of homogenous and non-homogenous second-order differential equations with constant coefficients;
- Numerical methods: roots of nonlinear equations: existence of solutions, bisection method, fixed-point iteration (simple iteration), convergence criteria, Newton - Raphson method and convergence of, the secant method, the trapezoidal rule, Simpson's rule;
- Integral transforms: Fourier series, Laplace transforms, inverse Laplace transforms, Laplace transforms of a derivative, tables of Laplace transforms;
- Statistics: interpretation and use of the mean, mode, median, range, variance, standard deviation on sets of data, method of least squares; correlation and regression;
- Probability: conditional probability, probability distributions, expected value;

Engineering Applications

- Statics: Mass, force and weight, forces in equilibrium, parallelogram of forces, resolution of, polygon of, moment of, couple, principle of moments, resolution of a force into a force and a couple, general conditions of equilibrium, free-body diagrams,;
- Frameworks: forces in frameworks, analytical methods (methods of sections, method of resolution);
- Determinate structures: axial force, shear force, bending moment, torque;

- Stress and strain: concepts of force and stress, deformation and strain, stress/strain relationships, uniaxial, biaxial, pure shear, strain energy, plane stress and strain, bulk solids handling;
- Electrical filters: RC filters, transfer functions, frequency response, transient response, Bode plots;
- Fourier analysis: RF spectrum, communications channels, channel blocking;
- Cryptography: cryptographic algorithms and protocols, key exchange, decryption techniques;
- Probability: dealing with uncertainty in engineering, game theory;

Teaching and learning activity

Learning and teaching take place through a combination of lectures, tutorials and independent study. The course is presented in the context of engineering challenges that the student is expected to solve with the underpinning material supplied through the tutorial sessions and supplementary material provided through the course online resources. Each topic will be introduced with a 'problem of the week' that will be solved using the key mathematical topic(s). The listings in the indicative content are examples of the concepts that need to be covered in the problems posed to the student.

The lecture sessions concentrate on the application of mathematics from an engineering perspective. This can be achieved in a specific engineering subject context, for example mechanics, structural analysis, the use of statistics in data analysis, numbers systems that are used in computer systems, communication and computer network systems, or the use of mathematics in business. These areas of applied mathematics are further reinforced with the appropriate mathematical simulation and/or analysis software tools.

The tutorial sessions concentrate on fundamental mathematical principles in order to provide a firm foundation in the core principles required for an understanding of various mathematic concepts, how to carry out appropriate mathematical calculations, use appropriate mathematical notation and terminology, and then be able to manipulate expressions and equations in a suitable manner. Each fundamental aspect of the topic for

each week will be supported through mathematical software tools (e.g. Excel, MATLAB).

Assessment

ACTIVITIES	PERCENTAGES
Assignments (5 in total; equally weighted)	75%
Problem solving questions	25%

HDE2 – MATERIALS FOR ELECTRICAL AND ELECTRONIC ENGINEERING

Aims

The aim of this course is to extend the student's understanding of materials and how they are used in Electrical and Electronic Engineering applications.

Learning outcomes

On successful completion of this course a student will be able to:

- 1 be able to demonstrate an increased awareness of materials commonly used in Electrical and Electronic Engineering
- 2 have a deeper understanding of the electrical properties of materials using Electromagnetic Field Theory.
- 3 begin to recognise and classify common materials and their application in electrical and electronic engineering.

Indicative content

Basic Electric Field Theory - concept of charge, electric force and current, conductors and resistance, choice of conductor material, cables and connectors, shielding, superconductivity.

Static Magnetic field, magnetic field from a current, ferromagnetic materials, magnets, Hall effect.

Dielectric effect –insulators- - capacitance, electrical breakdown.

Composite materials, Carbon fibre, Glass fibre materials, multi-layer PCB design.

Ceramic Materials, Crystal Resonators, Piezoelectric effect.

Use of ‘plastic’ and ‘polymer’ materials – encapsulation and housings.

Basic Semi-conductor theory - the PN junction, Field Effect Transistors, Photovoltaic Effect, IC manufacture, nanotechnology.

Electrochemical effects and Batteries.

Teaching and learning activity

The main activity on the course will be to review the design of an advanced electrical / electronic products, such as an iPad or mobile phone, from the perspective of an electrical engineer. Students will consider the engineering design challenges, such as low power consumption, size, weight, portability, ease of use and how to make them ‘smart’. The student will recognise and classify suitable materials that can meet these challenges. The problem-based activity will be supported through formal lectures and tutorial classes and laboratories as appropriate.

Assessment

ACTIVITIES	PERCENTAGES
Assignments	30%
Laboratory/ Industry	40%
Final Examination	30%

HDE3 - ENGINEERING PROFESSIONAL SKILLS

Aims

This course aims to provide effective inter-professional and interpersonal skills. The course is designed with a focus to communication, professional and management practices, ethical issues, numeracy, emerging technology, technical /computer enabled learning and project analysis. Each component of the course enhances students' personal and professional knowledge as well as the skills surrounding their programme specific areas.

In addition, the course develops understanding of design, manufacturing, construction, commissioning, operation or maintenance of products, equipment, processes, systems or services to optimise the application of existing and emerging technology. Students will learn appropriate code of professional conducts, obligations to society and their profession. Understand how to operate and act responsibly, taking account of the need to progress environmental, social and economic outcomes simultaneously.

Learning outcomes

Learning Outcome On successful completion of this course a student will be able to:

- 1 Understand the role of engineering, engineering failure and solution, technology, IT, and industrial management in a number of diverse context.
- 2 Develop appropriate level of communication and critical thinking.
- 3 Understand the engineering profession and codes of conduct.
- 4 Demonstrate application of professional and ethical practices, both theoretical and applied in engineering/technology/industrial context and where appropriate, beyond their remits.
- 5 Learn effective management within engineering context, iteration, quality and codes of conduct.
- 6 Learn and evaluate fundamentals of systems thinking and contemporary approaches to systems dynamics.
- 7 Learn and understand the emerging and new technology, engineering and management enabled techniques at operational level of their work.
- 8 Demonstrate applied knowledge and understanding of technology,

engineering and management projects, costing, risk and safety assessment and their implication in variety of business environments.

9 Understand Intellectual Property Rights (IPR) and how IPRs affect both the technical and non-technical work environment.

10 Understand research and scientific methodology along with measures of success.

11 Learn the role of end-users and market based principles within the wider scope of technology, engineering and management framework.

Indicative content

Part 1 – Communication and Critical thinking. Different approaches of communication within an engineering/technology/industrial management context, application of management roles and leadership within society. Demonstrate effective essay and Précis writing, comprehension and critical analysis. Able to identify the limits of own personal knowledge and skills while broaden and deepen own knowledge base through research and experimentation.

Knowledge and understanding

Breadth of Outlook

Personal Effectiveness

Part 2 – Professional Practice - Analyse both micro and macro-business environment in technology-enabled, knowledge-based context and learn how strategy, change, costing and risk management, and quality influence different professional practices. Understand verification and validation in engineering/technology context. Make informed decision on their career path. Demonstrate a personal commitment to professional standards, recognising obligations to society, the profession and the environment. Intellectual and Practical Skills.

Part 3 –Technical (lab/Industry sessions) - System thinking, Learn and evaluate fundamentals of systems thinking and contemporary approaches to systems dynamics. Understand be able to apply decision making models (decision trees, force-field analysis), operations, information management, business IT. Be able to identify constraints and exploit opportunities for the development and transfer of technology within own chosen field.

Computer systems (lab sessions) - Understand the fundamentals of computer systems, systems architectures and development approaches including servers and distribution methods for Data (databases). Learn the

management principles for IT systems development and deployment. Know how to use basic predictive methods, mathematical and otherwise, to model and simulate systems to enable analysis and performance. Have an awareness of the range and nature of risk in systems innovation, improvement, development and deployment in the context of business and commerce.

Part 4 – Ethics and Issues in Management (lectures/ Study notes)

Learn ethical issues, i.e. including corporate responsibility, legislation, industrial democracy, health and safety, and environment, not exclusive of other pertaining issues. Know concepts of conflict surrounding engineering/technology/industrial management practices and how such issues to be effectively managed.

Transferable Skills

Critical Thinking

Professional Management

Part 5 – Quality (lectures/ Study notes)

Learn and apply how quality affects both the technical and non-technical work environment with reference to ISO and BS practices. Know theories and applied concepts of material quality and management, product development. Understand market strategy from an engineering, technology, industrial perspective. Project management and risk evaluation. Be able to apply appropriate theoretical and practical methods to the analysis and solution of engineering, management and technical problems using research and scientific methodology along with measures of success. Understand, manage and apply safe systems at work. Be able to understand the role and application of Intellectual Property Rights (IPRs) and its impact on end-users. Learn the role of end-users and market based principles within the wider scope of technology, engineering and management framework.

Teaching and learning activity

Teaching and learning emphasis will be based on applied as well research based enquiry. The teaching activities include classroom, lab/practical, seminars and tutorials sessions.

The underlying strategy will be classroom driven but not exclusive to practical and of self-directed learning which reflects the andragogical model. Lectures will use a didactic approach to introduce material.

The course will comprise of:

(i) 16 weeks of teaching based on class room lectures/ distance learning covering part 1-2 and part 4-5. Part 1 and 2 deal with communication, practical skills along with professional practices. Part 4 and 5 deal with ethics and quality.

(ii) 8 weeks of lab/Industry sessions based on part 3. The sessions are divided into two 4 weeks sessions. 4 weeks are allocated for system think and 4 weeks are allocated for computer systems. The lab sessions cover fundamentals of systems thinking and contemporary approaches to systems dynamics, application of decision making models (decision trees, force-field analysis), operations, information management, business IT, and fundamentals of computer systems, systems architectures and development approaches including servers and distribution methods for Data (databases). Have an awareness of the range and nature of risk in systems innovation, improvement, development and deployment in the context of business and commerce.

(iii) 1 week intensive practical covers real life application, scenario building, research led enquiry and case study based analysis by field trip, visits, simulation etc.

Assessment

ACTIVITIES	PERCENTAGES
Homework	30%
Assignments	40%
Final Exam	30%

HDE4 - PRACTICAL AND EXPERIMENTAL SKILLS

Aims

This course provides an introduction to the basic and fundamental concepts and principles of engineering science, including fluid mechanics and hydraulics, structural systems and solid mechanics, materials science, mechanical principles, electrical and electronic principles, sensors and devices, computer and communications networking and their application to experimental and practical problems. This course also aims to develop practical experience in designing and carrying out laboratory tests and experiments and report writing; to gain experience of health and safety including personal protective equipment (PPE) that will protect the user against health or safety risks.

Learning outcomes

On successful completion of this course a student will be able to:

- 1 Apply standard scientific methodology to plan, design, conduct and report a range of engineering experiments
- 2 Gain an understanding of the physical aspects of the principal engineering disciplines
- 3 Gain an understanding of how physical measurements and systematic errors can affect results and the challenges of gaining precise and accurate empirical data
- 4 Understand the importance of units
- 5 Learn how to apply dimensional analysis to ensure that units match on either side of an equation or law

Indicative content

Weekly lab sessions:

Introduction to Laboratory Practice (2 weeks – lectures + tutorials/ Online)
Electrical Principles (2 weeks – introductory lectures + lab sessions)
Digital Electronics and Logic (2 weeks – introductory lectures + lab sessions)

Computer Components and Analysis (1 week – introductory lecture + lab sessions)
Mechanical Systems (2 weeks – introductory lectures + lab sessions)
Fluid Mechanics / Hydraulics (2 weeks – introductory lectures + lab sessions/ Industry experience)
Thermodynamics (1 week – introductory lecture + lab sessions/ Industry experience)
Structures (3 weeks – introductory lectures + lab sessions/ Industry experience)
Materials (2 weeks – introductory lectures + lab sessions/ Industry experience)
Communications, Networks and Optimisation (2 weeks – introductory lectures + lab sessions/ Industry experience)
Mechatronics + programming (2 weeks – introductory lectures + lab sessions/ Industry experience)
Control and Optimisation (1 week – introductory lecture + lab sessions/ Industry experience)
Introduction to Programming Technologies (Computer Engineering)

Teaching and learning activity

Learning and teaching will be by practical work/ Industrial exposure preceded by introductory lectures in each laboratory when necessary.

Practical laboratory work/ Industrial exposure will comprise:

(i) laboratory experiments and demonstrations related to fluid mechanics and hydraulics, materials science, structural concepts, mechanical principles, electrical principles, programming technologies, computer networking fundamentals; and,

(ii) choice of 1 x 5-day specialist intensive course from a range of courses related to each of the principal engineering disciplines. Choice of courses from, e.g.: Surveying; Advanced Lego Mindstorms (Computing / EIS); Networks – Design and Implement Basic Computer Network (Computing); Communications – Receiver and Transmitter (Electrical and Electronic); Business Game (Industrial, EPM, EBM, DIE); Reinventing Leonardo da Vinci's machines (Mechanical); Reverse Engineering (Mechanical, Industrial); Introduction to Programming Technologies. With the exception of Surveying, the intention is to rotate the choice of courses on an annual basis.

Students are encouraged to select a 5 day course from their preferred specialism, but this is not essential.

Assessment

ACTIVITIES	PERCENTAGES
Assignments	30%
Laboratory/ Industry	40%
Final Examination	30%

HDE5 – OPERATIONAL AMPLIFIERS

Aims

Course will extend learners understanding of the characteristics of operational amplifiers and will develop the skills needed to design and build operational amplifier circuits and active filters.

Learning outcomes

1. Understand the characteristics and parameters of operational amplifiers
2. Be able to design, build and test operational amplifier circuits
3. Be able to design an active filter to meet a given specification

Indicative content

Characteristics: input and output impedance; voltage gain; common mode rejection ratio; input bias; offset currents; unity gain bandwidth; slew rate; differential input range; full power bandwidth; drift; constant current source

Parameters: determine practically for common operational amplifier types the open loop gain-bandwidth product and the slew rate, offset voltage and

offset current for operational amplifiers

Amplifier circuits: derive gain equations for inverting and non-inverting amplifier circuits

Design, build and test: inverting, non-inverting, buffer, differential and summing amplifier circuits; this should be supported by software simulation of the designs, which should be tested to produce full specifications including gain, phase shift and roll-off characteristics; level shifter

Compensation: internal and external compensation of an operational amplifier; corner frequencies and roll-off rates; determine the effects on frequency of single-pole, double-pole and feed-forward compensation when applied to a suitable operational amplifier

Typical applications circuits: eg compensator, current-to-voltage converter, integrator, differentiator, Schmitt trigger and oscillator (RC relaxation or Wien Bridge type); to include mathematical modelling, computer simulation and practical investigation where appropriate

Filter: filter types (Bessel, Butterworth, Chebyshev, Sallen and Key); phase; attenuation characteristics for low-pass, high-pass and band-pass types; design of active filters to generate appropriate response functions

Specifications: design and test a controlled-source filter to produce a low-pass response that meets given specification, involving calculations and software simulation in addition to practical construction and testing

Teaching and learning activity

The main activity on the course will be to review the learners to investigate the operational amplifier and develop an understanding of their industrial applications. The unit is self-contained, presenting an overview of the device and providing all the necessary background theory and circuit design. The intention is to provide an insight into the applications aspects of the operations amplifier, which learners can then build on in other units and further study.

Assessment

ACTIVITIES	PERCENTAGES
Assignments	30%
Laboratory/ Industry	40%
Final Examination	30%

HDE6 - ELECTRICAL CIRCUITS**Aims**

Electrical circuits are part of the fabric of modern technology. This course is designed to equip students with foundational knowledge of electrical engineering, appreciation of electrical engineering principles and techniques for solving circuit problems and application of techniques to practical problems.

Learning outcomes

On successful completion of this course a student will be able to:

- 1 Explain the fundamentals of electrical DC and AC circuits with particular applications to electrical engineering;
- 2 Analyse simple electrical DC and AC circuits;
- 3 Determine equivalent circuits for networks through network theorems;
- 4 Formulate and solve transient circuit problems;
- 5 Demonstrate an understanding of single and three phase power circuits, unit notation and symmetrical components;
- 6 Calculate the real, reactive, and apparent power in AC circuit including instantaneous power, power factor, and power triangle;
- 7 Investigate the performance of circuits and devices using basic laboratory equipment and circuit simulator;

Indicative content

- DC circuits: series and parallel and mixed resistive circuits including voltage and current dividers. Voltages, currents and power in the resistive circuits. Applications of Ohm's law and Kirchhoff's laws in the solutions of resistive circuits. Circuit analysis using the node and mesh methods. Network theorems: Superposition theorem, Thevenin and Norton Equivalents, maximum power.
- Transient in dc circuits: energy storage elements, Charging and discharging, Transient analysis of simple RC, RL and RLC circuits, time constant, Steady state analysis, Faraday's law of induction.
- AC circuits: Response of basic elements, Inductive and capacitive reactance. Inductive and capacitive circuits. Complex impedance, current and voltages in an ac series circuit. Phasor representation of an ac series circuit,
- Power in an ac circuit: Single and three phase circuits, apparent power, reactive power, active power, power factor, power triangle, phase and line quantities, per unit notation, Power generation and distribution.

Teaching and learning activity

Teaching will be through one hour formal lectures in combination with several active learning techniques including: in class collaborative activities, ungraded quizzes with the extensive use of PRS system. Tutorials will provide a good opportunity to enhance understanding of the theoretical aspects. Practical supervised laboratory sessions and industry workshops will further enhance understanding of the subject with the aid of the specialised software. Problem based and open ended experiments will also be used to assess students understanding.

Proposed laboratory activities:

- Modelling of an electrical power system using MATLAB/Simulink.
- Modelling of power system using Cobalt Switchboard Simulator.

The Laboratory activities comprise of multi-week problem based projects.

Assessment

ACTIVITIES	PERCENTAGES
Assignment	50%
Exam	30%
Problem based questions	20%

HDE7 - PROFESSIONAL DEVELOPMENT FOR ENGINEERS**Aims**

The opportunity to pursue a fulfilling professional career in engineering or in other areas which recognize the strengths of an engineering education requires the development of an ethos of preparation for employment and continuing professional development. This course aims to provide a framework for the support, monitoring and assessment of the student's engagement with a range of opportunities both within the University and elsewhere for the development of skills and attributes which support employability and professional development.

Learning outcomes

On completing this course successfully you will be able to:

developed an increased awareness of their strengths and weaknesses in relation to attributes for employability and professional development and recorded these by building on their existing Personal Development Plan;

developed an understanding of how to prepare for employment including the writing of a CV, letters of application etc; explored the employment opportunities available in a range of appropriate professional areas and

demonstrated an understanding of the requirements of employers in these areas with the assistance of their Personal Tutor and others;

demonstrated a willingness to engage with a range of activities both within and outside the Industry which may support the enhancement of attributes for employability. These might include examples such as reflection on any employment experiences to date, and any other extra-curricular developmental activities such as volunteering, mentoring etc as identified in their Personal Development Plan, with the assistance of their Personal Tutor and others;

Indicative content

The specific requirements of an individual student, or groups of students may vary considerably, and will be indicated by negotiation with the Personal Tutor and recorded in a Personal Development Plan. A set of threshold competencies relating to attributes for employability will be identified.

Teaching and learning activity

The acquisition of these attributes will be through a combination of approaches, which may include, but will not be limited to: formal classes, self directed study, demonstrable engagement with a range of appropriate activities, or other means as directed by the Personal Tutor.

Assessment

ACTIVITIES	PERCENTAGES
Assignment	40%
Exam	30%
Mini Project	30%

HDE8 – ANALOGUE ELECTRONICS

Aims

Analogue Electronics is a very important and essential component in electronic circuits and systems. This course will deliver how modern analogue electronic circuits are analysed, simulated, designed and implemented, in the various areas of both traditional discrete and modern integrated circuits, by means of theoretical analysis, software simulation and practical building and test.

Learning outcomes

On successful completion of this course a student will be able to:

- 1 Analyse and design analogue circuit by using circuit simulation software.
- 2 Understand the principles of circuit modelling.
- 3 Recognise and understand the basic circuit configurations used in linear integrated circuits.
- 4 Analyse and design single and multistage amplifiers using equivalent circuits and computer models to meet given specifications.
- 5 Understand and apply the basic principles of feedback and design negative feedback circuits.
- 6 Have good knowledge of analysing, simulation and design of circuits containing Op-Amps.
- 7 Carry out a high-level simulation by using integrated circuit macromodel.
- 8 Understand principles involved in analysing, designing and applying oscillators for a given application.

Indicative content

By studying the course the student's understanding of analogue electronics will be extended in terms of the analysis, simulation and practical test of modern analogue integrated circuits and systems. The delivery of the course will use a problem-based pedagogy and the research-teaching nexus to engage and develop the students. In order to reflect the advanced analogue circuit analysis and design techniques and their applications the teaching and learning will be conducted through following 6 topics

(problems):

1. Simulation of analogue circuits by using specific computer-aided design software

- (1) The principles of circuit modelling including device model and integrated circuit macromodel;
- (2) Use SPICE circuit analysis and design programme.

2. Principles of analogue integrated circuits

- (1) Basic circuit configurations used in linear integrated circuits: Differential amplifiers; difference-mode; common-mode; current mirrors;
- (2) Measurement, analysis and simulation of differential amplifiers.

3. Design of amplifiers with required gain and frequency response

- (1) Transistor amplifiers: Small-signal equivalent circuit of transistor; equivalent circuit of amplifier; midband gain; cascaded amplifiers, transistor high-frequency model; bandwidth; dominant pole concept; Miller's theorem; lower and higher 3dB frequencies;
- (2) Design, building and analysis of amplifiers using BJT.

4. Application of the negative feedback technique in amplifier design

- (1) Feedback theory: Classification of feedback techniques; negative feedback and its properties; structures of amplifiers with negative feedback;
- (2) Simulation and analysis of amplifiers with negative feedback.

5. Operational Amplifier (Op-Amp): Theory and applications

- (1) Operational Amplifier and its applications: Inverting and non-inverting configurations, ideal Op-Amp, open-loop and closed-loop voltage gain; practical Op-Amps and their applications; slew rate; Op-Amp macromodel;
- (2) Design, building and analysis of inverting and non-inverting amplifiers.

6. Analysis and design of signal generators

- (1) Oscillators and applications for low and high frequencies: Basic principles, RC oscillators, LC oscillators, generation of square waveforms;
- (2) Measurement and analysis of Wien-bridge oscillator.

Teaching and learning activity

- Analogue Electronics deals with the transmission and processing of analogue signals and is one of the two major subjects in electronic engineering. Practically, the teaching system consists 3 parts: analogue circuit and system theory, use of computer aided design tool as well as practical building and measurement. The objectives of the teaching and learning can be achieved by employing various forms of activities such as lectures, tutorials and laboratories.
- Real problem and research related material will be added to the teaching contents such as lectures and labs etc. The students will be provided with advanced techniques and recent developments in analogue signal processing. For example, once the students have learnt the general transistor amplifier theory, how to apply the theory to analysis and design of practical amplifiers is a challenging task. A possible way to achieve the learning targets could be: Firstly, give the student the specifications of an amplifier such as dc bias condition, gain, bandwidth etc; then, the students can carry out their own research to find the best design including the circuit diagram, devices and components, power supply etc. Finally, the students can implement their design by using theoretical analysis, PSPICE simulation and practical building and test. This will provide the students with a good opportunity to understand circuit behaviour and to foster their problem-solving skills.
- Borrowed from the research experience in analogue circuit design, the pedagogy can be improved by strengthening the connection between teaching and research (finding the solutions to the given problems). The specific heuristic techniques will be used through the whole teaching/learning process. For example, how to avoid using resistors in the operational amplifier circuits that are too big is very important. The lecturer's research has shown that using a revised 'T' network with small resistances to replace the big resistances in original design can improve both gain and bandwidth. The students could demonstrate the method by simulation or practical measurement.
- When carrying out 'problem-based' teaching special attention will be paid to how to use effective way to foster the student's ability to analyse and solve engineering problems independently and how to enliven the atmosphere of the class and mobilize student's learning enthusiasm during the teaching.
- The delivery of the theory will be assisted by video, research

paper/publication, practical building/test and computer simulation, which can help the students to learn how knowledge is created, advanced and renewed, and to raise their excitement of changing knowledge.

- In order to develop students' ability to identify and analyse problems and to formulate, evaluate and apply evidence based solutions, they will be given special training for how to write coursework report by referring to 'research paper' and normal academic standards. The students will work in groups on experiments/labs to acquire and process data, then, write individual report based on their own research and data analysis. In addition, to provide the students with opportunities to discuss their research findings and methods with the tutors and other students, seminars and special invited lecture may be organised.
- An important criterion to assess student's assignment/lab report will be 'analysis of results'/'problem and solution'. The students are encouraged to carry out further research/investigation based on their analysis/testing results to find possible solution(s) for given engineering problems. The students will receive detailed feedback on their work.
- Get the students involved in the research and problem-based projects.

Assessment

ACTIVITIES	PERCENTAGES
Assignment	50%
Exam	30%
Problem based questions	20%

HDE9 - ENGINEERING MATHEMATICS 2

Aims

The intention of this module is to build upon the fundamentals of engineering mathematics and equip students with the knowledge and skill to be able to analyse a variety of engineering systems by the use of numerical and computer modelling techniques. Whilst following this module, students will acquire the confidence to be able to select appropriate modelling techniques and apply them to realistic engineering problems selected from a range of engineering disciplines. Students will also acquire experience in the use of mathematical simulators such as MATLAB® to create accurate and reliable computer models of engineering systems for analysis purposes. The module is designed to enhance self-study and team working skills by the use of numerical and computer modelling projects.

Learning outcomes

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

- 1 Demonstrate an understanding of various mathematical modelling techniques and theory and how they relate to the solution of a range of engineering problems
- 2 Use knowledge gained to analyse case studies involving the application of systems modelling techniques and implement said systems using leading mathematical software such as MATLAB®
- 3 Undertake detailed system analysis and verification by the use of mathematical techniques and computer simulations.

Indicative content

Simultaneous and differential equations, Cramer's rule, mesh analysis, nodal analysis, modelling of dynamic components, partial differential equations, review of Laplace transforms, analysis of, transfer functions, block diagrams, pole-zeros and the s-plane, stability analysis, computation of frequency and transient response of systems. Fourier transforms, discrete Fourier transforms, fast Fourier transforms, introduction to spectral

analysis of deterministic systems, frequency response & Bode plots. Numerical solution of state equations, Eigenvalues and Eigenvectors, stability of systems using state variable concepts, qualitative behaviour of non-linear systems. Numerical solution of ordinary differential equations, finite difference methods of solving differential equations. Difference equations, the Z-Transform, frequency and transient response of sampled systems, polynomial modelling of digital signals. Review of probability, distribution and density functions, Gaussian random variables, reliability of systems, scheduling (First-In First-Out, Last-In Last-Out, processor sharing, Shortest-Job First), queuing networks, heavy traffic/diffusion approximations. Iterative methods for nonlinear equations, discussion of errors (including rounding errors), polynomial interpolation and orthogonal polynomials. Continuous random variables, limit theorems, multivariate normal distribution, transition matrices, one-dimensional random walks and absorption probabilities. Industrial applications of numerical and computer modelling and associated financial and efficiency implications.

Teaching and learning activity

Learning and teaching will be via lectures and tutorials which will be supported by computer laboratories. The module is comprised of two parts. In term 1, the students will typically engage with a weekly common lecture (1hr) followed by a subject specific tutorial (2hr) concerning numerical modelling. In term 2, the students will engage in a subject specific computer modelling challenge which will involve a weekly computer laboratory (2hr) and a challenge instruction session (1hr). The computer modelling challenge will form the coursework element of the module and will require the application of the core knowledge delivered in term 1. Typical computer modelling challenges could include transient and frequency response of dynamic systems, state variable analysis of systems, or 2D & 3D finite element modelling of systems. Both parts of the module will be supported by detailed self-study materials which will be available online.

Assessment

ACTIVITIES	PERCENTAGES
Assignment	40%
Practical Exam	40%
Problem based questions	20%

HDE10 – CONTROL AND INSTRUMENTATION

Aims

The aim of this course is to provide a solid understanding of analysis and design of feedback control systems employed in a wide range of engineering applications. The course provides knowledge of the core concepts such as modelling, analysis and simulation of systems using both time domain and frequency domain techniques. In addition the course aims to provide understanding of measurement principles, terminologies and basic operation of commonly used instrumentation systems.

Learning outcomes

On successful completion of this course a student will be able to:

- 1 Design and analyse control systems; with particular emphasis on servo-mechanisms;
- 2 Model various types of control systems using block diagrams and transfer functions;
- 3 Predict the steady state, transient and frequency response of various types of control systems;
- 4 Gain insight into the terminology of instrumentation and the ideal characteristics;
- 5 Use the MATLAB/Simulink platform as an aid to the analysis and prediction of system responses.

Indicative content

Open and closed loop systems; principles and comparison of open and

closed loop control.

System type classification.

Block diagrams, representation of open and closed loop control systems, including the conversion between models and the generation of closed loop transfer functions.

Mathematical modelling of physical systems, including linear and rotational dynamics,

Servo-mechanisms, typical elements, performance, use of tacho' feedback.

Transfer Function analysis of transient and steady state response of systems.

Evaluation of system stability and steady state errors.

Frequency response analysis using Nyquist and Bode, gain margin and phase margin;

Use of root locus techniques to evaluate system performance.

Effect of external disturbances on system behaviour.

Use of MATLAB/Simulink for the prediction and analysis of system responses.

Operation and application of commonly used transducers used to measure position, velocity, force, pressure, temperature.

The meaning of linearity, standard deviation, accuracy and hysteresis.

Dynamic performance of transducers.

Teaching and learning activity

Teaching will be through one hour formal lectures in combination with several active learning techniques including: in class collaborative activities, ungraded quizzes with the extensive use of PRS system.

Tutorials will provide a good opportunity to enhance understanding of the theoretical aspects. Practical supervised laboratory sessions and workshops will further enhance understanding of the subject with the aid of the specialised software to analyse and design control systems. Problem based and open ended experiments will also be used to assess students understanding.

Proposed laboratory activities:

- Position control of the solar panel for an unmanned spacecraft.

- Motor Speed Control
- Phase lead/lag compensator design

The Laboratory activities comprise of multi-week problem based projects.

Assessment

ACTIVITIES	PERCENTAGES
Assignment	50%
Written Exam	30%
Problem based questions	20%

HDE11 – DIGITAL AND EMBEDDED ELECTRONICS

Aims

This module aims to provide students with an understanding of the concepts and theory underpinning digital and embedded electronic systems and to equip students with the necessary skills to design and implement them. Different types of digital hardware that exist will be introduced and their practical applications will be explored in the context of design based engineering exercises. This will give students a critical awareness of the tools and technologies available to computer engineers with which to meet engineering design challenges in the future.

Learning outcomes

On successful completion of this module students will be able to:

- 1 Design, construct and simulate combinational and sequential logic circuits.
- 2 Design software for microprocessor based systems.
- 3 Design, implement, test and evaluate embedded hardware solutions to engineering problems.

Indicative content

Students will study topics in digital, embedded design including:

Fundamentals of digital logic theory, including combinational logic design logic, truth tables and Boolean algebra; sequential design involving flip-flops and registers; design verification using commercial simulation software; A/D and D/A converters; programming for microprocessor/ microcontroller based hardware.

Teaching and learning activity

Formal lectures and tutorial sessions will be used in conjunction with supporting laboratory exercises to provide students with the background knowledge and practical skills required to take on a given engineering challenge, typically involving a sensor and/or robotics based scenario that incorporates proximity sensing, wireless communication and position monitoring such as the design of an autonomously moving vehicle. Students will undertake guided independent study in the development, implementation and testing of solutions to the design challenge.

Assessment

ACTIVITIES	PERCENTAGES
Assignment	50%
Practical Exam	30%
Problem based questions	20%

HDE12 – POWER SYSTEMS

Aims

The aim of this course is to develop the fundamental concepts of electrical energy system operation, and analysis; to provide a comprehensive understanding of the operation and design of the principal types of power plants and to provide models for the calculation of plant performance; and to provide students with an insight into, and an understanding of, applicable analytical methods.

Learning outcomes

On successful completion of this course a student will be able to:

- 1: Perform calculations to determine the characteristics and operation of machines.
- 2: Analyse the steady state operation of transmission systems.
- 3: Model a small power system using simulation software and use the models to critically analyse short-circuit fault levels, load flow calculations, and protection system design.

Indicative content

- System Components: conventional and renewable sources of energy, machines, transmission lines, distribution systems, loads.
- Transmission: Types of transmission systems. Theory and practice of electrical transmission systems, overhead transmission systems, earthing methods, subterranean and subsea transmission. Explanation of national-grid systems, local distribution systems and dc links.
- Load Flow Analysis: Development of impedance and admittance diagrams. Derivation of impedance and admittance matrices. The concept of bus voltages. Solution of the power flow problem using Gauss-Seidel and Newton-Raphson iterative techniques.
- Faults and Protection: Analysis of faults including short circuit and open circuit. The effects of faults on a system. Three-phase short circuit analysis of the synchronous generator. Synchronous generator stability under fault conditions. Symmetrical faults using Fortesque's theorem. Effect of

earthing methods on fault currents. Voltage and current instrumentation transformers. Signal-burden analysis of protection relays. Analysis of relay settings. Radial protection coordination. Generator, transformer and unit protection. Differential relays.

- Power Quality: Power quality issues and how power quality is measured. Effects of harmonics on power systems. Harmonics and harmonic calculations.

Teaching and learning activity

The course will be delivered through formal lectures, tutorial classes, laboratory experiments and self-study work.

Assessment

ACTIVITIES	PERCENTAGES
Assignment	40%
Written Exam	30%
Report on Self study	30%

HDE13 – COMMUNICATION AND ELECTROMAGNETIC WAVES

Aims

- To develop the students' knowledge and analytical skills about wireless devices and communication systems.
- To develop the students' problem solving ability using applied electromagnetic approach.
- To equip the students with sound knowledge of the theories and technologies underpinning wireless systems.

Learning outcomes

On successful completion of this course a student will be able to:

- 1 Analyse and critically appraise the behaviour of electromagnetic waves in wireless environment.
- 2 Apply the 'field' approach as opposed to 'circuit' approach in dealing with electrical systems.
- 3 Critically examining the use of key components (such as antennas) and techniques (modulation) in a wireless communication system.
- 4 Identify and discuss the relevance of the learned theories to various wireless application scenarios.

Indicative content

The course will be focused on practical engineering problems through which theories and concepts about electromagnetic (EM) waves, their propagation in both guided and unguided media and the principles underpinning wireless communications will be taught. The indicative contents are organised around the following engineering challenges:

- How it is possible to transmit information and power over a long distance without using any wires and even in vacuum: Review of Maxwell's equations; EM waves in vacuum.
- How coaxial TV cables support high-frequency signals: EM waves in the media and at the interfaces between them; behaviours of guided EM waves.
- What makes mobile communications possible:
 - o By non-line-of-sight communications: Propagation of EM waves and its modelling;
 - o By maximising the power transfer between circuits and free space: Radiation; antennas;
 - o By efficient use of the limited resource of electromagnetic spectrum: EM spectrum; channels; modulation; wireless communication systems.
- Current and future landscape for wireless communications: next generation mobile communications; Internet of Things; satellite

communications.

Teaching and learning activity

This course is organised around the fundamental question of ‘what makes wireless communications possible’. The problem-based activity will be supported by formal lectures, problem-solving classes and laboratories. The weekly two-hour lecture/tutorial session will provide the theoretical background and help build the knowledge base and develop problem-solving skills. This will be informed by current research on two areas: 1) integrated antennas for 5G and satellite communications; and 2) mobile communications. Students will undertake two problem based projects leading to practical work in the laboratories comprising activities such as designing using CAD software, prototype building and testing.

Assessment

ACTIVITIES	PERCENTAGES
Assignment	40%
Mini Project	40%
Problem based questions	20%

HDE14 – HARDWARE SYSTEMS AND CONTROL

Aims

Enable the students to understand the value of digital systems and their various applications. Students will be required to develop their ability to integrate and synthesise material from different sources, to critically reflect on the abilities of current systems and the way they can be overcome using new design concepts.

Learning outcomes

On successful completion of this course a student will be able to:

- 1: Critically evaluate existing digital technologies to determine their benefits for specific engineering applications and their drawbacks that will need to be overcome with future developments.
- 2: Reflect on currently existing systems to solve typical engineering problems.
- 3: Create real-time, high-performance designs using the latest design methodologies.
- 4: Investigate existing systems and their testing requirements, to design and built appropriate test environments.

Indicative content

Hardware – Software co-design:

Sequential versus parallel processing, their timing implications and specific benefits for certain applications such as: control, video processing, among others.

Embedded/High Performance Design:

Different types of communication (bus, network) and memory (Addressed, CAM, Associative,) and specific processor/logic concepts (pipelining) and their respective strengths for data flow optimisation within real-time, embedded and/or high performance designs.

Switching and finite automata for complicated designs, and the need for cellular/decentralised/autonomous design approaches to improve efficiency and performance.

Design Testing:

Design for testability, constructing of tests for designs and use them to improve simulation/automated testing of designs during development.

Teaching and learning activity

The course has a set of formal lectures, which bring knowledge on hardware design, as well as existing technologies. This is supported with a set of tutorials and practical sessions under academic supervision. Additionally, there are a number of student centred activities that deal with

knowledge acquisition and subsequent application. The course has a strong student centred focus, to deal with their interests and allow these specific interests to drive their knowledge forward; with academic supervision provided to add guidance where necessary.

Assessment

ACTIVITIES	PERCENTAGES
Assignment	50%
Written Exam	30%
Problem based questions	20%

HDE15 – OPTICAL FIBRE COMMUNICATION SYSTEM

Aims

Optical fibres now constitute the backbone of the world's long-distance telecommunications systems and are also being used increasingly in other areas, such as sensing, biophotonics, automotive, etc. The course sets out to provide a basic understanding of optical transmission systems concentrating on light propagation along fibres and light processing using fibre- and planar waveguide-based devices. Light propagation includes: modal propagation and Maxwell's equations; ray tracing, Snell's and Fresnel's Laws; single-mode, multi-mode and special fibres; pulse propagation and dispersions; nonlinear effects; fibre and planar waveguide fabrication; analytical and numerical techniques; birefringence and bend loss. Light processing devices include: couplers and splitters; gratings and arrayed waveguide gratings; Mach-Zehnder and multimode interferometers; optical amplifiers and attenuators; polarisers. With knowledge of the basic physical principles of these key photonic

components we consider how they affect the practical performance and limits; and how they influence the design of real-world telecommunication systems. Laboratory work covers mainly hands-on fibre-based experiments and some numerical simulations.

Learning outcomes

The knowledge of fibre optical components, links, and systems. The system relevant parameters of devices are derived from a physical description, and these parameters form the basis for designing fibre optic links.

After a completed course the participants should be able to:

- Understand, describe, analyze, compare the most important devices: light sources, fibres and detectors from both physical and system point of view.
- Design digital fibre optic links.

Indicative content

Dielectric wave-guides: Attenuation, wavelength dispersion. Light sources: Semiconductor laser, light emitting diode, rate equations, output power, modulation, noise, laser amplifiers, chirp. Detectors: PIN diode, avalanche diode, responsivity, bandwidth, noise, Systems: Direct detection systems, heterodyne systems, attenuation limitations, dispersion limitations, signal dependent noise, additive noise, bit error rate, optical networks, solitons.

Teaching and learning activity

The main activity on the course will be to review the design digital fibre optic links. The student will recognise and classify suitable materials that can meet these challenges.

The problem-based activity will be supported through formal lectures and tutorial classes and laboratories as appropriate.

Assessment

ACTIVITIES	PERCENTAGES
Assignments	30%
Laboratory/ Industry	40%
Final Examination	30%

HDE16 – MICROPROCESSOR SYSTEM**Aims**

The course is intended to enable students to design and develop programs and program 'architectures', to test and debug programs and to analyse and modify their execution behaviour, based on a thorough familiarity with the low-level architecture of a computer. Concepts such as RISC/CISC architectures, register sets, addressing modes, data structures, subroutines, [informal] high-level to low-level language translation techniques, polling, interrupt priorities, asynchronous producer-consumer systems are introduced.

Learning outcomes

The student will be able to analyse, specify, design, write and test assembly language programs of moderate complexity.

The student will be able to select an appropriate 'architecture' or program design to apply to a particular situation; e.g. an interrupt-driven I/O handler for a responsive real-time machine. Following on from this, the student will be able to design and build the necessary programs.

The student will be able to calculate the worst-case execution time of programs or parts of programs, and to design and build, or to modify, software to maximise its run time memory or execution-time behaviour.

The student will be able to characterise and predict the effects of the properties of the bus on the overall performance of a system.

The student will be able to describe some of the characteristics of RISC and CISC architectures.

Indicative content

Review of Binary and Hexadecimal Arithmetic

The Von Neumann Machine

The Programmer's Model of the MC68000

Data Representation: integers, characters, signed representations, arrays

Addressing modes: immediate, direct, indirect

Program flow control: unconditional branch and jump

The Condition Code Register

Conditions and conditional branching

High-level language constructs: while, if, for, etc.

Some complex 68000 instructions

Subroutines: mechanisms and parameter passing

Principles of Input/Output: polling

Exceptions and exception handling

Supervisor & user mode

Interrupts and interrupt handlers

Producer consumer organisation; queues and buffers

Introduction to the System Bus

Instruction Execution

Instruction Timing

Teaching and learning activity

Tutorials are a vital part of the course. Typically, topics you'll have seen in some guise will be introduced in the course of solving problems or designing solutions in the tutorial.

Occasionally, especially at the start, new ideas and techniques will be introduced. Sometimes you'll be asked to try to solve problems you have not directly been prepared for—you'll have to do some independent work, both at the tutorial and afterwards.

The problem-based activity will be supported through formal lectures and tutorial classes and laboratories as appropriate.

Assessment

ACTIVITIES	PERCENTAGES
Assignments	30%
Laboratory/ Industry	40%
Problem Based questions	30%

HDEE17 - INDIVIDUAL PROJECT

Aims

The individual project enables a student to study a topic in depth, to further develop experience in the retrieval and critical assessment of information and to plan, execute and report on an individual work programme. The preparation of an individual project enables students to use a range of skills that have been developed throughout their programme: for example, the skills of enterprise, initiative, design and analysis required for thorough investigation and research into a particular engineering topic; the motivation and time management skills necessary to produce a substantive and organised piece of reported work and the ability to synthesise and integrate complex information.

This course aims to: provide students with an opportunity to carry out a critical, in-depth study in an area of particular relevance to their chosen engineering specialism; foster enhanced problem-solving, presentation and management skills; encourage initiative and the investigative reading of background and source materials and apply this to the solution of a problem of some complexity; encourage students to develop the ability to integrate data and knowledge to provide an appropriate critical analysis; develop the ability to work on an individual basis, with limited direct supervision, to promote self-development skills.

Learning outcomes

On successful completion of this course a student will be able to:

- 1: Undertake a substantial programme of engineering work on an individual basis that integrates various facets of their chosen engineering specialism.
- 2: Use a wide range of skills to solve engineering and design problems.
- 3: Conduct and report an appropriate literature and state-of-the-art survey.
- 4: Design, conduct, analyse and report an engineering project.
- 5: Disseminate the findings of the project by poster and oral presentations, and in a properly structured written report.

Indicative content

Projects will generally fall into three categories: investigation, planning, design, construction and evaluation of a topic relating to the student's chosen engineering specialism; planning, execution and analysis based on laboratory or field investigations; in-depth study and critical appraisal and analysis of an existing or proposed engineering scheme, system or sector of the engineering industry or field of research. Topics for projects are provided by members of staff within the Department, by industrial organisations and, occasionally, by students themselves. The main criteria for the acceptability of a topic for an individual project are that it should offer a substantial challenge to the student's initiative, together with the development of engineering and management skills appropriate to the programme of study. The project will involve activities that are relevant to the formation of a professional practising engineer.

The student takes responsibility for their own decisions whilst executing the

project knowing that often there is no one unique solution to most engineering problems. This means that the student plans and carries out the project with a fair degree of independence, under the general guidance of the academic supervisor.

Teaching and learning activity

Student centred activity and weekly discussion with the project supervisor - a nominal one day per week for two semesters. Additionally a detailed logbook is to be kept that will be reviewed by the Supervisor at regular intervals.

Personal logs, A/V presentation and project reports are to follow standard templates.

Assessment

ACTIVITIES	PERCENTAGES
Field Work	30%
Project Report	70%

ELECTIVES (Any One Subjects)

HDEE1 - PROGRAMMING FOR ENGINEERS

Aims

This module aims to increase awareness of the uses of programming in engineering and the types of hardware interfaces available. Also to develop skills in algorithm design and the application of a high level computer language to implement a design. This will require the students to develop an understanding of the types of software engineering methodologies used

in industry.

Learning outcomes

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

- 1 recognise and classify a variety of computer system interfaces and how they are used
- 2 analyse the requirements of a system and develop an algorithm
- 3 demonstrate a greater understanding of the of the software development process
- 4 implement an algorithm in a high level computer language
- 5 develop a test schedule to confirm correct the operation of a computer program

Indicative content

System Interfaces

Parallel and serial communications, programmable input and output, A/D and D/A converters.

Software Design Process

The design of algorithms to efficiently solve a specific problem or a class of problems, the use suitable notation such as Structured English, state machines, flowcharts and so on to document the design using formal software engineering methods.

High level Programming

Basic data types, control flow, functions, parameter passing, aggregate types such as arrays and structures, bitwise operations, pointers, reading and writing I/O interfaces.

Teaching and learning activity

Formal lectures, online tutorials and laboratory work provide practical experiences of the design, implementation and testing of programs. This will include a number of design challenges to develop algorithms and programs to solve engineering problems. For example, creating engineering calculators with intuitive user interfaces or developing algorithm's allowing robots to navigate in a maze. The laboratory work will

include design tutorials using graphical drop and drag programming and formal structured programming in a high level language.

Assessment

ACTIVITIES	PERCENTAGES
Assignment	50%
Problem based questions	50%

HDEE2 – ELECTRONIC CIRCUIT DESIGN

Aims

- Explain the principles of amplification using electronic components;
- Describe the characteristics of electronic components and introduce the concept of functional flexibility;
- Explain the benefits of applying negative feedback in the context of operational amplifiers and circuits using discrete devices.

Learning outcomes

On successful completion of this course a student will be able to:

Demonstrate knowledge and understanding of the most important basic operational amplifier configurations and their applications.

Show that they understand the limitations of simple circuits.

Demonstrate knowledge and understanding of simple characteristics and circuit applications of semiconductor diodes, light emitting diodes (LEDs), photodiodes, field effect transistors (FETs) and bipolar junction transistors (BJTs).

Indicative content

- Operational (voltage) amplifiers; non-inverting and inverting circuits; limitations of real integrated circuits (ICs); adder and differential circuits; circuits with two or three op amps; understanding data sheets. (7 lectures)
- Related ICs: comparator; transimpedance and transconductance amplifiers. (2 lectures)
- Diode characteristics; applications of diodes, detector circuits; d.c. level control. LED, semiconductor laser and photodiode characteristics; non-linear circuit applications. (4 lectures)
- Field Effect Transistor (FET) characteristics; Bipolar Junction Transistor (BJT) characteristics; amplifier and switch circuits; biasing. (6 lectures)
- Capacitor characteristics; circuits with capacitors; coupling and decoupling; integrator and differentiator. (1 lecture)

Laboratories:

MultiSim: CAD based work using circuit analysis software to design and simulate basic electronic circuits.

ELVIS I: Using national Instruments ELVIS prototype boards to construct and test basic electronic circuits.

myDAQ: Using national Instruments myDAQ and PIC microcontroller boards to prototype a simple consumer product.

Teaching and learning activity

- The learning and teaching activities will comprise a mixture of lectures, tutorials and laboratories designed to understanding of the fundamentals of electronic circuit design.
- The problem-based pedagogy will be introduced using open-ended practical problems which students deliberate in groups to identify probable solutions.
- Laboratory/ Industry based sessions are designed to run across the year. An identified number of laboratories/ industry will be undertaken by the students to help them develop laboratory skills, report writing as well as statistical analysis of data collected from experiments.

Assessment

ACTIVITIES	PERCENTAGES
Assignment	50%
Sample electronic circuit design	50%

HDEE3 - APPLIED ENGINEERING PRACTICE

Aims

The aim of the course is to provide an opportunity for students to develop new skills and knowledge appropriate to their current (and potentially future) job role and their programme of study. These new skills and knowledge will be obtained through activity in the work-place, company provided training or taught courses at the university.

Learning outcomes

On successful completion of this course a student will be able to:

1 Identify and complete courses or training opportunities that will address the engineering subject areas proposed. At this level, the learning should comprise components of varying complexity and predictability requiring the application of a wide range of techniques and information sources.

OR

2 Identify and undertake new learning and development opportunities in the workplace that are relevant to the student's job role and programme of study. At this level, the activity should comprise components of varying complexity and predictability requiring the application of a wide range of techniques and information sources.

AND

3 Assess evidence of the subject areas studied or work activity and its application in the work place and relevance to the programme of study, which will be presented in a portfolio.

4 Evaluate the topic of training or work activity and its relevance and application in the workplace and programme of study (through reports included in the portfolio and via the end of course viva-voce).

Indicative content

This flexible course is based upon the individual's work practice. The content will depend entirely on what is relevant to the student and their own learning and development. It will rely upon opportunities for learning, development and application that the student has in the work place. It will also be interlinked with the needs of the employer. Students may find that additional taught courses (from an agreed list) at the university may support development needs for their job. The content of work activity and any taught or additional learning must be relevant to the student's job role, their employer and their programme of study. Credit can be sought for current or retrospective activity or training.

The 15 credits for this course can be made up from a combination of the following:

- An in-house (company) training programme(s) or course(s) run by a third party company.
- Learning, new skill or other development opportunities gained through new practices, projects and challenges in the workplace relevant to the student's job, company and programme of study that are presented in portfolio format for credit

Teaching and learning activity

The course is through independent, negotiated study supported by

individual tutorial sessions with a supervisor.

The student, following discussion with his/her academic supervisor and company mentor, must submit a short written proposal outlining the activity, course(s) and/or training programme(s) to be undertaken. The proposal must provide details of:

1 The Work based learning activity

1.1 Discuss the work based learning activity, including the amount of time spent/will be spent on it

1.2 Describe the activity in context to your work/job

1.3 Illustrate why this activity is relevant in the workplace/need for activity

1.4 Identify who you worked/will work with within the company and externally on the activity

1.5 Describe and illustrate how you will achieve/have achieved activity aims and outcomes

1.6 Is the activity now complete, or is there scope for further work or development?

2 Resources

2.1 What information is/was needed to complete the project activity in practice and in writing it up?

2.2 How and where you will source/have sourced it?

2.3 Will you/did you need support from other colleagues / external sources to complete the project activity?

3 Evidence

The report must be supported by a portfolio of evidence that illustrates project activity and provides overarching account of what has been learned/achieved in the process of the activity and how it has been applied. Please indicate briefly in this proposal:

3.1 What examples of evidence will you include in your portfolio to support the report? e.g. photographs, diagrams, statistics, emails, meeting notes, etc.

4. Timeline

Indicate using specific dates when you will achieve each of the following aspects of the project activity itself, the report and portfolio. In the case of reports on retrospective activity, please give dates when it took place.

Once the proposal is agreed, the student will be supported by the academic supervisor to present the activity or training for credit. This includes comment on up to two drafts of the written report and four one-to-one tutorial sessions.

Students will demonstrate, through the use of a portfolio, which they have accumulated knowledge and understanding from their studies that is at a standard and has the breadth of coverage consistent with a 30 credit Level 5 course. The level and credit value being based on a set of learning outcomes and level descriptors defined by the academic supervisor as being appropriate to a Level 5 course.

The academic supervisor must be satisfied as to the relevance of the subject matter, the level of the material and the degree of work involved when measured against the 300 learning hours of a 'standard' course. Guidance will be provided as to the suitability of the subject areas, how to meet the learning outcomes and the assessment criteria that will be applied.

In addition to the portfolio, students will take part in a professional discussion (viva voce) where they will summarise the key points of their activity or learning and answer questions related to their portfolio and discussion to demonstrate comprehensive understanding against the following:

the content of the discussion and the clarity of expression on the following:

- demonstration of knowledge about and depth of understanding of the subject covered
- ability to discuss and explain the activity/training clearly and succinctly
- ability to answer questions based upon information provided verbally and in the portfolio
- clear expression and explanation of how the learning from the project activity or training has or will impact on workplace practice and the company

Assessment

ACTIVITIES	PERCENTAGES
Portfolio Assignment	50%
Presentation of Industrial experience	50%

HDEE4 – INTRODUCTION TO MECHATRONICS

Aims

Mechatronics is the marriage of mechanical engineering with smart electronics and is vital to subjects such as industrial automation and robotics.

To interact with an object, a mechatronic system must know where the object is, be able to move the object and place it in the required new position. The electronics require information from sensors that can detect position, orientation, and visual or audio signals. The electrical inputs from the sensors have to be interpreted and the appropriate signals sent out to the actuators to perform the required operation. A good understanding of feedback control is also required to be able to make changes in the system from one steady position to another without oscillations or unpredictable movements.

You are introduced to the necessary skills and principles which underpin a range of mechatronic systems. You examine small single component

systems as well as larger systems integrating components from different engineering disciplines. You also look at the control concepts used in mechatronic systems and focus on system design and maintenance. The approach is broad-based, to reflect the fact that mechatronics is multidisciplinary and not confined to a single specialised discipline. You are encouraged to recognise a system, not as an interconnection of different parts but as an integrated whole.

Learning outcomes

On successful completion of this course a student will be able to:

1. Develop simple mechatronics systems via programming of an embedded system.
2. Develop creative and innovative mechatronic solutions for simple problems, anticipating financial and social consequences of any intended action.
3. Design and analysis of electric circuits, applying relevant theories.
4. Simulate a simple electric circuit using basic mathematical skills.
5. Conduct feasibility study for using mechatronics systems for solving assistive technology applications

Indicative content

Definitions of Mechatronics. Applications of Mechatronics (Automotive Mechatronics, MEMS and etc.).

Mechanical design. Static and dynamic stress analysis. Classical and numerical approach. Automatic computation in design. Numerical simulation. Computer aided engineering (CAE).

- **Measurement and actuation module** – Signals are received from the external world and feedback signal. This segment consists of actuators and sensors like stepper motors, solenoids, AC/DC, strain gauge, temperature sensor/pressure sensors/photo sensors.
- **Communication Module** – The relative position of actuators and position of sensors can be measured to generate appropriate signals. These signals are transferred through the communication module to the

CPU. The signal conditioning circuits, interfacing circuits and bus communication form the communication module.

- **CPU** – When the CPU receives the signal, they can perform logical and arithmetic operations with a processor and software. An appropriate control signal is generated by the CPU.
- **Output signal conditioning module** – This module includes amplifiers to drive plotter, audio-visual indicators, ADC/DAC's and displays. The output signal is forwarded to feedback module.
- **Feedback module** – This module generate signal proportional to the output signal which is forwarded to the measurement and actuation module. The signal from the external environment and the feedback signal are compared by the measurement and actuation module.

Teaching and learning activity

Learning activities include: lectures, tutorials, group project and laboratory simulation activities.

Assessment

ACTIVITIES	PERCENTAGES
Assignment	30%
Case Studies	30%
Design a concept	40%

HDEE5 - ENGINEERING OPERATIONS MANAGEMENT

Aims

To provide knowledge of operations management techniques for strategic and tactical decision making for identifying and meeting customer requirements. To develop an understanding of the unified and comprehensive operations management environment. To develop the student's understanding of Information Technology Tools for implementing Operations Management techniques and to appreciate the integration and synchronisation with the external supply chain. Knowledge gained and applied within an industrial context.

Learning outcomes

On successful completion of this course a student will be able to:

- 1: Understand the techniques used of operation management; decision tools, design of product and processes, planning organisation and control; analyse case studies of actual applications of operation management techniques.
- 2: Appreciate actual Operations Management execution systems such as Material Requirements Planning (MRP) and Enterprise Resource Planning (ERP) systems.
- 3: Understand the application of simulation and virtual manufacturing in the CIM environment.
- 4: Understand how a unified approach to operations management facilitates enterprise integration and supply chain management.
- 5: Appreciate the state-of-the-art Information Technology (IT) for implementing Operations Management.
- 6: Practical understanding of the Operations Management environment within an industrial commercial context.

Indicative content

Introduction and Concepts: Introduction to Operations Management, Decision Tools: Decision Analysis and Forecasting. Modelling Operations. Systems Approach to Operations. Enterprise Integration. Strategic Decisions and Operations: Product Strategies. Process Strategies. Location Strategies. Layout Strategies. Tactical Decisions and Control: Inventory Control. Operation and Capacity Planning, Material

Requirements Planning. Operations Scheduling. Lean Production and Just-in-Time. Enterprise Requirements Planning Management of the Supply Chain. Maintenance and Reliability.

Teaching and learning activity

The course will be taught by a combination of formal lectures and tutorials with appropriate computer based laboratories or computer based industries. Extensive use will be made of immerse simulation environments to develop a realistic and practical understanding the operations management environment within an industrial commercial context.

Assessment

ACTIVITIES	PERCENTAGES
Assignment	40%
Written Essay	30%
Industrial experience	30%

HDEE6 - QUALITY ENGINEERING

Aims

To provide knowledge of quality engineering techniques and the necessary management systems and philosophies for their successful implementation. To develop an understanding of how various quality engineering techniques can be implemented throughout the product and manufacturing life cycle. To develop an understanding how Total Quality Management can be used to strategic advantage to exceed customer requirements and facilitate process improvement. To develop the student's understanding of Information Technology Tools for implementing

Operations Management techniques and to appreciate the integration and synchronisation with the enterprise.

Learning outcomes

On successful completion of this course a student will be able to:

- 1 Understand the techniques of quality management, including product, process, and measurement system design, process control and improvement.
- 2 Understand quality systems and management techniques for implementing quality engineering techniques and facilitating empowerment and teamwork.
- 3 Analyse case studies of actual applications of quality engineering and management techniques.
- 4 Understand how a total quality management facilitates continuous improvement and world-class manufacturing.
- 5 Appreciate the state-of-the-art Information Technology (IT) for implementing quality engineering techniques.

Indicative content

- Quality Concepts - Statistical Concepts. Process Improvement Variation: Common and Special Causes of Variation. Prevention and Detection Systems, Graphical Techniques for Quality Improvement.
- Statistical Process Control - Concepts of Statistical Process Control. Variable and Attribute Control Charts, Process Capability, Acceptance Sampling.
- Experimental design - Design of Experiments. Analysis of Variance. Factorial Experiments.
- Reliability Engineering - Life Cycle Curve and Probability Distributions for Modelling Reliability. System Reliability.
- Quality Management Systems - Standards and Standardisation. ISO 9000 Series Quality Management System. ISO 14000 Series Environmental Management System.
- Total Quality Management - Concepts and Implementation of Total Quality Management. Integration with Design, Manufacture and Operations Management.

Teaching and learning activity

The course will be taught by a combination of formal lectures and tutorials with appropriate computer based laboratories or in industry. Use will be made of immerse simulation environments to develop a realistic and practical understanding the quality engineering environment.

Assessment

ACTIVITIES	PERCENTAGES
Assignment	50%
Presentation and Report	50%