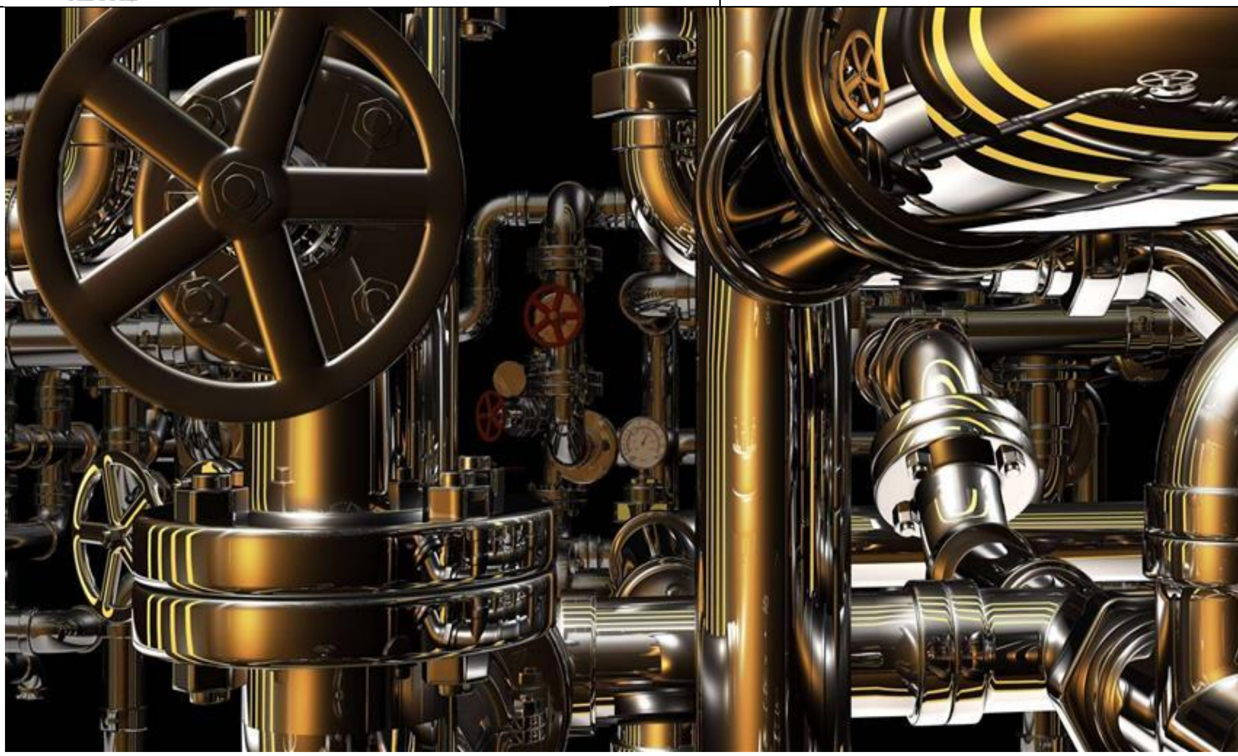
HIGHER DIPLOMA IN MECHANICAL



MECHANICAL ENGINEERING

Mechanical Engineering keeps the world moving, from bicycles to bi-planes, catapults to cranes, supercars to satellites and everything in between. Mechanical engineers apply the fundamentals of science and mathematics to create practical, useful solutions that the rest of us can use. If it moves or contains moving parts, mechanical engineers are behind it. Our programme prepares students for careers as professional mechanical technicians/engineers with the focus on innovation, analysis and development within a wide range of advanced engineering technologies. The programme, aims to develop a strong knowledge of engineering concepts across all mechanical subject areas, so as to form a basis for complex problem solving and innovation in whatever area the engineer is employed. A key feature of the programme is the exposure of students to real industrial problems, where leadership skills are developed through a team working approach.

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 mechanical engineering technologies, methods and standards
- 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 mechanical engineering solutions that better society
- To help you acquire the knowledge and skills required to perform a variety of professional roles within mechanical engineering and associated specialist fields.

CORE SUBJECTS		
Course Code	**Subject**	**Credit**
HDME1	**ENGINEERING MATHEMATICS**	15
HDME2	**DESIGN AND MATERIALS**	15
HDME3	**ENGINEERING PROFESSIONAL SKILLS**	15
HDME4	**PRACTICAL AND EXPERIMENTAL SKILLS**	15
HDME5	**STRUCTURAL MECHANICS**	15
HDME6	**ELECTRICAL CIRCUITS**	15
HDME7	**PROFESSIONAL DEVELOPMENT FOR ENGINEERS**	15
HDME8	**FLUIDS AND POWER DYNAMICS**	15
HDME9	**ENGINEERING MATHEMATICS 2**	15
HDME10	**THERMODYNAMICS**	15
HDME11	**MATERIALS 2**	15
HDME12	**MECHANICS AND DESIGN OF MACHINES**	15

HDME13	**ADVANCE FLUID MECHANICS**	15
HDME14	**HEAT TRANSFER**	15
HDME15	**ENGINEERING DYNAMICS**	15
HDME16	**NUMERICAL METHODS FOR MECHANICAL ENGINEERING**	15
HDME17	**INDIVIDUAL PROJECT**	25
ELECTIVE SUBJECTS (Any one Module from the following)		
HDMEE1	**PROGRAMMING FOR ENGINEERS**	15
HDMEE2	**PRINCIPLES OF ENGINEERING MECHANICS**	15
HDMEE3	**APPLIED ENGINEERING PRACTICE**	15
HDMEE4	**MATERIALS UNDER STRESS**	15
HDMEE5	**ENGINEERING OPERATIONS MANAGEMENT**	15
HDMEE6	**QUALITY ENGINEERING**	15

HDME1 - 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 stet 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/stain 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%

HDME3 - DESIGN AND MATERIALS

Aims

The course provides an introduction to the methods and practice of engineering design, allowing the student to become acquainted with the basic principles of design and the design process. This will include the important link between design and manufacture. The course also aims to develop the student`s visual thinking skills by giving them practice in sketching, and CAD drawing. Finally, the development of transferable skills, including team working, verbal and written communication skills will be practiced during a group design and make exercise.

Learning outcomes

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

1 • Understand and apply the principles of conceptual design, and be able to explain the rationale of an engineering design choice they have made.
2 • Understand the fundamental principles governing the engineering properties of materials and the interaction with processing.
3 • Choose appropriate materials for a given application using a rational selection process.
4 Apply project-planning principles and recognise the importance of team working.
5 • Communicate verbally and in written form details of an engineering design process.
6 • Prepare simple sketches, detailed and layout drawings, and interpret them as corresponding 3D objects.
7 • Produce fabrication drawings (blueprints) of components to ensure that they perform the desired function and can be manufactured.

Indicative content

The Design Process: methods and practice of engineering design; total design; market requirement; product design specification; conceptual design; detailed design; product specification.

Design Considerations: materials selection; manufacturing process selection; manufacturing; costing; marketing; design for sustainability and product life cycle assessment.

Materials Properties and Selection: materials and process information for design; materials properties; mechanical, electrical, thermal, general properties; stiffness limited design; strength limited design; fracture limited design; surface degradation of materials.

Project Planning: team working; design management; decision making; costing tools; sources of literature and information; intellectual property rights; product safety and liability.

Engineering Communication Skills: sketching; rendering; visualisation of 3D objects; orthographic projection; dimensioning to British and international standards; 2D CAD dimensioned and annotated drawings (using subject specific software); 3D solid CAD models of parts and assembly and corresponding orthographic drawings; Application of CAD to rapid prototyping.

Group Design and Make Project; An extended group (typically 4-6 members) design and make project will be carried out (either subject specific or cross-discipline) making use of the above skills and knowledge.

Teaching and learning activity

Part 1
Lectures will examine the design process and project planning aspects. These will be supplemented by tutorials. Sketching and CAD will be introduced in supervised laboratory sessions. Students will be provided with a set of notes allowing a self-teaching programmed learning approach. Students will be expected to develop their skills by following a set of exercises of increasing complexity. A detailed conceptual design exercise will provide a summative assessment to this part of the course.

An understanding of materials will be gained through lectures and supplementary tutorials. It is intended to use a design led approach in which the materials are matched to the property requirements. Once this is established the fundamental science underpinning the properties will be explored. The interrelationship between properties and manufacturing will also be considered.

Part 2
Students will take part in a group activity – a design and make exercise. This will integrate aspects of the design work that they have carried out in Part 1 as well as aspects of Level 4 engineering science theory. Each group (of around 4-6 students) will be allocated a supervisor who will facilitate progress on the project.

Students must communicate details of their design through a group oral presentation and a written report. An individual logbook is to be kept by each student-recording group and individual activities contributing to the project.

Assessment

Outline Details: Group Design Report of prescribed length and standardised format. A peer group assessment form is used to assess individual contributions to the project. In addition each student must keep an individual log book in which their own contribution to the project is to be highlighted.

Assessment

ACTIVITIES	PERCENTAGES
Take-Home Assignment	35%
Written Reports - Assignment	55%
Problem Sets	10%

HDME3 - 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%

The course is interactive and stimulating. Students will learn from the classroom, practical, seminars, workshops, tutorial and their peers by developing a multi-disciplinary perspective and pedagogic knowledge. The learning process incorporates “within group” and “between groups” reciprocity so that sharing of knowledge, experience and professionalism makes a real difference to their academic and applied experience. The course is thought-provoking and practical. Faculty wide experts across the school are involved in teaching and learning process of the course.

HDME4 - 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%

HDME5 - STRUCTURAL MECHANICS

Aims

This course aims to enhance students understanding of the principles of structural and engineering mechanics in analysis of engineering applications. The study of Structural Mechanics shall empower the students to undertake computation of deformations, deflections, internal forces (or stresses) within structures. Such knowledge will help engineers evaluate the performance of existing structures whilst also developing the knowledge required to design structurally sound engineering applications.

Learning outcomes

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

1 Apply standard expressions and formulae to calculate material properties.

2 Analyse the dynamics response of engineering structures.

3 Analyse the response of engineering structures due to different loading conditions.

4 Appraise, compare and design engineering structures whilst evaluating their structural response to different loading conditions.

Indicative content

Fundamentals of Structural Mechanics

• Mechanical properties of materials: Elasticity, Plasticity, Yield, Stress-Strain graphs; linear elastic material model, plastic deformation of materials; Mechanical Testing: Tensile, Compression, Shear, combined loading.

• Structures loaded in Bending: Statically Determinate Structures, Statically Indeterminate structures; Construction of Axial force, Shear Force and Bending Moment Diagrams.

• Behaviour of structures under complex loads: 2D Stress States; 2D Stress Tensor; Stress transformations; Principal Stresses and Strains; Construction of Mohr Circle; introduction to 3D Stress Analysis.

• Structural Vibrations: Damped and Undamped Vibrations, Types of Free Vibrations; Experimental determination of damping; Forced Vibrations and Forcing Functions; Amplitude Ratio; Magnification Factor; Rigid Body Vibrations; Energy methods for rigid body vibrations; Case studies of mechanical and structural vibrations.

Specialization A: Mechanics of Structures

• Torsion of Shaft: Torsional deformation of circular shafts; Torsion formula; Angle of Twist; Power transmissions; static indeterminacy and torsion; torsional deformation of solid non-circular shafts; torsion of thin-walled open cross-sections; stress concentration and torsion effects; inelastic torsion; residual stresses and ultimate torque;

• Mechanics of Pressure Vessels: Thin and thick walled cylindrical pressure vessels; spherical vessels;

• Buckling collapse of axially loaded structures: Stability of structures; ideal columns; critical load; buckling of pinned-end columns; Euler load; columns with different support types; buckling of real columns; secant formula; Concentric and Eccentric loading.

• Flexural Response of Structures: Pure bending; normal stresses and strains in beams; flexure formula; stress-concentrations in bending; shear stresses in beams; design of prismatic beams; design of beams with constant strength; design of composite beams;

• Deflection of beams: The elastic curve; Method of integration;

discontinuity functions method; Method of superposition; Moment-Area method; continuous beams;

• Structural Dynamics: Kinematics of rigid bodies: General equation of motion; translation, rotation; fixed-axes rotation; general plane motion; work-Energy relationships; virtual work; Impulse; Linear and angular momentum; Impact;

Specialization B: Principles of Structural Analysis

• Shear Stress distribution and analysis: Complimentary shear; derivation of shear stress formulae; thin-walled sections; shear flow direction and variation; shear centre; torsional shear stress.

• Symmetric and Asymmetric bending: Moment-curvature relationship in matrix form; stress-curvature relationship; analysis for given moments and stress conditions; stress distribution diagrams.

• Stiffness Method by Moment Distribution: Development of iterative solutions; fixed end moments; distribution and carry over factors; analysis of free bodies; shear force and bending moment diagrams for statically indeterminate beams and frames.

• Displacement Theory: Double integration of curvature to find deflection; Principle of virtual work and energy; Unit load method; flexural and axial effects; extension to relative displacements; displaced profiles; application to beams, frames, pin-jointed structures and interconnected structures.

Teaching and learning activity

The course is a very analytical course requiring intense learning over a sustained period of time. Therefore, the learning and teaching activities have been spread across a standard double term to allow students enough time to understand the principles of structural mechanics.

There learning and teaching activities have been divided into two parts:
• Part 1: Learning and teaching on the fundamentals of structural mechanics.
• Part 2: Learning and teaching with specialization/discipline focus.

Learning and teaching will be by lectures and tutorials. Understanding will be enhanced through tutorials and online teaching materials. A comprehensive laboratory practical programme will further aid understanding of the subject matter, in addition to developing essential practical and laboratory report writing skills.

Assessment

ACTIVITIES	PERCENTAGES
Assignments	30%
Quizzes (2)	20%
Laboratory/ Industry	30%
Final Examination	20%

HDME6 - 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%

HDME7 - 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%

HDME8 - FLUIDS AND POWER DYNAMICS

Aims

To introduce students to the topic of fluid mechanics and its relevance in Engineering and familiarise them with commonly used models to solve problems related to fluids at rest and in motion. Fluid problems are encountered in every aspect of life and engineers need to recognise and characterise different types of flows to select appropriate models to develop new systems or improve existing ones. By working on practical exercises and projects students will reinforce theoretical concepts and develop skills that help them breakdown problems and identify fluid concepts and models relevant to practical applications.

Learning outcomes

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

1 Understand the basic fluid properties and the physical laws that govern fluid behaviour

2 Analyse fluid problems and break them into more amenable ones and select appropriate models to solve them

3 Compute horizontal and vertical force components on curved immersed surfaces and find the resultant forces and their lines of action

4 Appreciate the principles of mass and energy conservation and the concepts of energy transformation in fluid machines

5 Evaluate head losses in fluid systems and power requirements, design pipelines and pumping systems

6 Explain the origin of lift and drag and correlate drag coefficient to flow velocity

Indicative content

Background theory:
Fluid properties, spatial variation of pressure, stresses in fluids

Design and sizing of retaining walls and sluice gates:

Pascal's law, forces on submerged surfaces and their lines of action, forces on floating bodies, buoyancy and stability, pressure measurement

Selection and sizing of flow metering devices:
Basic fluid dynamic principles, the flow pattern, flow types, open and closed systems, the continuity equation, Bernoulli's equation

Matching pipelines and pumping systems for specific duties:
The energy equation, Poisseuille's equation, D'Arcy's equation, Moody's chart and the determination of the friction factor, primary and secondary losses in confined flows, pump selection and sizing

Drag reduction on moving objects (cars, airplanes…)
Boundary layer with and without pressure gradient, effects of pressure gradient on boundary layer separation, flow past streamlined and bluff bodies, flow past a cylinder, flow past a sphere, drag and lift forces, boundary layer separation and vortex formation, boundary layer control

Flow measurement:
Velocity measurement, flowrate measurement, differential head producing devices, devices using flow velocity, criteria for meter selection, meter installation, other type of meters.

Scaling model size to prototype size
Non-dimensional groups in fluid mechanics, dimensional homogeneity, Buckingham's π theorem, similarity laws

Bulk solid conveying technology:
An overview of principal conveyor types; gravity chute, belt, chain, vibratory chute, air slide and pneumatic conveyor, with a detailed focus on the operation and key components of the latter

Teaching and learning activity

The module is delivered through a combination of formal lectures, tutorial sessions, directed learning and a comprehensive laboratory/ industrial programme. Lectures are driven by real applications where consideration is given to theoretical concepts essential to the solution of engineering problems. Tutorial sessions will be used to cement theories and help the student link theory to practice to develop analytical skills essential to the solution of fluid flow problems. Learning and understanding of different fluid mechanics topics is re-enforced by working on a number of real life challenges such as the design and calculation of hydraulic and fluid systems for diverse applications ranging from hydraulic lifting gears to innovative energy conversion systems, fluid distribution systems, thermal energy conversion and aerodynamic lift generating devices. These challenges are set for students to find answers to specific problems through the application of fluid mechanics concepts in an environmentally friendly manner. Some of the problems are open ended and will cultivate in students the practice of self-learning to develop confidence in their ability to research and learn independently. In addition to in-class demonstrations an extensive laboratory programme will further aid understanding of the subject matter by putting theories into practice as well as help students develop experimental and report writing skills.

Assessment

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

HDME9 - 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%

HDME10 - THERMODYNAMICS

Aims

The aim of this course is to equip students with the knowledge required to work as process engineers e.g. in energy or cooling related industries. Relevant case studies are introduced in the lecture to enhance student learning. The course is designed to provide study links between the theories discussed in lectures and tutorial/ practical exercises and lab classes. This course will equip students with the ability to analyse complex engineering systems and simplify the system under investigations by applying relevant assumptions. This course will also provide insights into the latest technology developments in the field of power and process engineering. Students have to provide evidence of their understanding of the thermodynamic subject by engaging in technical discussions and presentations on individual and group level. They also have to show their ability to apply thermodynamic fundamentals to solve open ended problems/ questions.

Learning outcomes

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

1 Explain theories and thermodynamic concepts in an applied engineering context;

2 Analyse practical/real systems and apply thermodynamic laws appropriately;

3 Demonstrate adequate understanding of the subject to be able to approach and seek the solution to unfamiliar problems;

4 Use diagrams and steam tables/ charts to find solutions for thermodynamic based engineering problems;

5 Evaluate thermodynamic concepts and show the capability to derive solutions for open ended questions;

6 Reflect on the outcomes of experimental/practical work and formulate appropriate conclusions.

Indicative content

Students will be introduces to a number of different case studies e.g. hydroelectric power plants, co-fired power stations and CHP plants.

Challenges could include:
• Assembly of a disassembled engine
• Convert heat to power in a self-build power generation unit
• Build a heat exchanger for a CHP system and evaluate efficiencies

The content of the lecture/ tutorial/ practical could include the following:

Fuels: bio vs. fossil fuels

Thermodynamic concepts:

• First Law of thermodynamics: First law of thermodynamics, systems, open and closed systems, the steady flow energy equation, Applications of the non-flow and steady flow energy equations to evaluate heat and work interactions in e.g. heaters, compressors and fans, turbines and throttling valves

• Second Law of thermodynamics: Reversible and Irreversible process, Carnot cycle, thermodynamic heat engines, refrigerators and heat pumps. Examine Carnot Cycle, determination of thermal efficiency for heat engine, refrigerator and heat pumps

• Properties of pure substances: Introduce the concept of a pure substance, use of property tables for determining thermodynamic properties, illustrate the P-v, T-s and P-T property diagram and P-v-T surfaces of pure substances, the ideal-gas equation of state

Cycles for open and closed systems:
• Power cycle
• Refrigeration cycle
• Otto and Diesel cycle

Heat transfer:
• Heat exchanger

• Conduction
• Convection

Teaching and learning activity

The course will be delivered through formal lectures, tutorial classes, laboratory/ practical and self-study work. Fundamental concepts will be introduced based on industrial related problem based challenges (some examples are listed below):

• Discuss Advantages and challenges using bio-fuels in traditional steam power plants (introduction of the concept of: heat, entropy, Rankine cycle, open systems)
• Explore the concept of CHP running on liquid fuels e.g. in internal combustions engines (introduce the concept of closed systems, Otto, Diesel, Bryton cycle, Ideal gas)
• Design a heat exchanger using relevant equations (explain the concept of heat transfer and understand the concept of entropy)

The thermodynamic theories are enhanced with lecture material supporting the understanding of the engineering practical aspects. Tutorials will provide an opportunity for the students to demonstrate their new skills and knowledge through guided/ self-study tutorial examples and problem sheets. Complementary practical learning exercises will further aid the understanding of the subject matter in addition to developing essential practical skills. A group or individual case study will be set to enhance the students' ability to solve open ended problems and demonstrate their ability to discuss topic relevant material.

Assessment

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

HDME11 - MATERIALS 2

Aims

The course aims to impart an appreciation of the central place that materials occupy in engineering. After all, engineers make things, and they make them out of materials. An engineer needs to make good choices in his/her selection of materials. To emphasise this, the course will take an applications driven and design approach through the examination of a range of materials selection case studies and challenges, such as selecting materials for the hot end of a gas-turbine engine and preventing failure of aerospace structures. However, it is intended that students also gain an understanding of the complexity of materials, the origin of their properties, to know which material properties are intrinsic and which can be manipulated through manufacturing, processing and heat treatment.

Learning outcomes

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

1 Deduce from the function of the component, the required properties of a material,
and the reason for selection of that material
2 Distinguish between the effects of intrinsic bonding, crystal structure and microstructure in determining material properties.
3 Explain the relationship between composition, processing (including heat treatment), microstructure and properties of materials (including failure properties).
4 Select materials for different applications based on knowledge of material
properties and taking account of the ability of the materials to be shaped manufactured in the correct form
5 Predict the consequences of materials utilisation on the environment and make
eco-informed materials selection choices.
6 Use information gathering, research, practical and communication skills

Indicative content

Enabling Theory and Background Material

Crystal structures, phases, introduction to phase diagrams, phase changes, solidification, glass transition, precipitation, grain growth, recrystallization.

Recap of Ashby Materials Selection and Process Selection procedures

Eco- informed materials choice: resources; life cycle analysis; eco-attributes of materials; eco-informed materials selection

The Importance of Processing – How to Manipulate Materials Properties

Materials Selection Case Studies and Challenges (Examples are given)

Selection of Materials for Automotive Applications
Car Bodies – low carbon steels, HSLA and other modern car body steels, aluminium alloys, GFRP
Engine parts – Q and T steels, alloy steels, cast irons, aluminium alloys, magnesium alloys
Tyres - elastomers

Selection of Materials for Oil Rigs (Failure Issues)
Brittle Fracture
Marine and Sour Gas Corrosion

Selection of Strong/Stiff/Light Materials for Aerospace Structures and Components
Aluminium alloys (precipitation hardening), composites, magnesium alloys, smart materials, future materials developments

Preventing Failure in Aerospace Structures – Designing for Fatigue Resistance

Materials for the Gas Turbine Engine
Stainless steels, titanium alloys, nickel base super alloys, inter-metallics, ceramics

Preventing Failure and Degradation within the Gas Turbine Engine

High temperature oxidation, hot corrosion, creep of metals (compare with creep of polymers) thermal fatigue, erosion

Selection of Materials for Buildings and Bridges
Structural steel, high tensile wire
Cement and concrete: properties of concrete, concrete mix design, standard test methods, quality control, strength and failure, deformation of concrete,
Reinforced concrete, fibre toughened concrete, high performance ductile concrete, self-healing concrete
Brickwork and blockwork: masonry construction and forms, structural behaviour, durability
Wood and timber: properties, stress grading by visual and mechanical means
Plastics: mixing, properties and modes of failure
Glass: applications in construction and properties
Composites: fibre-reinforcement, particle reinforcement, properties, testing

Materials for Biomedical Applications
Stainless steels, titanium alloys, CoCrMo alloys, polymers, glasses and ceramics, shape memory alloys,

Materials for Domestic Applications – focus on polymers

Materials for Packaging – focus on polymers, smart materials (e.g. thermochromic materials)

Teaching and learning activity

Teaching will mainly be through formal lectures. Presentation of the course content will be applications driven, examining materials selection issues for a range of diverse applications. Due regard will be given to predictions of future developments in materials usage. Eco-attributes of materials and eco-informed selection will be emphasised. Understanding will be enhanced through tutorials and online teaching materials. Case studies, materials selection and design exercises will be used to extend the subject matter and assess students understanding.
Materials selection software packages will also be utilised. The software will be used to promote independent “enquiry based learning”. A comprehensive laboratory practical programme will further aid

understanding of the subject matter, in addition to developing essential practical and laboratory report writing skills. Some of the laboratories will be "open ended" and will therefore develop research and experimental design skills.

Assessment

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

HDME12 - MECHANICS AND DESIGN OF MACHINES

Aims

The course aims to cover fundamental backgrounds and technical skills about mechanics of machines, design of machines, and related core knowledge of engineering design and product development. Students will learn about kinematics and kinetics of particles and rigid bodies, as well as topics of engineering dynamics, including the effects of forces on the motion of particles, rigid bodies and vibrating systems. Students will also study and investigate about working principles, design and manufacturing aspects of the machine elements, engineering systems and products. For example; students will learn how to optimally select, design and manufacture the gears and bearings for friction reduction and energy transmission applications, and how to analyse and evaluate the kinematics, kinetics and dynamics in design and development of machines and engineering systems so that they meet well technical requirements and function effectively. State of the art topics about engineering design and product development are introduced and discussed, together with the problem-based learning case studies and group projects. Lab sections include the topics such as Drop test, Impact test, Vibration test, Analysis of machines and engineering systems, CAD, RE, RP&M, and CNC machining which are fundamental and important for students to enhance technical backgrounds and skills in engineering mechanics, design and product development.

Learning outcomes

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

1 Comprehend theories and fundamentals of kinematics, kinetics, and dynamics of particles, rigid bodies and vibrating systems for design of machines and machine elements
2 Define engineering problems relating to the kinematics and dynamics of particles and rigid bodies
3 Understand working principles, design, selection, and manufacturing aspects of machine elements
4 Demonstrate understanding of fundamentals of design and product development in general and design of engineering systems, machines and machine elements in particular

Indicative content

• Kinematics and kinetics of particles and rigid bodies.
• Motion of machinery: Effects of forces on the motion of particles, rigid bodies and vibrating systems.
• Types of mechanisms, motion analysis, velocity and acceleration diagrams, forces, torque and power, problems and troubleshooting.
• Machine elements: Classification, working principles, selection, design and manufacturing:
- General introduction and scope of machine components.
- Friction reduction – bearings.
- Energy Transmission: gears, belts and chains, cams.
- Locating and energy transmission: Fastening and power screws.
- Energy Storage: springs, flywheel.
- Shafts and shaft components.
- Sealing: static and dynamic seals.
- Switching: clutches, valves, Geneva Mechanism.
- Energy conversion: turbo machinery, brakes, engines, actuators, rockets.
- Others: housing, hinges, pivots, linkages, levers.

• Engineering design and product development:
- Product design and development process and methods
- Design optimisation and material selections
- Prototyping, manufacturing and product assembly

• Advanced tools and technologies for Engineering Design and Product Development: CAD/CAM/CNC/CAPP, CAE, 3D Visualisation and Animations, Rapid Prototyping & Manufacturing, and Reverse Engineering.
•
• Problem-based learning case studies and lab sections.

Teaching and learning activity

The lectures are supported with comprehensive videos, demonstrations, lecture notes and presentations. Additional guides and tutorials are available for students at the end of the main contents of a course. State of the art industrial applications and case studies are used to support presentations, tutorials and in-class activities, with an online access to web-based materials, discussion forums, and training videos of software and tools. The problem-based learning group projects and lab sections are designed for students to apply the theories into the practice, as well as to develop both practical and transferable skills.

Assessment

ACTIVITIES	PERCENTAGES
Assignment	40%
Industrial Training	40%
Problem based questions	20%

HDME13 - ADVANCE FLUID MECHANICS

Aims

The aim of the course is to build on the knowledge and skills learned in the fluids and powder dynamics course in year two and acquire knowledge on more advanced theories of fluids in motion, with the view to be able to solve complex fluid problems and pursue a career in the field of fluid dynamics.

Learning outcomes

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

1: Acquire an in-depth knowledge of theories relevant to Fluid problems.
2: Analyse fluid behaviour in specialised applications.
3: Apply advanced mathematical methods to solve typical fluid mechanics problems.
4: Solve Engineering problems involving vortex flows.
5: Make assumptions for the solution of turbulent flows.
6: Use turbulence models to solve basic turbulent flow problems.

Indicative content

• Continuum hypothesis
• Lagrangian and Eulerian description of the flow
• The inviscid fluid
• The Reynolds transport theorem
• Conservation of linear momentum
• Conservation of angular momentum
• The Navier Stokes equations
• Fully developed flows and stability of viscous flows.
• The velocity potential and stream function.
• Circulation and vorticity.
• Free and forced vortex.
• Mean and fluctuating quantities.
• Origin of turbulence.
• Turbulence modelling.
• Eddy viscosity models / Reynolds stress transport models.

• Theoretical assumptions for the calculation of turbulent flow.
• Prandlt's mixing length.
• Universal velocity – distribution laws.

Teaching and learning activity

The course will be delivered through formal lectures and tutorials. Individual and group project will be integral in the learning process to enable students to put the theory into practice. Reading tasks will be set to achieve objectives.

Assessment

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

HDME14 - HEAT TRANSFER

Aims

To analyse the thermodynamic cycles of various types of thermal power plant. To develop a knowledge of the various types of thermal power plants. To predict the performance of various thermal power plant for varying loads. To develop an understanding of the fundamental modes of engineering heat transfer processes. To undertake the thermal design of heat transfer equipment.

Learning outcomes

On successful completion of this course a student will be able to:
1: Demonstrate an awareness of the characteristics of thermal power plant.

2: Undertake the critical thermodynamic design of such equipment for a particular duty.
3: Demonstrate an understanding theory of the various modes of engineering heat transfer.
4: Apply the principles of heat transfer to engineering situations and the design of heat transfer equipment.
5: Demonstrate an awareness of the characteristics of thermal power plant.

Indicative content

Simple Power Plant based on Ideal Rankine cycle. Deviation of the actual vapour cycle from the ideal one.
Ideal Rankine cycle modified with reheat, Ideal Rankine cycle modified with regeneration.
Open feed water heater, closed feed water heaters.
Description of combustion characteristics of SI and CI engines.
Theoretical and actual combustion process.
Effect of fuel properties and limitations on engine performance.
Development of GT engine cycles from the simple cycle through reheat, intercooled and the use of heat exchangers.
The application of single and multi-shaft GT engines for power generation and the matching of engine component characteristics for particular types of load.

Review of methods of heat transfer:
Conduction: Mechanism, Fourier's equation, the electrical analogy, heat transfer through walls, cylinders, other geometries. Conductors, insulators, lagging, economics/practicalities of lagging. Film/surface heat transfer coefficient (introduction to convection effects). Overall heat transfer coefficient.

Convection: Mechanism, natural and forced convection, relevance of dimensional analysis, use of dimensionless groups, heat exchangers.

Radiation: Mechanism, surface effects, Stefan-Boltzman equation, Kirchoff's law, black and grey bodies.
Examples of relative contributions of conduction, convection and radiation effects.

Teaching and learning activity

The student is expected to spend another 8 hours self-study per week in order to complete the tutorial problems and course work assessment items in addition to reading the subject matter. The course will aim to adhere to the indicated structure although the course coordinator reserves the right to alter week-by-week activities to cater to the students learning requirements, changes in technology and changes in resources availability.

Assessment

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

HDME15 - ENGINEERING DYNAMICS

Aims

To provide the student with an opportunity to enhance and extend their understanding of applied mechanics and dynamics in terms of advanced analysis and modelling of dynamic systems.

Learning outcomes

On completing this course successfully you will be able to:

Apply numerical analyses in applied mechanics examples.
Analyse systems (that have several degrees of freedom) in two and three dimensions using classical and Lagrangian mechanics.

Reflect on the outcome of experimental work and formulate appropriate conclusions.
Evaluate and critically appraise the design of systems and the response of systems with reference to initial conditions and synthesis of elements within any given design.

Indicative content

Kinematics and kinetics of systems with respect to fixed and moving reference frames. Applications to translating and rotating systems using vector and matrix notation for mechanisms, Energy concepts, kinetic and potential energy. Lagrange's equations of motion with applications to vibrating systems having two and three degrees of freedom. Effect of damping. Vibration absorbers and vibration isolators and instruments. Characteristic equations and mode shapes for coupled system and lumped parameter models. Matrix representation. Orthogonality of modes. Introduction to the matrix displacement method. Stiffness and flexibility matrices, modes shapes, global and local co-ordinates. Rotation matrix. Applications to two and three dimensional trusses and stiff-jointed frames.

Teaching and learning activity

Formal lectures with problem solving tutorials and associated laboratory based case study exercise.

Assessment

ACTIVITIES	PERCENTAGES
Assignment	40%
Case study	40%
Problem based questions	20%

HDME16 - NUMERICAL METHODS FOR MECHANICAL ENGINEERING

Aims

The aim of the course is help students develop the necessary skills and learn the concepts of computer-aided solutions to typical Mechanical Engineering problems to be able to formulate mechanical, fluid and heat transfer problems ready for computer simulation using industry standard FEA and CFD software.

Learning outcomes

On successful completion of this course a student will be able to:
1 Identify and explain equations governing typical fluid flow problems.
2 Identify the type of analysis suitable for the solution of a problem.
3 Formulate a problem for computer simulation.
4 Carry out FEA hand calculations for simple one-dimensional elastic problems.
5 Drive commonly used industrial computer software to simulate simple stress analysis, fluid flow and heat transfer problems.
6 Analyse and validate simulated results against analytical and experimental results.

Indicative content

Deformation of a tapered support column under tensile/compressive loading
Introduction of Finite Element Analysis (FEA), Revision on matrix manipulation, flexibility method, stiffness method, interpolation functions, the shape function, element selection, discretisation of a domain, analysis type selection, building an FEA model, one dimensional FEA.

Overhead crane support plate
FEA with higher order elements, 2D plane stress element, node coupling, using symmetry features and reduction of model size, loads and constraints, comparison of full model size results against reduced model size results

Cable tie anchors
2D truss elements, supressing degrees of freedom in an element, section properties, boundary conditions, 2D displacement of a truss framework

Mechanical integrity of a pressurised pipeline
Constant strain triangular element, elastic strain, 2D plain strain element, principal stresses, axisymmetric solid element,

Water supply pipeline
Introduction to Computational Fluid Dynamic (CFD), flow models, forms of flow governing equations, integral approach, differential approach, conservation and non-conservation forms of the transport equations, discretisation methods

Fluid mixing in a process mixer
Main stages in a CFD simulation, use of symmetry conditions, boundary conditions, uniform/non-uniform mesh distribution, mesh optimisation, convergence testing, model duplication,

Teaching and learning activity

The course introduces students to the basic concepts of Finite Element Analysis (FEA) and Computational Fluid Dynamics (CFD). Students will learn how to analyse engineering problems, identify the type of analysis warranted and formulate problems ready for computer simulation. Theoretical concepts will be introduced through formal lectures and re-enforced through weekly laboratory sessions, working on real engineering problems. Throughout the course students will be set challenges such as the design of pin jointed roof structures, cable anchoring steel plates, heat exchangers, pressurised pipelines and fluid mixers. Students will be set an overarching multi-physics challenge that covers, fluid flow and heat transfer. This will involves the optimisation of an air cooling system for computer microprocessors and electronic components.

Assessment

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

HDME17 - 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)

HDMEE1 - PROGRAMMING FOR ENGINEERS

Aims

This module aims to increases 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%

HDMEE2 - PRINCIPLES OF ENGINEERING MECHANICS

Aims

This course aims to introduce the theoretical principles needed in understanding the nature of motions and effect of forces on such motions for dynamic systems. It will also provide the skill required in the analysis of a range of problems in mechanics involving the determination of the stresses, strain, deformations for members under various common loading situations.

Learning outcomes

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

1 Justify the importance of coordinate systems in representation of kinematics of dynamic systems.
2 Undertake the kinematic analysis of dynamics of engineering systems.
3 Undertake simple analysis of the kinetics of dynamics of engineering systems.
4 Demonstrate understanding of the relationship of internal loadings and stresses, strains, deformations of deformable bodies.

5 Analyse engineering systems under various common loading situations as axial, torsional loads.
6 Reflect on the outcome of experimental work and formulate appropriate conclusions.

Indicative content

Part 1: Engineering Dynamics
• Bloodhound supersonic car [2 weeks]: motion representation; coordinate systems; rectilinear motion; equilibrium, free body diagrams, etc.
• Dynamics of F1 cars [2 weeks]: Newton's Second law of motion; Force-mass-and-acceleration Method for solving kinetics problems; general kinetics of motion considerations.
• Satellite launch [3 weeks]: 2D motion for rigid bodies and particles; coordinate systems; curvilinear motion; projectile motion; general motion; motion representation in 3D space, etc.
• Highway crash barriers: [2 weeks] Impulse, Momentum, Impact, Coefficient of restitution; Energy dissipation; work and energy; conservation of energy, etc.
• Dynamics of a Wind turbine blade [2 weeks]: Rigid bodies considerations; rotational motion; fixed-axes rotations; angular velocity; angular acceleration; rotational energy; etc.
Part 2: Mechanics of Materials
• Mechanics of the Engine block [2 weeks]: internal resultant forces; normal and shear stresses; average stresses; deformation; etc.
• Mechanics of a Reinforced concrete column [2 weeks]: deformation, normal stresses and strains for prismatic and non-prismatic bars; stepped composite bars; statically determinate and indeterminate structures; special cases of axially loaded beams: thermal deformation and stress; stress concentrations
• Mechanical properties of engineering materials [2 weeks]: Tension, Compression, Modulus, Yielding, Strain Hardening, Hooke's Law, etc.
• Design of Pressurized Vessels [1 week]: Design considerations; thick and thin-walled cylindrical pressure vessels; cylindrical vessels; spherical vessels; failure modes; allowable loads, factor of safety.
• Design of Power Transmission Shafts [2 weeks]: torsion formula for solid and hollow shafts; multiple prismatic shafts; power transmission; stress concentrations, etc.
• The engineering challenge of The Water Cube (Beijing Olympic) [3 weeks]: the history, Beijing; structural considerations; multiple loaded

analysis; plane stress; stresses on inclined planes; principal stresses; maximum shear stress; construction of Mohr`s circle for plane stresses and strains, strain rosettes.

Over-arching Challenge and relevant laboratories

A typical overarching mechanics challenge that can be addressed in this course is: The Design of the next-generation F1TM Cars. To address the design requirements for next generation F1TM cars, the following are examples of probable key challenges with laboratories designed to help the student address the challenges. Some of these will be chosen to aid the student's learning.

1. Challenge 1: What is the mechanical properties that bespoke composite materials used in the F1 cars? It is important that these properties have to be addressed at dynamic loading rates.

Practical: Split Hopkinson Pressure Bar to Impact rates mechanical behaviour of materials

2. Challenge 2: Jet-powered engines are a possible option for such next-generation F1TM cars. To achieve this, the engines should be able to sustain high pressure loads.

Practical: The mechanics and design thick and think cylindrical pressure vessels

3. Challenge 3: The energy generated by engines will be transmitted to the wheels using lightweight high stiffness and strength axial shafts. What is the torsional response of the shafts?

Practical: Undertake a torsional testing of bespoke designs of different shaft designs.

4. Challenge 4: The F1TM cars of the future must excellent crash and impact protection barriers to protect drivers, support staff and spectators. How can you design such crash barriers?

Practical: Undertake an impact test using an instrumented charpy impact tester available in Hawke, to investigate the response of example crash barriers.

6. Challenge 6: The shock-absorber systems in a F1TM car...

Teaching and learning activity

T• The course is a very fundamental course in understanding the mechanical response of engineering structures. It is an analytical course requiring intense learning over a sustained period of time. Therefore, the learning and teaching activities have been spread across a standard double term to allow students enough time to understand the principles of engineering mechanics.

• The learning and teaching activities will comprise a mixture of lectures, tutorials and laboratories designed to embed understanding of the fundamentals of engineering mechanics.

• Lectures will be delivered using a combination of traditional lecturer-centric approach as well as flipped classroom approach in which a problem-based learning pedagogy will be integrated within the flipped classroom.

• The focus of the lectures and tutorials will be on demonstrating using real problems the theoretical considerations and formulations needed when tackling engineering problems. This is designed to help students learn about the principles of engineering mechanics whilst solving real mechanical problems.

• The problem-based pedagogy will be introduced using open-ended practical problems which students deliberate in groups to identify probable solutions.

• Tutorial sessions will be dedicated to tackling textbook-style example problems to ensure students can relate theories developed in class to present analytical solutions to problems. This will prepare them for the examinations.

• 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 collated from experiments.

Assessment

ACTIVITIES	PERCENTAGES
Assignment	50%

Problem based questions	50%

HDMEE3 - 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%

HDMEE4 - MATERIALS UNDER STRESS

Aims

To provide the student with the tools for analysis of ductile, brittle and fatigue fracture processes. To assist the student in the recognition of various failure modes, and to explore procedures for evaluation these. To enhance their understanding of the mechanical properties of the various classes of material.

Learning outcomes

On successful completion of this course a student will be able to:
1: Identify, and relate to the underlying mechanisms, a range of materials failure modes.
2: Understand the factors influencing the occurrence of various types of fracture and devise the solutions to mitigate them.
3: Critically analyse information and data to plan and implement a solution to an engineering problem.
4: Draw robust conclusions from experimental results and interpret and explain them with respect to accepted theory.

Indicative content

Fracture and Fracture Mechanics:
Materials Failure: modes of failure, failure mechanisms for metals, ceramics and polymers, fracture surfaces and the interpretation of features.

Stress Concentrations: stress concentration factors.

Fracture Mechanics: Griffiths energy criteria for failure; stress analysis of cracks; stress intensity factors; Y-calibration factors for different shaped flaws; crack tip plasticity; plasticity correction factors; plane strain and plain stress failure.

Fracture toughness testing: plane strain fracture toughness testing; crack opening displacement; toughness of ceramics.

Transition Temperature approach to fracture control: impact energy; transition temperature in steels; impact energy-fracture toughness correlations.

Statistical nature of fracture: Weibull analysis.

Macroscopic and microscopic examination of fracture surfaces: case studies of failures; improving the toughness of materials; metals, ceramics, polymers.

Thermal stresses and thermal shock failure.

Environmental assisted cracking.

Fatigue:
Introduction to fatigue: occurrences of fatigue; macroscopic and microscopic features of fatigue fracture surfaces

Measuring fatigue: S-N curves; fatige life; fatigue limit and fatigue stress; effect of mean stress on fatigue life; Palgrem and Miner cumulative damage law.

High and low cycle fatigue: stress and strain controlled fatigue; cyclic softening and cyclic hardening; Basquins Law and Coffin-Manson relationships.

Fatigue crack growth: microstructural short crack regime; physically short crack regime; LEFM long crack regime; Paris Law equation; effect of mean stress; effect of grain size, effect of corrosive environments.

Notch effects and fatigue initiation: stress concentration effects; notch sensitivity factor; fatigue notch factor.

Fatigue of welds:

Fatigue of polymers: effect of loading frequency; effect of surface treatments.

Design against fatigue failure: materials selection; metallurgical treatments; reduction of stress concentrations; surface finishing.

Teaching and learning activity

The course will be taught by the following learning mechanisms:

Formal lectures, Tutorials + problem solving classes, Laboratory practicals and case studies.

Assessment

ACTIVITIES	PERCENTAGES
Assignment	30%
Case Studies	30%
Problem based questions	40%

HDMEE5 - 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%

HDMEE6 - 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 Courses 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. IS0 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%