



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

PROGRAMME OF STUDY HANDBOOK (SINGLE HONOURS)

PROGRAMME TITLE

**Part-Time BEng (HONS) Manufacturing Systems
Engineering Level 4**

**SCHOOL OF ENGINEERING, MANUFACTURING
AND LOGISTICS**

**FACULTY OF ARCHITECTURE, COMPUTING
AND ENGINEERING**

2015-2016

MODULE CODE: M4X00385
TITLE: Engineering Science 1
DATED: 17/07/2014

LEVEL: 4
CREDITS: 20

JACS CODE: H300

AIM(S)

To provide a basic understanding of the principles and applications associated with general aspects of mechanical engineering science

LEARNING OUTCOMES

Upon the successful completion of this module, the student should be able to:

- 1 show a detailed knowledge and understanding of key principles in structures and dynamics analysis (component A);
- 2 demonstrate an understanding and knowledge of modelling and solving numerical problems structures and dynamics, based on knowledge of the relevant engineering principles (component A);
- 3 demonstrate the ability to apply appropriate theoretical and practical methods to the analysis and solution of structures and dynamics engineering problems (components A and B);
- 4 show cognitive skills with respect to modelling and simplifying real problems, and applying mathematical methods of analysis (components A and B) and
- 5 demonstrate key transferable skills in problem formulation and decision making, interpreting experimental results. (component B)

INDICATIVE CONTENT

- Free Body Diagrams
- Mechanics and structures
- Reaction forces
- Static equilibrium
- Hooke's Law
- Direct stress/strain, Shear stress/strain
- Shear force and bending moment diagrams
- Simple theory of elastic bending

- Simple theory of elastic torsion
- Second moments of area, Neutral axis, Parallel axis theorem
- Polar second moments of area
- Dynamics
- Friction
- Linear and Angular motion – inertia, radius of gyration etc
- Newton's Laws
- SHM
- Work / energy / momentum / power

LEARNING AND TEACHING STRATEGY

Concepts and theory delivered through lecture periods and review of notes (handouts) supplied. Continual complementary example / application problems supportive of theory considered, with whole class participation through interchange of ideas and discussion. Student centred examples similarly undertaken for consolidation/reflection of principles/practices already considered.

Supportive tutorial periods will focus on reviewing retrospectively work covered earlier with the aim of addressing difficulties encountered by individual students. Similarly, further application examples can be undertaken at a pace to meet individual needs (within reason).

Allocation of teaching to deliver the module is as follows :

Activity type	Hours	Percentage
Scheduled learning	60	30
Independent learning	140	70
Placement learning	0	0
TOTAL	200	100%

ASSESSMENT

Assessment Component 1 – 70%

A single 2-hour examination

Assessment Component 2 – 30%

Coursework - approximately -1200 words

Exemplar:

Assignments for this module are expected to have a practical element whereby the students are expected to use engineering equipment in order to perform an experiment which explores the laws that they have been studying. The experiment will be conducted by the students and the results collated, analysed and reported, with particular reference to the validation of the laws being investigated and with particular attention to the resolution and errors of the experimental methodology.

Assessment Summary

Activity type	Percentage
Written	70
Coursework	30
Practical	0
TOTAL	100%

BIBLIOGRAPHY**Essential**

Hearn, E. J., Mechanics of Materials, volume1, (Butterworth-Heinemann, 1997)

Bacon, D. H., Mechanical Technology

Recommended

Benham, P. P., Crawford, R. J. and Armstrong, C. G., Mechanics of Engineering Materials

Background

Bolton, W., Mechanical Science (Wiley-Blackwell, 2006)

MODULE CODE: M4X00386
TITLE: Engineering Science 2
DATED: 17/07/2014

LEVEL: 4
CREDITS: 20

JACS CODE: H300

AIM(S)

- This module aims to build on Engineering Science 1 to provide an understanding of the principles and applications associated with general aspects of mechanical engineering science.

LEARNING OUTCOMES

Upon the successful completion of this module, the student should be able to:

- 1 show a detailed knowledge and understanding of key principles in fluid and thermo dynamics analysis and electricity (component A);
- 2 demonstrate an understanding and knowledge of modelling and solving numerical problems in fluids and thermo dynamics, based on knowledge of the relevant engineering principles and electricity (component A);
- 3 demonstrate the ability to apply appropriate theoretical and practical methods to the analysis and solution of fluids and thermo dynamics engineering problems and electricity (components A and B);
- 4 show cognitive skills with respect to modelling and simplifying real problems, and applying mathematical methods of analysis (components A and B); and
- 5 demonstrate key transferable skills in problem formulation and decision making, interpreting experimental results (component B)

INDICATIVE CONTENT

Electrical

- i) Electricity, Voltage, Current and Resistance
- ii) Ohm's Law
- iii) Kirchoff's Laws
- iv) Power Laws
- v) Resistor Networks } R – C Networks
- vi) Capacitor Networks }
- vii) Power supply internal resistances
- viii) Magnetism

- ix) Electromagnetism
- x) Electromagnetic induction
- xi) Lenz's Law
- xii) Motors and Generators
- xiii) AC/Rectification/Phases
- xiv) Transformers Fluids
- xv) Continuity/Mass flow rates
- xvi) Pressure/energy
- xvii) Pressure heads and manometers
- xviii) Bernoulli's Equation
- xix) Pilot tubes
- xx) Viscosity/Newtonian Fluids
- xxi) Reynold's Number
- xxii) Pneumatics and Hydraulics

Thermodynamics

- i) Gas Laws
- ii) 1st and 2nd Laws of Thermodynamics
- iii) Enthalpy, Internal Energy, Entropy
- iv) Basic Engine Cycles

Deflection of Beams

- i) Double integration method
- ii) Standard cases and superposition
- iii) Buckling of Struts

LEARNING AND TEACHING STRATEGY

Concepts and theory delivered through lecture periods and review of notes (handouts) supplied. Continual complementary example/application problems supportive of theory considered, with whole class participation through interchange of ideas and discussion.

Student-centred examples similarly undertaken for consolidation/reflection of principles/practices already considered.

Supportive tutorial periods will focus on reviewing retrospectively work covered earlier with the aim of addressing difficulties encountered by individual students.

Similarly, further application examples can be undertaken at a pace to meet individual needs (within reason).

Allocation of teaching to deliver the module is as follows :

Activity type	Hours	Percentage
Scheduled learning	60	30
Independent learning	140	70
Placement learning	0	0
TOTAL	200	100%

ASSESSMENT

Assessment Component 1 – 70%

A single two-hour examination.

Assessment Component 2 – 30%

Coursework (1200 words)

Exemplar

Analysis of Resistor Manufacturing Output

On the following page you have been supplied with two sets of data for two identical machines used for a production run of 10,000 100Ω resistors each, all measured to the nearest whole number of Ohms. Not all resistors produced are sold as a single product but are graded into 4 possible types depending upon their tolerance. The sales value per resistor for each tolerance band is also supplied.

Produce Histograms for both sets of data.

Note: When binning resistors into tolerance ranges start with the smallest range. For example once you remove the ±1% then the ±5% will have no values in the ±1% range.

By analysing this data discuss the following:

For the two machines consider the mean value and spread of the values. Which machine, if any requires recalibration and is this justified?

What information about how the production process is working do the two sets of data tell you?

The unit prices are given to one-thousandth of a pound. Is this possible, what does it mean and why would a company do this?

What are the yields for each range of products and how do the two machines compare?

Hint: consider the total sales value and rejection rate for each machine for each of the 10,000 component production runs.

Assessment Summary

Activity type	Percentage
Written	70%
Coursework	30%
Practical	
TOTAL	100%

BIBLIOGRAPHY

Essential

Bird, J., Science for Engineering (Routledge, 2012)

Bird, J., Mechanical Engineering Principles (Newnes, 2002)

Shigley, J., Mechanical Engineering Design - 9th Edition (McGraw Hill, 2011)

Background

Bolton, W., Mechanical Science (Wiley-Blackwell, 2006)

Hannah, J. and Hillier, M. J., Mechanical Engineering Science (Prentice Hall, 1999)

MODULE CODE:	M4X00391
TITLE:	Mathematics
DATED:	17/07/2014
LEVEL:	4
CREDITS:	20
JACS CODE:	G120

AIM(S)

This module introduces the student to the mathematical ideas and techniques necessary for an understanding of the mathematics encountered in further engineering modules.

LEARNING OUTCOMES

Upon the successful completion of this module, the student should be able to:

- 1 demonstrate understanding and competency with respect to a range of algebra and functions mathematical techniques which are the basis of the mathematics required in engineering. (component A);
- 2 demonstrate understanding and competency with respect to a range of calculus mathematical techniques which are the basis of the mathematics required in engineering. (component A);
- 3 demonstrate understanding and competency with respect to a range of mathematical techniques required in the solution of differential equations which are required when analysing engineering problems (component A), and
- 4 design and implement simple numerical algorithms to demonstrate competence in the use of computer software to analyse and solve engineering problems including the writing of simple programs (component B)

INDICATIVE CONTENT

- 1 Differential calculus: standard rules; Newton's method for finding roots; simple partial differentiation
- 2 Integral calculus: standard integrals; integration by parts; numerical integration
- 3 Complex numbers I: algebra; Argand diagram; polar form; Euler's formula
- 4 Differential equations: classification; simple first and second order differential equations
- 5 Differentiation: maxima, minima and points of inflection; curve sketching; implicit, parametric and logarithmic differentiation

- 6 Integration: substitution; applications to centroids, volumes of revolution etc
- 7 Integration: integration of rational functions; improper integrals
- 8 Integration: double integral; polar coordinates; triple integrals
- 9 Vectors I: basic properties, Cartesian components, scalar and vector products
- 10 Vectors II: triple products, differentiation and integration of vectors, vector equations of lines and planes
- 11 Complex numbers II: De Moivre's theorem; roots; logarithm of a complex number. Matrix algebra I: terminology; addition, subtraction and multiplication of matrices; determinants
- 12 Matrix algebra II: inverse of matrix using cofactors; sets of linear equations; solution of sets of linear equations using elimination method; inverse of matrix using elimination method
- 13 Matrix algebra III: rank; eigenvalues and eigenvectors
- 14 Ordinary differential equations: solution of first order equations (separable, homogenous, linear and exact)
- 15 Ordinary differential equations: linear operators; second order linear inhomogeneous equations with constant coefficients; free and forced oscillations

LEARNING AND TEACHING STRATEGY

Lectures will be followed by tutorials, and an examples sheet on each topic covered thus providing each student with the opportunity to practice and consolidate mathematical concepts.

Supportive tutorial periods will focus on reviewing retrospectively work covered earlier with the aim of addressing difficulties encountered by individual students. Similarly, further application examples can be undertaken at a pace to meet individual needs (within reason).

Allocation of teaching to deliver the module is as follows :

Activity type	Hours	Percentage
Scheduled learning	60	30
Independent learning	140	70
Placement learning	0	0
TOTAL	200	100%

ASSESSMENT

Assessment Component 1 – 50%

Assessment Component 2 – 50%

Both assessment components (1.5 hours each) will be written examinations

Assessment Summary

Activity type	Percentage
Written	100%
Coursework	
Practical	
TOTAL	100%

- 4 Methodologies for the generation of design solutions to conceptual and adaptive design problems. To include; creativity, innovation, evaluation, optimisation, design isolation, manufacture, reliability, sustainability, safety and cost implications
- 5 Tolerancing principles, limit and fit calculations, geometric dimensioning and tolerancing theory and applications

LEARNING AND TEACHING STRATEGY

The theoretical concepts and techniques will be delivered in lecture format. Demonstrations will be given and supervised laboratory work will facilitate the introduction of the software applications required for this module.

Supportive tutorial periods will focus on reviewing retrospectively work covered earlier with the aim of addressing difficulties encountered by individual students. Similarly, further application examples can be undertaken at a pace to meet individual needs (within reason).

Allocation of teaching to deliver the module is as follows :

Activity type	Hours	Percentage
Scheduled learning	60	30
Independent learning	140	70
Placement learning	0	0
TOTAL	200	100%

ASSESSMENT

Assessment Component A – 50%

Practical Detail

The first element of assessment is intended to assess the student's ability to use the solid modelling software to create individual components and to construct assemblies models with appropriate degrees of freedom.

This will take the form of an assignment which will may be carried out during a time constrained, supervised laboratory session (assessment session). The component and assembly models will be graded directly. A written report will, therefore, usually not be required.

Assessment Component 2 – 50%

Mini Project Coursework

The second element of assessment will involve students being issued with a design challenge/problem and involve the application of design methodologies and tools in order to arrive at a design solution.

A report, detailing the strategies applied and the tools employed will be compiled by the students and submitted for assessment. The report will be accompanied by solid models and technical drawings used to specify the final designs.

Exemplar:

Students will be asked to complete a mini-project in small groups – maximum of 3.

The aim of the project is to design or redesign a component of their choice preferably that does work – and must include an assembly.

- 1 *Students are expected to develop a specification and following the course guidelines, justifying all their design decisions*
- 2 *Engineering drawings are compulsory and should be presented in accordance to BS8888. Each student must draw at least one of the parts of the assembly*
- 3 *A 10-minute presentation to the company's Chief Designers (Dragon's Den type) and presentation of written supporting information in the form of a report no longer than 20 pages (plus appendix) at the time of the presentation (word count - 2500-3000)*

Assessment Summary

Activity type	Percentage
Written	0%
Coursework	50%
Practical	50%
TOTAL	100%

BIBLIOGRAPHY

Essential

Pugh, S., Total Design: Integrated Methods for Successful Product Engineering (Prentice Hall, 1990)

Simmons, C. and Maguire, D., Manual of Engineering Drawing to British and International Standards (Newnes, 2003)

Recommended

Pahl, G., Beitz, W., Feldhusen, J. and Grote, K .H., Engineering Design: A Systematic Approach (Springer, 2006)

Ullman, D. G., The Mechanical Design Process (McGraw Hill Higher Education, 2002)

Solidworks Tutorials and Help Files

Background

Bolton, W., Mechanical Science (Wiley-Blackwell, 2006)

MODULE CODE: M4X00384
TITLE: Engineering Applications and Study Skills
DATED: 17/07/2014

LEVEL: 4
CREDITS: 20

JACS CODE: H300

AIM(S)

- 1 Introduce the student to workshop and laboratory skills and safety practices through the media of degree pathway specific technology whilst allowing them to critically evaluate and apply theoretical engineering concepts to specific applications and problem solving exercises.
- 2 Accelerate their learning process and strategies. The students will be encouraged to develop a reflective, active, positive approach to learning, and to take responsibility for their own learning. Such skills promote a deeper learning approach and understanding of the topics studied throughout the programme; they support lifelong learning, and are the transferable skills desired in the employment context.

LEARNING OUTCOMES

Upon the successful completion of this module, the student should be able to:

- demonstrate knowledge and understanding of specific engineering concepts and how their theoretical characteristics are used in discipline specific engineering applications;
- apply practical engineering skills and demonstrate know-how of practices, skills, safety and standards with respect to laboratory and workshops, and
- demonstrate key transferable skills in the creation of a personal development plan based on a self-evaluation of skills and demonstrate awareness of reflective practice on their application and achievement of the study skills learned.

INDICATIVE CONTENT

- 1 An awareness of and practice in, the use of equipment for the measurement of fundamental quantities.
- 2 Familiarity with basic electronic and mechanical components, laboratory and workshop equipment and their real world applications and behaviour.
- 3 Health & Safety procedures and legislations, personal protective equipment and safe working practice.
- 4 Understanding the learning process and identifying skills (eg self-evaluation, skills needed for higher education, transferable skills, action plans for personal development).

- 5 Organising study (eg time management, organising space, organising resources)
- 6 Structuring study and sourcing information - effective note taking, using the library and the internet, referencing convention. Revision and examination techniques.
- 7 Communicating and presenting information (eg presentation techniques, styles, the appropriate use of graphs, charts, measures of central tendency)
- 8 Developing an appropriate writing style (eg planning and structuring essays and reports, linking ideas together, using facts, opinions or arguments, analytical thinking, etc.)

LEARNING AND TEACHING STRATEGY

Engineering Applications

Lectures will be used to introduce key ideas and theoretical concepts. During seminars and tutorials, students will apply the theoretical concepts to practical situations using prepared case study material, and current day events and happenings that may occur within students own, or other organisations. The course will be augmented by demonstrations, technical articles, readings and discussions as appropriate. Students are expected to take considerable responsibility for their own learning, and read widely from the literature relevant to the subject area.

Investigative and practical application skills will also be developed in this module through live testing, directed reading and library research. In addition, the student will be required to undertake a range of activities and reflect on the Health & Safety issues that they would have to respond to.

Study Skills

The conceptual, theoretical issues are suited to delivery during weekly lectures. However, for the exploration of these topics and their application within the students' studies, tutorials are the most appropriate strategy. Seminars will allow students to disseminate to their peers the results of their research.

Allocation of teaching to deliver the module is as follows :

Activity type	Hours	Percentage
Scheduled learning	60	30
Independent learning	140	70
Placement learning	0	0
TOTAL	200	100%

ASSESSMENT

Assessment Component 1 – 50%

The Study Skills assessment will take the form of a series of short reports and presentations which will enable the tutor to assess student's aptitude in report writing, application of research techniques and referencing conventions.

Students will also be asked to present their work using PowerPoint (or similar). The assessment mark will be an aggregate of these reports and presentations (word count – 2000 words)

Assessment Component 2 – 50%

Students will be required to work towards proposing appropriate technical solutions to address problems which could affect an engineering/manufacturing concern). This could involve a basic design, manufacture and test exercise. Students may be required to work in groups or as individuals to develop solutions.

The assessment is intended to involve practical application of basic theoretical principles. It is intended that the practical application would be recorded and evaluated in a technical report. Students may, therefore, be required to produce practical/physical, applied solutions as well as a piece of written coursework and a reflective presentation (word count – 2000 words)

Exemplar

The module provides a theoretical background, complemented through practical investigated techniques, using dedicated instruments whilst considering Health & Safety. One of the teaching and learning assessment processes for this module is to evaluate a combination of outcomes that the student has demonstrated through a practical experiment within a safe working environment.

The experiment is conducted by an individual student whilst being observed and their results are collated, analysed and reported, with particular reference to the fundamental understanding of engine construction, chassis development, ignition and fault diagnosis which is established through the practical work and theoretical discussions with particular attention to the resolution and errors of the experimental methodology.

Assessment Summary

Activity type	Percentage
Written	
Coursework	50%
Practical	50%
TOTAL	100%

BIBLIOGRAPHY

Essential

Bosch Automotive Handbook (Bentley, 2011)

Hillier, V. A. W., Hillier's Fundamentals of Automotive Electronics (Nelson Thornes, 2012)

Bird, J., Science for Engineering (Routledge, 2012)

Bird, J., Mechanical Engineering Principles (Newnes, 2002)

Shigley, J., Mechanical Engineering Design - 9th Edition (McGraw Hill, 2011)

Background

Bolton, W., Mechanical Science, Wiley-Blackwell (2006)

Hannah, J. and Hillier, M. J., Mechanical Engineering Science (Prentice Hall, 1999)

MODULE CODE:	M4X01163
TITLE:	Materials and Intro to Manufacturing Technology
DATED:	17/07/2014
LEVEL:	4
CREDITS:	20
JACS CODE:	J511

AIM(S)

- To develop a knowledge base and understanding of the structure, properties and basic selection of all classes of materials
- To develop a knowledge and appreciation of the processes used in the manufacture of components with a view to providing basic process selection parameters using a broad range of industrial applications to illustrate this

LEARNING OUTCOMES

Upon the successful completion of this module, the student should be able to demonstrate:

- 1 an understanding of the structure and properties of metallics, polymers and ceramics
- 2 knowledge of the applications, advantages and limitations of different manufacturing processes, and
- 3 knowledge and understanding of engineering materials and manufacturing process selection

INDICATIVE CONTENT

- Materials and the environment: Recycling, corrosion, UV degradation, hygroscopy
- Material failure: Fatigue, creep and fracture, crack criteria, stress concentration factors, residual stresses. Preventative measures and design implications
- Polymeric and ceramic material processing (Mould design, process parameters and defects)
- Solidification, metals and alloys, polymers and co-polymerisation, glass transition temperature in polymers and ceramics
- Metallic Casting processes, Sand Casting, Gravity Die Casting, Pressure Die Casting, Investment Casting etc

- Forming processes. Such as Forging (Smith, Drop, Press, Upset), Rolling, Extrusion, Deep Drawing and sheet metal processing
- Secondary processing - machining and cutting (tool/material wear). Forces and energy dissipation: coatings (electro-plating, thermal spraying, powder coating and cladding)
- Thermal equilibrium diagrams. Ferrous and non-ferrous alloys, Heat treatment, Strengthening Mechanisms, work hardening, structure alignment, precipitation hardening, surface and bulk hardening mechanisms
- Joining - Welding processes, joint design, welding procedures and typical defects

LEARNING AND TEACHING STRATEGY

Lectures will introduce the students to the concepts, principles and practices. Tutorials and seminars will introduce practical examples which will be used to support the application, discussion, and critical evaluation of techniques learned. Case studies will also be used to develop understanding and application of the techniques.

Allocation of teaching to deliver the module is as follows :

Activity type	Hours	Percentage
Scheduled learning	50	25%
Independent learning	150	75%
Placement learning		
TOTAL	200	100%

ASSESSMENT

Assessment Component 1 – 50%

The aim of the assessment will be to enable students to apply theoretical concepts learnt in the classroom, as the module aims to develop students' understanding of the materials and process selection for a given product.

The assignment will encourage the application of CES material and process selection software, to consider the materials and manufacturing process currently used. The assessment will be in the form of an engineering report and will also include a 10-minute presentation of the findings to the peer group and module lecturing staff.

Assessment Component 2 – 50%

An examination (2 hours) will provide an appropriate way to assess the theoretical materials and manufacturing process understanding under time-constraints. This will be a closed book examination and will feature both multiple choice and open questions in order to assess both depth and breadth of understanding.

Assessment Summary

Activity type	Percentage
Written	50%
Coursework	50%
Practical	
TOTAL	100%

BIBLIOGRAPHY

Essential

Groover, M. P., Principles of Modern Manufacturing - 4th Edition (Wiley, 2011)

Callister, W. D.; Rethwisch, D. G., Materials Science and Engineering - 8th Edition (Wiley, 2011)

Recommended

Ashby, M. and Johnson, K., (2010) Materials and Design: The Art and Science of Materials Selection in Product Design - 2nd Edition (Butterworth-Heinemann, 2010)

Ashby, M. and Jones, D., Engineering Materials: An Introduction to Properties, Applications and Design - 4th Edition (Butterworth Heinemann, 2011)

Chiles, V., Black, S. and Lissaman, A., Principles of Engineering Manufacture - 3rd Edition (Elsevier, 1996)

Beddoes, J., Principles of Metal Manufacturing Processes (Elsevier Butterworth Heinemann, 1999)

Journals

Journal of Manufacturing Processes, the Society of Manufacturing Engineers (SME)