

ASIAN UNIVERSITY
OF
SCIENCE AND TECHNOLOGY

Curriculum

BACHELOR OF ENGINEERING (B.Eng.)
MECHANICAL ENGINEERING PROGRAMME

หลักสูตรวิศวกรรมศาสตรบัณฑิต (วศ.บ.)

สาขาวิชาวิศวกรรมเครื่องกล

FACULTY OF ENGINEERING AND TECHNOLOGY

คณะวิศวกรรมศาสตร์

October 2005

Curriculum
Bachelor of Engineering in Mechanical Engineering
Faculty of Engineering and Technology
Asian University of Science and Technology

1. Degree full name:

หลักสูตรวิศวกรรมศาสตรบัณฑิต สาขาวิชาวิศวกรรมเครื่องกล
Bachelor of Engineering Programme in Mechanical Engineering

2. Degree abbreviation:

วศ.บ. (วิศวกรรมเครื่องกล)
B.Eng. (Mechanical)

3. Responsible Faculty: Faculty of Engineering and Technology

4. Resource development

Budgets are controlled centrally, meaning Department level resource development is progressed through requests for expenditure.

Since the successful accreditation of the previous curriculum in June 2004, the programme resources have been continuously developed for both existing and new courses. This includes library books, online journals and databases, as well as laboratory equipment including a new mechatronics and robotics lab.

5. Assessment and Quality Assurance:

The assessment methods, passing criteria and quality assurance procedures will be in accordance with the University Regulations, with further details included in Departmental level documentation.

6. Rationale and Objectives:

The Mechanical Engineering programme will develop in students the capability to:

- communicate clearly, using written, oral and visual methods;
- have coherent and in-depth knowledge of their chosen discipline;
- reason logically, and use professionally-based judgement.

- be able to model and analyse complex systems, and formulate and apply engineering strategies to non – engineering problems ;
- bring professional engineering skills and experience to their work or further studies after graduation, developed through projects and internships. For example, they would know how to work independently and in multi-disciplinary and multicultural teams;
- be able to accept responsibility with all the obligations that that entails, as well as being able to assert their rights, based upon the analytical and critical review of the issues involved;
- value ethics, integrity and honesty and provide leadership in both their professional and personal life;
- possess an international perspective in their professional performance and decision-making;
- recognise and utilise life-long learning needs and opportunities.

The programme provides knowledge and associated skills in the broad field of mechanical engineering. All students will study widely within the classic fundamental field of the discipline, then deepen by further study of modern day applications and related engineering fields. This will allow for students to keep up to date with emerging areas of specialization, at least to a sufficient depth for immediate industrial application or as a base for higher level degrees. Over the four year programme a range of skills-based, generic subjects will be sustained in order to develop versatile graduates as ‘life-long learners’. Such subjects will include Communication Skills to develop the use of English language, Professional Engineering courses, Computing and Liberal Arts studies. Free Electives are included to give wider options from other Faculties. At all times and in any subject, concepts from outside the traditional theoretical content of Engineering will be brought into the courses, reflecting the reality of the complex nature of work undertaken by a practicing Professional Engineer. This will be especially emphasised in the project based courses and applied elective courses. Furthermore, all specialist subjects will not only give students an understanding of fundamental principles, but will develop a capacity to keep abreast of knowledge.

A range of teaching and learning methods will be deployed across the programme. Classic lecture, tutorial and structured laboratory methods will be blended with the more modern approaches of project based learning, simulation, student centred objective driven coursework, and multimedia and e-learning. Directed and resource-based learning, including appropriate use of information technology, will be employed throughout and will contribute to the development of ‘life-long learners’. The general theme is move away from the classic lecture based style towards more modern methods as the students move from the 1st to the 4th year. However, each subject will adopt a strategy designed to impart a sense of personal responsibility for learning on the part of the student, and will

select the teaching method most suitable to being able to achieve the overriding objectives of the subject.

The Main Project in the final three semesters is an important feature of the programme, allowing students to apply their skills and knowledge in a specialist area of engineering. The length of the project requires the student to plan and time manage an extended activity, which introduces important aspects of engineering practice, including an element of project management, beyond the narrowly technical. The major deliverables will be a substantial project report and a presentation to an audience that might include external experts or industrialists. The overall scale of the project is intrinsically important, and makes formal completion of a series of intermediate stages inappropriate. Nonetheless, some checks and balances will be introduced through a requirement for interim reports, presentations etc. In particular, a feasibility study and initial planning stage will be formally required in the element described as Main Project (Part A), during semester 6. This will ensure that basic planning, literature surveys and critical, potentially time consuming aspects, such as equipment fabrication and special component purchase, will be in place before the Main Project (Part B) starts in semester 7.

7. Time Schedule:

The first batch of students to follow this programme will graduate in May 2006.

8. Entrance Requirements:

Students must satisfy the following general entrance requirements:-

The Applicant must possess:

- M.6 Certificate (Grade 12) or its equivalent (5 'O' levels with an average of C or better);
- good physical and mental health and be without any communicable diseases;
- clear record of good behaviour;
- working knowledge of English.

9. Selection Criteria:

The Applicant to be considered for entry, may be admitted through one of the following methods:

- i) passing the entrance examination which is privately held and evaluated by the Asian University of Science and Technology (January), or
- ii) passing the evaluation of the Scholastic Aptitude Test (SAT) result and high school academic performance. This admission method is restricted to students from international schools in Thailand and high school students from foreign countries where this system is available. The SAT result copy must be certified by the relevant authority and must reach the University by the end of March.
- iii) Possessing an International Baccalaureate, United Kingdom 'A' levels, Australian HSC or equivalent standard for direct entry.

Note: Applicants in categories ii) and iii) above will be required to attend an interview and may be exempted from the Entrance Examination requirement.

10. Credits and Study Pattern code:

The programme comprises a number of separate but interrelated “Subjects”, each carrying a designated Credit value. The full programme contains a proportion of “General Subjects”, “Major Core Subjects”, “Major Elective Subjects” and “Free Elective Subjects”. Students must study a total of 150 credits in the whole programme.

The Study Pattern Code, included with each subject descriptor a(b-c-d), gives: (a) the credit value, (b) the formal lecture time per week, (c) the tutorial, workshop or practice time per week and (d) the minimum amount of independent study that a student is expected to devote within a subject. With the wide range of teaching methods, item (c) could be quite varied in its detail content. It could be a tutorial based on a specific problem, a tutorial where the students discuss ideas or work on their problems with staff. It could be a computer lab session, or time spent in design, prototyping and testing of systems in a laboratory or workshop environment. In addition to the (b), (c) and (d) categories described, a subject may hold a structured laboratory session as a toll to develop ideas as well as basic laboratory skills. This Study Pattern Code guides the academic staff in the design of the subject and guides the student as to the total work effort and time that should be devoted to any subject.

11. Subject codes:

Decided according to degree programme names or subject areas, with every subject carrying a unique code. The code is based on $XXp-q-r$, where XX , is one of the following:

General subjects.

MA: Mathematics **PH:** Physics **CH:** Chemistry **MS:** Material Science
HU: Humanities **SS:** Social Science **LC:** Language and Communication Skills

Major subjects.

These are managed within one of the engineering programmes. If managed within Mechanical Engineering, it carries the code **ME**. If managed within another programme, it carries the code they use as defined in their documentation. Major subjects that are common between departments but managed outside or across departments, carry a code given by the subject title.

Free elective subjects.

These fall into one of the other categories, depending on the subject that the student selects, following the rules of selection.

Also, where pqr is an identifying number:

p: Indicates the earliest year when the subject would typically be taken. Electives are indicated by “**E**” instead of a number.

- q:** A spare digit, nominally zero and only used if needed to match the 3 digit system of other departments. Electives are use their group letter “**A**”, “**B**” or “**C**”, which relates to selection criteria as given in section 3.4.
- r:** Differentiates between subjects that would otherwise have the same number.

The coding system does not apply to “Monitored Professional Development”, which can occur during any of the three summer breaks.

12. Curriculum structure - introduction

This is a four year, full time programme leading to the award of B.Eng. in Mechanical Engineering, with progression on a year by year basis.

Year One.

The first two semesters (year 1) have been designed as a broad based curriculum suited to both the Applied Science and Engineering Faculty programmes. The subjects provide a grounding for all scientists and engineers, or to provide an engineering feel or perspective, of value to all students. These subjects include practical sessions to engender good working practices and skills in laboratories and computer suites. Laboratory safety is also a particular focus of attention in this early stage of the programme. The Communications Skills subject operates to improve the general use of English and to focus on those communication skills essential to the practicing scientist and engineer. Appropriate exemplar materials for this subject will be developed through close co-operation between the Language staff and the science subject specialists. Good use of English is considered to be an integral part of all subjects and a responsibility of every member of staff.

Year Two

Having chosen Mechanical Engineering as their “Major”, student start what are seen as the classic fundamental subjects, deepening the scientific rigour and giving the foundation for a breadth of studies that all use these most common of concepts. Students are also exposed to a much deeper content of Professional Engineering skills, both formally and informally, and continue in their maturity towards fully independent and life-long learning.

Year Three

The themes from the 2nd year are continued in the 5th semester (1st semester of the 3rd year). In the 6th semester (2nd semester of the 3rd year) a switch is made where students are exposed to a larger number of courses that allow for application of various concepts showing the true interdisciplinary nature of Engineering. This is facilitated through the Main Project Part A and the Design Make and Test courses, as well as the selection of Electives. Some electives may also allow for much deeper theoretical study in a specific field.

Year Four

The final year is dominated by the Design Project, giving the opportunity for students to apply their skills and knowledge in a more independent and creative mode of learning, and in many ways is regarded as the final test of their Engineering ability. Topics for the project will be sought and selected in collaboration with a Supervisor and may involve some degree of external collaborative work on the part of the student and Supervisor. The theme from the 6th semester continues, with more Electives. At this stage, the students are expected to operate almost entirely on an self sustainable and fully responsible basis.

13. Curriculum structure – subject listing

<u>Code</u>	<u>Title</u>	<u>Credits</u>
-------------	--------------	----------------

General Subjects*Social Sciences*

Students choose 1 of the Social Science subjects from the Faculty of Liberal Arts approved list, and depending on staff availability. The choice must be approved internally with the ME Dept. These subjects are normally 3 credits, and managed by the Liberal arts Faculty.

Humanities

Students choose 1 of the Social Science subjects from the Faculty of Liberal Arts approved list, and depending on staff availability. The choice must be approved internally with the ME Dept. These subjects are normally 3 credits, and managed by the Liberal arts Faculty.

Language and Communication Skills

LC1-0-1	Communication Skills 1	3
LC1-0-2	Communication Skills 2	3
LC2-0-1	Communication Skills 3	3
LC4-0-1	Professional Development	3

General Science and Mathematics

MA1-0-1	Mathematics 1	3
MA1-0-2	Mathematics 2	3
MA2-0-1	Mathematics 3	3
MA2-0-2	Mathematics 4	3
PH1-0-1	Physics 1	3
PH1-0-2	Physics 2	3
CH1-0-1	Introduction to Chemistry	3
MS1-0-1	Material Science	3

Total: 42**Major Subjects***Core Subjects*

ME1-0-1	Visualisation and CAD	3
IS1-0-1	Introduction to Computing	3
ME1-0-2	Introduction to Manufacturing Technology	3
CS1-1-1	Computer Programming 1	3
ME2-0-1	Mechanics of Solids 1	3
ME2-0-2	Engineering Dynamics	3
EE2-0-1	Fundamentals of Electrical Engineering	3
ME2-0-3	Thermodynamics	3
ME2-0-4	Professional Engineering 1	1

ME2-0-5	Mechanics of Solids 2	3
ME2-0-6	Mechanical Vibration	3
ME2-0-7	Engineering Materials and Failure	3
ME2-0-8	Fluid Mechanics	3
ME2-0-9	Engineering Research Methods	3
ME2-0-10	Professional Engineering 2	1
ME3-0-1	Mechanical Design	3
ME3-0-2	Computational Continuum Mechanics	3
ME3-0-3	Mechatronics	3
ME3-0-4	Heat Transfer	3
MA3-0-1	Engineering Mathematics	3
ME3-0-5	Professional Engineering 3	1
ME3-0-6	Main Project Part A	3
ME3-0-7	Design Make and Test Project	3
ME4-0-1	Main Project Part B	12
ME4-0-2	Advanced Thermofluids	3
MPD	Monitored Professional Development	3
Total:		81

Electives

Students must have completed a total of 7 subjects chosen from the list, with no more than 3 taken from *Group A*. *Group C* subjects have pre-requisites. Selection depends on staff availability, and must be approved internally within the ME Dept.

Group A

ME.E-A-01	Entrepreneurship	3
ME.E-A-02	Trends and Challenges in Engineering	3
ME.E-A-03	Innovation and Technical Change	3
ME.E-A-04	Literature Research Project	3
ME.E-A-05	Industrial Safety Management	3
ME.E-A-06	Production and Operations Management	3
ME.E-A-07	Production Planning and Control	3
ME.E-A-08	Maintenance Engineering	3
ME.E-A-09	Air Pollution	3

Group B

ME.E-B-01	Vibration Engineering	3
ME.E-B-02	Combustion	3
ME.E-B-03	Advanced Materials and Manufacturing	3
ME.E-B-04	Structure, Properties and Applications of Polymers	3
ME.E-B-05	Advanced Stress Analysis	3
ME.E-B-06	Introduction to Micro Electrical Mechanical Systems	3
ME.E-B-07	Advanced Mechatronics	3
EE0-0-9	Introduction to Non Destructive Testing	3
ME.E-B-08	Tribology	3
ME.E-B-09	Fracture Mechanics	3
CS2-1-1	Computer Programming 2	3

ME.E-B-10	Introduction to Robotics	3
ME.E-B-11	Optimisation and Uncertainty	3
ME.E-B-12	Department Special Topics	3
ME.E-B-13	Engineering Faculty Project	3
<i>Group C</i>		
ME.E-C-01	Computational Fluid Dynamics	3
ME.E-C-02	Advanced Robotics	3
	Total:	21

Free Electives

Students choose 2 subjects from approved curricula of any Department/Faculty in the University other than from the Engineering Faculty. Selection depends on staff availability, timetabling and must be approved internally within the ME Dept.

Total:	6
Grand total:	150

14. Curriculum template

MECHANICAL ENGINEERING PROGRAMME

Semesters		Main Project Part B					Credits	
8		HU/SS 2 3(varied)	Elective 5 3(varied)	Elective 6 3(varied)	Elective 7 3(varied)	Main Project Part B 12(0-12-8)		18
7		Free Elective 2 3(varied)	Professional Development 3(1-2-4)	Advanced Thermofluids 3(1-2-4)	Elective 4 3(varied)			18
Summer break - possibility of accredited work experience								
6		HU/SS 1 3(varied)	Elective 1 3(varied)	Elective 2 3(varied)	Elective 3 3(varied)	Design, Make and Test Project 3(0-4-4)		18
5	Professional Engineering 3 1(1-0-1)	Free Elective 1 3(varied)	Engineering Mathematics 3(3-0-4)	Heat transfer 3(3-0-4)	Mechatronics 3(3-0-4)	Comp. Continuum Mech. 3(2-1-4)		19
Summer break - possibility of accredited work experience								
4	Professional Engineering 2 1(1-0-1)	Eng. Research Methods 3(0-4-4)	Mathematics 4 3(3-1-4)	Fluid Mechanics 3(3-1-4)	Eng. Materials & Failure 3(3-1-4)	Mechanical Vibration 3(3-1-4)		19
3	Professional Engineering 1 1(1-0-1)	Communication Skills 3 3(2-2-4)	Mathematics 3 3(3-1-4)	Thermodynamics 3(3-1-4)	Fundamentals of Electrical Eng. 3(3-1-4)	Engineering Dynamics 3(3-1-4)		19
Summer break - possibility of accredited work experience								
2		Communication Skills 2 3(2-2-4)	Mathematics 2 3(3-1-4)	Physics 2 3(3-1-4)	Materials Science 3(3-1-4)	Computer Programming 1 3(3-1-4)		18
1		Communication Skills 1 3(2-2-4)	Mathematics 1 3(3-1-4)	Physics 1 3(3-1-4)	Introduction to Chemistry 3(3-1-4)	Introduction to Manufacturing Tech. 3(3-1-4)		18
		Subject categories		Total		Maximum from accredited training		147
		Name	Colour code	Credits		Grand Total		150
		Major - Core		81				
		Major - Elective		21				
		General		42				
		Free electives		6				
				150				

15. Subject descriptions

The following gives the top level content of each subject in the programme, following the subject listing given above.

Language and Communication Skills

Communication Skills 1 **LC1-0-1**

3(2-2-4), Pre-requisites: none

This lower intermediate English course focuses on the language needed for first year students, integrates receptive with productive skills, and is thematically integrated to the concurrent engineering subjects. The syllabus derives from the language learning needs stipulated by content teachers with emphasis on the comprehension of written and spoken academic information. These will focus on the comprehension of written and spoken academic information. Language assignments will integrate content course requirements in support of academic skill development.

Communication Skills 2 **LC1-0-2**

3(2-2-4), Pre-requisites: LC1-0-1

This intermediate English course focuses on the language needs of first year students in the engineering programmes. Academic study skills are enhanced through the comprehension and manipulation of oral and written academic English. Thematic modules keyed to major course content include structural, lexical and oral support, with students encouraged to take an independent approach to improving their English.

Communication Skills 3 **LC2-0-1**

3(2-2-4), Pre-requisites: LC1-0-2

This upper intermediate English course builds on the skills needed for academic expression in the second year of the engineering programme. Further development is given to organising of information, use of outside resources, and assessment of relative importance of information. Emphasis is placed on the synthesis and analysis of information for formal academic presentations, both orally and in writing. The planning, preparation and presentation of both group and individual projects will be required.

Professional Development **LC4-0-1**

3(1-2-4), Pre-requisites: LC2-0-1

This course helps engineers to prepare for professional life. Students are introduced to the concepts of professionalism and ethical practice, which are then explored further through a series of hypothetical and real-life case studies and student-researched presentations. Another strand of the course looks at the skills needed to compete in the employment market: writing CVs and job application letters, and techniques for successful interviewing. A third strand of the course covers the practical professional skills (suited to graduating students) of writing technical reports and planning and delivering effective oral presentations.

*General Science and Mathematics***Mathematics 1****MA1-0-1****3(3-1-4) Pre-requisites: none**

Differential calculus: Functions and their properties (including revision of basic algebraic and trigonometric functions); limits and continuity; derivative, the tangent problem; derivatives of trigonometric functions; chain rule; local linear approximations, differentials, basic error analysis; implicit differentiation, inverse functions, exponential, logarithmic and hyperbolic functions and their derivatives; l'Hopital's rule, indeterminate forms; analysis of functions and their graphs, applications of the derivative.

Introduction to integral calculus: The area problem; indefinite integral, integration by substitution and by partial fractions; sigma notation, definite integral, the first fundamental theorem of calculus; properties of definite integrals, evaluating definite integrals by substitution, the mean-value theorem, the second fundamental theorem.

Vector algebra and analytic geometry: Vectors in 2-D and 3-D spaces; linear dependence and linear independence of vectors, basis; simultaneous linear equations, determinants and matrices; application of vectors to plane geometry; scalar and vector products, equation of lines, planes and surfaces; tangent and normal vectors to curves in 2-D and 3-D spaces; rectangular, spherical and cylindrical co-ordinate systems.

Mathematics 2**MA1-0-2****3(3-1-4) Pre-requisites: MA1-0-1**

Integral calculus: Some applications of the definite integral: areas, volumes of solids of revolution, plane curves length, areas of surfaces of revolution; integration methods, integration by parts, trigonometric integrals; integration using tables and Computer Algebra Systems; numerical integration; improper integrals.

Functions of more than one variable: Limits, continuity, level plots, partial differentiation, change of variables, total differential and its relation to partial derivatives; extrema of functions of two variables, a necessary condition; conditional extrema, including the use of Lagrange multipliers.

Multiple integrals: Double integrals in rectangular and polar coordinates, surface areas; triple integrals, centroid, centre of gravity, cylindrical and spherical coordinates, change of variables.

Complex numbers and functions: i-j notation, complex plane; polar and exponential forms; exponential function, trigonometric, circular and hyperbolic functions; logarithmic and power function; basic mapping properties.

Mathematics 3**MA2-0-1****3(3-1-4) Pre-requisites: MA1-0-2**

Ordinary differential equations: Basic ideas and concepts; separable ODEs, exact ODEs; first order linear ODEs, applications; second order ODEs with constant and variable coefficients; initial and boundary value problems; elementary use of Laplace transforms, damped and forced oscillations.

Calculus of vector-valued functions: Introduction to vector-valued functions and their calculus; change of parameter; arc length; unit tangent, normal, and binormal vectors; curvature; vector fields.

Introduction to statistics: Elementary probability: Experiments, outcomes, events, probability, permutations and combinations, random variables, probability distributions; elementary statistics: random sampling, sample mean, sample variance, estimation of parameters, testing of hypothesis.

Mathematics 4

MA2-0-2

3(3-1-4) Pre-requisites: MA2-0-1

Sequences and series: Properties of sequences; series with positive terms, alternating series, convergence tests; series of functions, representation of elementary functions by Taylor's series, Taylor's theorem with remainder; power series and their properties, radius of convergence, power series as Taylor's series, approximations; series solutions of ODEs.

Fourier analysis: Fourier series, standard formulae, even and odd functions, half range series, complex Fourier series, spectrum of a periodic function, Parseval's theorem, Fourier transform, convolution theorem.

Linear algebra: Linear models, simultaneous linear equations, methods of solutions, linear transformations; vector spaces, coordinate systems; eigenvalues and eigenvectors, symmetric and orthogonal matrices, digitalisation, positive-definite matrices; orthogonality and least squares.

Numerical methods: Error analysis, interpolation and approximation, numerical integration and differentiation, direct and iterative methods for solving equations and linear systems, numerical solutions of initial-value problems for ordinary differential equations, approximation theory.

Physics 1

PH1-0-1

3(3-1-4) Pre-requisites: none

Mechanics; conservation of energy; conservation of linear momentum; torque; statics (conditions of equilibrium); dynamics of rotational motion; fluid statics; introduction to fluid dynamics (including Bernoulli's equation and equation of continuity); temperature and heat (including concept of heat capacity); ideal gas laws (kinetic interpretation of pressure and energy); elasticity (stress and strain, Young's modulus).

The laboratory programme will include experiments on, for example, Basic physical measurements, Young's Modulus, the Gas Laws, Specific heats and heat capacity. It will also include a grounding in basic laboratory skills, including safety, keeping a log book, report writing, and analysis of results during the lab to check for errors.

Physics 2

PH1-0-2

3(3-1-4) Pre-requisites: PH1-0-1

Oscillatory motion, energy of SHM, pendula, damped SHM, forced oscillations and resonance. Introduction to waves and wave motion, Doppler effect. Superposition and interference of waves, standing waves and beats. Nature and propagation of light, reflection, refraction, refractive index, velocity of light. Lenses, human eye and optical instruments. Physical optics, diffraction and polarization of light. Magnetic fields and forces, motion in a magnetic field, force on a conductor, magnetic dipoles, torque on a current loop. Ampere's law, solenoids and Biot-Savart Law, magnetic materials. Electromagnetic induction, magnetic flux, Faraday's law, Lenz's law, self-induction, resistance-inductance circuits, energy in an inductor. Atomic structure and spectra.

The laboratory programme will include experiments on, for example, SHM, Simple pendulum, basic optics including diffraction and interference, waves on strings and in pipes. Continuation of developing basic laboratory skills.

Introduction to Chemistry

CH1-0-1

3(3-1-4) Pre-requisites: none

Stoichiometry and basis of the atomic theory. Properties of gas, liquid, solid and solution. Chemical equilibrium, ionic equilibrium. Chemical kinetics. Electronic structure of atoms. Chemical bonds. Oxidation, reduction and corrosion. Thermochemistry.

These basic principles and concepts will be developed using relevant examples from different fields of applied science and will highlight the engineering applications of chemistry.

The subject will develop an ability to solve simple chemical problems and will provide experience in basic laboratory techniques. Exemplar procedures will include measurement of quantity with consideration of accuracy and precision, melting point and boiling point determinations, simple methods of separation, volumetric and gravimetric analysis. General laboratory safety guidelines will be studied and methods of handling dangerous substances. Continuation of developing basic laboratory skills.

Materials Science

MS1-0-1

3(3-1-4) Pre-requisites: PH1-0-1, CH1-0-1

Introduction to range of properties of metals, polymers and fibre composites, typical strength and stiffness. Atomic structure, bonding and theoretical strength. Crystal structure, defects, dislocations, deformation of crystalline material. Strain hardening, strengthening mechanisms and alloying. Solid solutions, non-equilibrium transformation and precipitation hardening, phase diagrams. Steels and their heat treatment. Relationship between molecular structure and properties. Polymeric materials, fibre-composites and ceramics. Electrical properties of materials, conductors, semi-conductors, insulators, conductivity, Ohm's law. Continuation of developing basic laboratory skills.

*Major Subjects - Core Subjects***Visualisation and CAD****ME1-0-1****3(2-2-4) Pre-requisites: none**

A grounding in descriptive geometry, special awareness and conversion between 2D and 3D: Geometric representation of engineering objects; Planar and isometric grids for construction; 3D modelling through the concepts of Boolean operations and sweeping techniques (linear / circular); Standards and practices of engineering drawing: line types (e.g. hidden, centreline, construction); line forms (interpolation / approximation); Projection theory; principal views (e.g. 1st and 3rd-angle convention); isometric and oblique drawings, auxiliary views, dimensioning; tolerances, annotation of drawing (lettering and symbol types); component and assembly drawings, parts list, draft identification and standard notes; representation of surface texture (hatching); three-dimensional modelling, rendering).

Application through use of a modern CAD package. Background to CAD; relationship with the design process, CAD/CAM and computational analysis of structures.

Introduction to Computing**IS1-0-1****3(3-1-4) Pre-requisites: none**

Basic computer system and organization. Hardware and software functions and components. Basic file systems, data organisation, and database management. History of computing and its impact on our modern lives. Computer networks and their usage. Introduction to problem solving concepts and software engineering approaches. The computer as a shared resource and its usage ethics. Contemporary software packages and applications.

Laboratory sessions and projects are aimed at developing and strengthening the general ability to use the computer for document preparation, numerical computation, data management, and accessing the network resources both locally and remotely.

Introduction to Manufacturing Technology**ME1-0-2****3(3-1-4) Pre-requisites: ME1-0-1**

A broad introduction to manufacturing processes and equipment, with application to a range of modern materials and the analysis of the design of machine elements and their manufacturing and assembly methods.

Non cutting processes: Cold and hot forging; low and high rate forming, ordinary, bending, vacuum, spinning and thermoforming, sheet and bulk forming including extrusion and calendering; Sand, die and investment casting, gravity, low pressure and rotational casting; blow, compression, injection moulding and their derivatives; powder metallurgy and sintering, and processes assisted by high pressure.

Cutting processes: Turning, milling, drilling, boring, reaming, grinding, lapping, honing, polishing and superfinishing; welding, sawing, deburring, filing, and others.

Joining and assembly methods and practises: Welding, abrasion, adhesives, rivets, mechanical interlocking, friction devices and fasteners; rated torque, even loading, minimum residual friction/stresses.

Workshop and factory equipment: Lathe and milling machines, flat and circular grinders, band and circular saws, and other traditional equipment; CNC, CAD/CAM, CIM, FMS, robotics and other modern equipment and processes related to that equipment.

The course will also give students an awareness that more advanced methods exist, such as plasma, electron beam, ion beam, ultrasonic, electro-chemical, chemical, water jet, and laser concepts for cutting, welding, machining and other processes.

It will briefly include considerations of the interrelationships of design, materials and manufacture: Relationship between materials and process choice; importance of function, resources (material and financial) and market; case studies; cost effectiveness, process selection and limitations, including rapid prototyping.

Computer Programming 1

CS1-1-1

3(3-1-4) Pre-requisites: IS1-0-1

Introduction to problem solving methods, algorithm development and software engineering; software development process, program design, coding, review, testing, and documentation; programming using a modern programming language that supports modular development. The course has a closed laboratory that includes activities dealing with the computing environment, the software development process, and programming exercises.

Mechanics of Solids 1

ME2-0-1

3(3-1-4) Pre-requisites: none

Definition of stress and strain; general conditions for solution (equilibrium, compatibility, stress-strain relationships) in one dimension. Introduction to ultimate and allowable stress, stress concentration and safety factor. Beams: shear force and bending moment diagrams, second moment of area, longitudinal and shear stresses, deflection, statically determinate and indeterminate. Analysis of basic structures, trusses and columns. Stability of structures, Euler's formula for pin-ended columns, extension of Euler's formula to columns with other end conditions. Torsion of circular sections, elastic stress-strain relationships in three dimensions, relationships between elastic constants, change in volume of hollow cylinders and spheres.

Engineering Dynamics

ME2-0-2

3(3-1-4) Pre-requisites: none

Revision of statics: definitions, units, free body diagrams, equilibrium condition, Coulomb friction.

Kinematics: relative velocities and accelerations in mechanisms, vector equations and vector diagrams, general expression by differentiation, equivalent mechanisms.

Dynamics: laws of motion, D'Alembert's principle, impulse-momentum and work-kinetic energy equations, potential energy, impact, translational motion, rotational motion, general plane motion, moments of inertia and angular momentum.

Fundamentals of Electrical Engineering

EE2-0-1

3(3-1-4) Pre-requisites: none

DC Circuit Analysis: Resistive circuits, definitions and principles, Kirchhoff's laws, mesh analysis, nodal analysis, superposition, Thevenin's theorem, Norton's theorem, maximum power transfer.

Steady state AC analysis: Inductors and capacitors, combination of components, introduction to j-notation, phasor diagrams, power, power factor, frequency response and resonance.

Operational Amplifiers: Linear operational amplifier circuits, inverting amplifiers, non-inverting amplifiers, difference amplifiers, differentiators and integrators.

Transients: First order RC and RL circuits, second order circuit; series RLC circuit and parallel RLC circuit.

Thermodynamics

ME2-0-3

3(3-1-4) Pre-requisites: none

Introduction to thermodynamics: its history linked to power plant development, its relevance in the context of energy reserves and the environment.

Basic concepts: microscopic and macroscopic points of view, system and control volume approaches, properties, state, equilibrium, processes and cycles.

Energy, heat, work and the first law: kinetic, potential and internal energy; heat transfer; displacement work and shaft work; the first law (cyclic and non-cyclic) for a system.

Properties of substances: pure substances; the two-property rule, state diagrams; intensive and extensive properties; internal energy enthalpy and specific heats; ideal and perfect gases; phase changes, vapour and liquid properties, steam and water.

The first law for flow processes: the energy equation; application to throttling processes, nozzles, turbines, compressors, heat exchangers.

The second law: heat engines and efficiency; Carnot and thermodynamic reversibility; the second law of thermodynamics and its consequences.

Entropy: Clausius inequality, definition of entropy, state diagrams using entropy; TdS relationships; isentropic processes for perfect gases and steam; isentropic efficiency.

Power cycles: Otto, Diesel, Joule and Rankine cycles as models for reciprocating engines, gas turbine and basic steam plant.

Professional Engineering 1

ME2-0-4

1(1-0-1) Pre-requisites: none

The three “Professional Engineering” subjects emphasise an awareness of the engineering profession and some of the skills of most value to the students for their current academic studies as well as for industrial experience and their first placement on graduating. The courses are designed to give motivation for studies, a link to the real world of engineering, a forum for discussion and a guide for “Initial Professional Development” (IPD). It is intended that students will develop life long professional habits, and continue to manage their own IPD upon graduation, leading to further professional qualification and hence “Continued Professional Development” (CPD). Students will be guided in building a portfolio of source material with comments, demonstrating their progression. This will form the basis of the continuous assessment.

In addition to the core theme, specialised studies will focus on developing skills. Students will also therefore be assessed by appropriate exercises and submitting critical reviews of their development. However, the main outlet for practising these skills will be as part of other subjects and projects during their studies and industrial placements. For “Professional Engineering 1”, after a broad introduction to the nature of Professional Engineering, the specialised topics will be: Basic lab skills, report writing (lab, short technical paper, project reports), maintaining a logbook (lab, project and personal/dairy), time management, basic concepts of problem solving skills and elementary project management.

Mechanics of Solids 2**ME2-0-5****3(3-1-4) Pre-requisites: ME2-0-1**

Stress and strain analysis in two dimensions, principal values, maximum shear stresses; Mohr's circle for stress and strain; Tresca and von Mises yield criteria and the concept of equivalent uniaxial stress; displacement relationships and compatibility; the analysis of strain gauge results; stress and strain in cylindrical polar coordinates (three dimensions with axial symmetry); Hooke's law for three dimensions and the elastic constants; the elastic limit and plastic flow effects; plastic collapse.

Applications in elasticity: shafts in bending and torsion, thin section tubes in torsion, high pressure monobloc and compound cylinders, Lamé's equations, rotating discs; applications in elasto-plasticity: beams and shafts in bending and torsion, limit loads, permanent set and residual stress; simple work-hardening solutions; plastic deformations of monobloc cylinders.

Mechanical Vibration**ME2-0-6****3(3-1-4) Pre-requisites: ME2-0-2**

Basic concept using spring-mass systems: Single-degree-of-freedom systems, natural frequency, viscous damping, critical damping coefficient, response to external force, resonance, transmitted force, amplitude and phase relationships, abutment excitation; multi-degree-of-freedom systems, normal and higher modes.

Introduction to waves: Fundamental wave types and basic properties of waves; transverse and longitudinal, sound and standing waves, reflection, dispersion, group velocity. Examples of waves in solids and liquids.

Continuous media: Comparison of spring-mass concepts to the vibration of real structures (pseudo infinite MDOF), one to three dimensions, simple and complex geometry. Introduction to modes, mode shapes and nodes. Analytical and standard solutions of simple engineering components, response to various forms of excitation, including impact. The link between waves and the vibration and excitation of real structures.

Engineering Materials and Failure**ME2-0-7****3(3-1-4) Pre-requisites: MS1-0-1**

Review of the full range of modern engineering materials, typical range of properties, example applications, use of materials maps, and sources of materials data for reference purposes.

Yielding: Engineering factors affecting plastic deformation, hydrostatic and deviatoric stresses, use of yield criteria, work-hardening, necking and superplasticity; effects of temperature and strain rate. Reversed plasticity and shakedown.

Fatigue: Mechanism of fatigue failure, crack initiation and growth, stage I and stage II cracks; S-N curves, low and high cycle fatigue, Coffin-Manson and Basquin's laws, effect of mean stress, Soderberg, Goodman and Gerber rules, stress concentration, stress rate, cumulative damage and Miner's rule. Fatigue design philosophies.

Fracture: Introduction to linear elastic fracture mechanics, brittle/ductile, fast fracture, application to Paris law of fatigue crack growth rate, fracture toughness in plane strain and plane stress, cleavage and microvoid coalescence.

Nature of creep; deformation and fracture, relation between stress, creep rate and temperature, correlation of creep data by Larson-Miller parameter. Relaxation as a special case.

Introduction to welding processes, residual stresses; microstructure of welds and heat affected zones, effects of stress relief, fatigue and fracture of welds.

Principles of corrosion and oxidation: Corrosion resistant materials, Pourbaix diagrams, factors affecting corrosion cracking, hydrogen embrittlement in metals and stress corrosion cracking, prevention methods and cost of corrosion.

Fluid Mechanics

ME2-0-8

3(3-1-4) Pre-requisites: none

Introduction to Fluid Mechanics: The concept of stress in a fluid and the continuum model.

Fluids Without Motion (Hydrostatics): Pascal's law, variation of pressure with depth, Archimedes' principle; forces on submerged bodies and manometry.

Introduction to Motion: Classes of fluids and fluid motion, Laminar and turbulent flow, Reynold's number, boundary layers, introduction to Newton's law of viscosity, velocity profiles and the no-slip condition.

Conservation of Mass (Continuity equation): Continuity of mass in motion: Pathlines, streaklines, timelines, streamlines and streamtubes, mass and volumetric flow rate; Acceleration of particles and steady motion in a fluid.

Conservation of Energy (Bernoulli's equation): Energy and forces in one dimensional flow: Euler's equation of motion, Bernoulli's equation for an incompressible perfect fluid. Applications: Flow measurement, discharge through an orifice, pressure gradients, the Coanda effect, flow induced by a piston and pumps; Pressure drop in pipes: Turbulence, the Moody diagram and the extended Bernoulli equation.

Viscous Flows (Newton's law of viscosity): Hagen-Poiseuille flow in a pipe and flow between sliding plates. Applications: Parallel moving plates, tilting pad slipper bearings and stepped bearings.

Conservation of Momentum (Force-momentum equation): Linear momentum theorem: Force-momentum for steady flow, control volumes, momentum fluxes; Momentum and boundary layer drag, drag coefficients and vortex induced vibration. Applications: Steady jet, sluice-gate, Borda head loss, drag on a bluff body and a flat plate, Karman vortex street and cascade of blades.

Introduction to ideal fluid theory: Stream functions, circulation and vorticity, rotational and irrotational flow, free and forced vortices, velocity potential and the Kutta-Joukowski theorem. Applications: Centrifugal pumps, stirring coffee, pressure distribution in tornadoes, the Magnus effect, lift on an aerofoil (including both ideal and real fluid analysis).

Engineering Research Methods

ME2-0-9

3(0-4-4) Pre-requisites: none

Students will participate in group projects in which they investigate technological and other aspects of a real engineering problem or basic research topic. They are introduced to a linear view of research, which is described as being split into Part A and Part B. Part A being information gathering and assimilation, forming a critique and drawing conclusions by identifying areas for development, and then selecting one focussed topic, conceptualising the problem and forming possible theories of explanation, developing options for a means to test any hypothesis. Part B being the detailed investigation of that topic, design and implementation of models and/or experiments, and final analysis for

proof, conclusions, identifying further work and publication. The scope and technical depth of the projects, and the expected outcome and level of reporting will be suitable to students at this stage of their degree. The subject will be organised to provide an approximate 60:40 split between Parts A and B, allowing students to gain confidence in their abilities, having seen a real outcome from their work. The project will also be used as a vehicle for illustrating issues related to team work, basic project management including being responsible for a small budget. It ends with an oral presentation and a detailed bound report, with a copy held in the department reference library.

Professional Engineering 2

ME2-0-10

1(1-0-1) Pre-requisites: ME2-0-4

The three “Professional Engineering” subjects emphasise an awareness of the engineering profession and some of the skills of most value to the students for their current academic studies as well as for industrial experience and their first placement on graduating. The courses are designed to give motivation for studies, a link to the real world of engineering, a forum for discussion and a guide for “Initial Professional Development” (IPD). It is intended that students will develop life long professional habits, and continue to manage their own IPD upon graduation, leading to further professional qualification and hence “Continued Professional Development” (CPD). Students will be guided in building a portfolio of source material with comments, demonstrating their progression. This will form the basis of the continuous assessment.

In addition to the core theme, specialised studies will focus on developing skills. Students will also therefore be assessed by appropriate exercises and submitting critical reviews of their development. However, the main outlet for practising these skills will be as part of other subjects and projects during their studies and industrial placements. For “Professional Engineering 2”, the specialised topics will be: Carrying out a literature survey, teamwork, meetings, dealing with other professionals, presentations, writing a resume/CV and interviews.

Mechanical Design

ME3-0-1

3(3-0-4) Pre-requisites: none

Design methods, concept generation, choice, optimisation, selection of materials, machine elements, assembly methods, design brief and mechanical design specification. Concepts of concurrent engineering, manufacturing planning, and production. Concurrent engineering design processes and design for manufacturability (DFM), use of computers to optimise designs, modelling and rapid prototyping process, design analysis.

Computational Continuum Mechanics

ME3-0-2

3(2-1-4) Pre-requisites: MA3-0-1

This subject aims to provide students with the basic knowledge and skill to use a suitable package for later subjects and project work. The course is divided into three parts.

Part 1 will give a summary of commercially available Finite Volume and Finite Elements packages: Applicability to subject areas, strengths and weaknesses, trends in industrial standards and preferences, research and educational versions.

Part 2 covers the theoretical bases of the FV and/or FE methods (It will be at the lecturers discretion to choose one, or both): The concepts of continua, time and space discretisation and equation discretisation. Forces acting on solids and fluids and the motion of a

continuum element. Conservation laws and constitutive relationships. Review of supporting mathematics, including PDEs and numerical methods (covered at the start of “Engineering Mathematics”) tensors, surface and volume integrals approximations and gradients approximations. Issues related to conservativeness, boundedness, stability, cost versus accuracy, consistency and convergence of the methods, initial and boundary conditions, interpreting and checking the validity of the results. Part two is covered to a sufficient depth only to allow competency for Part 3.

Part 3 will focus on the application of the above to a specific FE and/or FV package, gaining basic experience through structured tutorials and project work.

Mechatronics

ME3-0-3

3(3-0-4) Pre-requisites: EE2-0-1

Instrumentation and measurement system analysis and design; Physical system modelling: introduction to dynamic system modelling, modelling electromechanical systems. Sensors and actuators; Computer data acquisition and control. Electrical circuits and digital electronics devices, microcontroller interface and programming.

Laboratory instrumentation: Use of breadboards to create circuits, designing and constructing mechatronic systems, use of computer based hardware/software for data collection. Sensors, actuators and feedback controls.

Heat Transfer

ME3-0-4

3(3-0-4) Pre-requisites: ME2-0-3, ME2-0-8

Heat transfer mechanisms: Conduction, convection, radiation; common engineering occurrence and their importance.

Radiation: Stefan-Boltzman law; black and grey bodies; emission and absorption; radiosity; radiation resistance networks.

Conduction and convection: Thermal conductivity and heat transfer coefficient; Fourier’s and Newton’s laws; thermal resistance of plane, cylindrical and spherical walls and fluid boundary layers; thermal resistance networks; thermal insulation; overall heat transfer coefficient; cooling by fins; radiators

Dimensional analysis: The Buckingham’s “pi” theorem, application to thermofluids in general and to convection problems in particular, physical significance of dimensionless groups.

Convection and thermal boundary layers: Two-zone model; forced and free convection; heat transfer correlations; Nusselt and Prandtl numbers, Chilton-Colburn analogy.

Boiling and condensation: Phenomenological description.

Heat exchangers: Counter-flow, co-flow and condensing flow; effectiveness. LMTD and effectiveness-NTU methods.

Unsteady conduction in space and time: One-dimensional conduction with convective boundaries; conductors with internal energy generation and dissipation; derivation of fin efficiency; separable two-and three-dimensional problems; heat treatment and cooling; Fourier and Biot numbers.

Engineering Mathematics

MA3-0-1

3(3-0-4) Pre-requisites: MA2-0-2

Introduction to PDEs, 2nd order PDEs, solutions by analytical and numerical methods: Classification, Laplace, wave and diffusion equations, separation of variables, use of

Fourier series. Picard iteration, Runge-Kutta, Crank-Nicholson, Jacobi and Gauss-Seidel methods. Five point analysis.

Vector calculus: Div, grad, curl and their relations; line, double and volume integrals. Independence of path and potentials. Green, Gauss and Stokes theorems. Maxwell's equations.

Complex variables: Analyticity, differentiability in a region, Cauchy-Riemann equations, Laplace's equation. Simple mappings, multivalued functions. Conformal mappings. Cauchy's theorem and residue theorem. Evaluation of complex integrals including poles on the real axis.

Professional Engineering 3

ME3-0-5

1(1-0-1) Pre-requisites: ME2-0-10

The three "Professional Engineering" subjects emphasise an awareness of the engineering profession and some of the skills of most value to the students for their current academic studies as well as for industrial experience and their first placement on graduating. The courses are designed to give motivation for studies, a link to the real world of engineering, a forum for discussion and a guide for "Initial Professional Development" (IPD). It is intended that students will develop life long professional habits, and continue to manage their own IPD upon graduation, leading to further professional qualification and hence "Continued Professional Development" (CPD). Students will be guided in building a portfolio of source material with comments, demonstrating their progression. This will form the basis of the continuous assessment.

In addition to the core theme, specialised studies will focus on developing skills. Students will also therefore be assessed by appropriate exercises and submitting critical reviews of their development. However, the main outlet for practising these skills will be as part of other subjects and projects during their studies and industrial placements. For "Professional Engineering 3", the specialised topics will be: Negotiation, change management, managing people in organisations and project management.

Main Project Part A

ME3-0-6

3(0-6-4) Pre-requisites: ME2-0-9

Common to "Main Project Part A" and "Main Project Part B":

Students will undertake an extensive individual project with a depth of content and emphasis on real engineering issues linked to industry if possible. The project can contain any mix of modelling, design, experiment and related to physical phenomena and/or engineering management. Students will be exposed to the full research process as described in "Engineering Research Methods", and will be guided by a supervisor through weekly meetings throughout all three semesters. The scope and depth of the project, and the expected outcome and level of reporting will be suitable to students at this stage of their degree. The subject will be organised to provide an approximate 20:80 split between Parts A and B, matching the credit value. The project serves as the pinnacle of the programme activities. It will give an opportunity for students to apply the knowledge gained throughout the programme in a more independent mode of learning. It will also be used as a test of issues such as complex project and time management skills, and achieving project aims and objectives, on time and within budget.

Specific to Part A:

Part A requires completion of the initial research phase. If relevant, it should include initiating outsourced work or placing order for equipment that might have long lead times. It ends with a detailed report containing the project specification, plan and budget, with a copy held in the department reference library.

Design Make and Test

ME-3-0-7

3(0-4-4) Pre-requisites: ME3-0-1

Students will undertake a group project with a depth of technical content, ending with a proven functioning mechanical artefact. The project will emphasise the process of design, experiment and validation of the function of the artefact. This can be supported by modelling if appropriate. Students essentially carry out Part B of the research process as described in “Engineering Research Methods”. Students will hold weekly meetings to review progress with a supervisor, who will have completed the equivalent Part A before the subject starts. The subject will therefore have a split of approximately 10:90 between Part A and B. The scope and depth of the project, and the expected outcome and level of reporting will be suitable to students at this stage of their degree. The project will further reinforce project and time management skills, teamwork, and achieving project aims and objectives, on time and within budget. It ends with an oral presentation, artefact demonstration, and a detailed bound report, with a copy held in the department reference library.

Main Project Part B

ME4-0-1

12(0-12-6) Pre-requisites: ME3-0-6

See also “Main Project Part A”

Specific to Part B:

Part B requires full completion of the project, according to the project specification and other documents from Part A. There is some flexibility allowed in this regard, noting that real complex projects may not follow an ideal linear process, allowing for iteration and circular development of the project. However, the project objectives should remain fixed. Part B may be partly or fully undertaken in the summer between the 3rd and 4th years if sponsored by industry and having real valued input to the company concerned. Otherwise, it normally lasts for both semesters in the 4th year. It ends with an oral presentation and a comprehensive bound report, with a copy held in the department reference library.

Advanced Thermofluids

ME4-0-2

3(1-2-4) Pre-requisites: ME3-0-4

This course deepens the study in the three main areas of Fluid Mechanics, Thermodynamics and Heat Transfer, demonstrating the integrations of these subjects. A real engineering problem is presented to the students at the start, followed by formal lectures to cover topics such as those listed below. Further study will depend on the specific problem selected for the course, and will be driven by a peer group and self learning process, with close monitoring and guidance from staff.

Formal lectures might include: Review of fundamental laws, dimensionless groups, simplification of conservation equation by qualified assumptions, order of magnitude analysis, differential control volume analysis, boundary layer integral and profile

methods, ideal fluid theory and potential flow, laminar and turbulent flows; pipe, wall and bluff body flows, drag and friction factors. Convective/diffusive, compressible/incompressible, steady/unsteady heat and mass transfer. Gas and gas-vapour mixtures: mixtures of ideal gases: the Gibbs-Dalton law; properties of ideal gas mixtures; mixtures of an ideal gas and a vapour (air-water): dew point, specific and relative humidity; use of psychrometric chart. Stagnation temperature and pressure; relations between stagnation and static states; sonic velocity, Mach number; choking, critical pressure ratio; divergent, convergent and convergent-divergent nozzle flow; normal shock waves; nozzle and diffuser efficiencies; Turbomachinery: types of turbomachine; Euler turbomachine equation and energy equation; velocity vector triangles; definitions of efficiency; degree of reaction and relationship to blade shape.

Monitored Professional Development

MPD

3(NA) Pre-requisites: none

A minimum of 480 hours structured and documented work experience, undertaken during summer breaks between 1st and 4th years of study. It is intended to be able to contribute to evidence of professional development as typically required by professional institutions. Any particular placement may be undertaken in an industrial, academic or other environments (such as NGOs), as long as the overall experience of a combination of placements provides the required content. The content may be drawn from a range of hands on, office based, observation and shadowing, enquiry and investigation, projects or routine tasks, shop floor to boardroom experience. Overall, there must be a balance and reasonable coverage of technical, managerial and other factors that build towards a fuller and more rounded engineer. Documentation would be signed off, and would normally include the initial conditions (such as the overall plan, aims, timing, pay, work hours, project specification, contacts and lines of reporting), significant events during the placement (using a log book, checking of progress, meetings with a mentor) and a review at the end (report, feedback, references). This will be managed by department staff, in conjunction with third party representatives. Summer work that contributes towards “Main Project Part B” will not count.

*Major Subjects - Elective Subjects*Group A**Entrepreneurship** **ME.E-A-01****3(3-0-4) Pre-requisites: none**

The aim of this course is to provide students with an exciting introduction to the theory and practice of entrepreneurship and new venture creation. The course assumes no prior knowledge of the subject area and will equip students with real world knowledge and skills required to launch and manage a successful new venture.

Sample topics include Introduction to entrepreneurship and new venture creation, Fundamentals of business, Origins of new ventures, The entrepreneur and the team, Appraising the business opportunity, Raising and managing the money, Technologies, Marketing and sales, Business planning and Managing growth and succession.

Trends and Challenges in Engineering **ME.E-A-02****3(1-2-4) Pre-requisites: none**

Students study some of the greatest current and likely future challenges to engineers and the engineering profession, covering not only technological issues, but politics, economics, society. Current events in the news and other media will be critically reviewed, along with the role of the engineer and the wider cause and effect of engineering. Students will be stimulated by examples from the lecturer, and then expected to research and present their own finding, supported through weekly workshops or tutorials, to develop and discuss ideas. The course may contain active participation in seminars, interviews and other means of linking in to external stimuli.

Innovation and Technical Change **ME.E-A-03****3(1-2-4) Pre-requisites: none**

What is innovation? Sources of innovation. The right culture. Government/institutional policies. Technology forecasting and social change. Company strategies. Simple models of the innovation process. Commercialisation of innovations. The course will consider links to topics subject such as the role of engineers and innovation in sustainable development. It may allow for participation in external competitions, active participation in seminars, interviews and other means of linking in to external stimuli in order to feel the effects of these activities on innovation.

Literature Research Project **ME.E-A-04****3(0-3-4) Pre-requisites: none**

Students will undertake an extensive individual project with a depth of content and emphasis applicable for basic academic research. Students will be exposed to Part A of the research process as described in “Engineering Research Methods”, but will be more extensive and deeper than that carried out in “Engineering Research Methods”, and not necessarily as applied as that carried out in “Main Project Part A”. Students will be guided by a supervisor through weekly meetings. The scope and depth of the project, and the expected outcome and level of reporting will be suitable to students at this stage of their degree, reaching towards that required at the start of postgraduate level research. It

ends with a detailed report equivalent in style to a literature review publication, with a copy held in the department reference library.

Industrial Safety Management

ME.E-A-05

3(3-0-4) Pre-requisites: none

The principles and practices of safety engineering in product design and workplace; safe practices and hazard control; safety standards and codes; inspection procedures; governmental regulations and safety statistics; The Occupational Safety and Health Act (OSHAct) and Thai legislation; principles of safety management; elementary industrial psychology.

Production and Operations Management

ME.E-A-06

3(3-0-4) Pre-requisites: none

An overview of production and its relationship with other functional areas of the company. Job, batch, mass and flow production. Functions of production planning and control. Fixed functional and product plant layouts. Plant and machinery investment and replacement decisions. Work study and work measurement. Inventory systems. Economic order and batch quantities. ABC classification. Work allocation, loading and scheduling; local scheduling rules. Assembly lines and line balancing. Multi-product scheduling. Computers in production planning and control. Applications of operational research techniques to production planning. Quality control.

Production Planning and Control

ME.E-A-07

3(3-0-4) Pre-requisites: none

An overview of production and its relationship to organisation, management and control. Modern ethos, strategies, systems and external constraints. Components and functions of integrated production, planning, and control systems; consideration of material, equipment, manpower and other factors for optimising continuous and intermittent manufacturing operations; demand forecasting; hierarchical production planning; capacity planning; line balancing; operation sequencing and scheduling to obtain low production cost and least idle time; project planning, and considerations of energy efficiency, cleaner production, waste minimisation and sustainability of industrial production.

Maintenance Engineering

ME.E-A-08

3(3-0-4) Pre-requisites: none

Maintenance concepts, preventive maintenance, corrective maintenance, maintenance organisation, planning and control of maintenance activities, materials and spare part management; reliability and failure statistics, application of waiting line theory to maintenance problem, critical part scheduling, measurement and evaluation maintenance performance.

Air Pollution

ME.E-A-09

3(3-0-4) Pre-requisite: CH1-0-1

Air pollution – sources and scale; air quality standards; major pollutants: oxides of sulfur, nitrogen and carbon, methane and ozone; sampling and monitoring techniques; meteorological fundamentals; transport and dispersion; inversion trapping; heavy gas

dispersion; aerosols; dry and wet deposition; indoor air pollution. Water pollution modelling; dispersion of pollutants in rivers, lakes, estuaries and oceans. Interaction between air and water pollution.

Group B

Vibration Engineering

ME.E-B-01

3(1-2-4) Pre-requisites: ME2-0-6

This course concentrates on applying the theoretical principles of vibration and vibration analysis techniques, to solve practical vibration problems. It includes the logical analysis of reported vibration problems, use of hand calculation methods, modal analysis, finite element modelling, use of vibration measurement equipment, processing and interpretation of measurements, and the development of strategies for the solution of problems. Practical examples might range from low to high frequency, continuous excitement to impact, component to machine and plant level, mechanical and sound.

Combustion

ME.E-B-02

3(3-0-4) Pre-requisites: CH1-0-1, ME3-0-4

The course provides an understanding of the modern technological challenges in the design of energy generation and propulsion devices, specifically linked to the science of combustion. This includes the thermofluids and chemistry of combustion, energy efficiency, and other constraints such as materials limits, market forces and emissions regulations.

Advanced Materials and Manufacturing

ME.E-B-03

3(1-2-4) Pre-requisites: ME2-0-7

The subject aims to cover the most up to date and relevant topics and applications, as a principle input to engineering problems, research and development, product and process innovation.

Through case studies and project work, students will have a mix of forward and reverse engineering practise to develop their understanding. It will typically include personal research, qualitative and quantitative modelling, and may include the wider topics of design, management and resource issues.

Structure, Properties and Applications of Polymers

ME.E-B-04

3(3-0-4) Pre-requisites: ME1-0-2

This course covers a broad range of topics related to engineering polymers, giving students an understanding of the basics in each topic.

Structure-property relationships: monomers, oligomers and polymers. Thermoplastics and thermosets. Blends and copolymers. Conformation and configuration of CC backbone chains; tacticity. Chain flexibility and mobility. Amorphous polymers in melt, rubbery and glassy states. Entanglements. Chain mobility under stress. The glass transition: factors affecting T_g. Elastomers. Crystallinity. Factors affecting crystallinity and T_m. Orientation. Blends. Thermoplastic elastomers. Liquid crystal polymers. Additives. Introduction to polymer composites and foams.

Stress analysis of polymers: temperature and time effects on modulus. Transient tests: creep, relaxation and recovery. Modulus as a function of time. Spring-dashpot models. Linearity and non-linearity. Use of creep and relaxation data: the pseudoelastic design method. Application to common design features (e.g. snap fits, beams). Other effects on stiffness.

Processing of polymers: principal methods of processing plastics, rubbers and short-fibre composites: extrusion, blow moulding, calendering, rotational casting, thermoforming, compression moulding, injection moulding and their derivatives. Polymer melt properties. Melt flow index. Melt viscosity: strain rate and temperature effects. Melt elasticity, slip and fracture. Shrinkage. Mouldability: the spiral flow test. Curing of thermosets and rubbers. Processing effects on properties. Flow line orientation. Incomplete and shear-promoted crystallisation. Residual stresses. Moulding faults and warping. Failure of polymers: the causes of, phenomena of, tests for and design against: surface failure modes (wear, solvent attack, swelling, weathering, chemical attack, crazing and flammability); ductile failure modes (yield and thermal fatigue); and brittle fracture modes (slow and environmental stress cracking, fatigue crack growth and impact fracture). Strengthening and toughening of plastics. Designing with polymers: selection of plastics by prior use and by database interrogation methods. Recognising polymers. Design of injection moulded rigid components. The Moldflow system. Foam and structural foam. Post-processing and assembly operations. Design for recovery, recycling and disposal.

Advanced Stress Analysis

ME.E-B-05

3(3-0-4) Pre-requisites: ME2-0-5, ME2-0-7

The aim of the course is to present the stress analysis needed to design a range of engineering components such as thick walled pressure vessels, rotating discs, plates and shells.

Thick walled cylinders: Revision of Lamé equations and boundary conditions for monobloc cylinders; extension of Lamé equations to include thermal effects and body forces (thin rotating discs); stress distributions; examples.

Compound cylinders: Deficiencies of monobloc cylinders; interference stresses; modified stress distribution under internal pressure; applications and examples.

Yielding of thick-walled cylinders: First yield, full yield, partial yield for non work hardening materials; limit loads, residual stresses, autofrettage; examples.

Bending theory of axisymmetric plates: Review of bending of beams; extension to axisymmetric plates; boundary conditions, applications and examples including built in and simply supported solid plates with uniform load, central point load and annular loads, plates with central holes; thermal stresses.

Theory of shells: Membrane theory of axisymmetric shells; derivation of relationships between applied loads, stresses and geometry of shells; examples including internal pressure, hydrostatic loading and self weight.

Energy methods: Elastic strain energy for multi-axial loading systems; Castigliano's theorem; applications to statically indeterminate and deflections in pin jointed structures; straight and curved beams and other examples.

Stress and strain: Strain discontinuities, force discontinuities, residual stresses (heat exchanger), stress categories of "primary" load determined, and "secondary" strain determined; shakedown stress limits; relaxation and creep (bending of beams, multi-axial

stress states eg thin walled cylinder, and under variable stress conditions), definition of mechanical equation of state, use of reference stresses.

Introduction to Micro Electrical Mechanical Systems

ME.E-B-06

3(3-0-4) Pre-requisites: ME3-0-3

History of MEMS: Lithography: photolithography, dimension, resolution, line-width, photochemical quantum efficiency. Pattern transfer: dry etching, wet etching. Micromachining: wet bulk (Silicon crystallography, Silicon as substrate and as a mechanical element In MEMS); Surface (mechanical properties of thin films, micromachining processes). Micromodelling, Scaling, Miniaturization techniques, MEMS CAD and Simulation Programs, Miniaturization applications: microfluidic systems, mechanical Microsystems.

Advanced Mechatronics

ME.E-B-07

3(3-0-4) Pre-requisites: ME3-0-3

Modelling of the behaviour of controlled systems, Response of dynamic systems, Dynamics of Mechatronic systems, Advanced microcontrollers interface and programming. Computers and Logic systems: logic concepts and design, system interface, synchronous and asynchronous sequential systems.

Introduction to Non Destructive Testing

EE0-0-9

3(3-0-4) Pre-requisites: PH1-0-2

Covering the common methods of liquid dye penetrant, magnetic particle, Eddy current and ultrasonics. Specialised NDT for aerospace and nuclear applications. Outline of the latest technology in the NDT field. The course will include a strong content of hands on and field test case studies.

Tribology

ME.E-B-08

3(3-0-4) Pre-requisites: ME2-0-7, ME2-0-8

Introduction. Viscosity. Oil properties and composition. Reynolds equation. Hydrodynamics, thrust and journal bearings. Hydrostatics and squeeze film effects. Elasto-hydrodynamics; use in rolling element bearings and gears. Boundary lubrication. Surface roughness and friction. Modes of lubrication failure, wear, seizure, fatigue. Testing and specification of lubricants for practical systems.

Fracture Mechanics

ME.E-B-09

3(3-0-4) Pre-requisites: ME2-0-7

Building on the basic content from “Engineering Materials and Failure”, looking at the following in more depth including case studies:

Mechanisms of fracture; cleavage; ductile to brittle transition, influence of temperature, strain rate and stress state; significance of cracks and defects; introduction to linear and yielding fracture mechanics; stress intensity factor K_I and fracture toughness K_{Ic} ; Griffith energy concepts; stable and unstable fracture; effects of plasticity: plane stress-plane strain transition; small scale yielding; extensive yielding; crack opening displacement. Application of principles to high and low strength steels and welded structures; use of design codes of specifying maximum tolerable defect sizes in components. LEFM testing protocol.

Computer Programming 2**CS2-1-1****3(3-1-4) Pre-requisites: CS1-1-1**

This course emphasizes program design, style, data abstraction, information hiding, and testing; advanced programming features; introduction to object-oriented concepts, basics of algorithm analysis, exception handling, string processing, recursion, pointers, and simple data structures. The course has a closed laboratory that includes activities dealing with the computing environment, the software development process, and programming exercises.

Introduction to Robotics**ME.E-B-10****3(2-1-4) Pre-requisites: ME3-0-3**

A summary of current uses and trends in robotics. Spatial Description and Transformation: position & orientation, attached coordinate systems or frames. Manipulation Kinematics: forward & inverse kinematics, joint angles, joint variables. Jacobians: velocities and statics forces. Dynamics: Lagrangian equation, generalized force. Trajectory Generation: trajectory planning and control.

Optimisation and Uncertainty**ME.E-B-11****3(2-1-4) Pre-requisites: MA3-0-1**

This course will cover the basics of engineering optimisation applied to a diverse range of problems in engineering where optimal solutions are required, often in the presence of uncertainty. Use will be made of standard computer algebra packages and simulation packages such as Mathcad and Matlab.

Topics to be covered include: techniques for optimising multivariate cost or objective functions, uncertainty modelling (including statistical distributions commonly encountered in engineering), Monte-Carlo simulation techniques, limit-space techniques, matrix algebra, reliability and maintenance, Markov chain analysis, and an outline of Kalman filtering and state estimation.

The course will look at areas as varied as optimising the operation of power plants, predicting pipeline failure probabilities, optimising traffic flow at a road junction and reducing the uncertainty of measured signals.

Students will be expected to carry out a significant project in one of the above subject areas.

Department Special Topics**ME.E-B-12****3(to be decided) Pre-requisites: none**

Selected topics of current interest to the Department and not covered by existing courses, allowing for the possibility of taking advantage of rare opportunities at very short notice.

Engineering Faculty Project**ME.E-B-13****3(0-4-4) Pre-requisites: none**

A special subject giving provision for inter-department project work, emphasising the increasing trend of boundaries between traditional disciplines being broken down. The management will be of the same standard as other predominantly project based subjects, such as “Engineering Research Methods”, “Design Make and Test”, “Main Project A”

and “Main Project B”. The content may be a mix between management and technology, research, design and so on.

Group C

Computational Fluid Dynamics

ME.E-C-01

3(1-2-4) Pre-requisites: ME2-0-8, ME3-0-2

Equations of fluid mechanics and heat transfer and possible approaches to their solution by numerical Methods. Review of advantages of various numerical approaches for heat-conduction, inviscid, boundary layer and separated flow equations. The use of computer packages to obtain useful results. Consideration of the approximations, limitations, cost and advantages. Heavily weighted towards application to the solution of practical problems such as those related to manifolds, mixers, heat exchangers, sprays and in-cylinder flows.

Advanced Robotics

ME.E-C-02

3(2-1-4) Pre-requisites: ME.E-B-10

Rigid body dynamics of robots: constraint motion, holonomic and non-holonomic motion. Robot control: motion control modelling, linear feedback motion control, robust and adaptive motion control, precision positioning of rotary and linear systems. Vision systems, Introduction to Neuron network.