MEng Electrical and Electronic Engineering: Year 1 Modules

EN0408 Computer Programming (CORE, 20 Credits)

SYNOPSIS OF MODULE
This module aims to provide the student with the ability to develop a C program from a given specification. This is achieved through the use of structured program development using Pseudo code and C programming methodology. The student will learn how to produce a program in C and how to write C programs to perform a number of Engineering tasks using arrays and character arrays, amongst others, to solve specific engineering problems. In addition to this the student will, in semester two, learn how to produce C programs to execute on a microcontroller that can control hardware and perform engineering applications such as to control Traffic Lights, develop a home alarm system, measure distance to name a few examples.

Assessment will be via two assignments each worth 50% of the module and each submitted by the students at the end of each semester.

INDICATIVE READING LIST OR OTHER LEARNING RESOURCES
1. Recommendations for purchase by students
N/A
2. Books
* Banzi, M. (2008). Getting Started With Arduino. O'Reilly. ISBN 978-0-596-15551-3
* Hanly J. R., Elliot B., Koffman. (1995). C Programming Design for Engineers. Pub. Addison-Wesley

* McGarth, M. (Dec. 2008). C Programming in easy steps. 3rd Ed. Pub. Computer Step. ISBN 1840783636

* Minns, P. D. (2010). Course Notes on C Programming. Northumbria University

* Minns, P. D. (2010). PICing with C notes if using the Microchip PIC microcontroller. Northumbria University

* Minns, P. D. (2010). Workshop material on C programming IDE and the chosen microcontroller IDE as well as example C programs to help the student understand the concepts. Northumbria University.
3. Journal Articles
N/A
4. Journals and Newspaper Titles
N/A
5. Databases and Websites
* IEEEXplore database

* http://arduino.cc/ - the Arduino home page
6. Any Other Resources
N/A

OUTLINE SYLLABUS
C Programming on a PC

Introduction to computer systems
The concept of a program as a binary file, as an assembly file, and as a high level program, in terms of the increasing levels of abstraction

Pseudo code
Pseudo code and its use to convert a specification into a structured sequence of program instructions. Converting the Pseudo code into a C program using the C programming language syntax using decision making, repeating operations, C functions following both top down and bottom up design.

Standard constructs
For example if-then-else, while-do, do-while, loop, switch-case and structures with examples of each.

Data types
The introduction of data types and the correct use of these data types in program development. Use of arrays and strings.

Functions
Classic style and modern style, parameter passing, returning data values, pass by reference. The use of pre-declared functions, and user defined functions. The purpose and use of prototypes

Introduction to pointers
Pointer variables, pointer operators, passing pointers as parameters, casts, allocating memory for pointers, the malloc and calloc functions.

File access in C
Sequential file access. The C structure and its use.

Debugging
How to debug a program and correct potential errors.

The application of writing C programs to solve particular problems
For example, to create a database and/or to solve an engineering problem.

C Programming on a Microcontroller

Introduction to using C programs to execute on a microcontroller
The limitations and the advantages. Common techniques used in C programs designed to run on microcontrollers

Registers
Control registers, status registers, input and output registers, how to access registers in C. Bit masking for inputs and outputs, special C functions to set/clear register bits, interrupts, using time delays (using both software and hardware timers)

Controlling peripheral devices in the microcontroller
The Analogue to Digital converter (ADC), the serial I/O port with example C programs.

Development of specific C programs to a given specification
For example, a Traffic Light controller, a home alarm system or a distance measuring device.

AIMS OF MODULE
This module aims to introduce the student to both the development of C programmes on the windows platform using formal design methods and how to develop C programs to execute on a microcontroller to perform engineering applications that might otherwise be developed with digital hardware. This will start with an introduction to the C constructs, how and when to use them, with graded examples. Later the student will be given engineering problems for which they will write C programs to solve.

LEARNING OUTCOMES
The student will be able to:

1. Develop a program from a specification and provide suitable documentation. UKSPEC US1, US2, US3

2. Manufacture and debug programs that include algorithmic sections and/or hardware control and prove that they meet the required specification (program debugging) for C programs designed to run on a PC and a Microcontroller. UKSPEC P2, E3, E4.

3. Interpret the features of the C programming language, including effective use of libraries within the realisation of a design. UKSPEC P1, P2, P6.

4. Develop a C program from a specification to solve an engineering problem using a PC and also a microcontroller. UKSPEC E1, E2, E3, E4. P2.

PRE-REQUISITES
None

CO-REQUISITES
None

DISTANCE LEARNING DELIVERY
N/A

LEARNING AND TEACHING STRATEGY
The module consists of a number of two hour per week lectures and two hour per week workshops over two semesters. The lectures provide the student with information on programming in C, while the workshops provide the student with practical sessions to develop their programming skills. Some of the practical sessions are available to the students to work on application problems, although students are expected to do the bulk of this work in their independent study time. The use of regular workshops allows for formative feedback and can assist in reducing the formation of "bad practice". Two assignments are given, to be handed in at the end of each semester in which the student is expected to develop C programs to meet a particular specification. These assignments involve using many of the ideas and concepts developed during the module

ASSESSMENT AND FEEDBACK STRATEGY
a Summative assessment and rationale for tasks

An assignment to be submitted at the end of semester one involving the creation of a computer program in C to solve an engineering problem (50%) This is to test the students understanding of the work covered during semester one.

Another assignment will be given during semester two involving the creation of a C computer program to execute on a microcontroller (50%). This will test the students understanding of the work done in semester two.

b. Additional formative assessment - detail of process and rationale

Formative assessment will be via feedback during the workshop periods during which the student will be working on problems designed to help them to understand the content covered during semester one and semester two.

c. Indication of how students will get feedback and how this will support their learning

Feedback will be in the form of verbal (formative) during the workshop periods and summative feedback will be via written comments on the student's assignment work.

IMPLICATIONS FOR CHOICE
EN0565 Programming & Digital Systems

EN0409 Digital Electronics and Communications (CORE, 20 Credits)

SYNOPSIS OF MODULE
This module aims to introduce the student to digital electronics and communication systems. In particular, digital electronics focuses on logic gates and basic combinational and sequential logic circuits. The communications aspects will include telephone systems and internet technologies.

The module will be assessed using laboratory work (30%) and an examination (70%).

INDICATIVE READING LIST OR OTHER LEARNING RESOURCES
1. Recommendations for purchase by students
N/A
2. Books
* Floyd, T. (2006). Digital Fundamentals, 9th Ed., Pearson. ISBN 0-13-197255-3
* Zheng, Y., and Akhtar, S. (2002). Networks for Computer Scientists and Engineers, Oxford, ISBN 0-19-511398-5

3. Journal Articles
N/A
4. Journals and Newspaper Titles
N/A
5. Databases and Websites
* IEEEXplore database
6. Any Other Resources
N/A

OUTLINE SYLLABUS
Basic Digital Electronics

Introduction to basic logic gates, AND/OR/NOT/NAND/NOR/XOR. Use of truth tables to solve simple logic problems involving switching logic and logic gates. Introduction to Boolean Algebra. Use of Boolean Algebra to solve some logic problems. Use of Karnaugh maps to help minimise Boolean Logic functions.

Combinational and Sequential Logic

Development of simple arithmetic circuits using combinational logic.
Introduction to sequential logic systems, the basic set-reset flip-flop (SRFF), the clocked SRFF; the JKFF, the DFF, the TFF, the master-slave JKFF (and DFF). Building simple counters and shift registers from JKFF and DFF.

Basic Telephone Systems

Introduction to the POTS, ISDN, VOIP and emerging telephone systems. Telephone line encoding technology, A-law, u-Law companding and Analogue to Digital conversion ADC, Digital to Analogue Conversion DAC techniques.

Basic Network Systems

The OSI 7 layer model for networking, Ethernet Frames and IP addressing. Current physical layer technologies, for example Ethernet, Wireless Ethernet, Bluetooth, Zigbee

AIMS OF MODULE
The module will introduce the student to digital electronics, covering key structural elements in sequential and combinational logic circuitry, and communication techniques, including those for telephone and network communication systems

LEARNING OUTCOMES
The student will be able to:

1. Explain the operation of logic circuitry, and design combinational logic circuits using truth tables, Boolean algebra and Karnaugh maps. (UKSEC US1)

2. Explain the operation of sequential logic, and use it to develop circuits such as binary counters and shift registers. (UKSPEC D1)

3. Demonstrate understanding of telephone system technology, including ADC and DAC techniques. (UKSPEC US3)

4. Demonstrate an understanding of the technology protocols and address space used in the Internet, and other modern communication channels. (UKSPEC E2)

PRE-REQUISITES
None

CO-REQUISITES
None

DISTANCE LEARNING DELIVERY
N/A

LEARNING AND TEACHING STRATEGY
Formal lectures will be used to cover the relevant theory. Demonstrations and quizzes will be deployed in the lecture to deepen understanding through interaction. The quizzes will provide formative feedback to the student. Case studies may also be deployed to enrich the lecture learning environment. Seminars will be used to go through set problems and to prepare for the examination.

The lab work will include a set of laboratories designed to exemplify key elements of learning in the module, for example, a laboratory on Internet protocol addresses covering network addresses and basic network tools.

ASSESSMENT AND FEEDBACK STRATEGY
a Summative assessment and rationale for tasks

Summative assessment is via a test paper based on laboratory work (30%) and an end of year exam (70%).

Formative test papers will be used (for example on blackboard) based on all of the laboratory work such that students can complete the lab work, and then take tests based on that work within a short timeframe. The use of such formative tests provides the opportunity for quick feedback to the student as directly after the laboratory tests results will be available with solutions and explanations of the correct answers. One final test paper will form part of the summative assessment and may comprise questions from all of the previous tests. It will be set at the end of the final laboratory.

b. Additional formative assessment - detail of process and rationale

Formative in class tests based around key theory will be provided periodically in the lecture sessions to ensure that theory is being understood by the cohort. In addition, formative feedback will be provided on the interactive workshop tasks.

c. Indication of how students will get feedback and how this will support their learning

As noted above, automatic feedback is built into the laboratory tests. Verbal feedback is provided on the workshop activities and on the class tests in the lecture sessions. Examination feedback will be provided following the normal processes to show generically where the cohort has a strong or a weaker answer to the examination.

IMPLICATIONS FOR CHOICE
EN0565 Programming and Digital Systems
EN0566 Communication Systems

EN0410 Electrical and Electronic Principles (CORE, 20 Credits)

SYNOPSIS OF MODULE
This module aims to introduce the student to electrical circuit theory and analogue electronics. It enables the student to analyse basic DC and AC circuits and to familiarise with fundamental electronic components such as operational amplifiers and semiconductor diodes.

The module will be assessed using a laboratory report (40%) and an examination (60%). Formative feedback is provided throughout the year during the seminars and laboratory sessions.

INDICATIVE READING LIST OR OTHER LEARNING RESOURCES
1. Recommendations for purchase by students
N/A
2. Books
* Bird, J. (2010). Electrical Circuit Theory and Technology. 4th edn. Elsevier
* Boylestad, R. (2010). Introductory Circuit Analysis. 12th edn. Pearson
3. Journal Articles
N/A
4. Journals and Newspaper Titles
N/A
5. Databases and Websites
* IEEEXplore database
6. Any Other Resources
N/A

OUTLINE SYLLABUS
DC CIRCUIT THEORY

Introduction to ideal linear elements: resistor, inductor and capacitor. Current and voltage division rule. Applications of superposition: Kirchhoff's law, Thevenin and Norton Theorems. Mesh and Nodal analysis. Matrix form for mesh and nodal analysis. Properties of step function, response of simple RL and RC circuits.

AC CIRCUIT THEORY

Properties of sinusoidal and periodic waveforms, average, RMS values. Phasors and phasor diagrams, and j operator. Complex impedance, impedance diagrams. Applications to series circuits. Power in AC circuits, power factor, apparent power, active power, and reactive power. kVA diagram and power factor correction. Complex admittance and applications to parallel circuits. Series and parallel RLC circuits. Frequency response of simple RLC circuits.

ANALOGUE ELECTRONICS

Introduction to the properties of an ideal operational amplifier. Simple inverting and non-inverting applications using virtual earth principles. Properties and parameters of a non-ideal op-amp including gain-bandwidth and off-sets. Op-amp applications including summer, integrator and differentiator. Linear and non-linear applications. Introduction to basic semiconductor physics: electrical conductivity, intrinsic and extrinsic semiconductors, p-n junction and diode, simple rectifier and Zener diode.

AIMS OF MODULE
The module aims to provide an understanding of basic circuit theory and analogue electronics, including the applications of operational amplifiers and simple semiconductor devices.

LEARNING OUTCOMES
The student will be able to:

1. Demonstrate application of the key principles of DC circuit theory including Kirchhoff's laws of current and voltage, and rules for current and voltage

division

2. Analyse and solve simple AC series and parallel circuits using phasors and complex numbers

3. Explain the operation of ideal and non-ideal op-amp circuits and design simple op-amp applications

4. Understand the operation of simple semiconductor devices.

PRE-REQUISITES
None

CO-REQUISITES
None

DISTANCE LEARNING DELIVERY
N/A

LEARNING AND TEACHING STRATEGY
The module will be delivered using a combination of formal lectures, seminars and laboratory sessions. Theoretical material delivered in lectures will be augmented with a strong practical element involving group work and interactive demonstrations in the laboratory. Seminars will be used as an opportunity for students to develop problem solving skills through worked examples which are relevant to real-world applications.

ASSESSMENT AND FEEDBACK STRATEGY
a Summative assessment and rationale for tasks

Summative assessment will include a laboratory report (40%) and an examination (60%). Writing the laboratory report enables the student to develop essential engineering skills and encourages good laboratory practice, while the examination is used to assess knowledge, understanding and problem solving skills.

b. Additional formative assessment - detail of process and rationale

Class tests and informal quizzes will be used throughout the year to help the student measure their progress and to support their learning.

c. Indication of how students will get feedback and how this will support their learning

This may take several forms including: written comments on class tests; verbal comments on class tests; general feedback on the seminar and laboratory work - delivered in class or via blackboard; written feedback on the laboratory report; examination feedback will be provided following the normal processes to show generically where the cohort has a strong or a weaker answer to the examination.

IMPLICATIONS FOR CHOICE
None

EN0411 Fundamentals of Energy Systems (CORE, 20 Credits)

SYNOPSIS OF MODULE
This module introduces the student to the fundamental concepts of energy and power. The underlying electrical engineering, physics and mathematics is illustrated using examples from electricity generation, distribution and storage. Emphasis is given to sources of sustainable energy amidst current concerns about climate change, finite natural resources and energy security.

Assessment is by a workshop logbook (30%) and an examination (70%). In addition, seminar and workshop sessions are used to provide the student with formative feedback.

INDICATIVE READING LIST OR OTHER LEARNING RESOURCES
1. Recommendations for purchase by students
N/A
2. Books
* Bird, J. (2010) Electrical Circuit Theory and Technology. 4th edn. Elsevier
* MacKay, D. (2008) Sustainable Energy-Without the Hot Air. UIT
* Young, H., Freedman, R. (2007) University Physics. 12th edn. Pearson
3. Journal Articles
N/A
4. Journals and Newspaper Titles
N/A
5. Databases and Websites
* IEEEXplore database
6. Any Other Resources
N/A

OUTLINE SYLLABUS
INTRODUCTORY PHYSICS

Basic SI units. Kinematics, Newton's laws of motion and force. Work, kinetic and potential energy, and power. Laws of energy conservation. Kinematics of circular motion: period, frequency and angular velocity.

Basic electromagnetism. Electric charge: conductors, insulators and semiconductors. Electric field. Electrostatic potential energy and potential. Magnetic field of an infinitely long straight wire, single turn coil and at the centre of a solenoid. Magnetic flux. Forces on a current carrying conductor on a magnetic field. Electric motors. Force on charged particles in a magnetic field. Electromagnetic induction: Faraday's law and Lenz's law. Electric generator.

THREE PHASE POWER AND POWER ELECTRONICS

Production of three-phase power. Phase and line voltages and currents in star and delta systems. Earthing on low-voltage systems. Measurements of three-phase power.

Introduction to single-phase transformer: principle, construction, referring of impedances, losses and efficiency, and equivalent circuit.

Power electronic switching devices: Rectifiers, MOSFET, transistor, IGBT, and thyristor. Single-phase rectifier circuits,

ELECTRIC POWER GENERATION

Conventional power generation: gas and coal-fired power stations, combined heat and power, IGCC, nuclear power. Generating plant performance. Load curve and load factor. Fundamentals of power transmission and distribution.

Renewable power generation: wind energy and Betz limit. Solar spectrum, p-n junction, photovoltaics. Solar thermal. Wave and tidal power, and linear generators. Efficiency of renewable energy systems. Feed-in tariff.

ELECTRICITY STORAGE AND ENERGY EFFICIENCY

Technologies: capacitors and super capacitors, batteries, flywheels, pumped storage. Electric vehicles. Concept of energy saving and devices, e.g. Light-emitting diodes.

AIMS OF MODULE
The module aims to introduce key concepts in energy systems and their application to both conventional and renewable electrical power generation. The underlying electrical engineering, physics and mathematics will be applied to examples from electricity generation, distribution and storage, including examples from renewable and conventional energy systems.

LEARNING OUTCOMES
The student will be able to:

1. Demonstrate a firm understanding of the concepts of energy and power

2. Describe, in simple terms, the underlying physical principles which govern the operation of the major renewable and non-renewable energy systems

3. Solve simple problems and perform basic analytical tasks which relate to electrical power generation, power systems and devices.

PRE-REQUISITE(S)
None

CO-REQUISITE(S)
None

DISTANCE LEARNING DELIVERY
N/A

LEARNING AND TEACHING STRATEGY
The theory and basic analytical procedures will be studied in formal lectures and practical problems will be analysed in seminar classes. Lectures will involve interactive elements such as quizzes, worked examples and formative tests. These can also be used to introduce aspects of research activity within the School.

Seminars will primarily provide an opportunity for students to apply and develop their analytical and problem solving skills. The seminar is also an opportunity to support student learning through formative feedback.

Workshop sessions will introduce students to the practical application of their learning, augmenting materials presented in lectures and seminars.

Where practically possible, students' learning will be supported by a visit to a regional company involved in the development of relevant energy technologies.

ASSESSMENT AND FEEDBACK STRATEGY
a Summative assessment and rationale for tasks

The module will be assessed using a combination of a workshop logbook at the end of semester 1 (30%) and an examination at the end of semester 2 (70%). The workshop logbook will be created by the student during each workshop. This is aimed to help the student develop essential practical engineering skills such as recording experimental details and performing systematic investigations.

b. Additional formative assessment - detail of process and rationale

In-class tests will be used as check-points of student understanding and will provide students with a measure of progress against the learning outcomes. In addition, formative feedback will be provided during the seminars and workshops.

c. Indication of how students will get feedback and how this will support their learning

Feedback will be provided throughout the academic year. This will be both formal e.g. following a piece of summative assessment, and informal e.g. during a seminar or laboratory session. This dialogue (both written and verbal) is intended to support the students' learning and identify any areas which might require specific focus.

IMPLICATIONS FOR CHOICE
None

EN0414 Research, Analysis and Presentation (CORE, 20 Credits)

SYNOPSIS OF MODULE
This module aims to introduce the student to gathering research data from either laboratory or reference material, analysing the acquired data in an appropriate manner and then presenting the key findings.

The module will be assessed using an assignment based on laboratory work (50%) and a research presentation (50%). Formative feedback will be provided throughout the year during laboratory sessions.

INDICATIVE READING LIST OR OTHER LEARNING RESOURCES
1. Recommendations for purchase by students
N/A
2. Books
* British Standards Institute (1990) BS5605: Recommendations for citing and referencing published material [Online]. Available at: https://bsol.bsigroup.com/BsolHomePage/ (Accessed: 16th July 2012)
* Matthew, C. (2000) A guide to presenting technical information: effective graphic communication. Professional Engineering Publishing
3. Journal Articles
N/A
4. Journals and Newspaper Titles
N/A
5. Databases and Websites
* IEEEXplore database
* The IET Technical Report writing guide, Accessed 14th June 2012, http://www.theiet.org/students/resources/tech-report-writing.cfm
6. Any Other Resources
N/A

OUTLINE SYLLABUS
Research
Research methods will demonstrate where and how to gather information; researching for knowledge and information which can be applied to generate solutions to real world problems. The ability to select from a number of research methods is important for example the ability to research a method to design simple laboratory tests.

Analysis
Correct use of units and symbols for science and engineering along with the use of data analysis techniques. Specific techniques may include for example: mean and standard deviation, simple regressive techniques, log - log and log linear relationships, and error analysis. Simple measurement techniques for example measuring: velocity, voltage, current and power. Key factors in measurement include the need to analyse: accuracy, errors, resolution and the need for calibration.

Presentation
Key communication skills in report writing, log book writing (of laboratory data), and the presentation of information. A number of key skills are in focus here namely the highlighting of key findings and drawing suitable conclusions from a piece of work. Both written and oral presentation skills exemplified.

AIMS OF MODULE
This module aims to introduce the student to gathering research data from either laboratory or reference material, being able to analyse the acquired data in some manner and then be able to present the key findings.

LEARNING OUTCOMES
The student will be able to:

1. Describe and illustrate the understanding of science and engineering principles using a range of verbal, written and graphical techniques when researching and analysing real world problems. (UKSpec US1)
2. Analyse and interpret experimental data obtained from instrumentation with knowledge of the characteristics of the particular equipment. (UKSpec P1)
3. Participate in the operation and planning of team work. (UKSpec D4)
4. Demonstrate knowledge and understanding of engineering principles and methodology through engagement with experimental work and by using them to analyse engineering processes. (UKSpec E1)
5. Demonstrate engineering laboratory skills with an overview awareness of Health and Safety issues. (UKSpec P2)

(USx, Ex, Dx etc denotes specific UKSpec learning outcomes as stated in IET Handbook of Learning Outcomes)

PRE-REQUISITES
None

CO-REQUISITES
None

DISTANCE LEARNING DELIVERY
N/A

LEARNING AND TEACHING STRATEGY
The module will be delivered using a combination of formal lectures and laboratory sessions. Theoretical material delivered in lectures will be augmented with a strong practical element involving group work and interactive demonstrations in the laboratory. Student presentations will be used as an opportunity for students to practice and develop key transferable skills through exemplified research work which are relevant to real-world applications.

ASSESSMENT AND FEEDBACK STRATEGY
a Summative assessment and rationale for tasks

Summative assessment will include an assignment (50%) and a presentation (50%). The assignment will be a report based on laboratory work

designed to enable the student to develop essential engineering skills and encourages good laboratory practice. While the presentation (individual) will be on a research topic and will be used to assess the development of the communication skills needed by engineering professionals.

b. Additional formative assessment - detail of process and rationale

Laboratory sessions will be used to gain key formative feedback on the build of a suitable experiment. Feedback in this context is often verbal, noting key skills in following detailed plans or in thinking skills to solve practical problems.

c. Indication of how students will get feedback and how this will support their learning

This may take several forms including: written comments on lab work; verbal comments during lab work; general feedback on the laboratory work - delivered in class or via blackboard; written feedback on the assignment based on laboratory report; presentation feedback on an individual's performance.

IMPLICATIONS FOR CHOICE
None

MS0265 Engineering Mathematics (CORE, 20 Credits)

SYNOPSIS OF MODULE
The module provides a first level course in engineering mathematics. Fundamentals of algebra, trigonometry and calculus are reviewed. The student's knowledge of calculus is extended and complex numbers, matrices, vectors and differential equations are studied. The module is taught via a combination of lectures and problem solving sessions. Assessment is by formal examination at the end of the year. Informal feedback on work in progress is given continuously during seminars and formal feedback will be given directly after the exam.

INDICATIVE READING LIST OR OTHER LEARNING RESOURCES
Recommendations for purchase by students
Stroud K.A, (2007), Engineering Mathematics, Palgrave

Books
James G, (2008), Modern Engineering Mathematics, 4th edn. Prentice Hall

OUTLINE SYLLABUS
Review of basic algebra: transposition, simplification, quadratic equations, simultaneous equations.
Review of trigonometry: functions sin, cos, tan, inverses, sec, cosec, cot; identities, Rsin (x+a).
Review of basic calculus: Derivative as slope and rate of change, standard derivatives; product, quotient and function of a function rules; integration as reverse of differentiation, standard integrals, area under a curve; differential equations and solution by direct integration.

Complex numbers: addition, subtraction, multiplication, complex conjugate and division in algebraic form. The Argand diagram. Polar form and exponential form, with multiplication and division. De Moivre's theorem (powers and roots). Locus problems.

Calculus: Implicit, parametric and logarithmic differentiation. Maxima and minima. MacLaurin's series. Partial differentiation, first order change, analysis of errors, method of least squares. Integration techniques (substitution, partial fractions, by parts) and simple applications of integration.

Matrices and Determinants: second and third order determinants, evaluation, properties, Cramer's Rule for solution of simultaneous equations; matrices, addition, subtraction, multiplication, transpose, inverse (via adjoint), solution of simultaneous linear equations by matrix inversion.
Vectors: sum, difference, magnitude, components, Cartesian representation in three dimensions; scalar and vector products, application to simple geometrical and physical problems.

Differential Equations: solution of first order by separation of variables and integrating factor; second order with constant coefficients, auxiliary equation, complementary function, particular integral by substitution (including snag case), application to, for example, mass-spring-damper and / or L-C-R circuits.

AIMS OF MODULE
The module will provide the student with a sound understanding of basic methods in engineering mathematics.

LEARNING OUTCOMES
The student will be able to:

1. Use the basic skills of algebraic and trigonometric manipulation.
2. Employ techniques of differentiation and integration and apply them to simple physical problems.
3. Partially differentiate functions of several variables and apply to , for example, analysis of errors and the method of least squares.
4. Manipulate complex numbers in algebraic, polar and exponential form, and use De Moivre's theorem.
5. Manipulate determinants and matrices, and use both to solve systems of linear simultaneous equations.
6. Manipulate vectors and apply them to simple geometrical and physical problems.
7. Solve first and second order differential equations used to model simple mechanical systems and electrical circuits.

PREREQUISITES
None.

COREQUISITE(S)
None.

DISTANCE LEARNING DELIVERY
None.

LEARNING AND TEACHING STRATEGY
This module will be delivered using a combination of lectures and skills periods during which students will work on set problems or those taken from

the recommended text. At the start of the module the student will be provided with a week by week study guide to facilitate the learning process.

ASSESSMENT AND FEEDBACK STRATEGY
a Summative assessment and rationale for tasks

A formal examination (100%) at the end of the year will give students the opportunity to apply their knowledge and problem solving abilities to engineering mathematics and will address all learning outcomes.

b. Additional formative assessment - detail of process and rationale

Students attend seminars throughout the academic year, during which they will work through problems to develop their knowledge and skills, with the support of the tutor.

c. Indication of how students will get feedback and how this will support their learning

Informal feedback on work in progress is given continuously during seminars.
Formal feedback will be given directly after the exam.

IMPLICATIONS FOR CHOICE
None

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MEng Electrical and Electronic Engineering: Year 2 Modules

CG0037 Advanced Engineering Mathematics (CORE, 20 Credits)

SYNOPSIS OF MODULE

This module is designed to provide the student with a basic course in Laplace Transforms, their use in solving ordinary differential equations arising from physical problems, and their use in describing the behaviour of simple control systems. The student will be introduced to the concept of the harmonic components of a periodic waveform and be shown how this is useful in matching general solutions of partial differential equations to particular boundary or initial conditions. The solution of systems of linear ordinary differential equations using matrix methods will also be considered.

The module will be delivered using a combination of lectures and seminars.
Assessment is by formal examination.

INDICATIVE READING LIST OR OTHER LEARNING RESOURCES
Croft A and Davison R (2010) Mathematics for Engineers: A Modern Interactive Approach, 3rd edn. Prentice Hall

James G (2010) Advanced Modern Engineering Mathematics, 4th edn. Addison - Wesley

Stroud K A and Booth D J, (2011) Advanced Engineering Mathematics, 5th edn. Palgrave

OUTLINE SYLLABUS

Laplace Transforms: Definition, simple transforms, linearity.

First shift theorem. Inverse transforms, linearity, use of the first shift theorem and partial fractions. Transforms of derivatives. Transforms of an integral. The Heaviside Unit Step function. The second shift theorem. Solution of linear ordinary differential equations with constant coefficients, including systems of such equations. The Delta function and the Impulse Response function; transfer function. Initial and final-value theorems. Convolution and the convolution theorem. Poles of the transfer function and stability. Steady-state response. (50%)

Periodic functions and Fourier series. Full-range and half-range series. Even and odd functions.
Coefficients in complex form. Application to the solution of partial differential equations by the method of separation of variables. (25%)

Matrices, eigenvalues and eigenvectors. Algebraic evaluation of the eigenvalues and eigenvectors of a matrix. Application to the solution of a system of linear ordinary differential equations. (25%)

AIMS OF MODULE

1. To apply Laplace Transform methods to the solution of ordinary differential equations.

2. To examine the behaviour of simple control systems using Laplace Transform concepts.

3. To explain how a periodic waveform can be represented as an infinite series of sinusoids.

4. To explain how partial differential equations arise as natural descriptions of phenomena in the physical world and find their separated solutions.

5. To introduce the concepts of the eigenvectors and eigenvalues of a matrix, and to show how these can be found by algebraic means.

6. To explain how systems of ordinary differential equations arise as natural descriptions of phenomena in the physical world, and to find their solutions using matrix methods.

LEARNING OUTCOMES

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

1. Obtain direct and inverse Laplace Transforms using standard results.

2. Formulate simple physical problems as ordinary differential equations and use the method of Laplace Transforms to obtain their solution.

3. Find the impulse-response and transfer functions of a system.

4. Determine the behaviour of a system and its stability.

5. Determine the overall transfer function of a system compromising interconnected subsystems using block-diagram techniques.

6. Find the Fourier Series of a periodic waveform.

7. Find the separated solutions of a partial differential equation.

8. Determine the eigenvalues and eigenvectors of a matrix and use to solve a system of linear ordinary differential equations.

PREREQUISITES

None

COREQUISITE(S)

None

DISTANCE LEARNING DELIVERY

None

LEARNING, TEACHING AND ASSESSMENT STRATEGY

The module will be delivered using a combination of lectures, set work and skills periods in which students will be able to obtain help with problems associated with the module.

Examination assesses all Learning Outcomes.

IMPLICATIONS FOR CHOICE

None

EN0564 Analogue Electronics and Instrumentation (CORE, 20 Credits)

SYNOPSIS OF MODULE
The sensor systems instrumentation needed to measure a variety of different measurands (for example temperature, pressure and lux level) will be covered, with a view to both the sensors and the signals they produce. Amplifiers and signal conditioning devices will be covered that convert the sensor output into usable signals for typical process control platforms. Operational amplifiers will be used extensively in the module, leading up to an understanding of discrete electronic transistor design.

CAD tools will be used to enhance student understanding of instrumentation systems and circuit design, operation and testing (for example Labview and OrCAD).

The module is assessed using an in-class laboratory test paper (30%) and an examination (70%) at the end of the year. Formative feedback is provided throughout the year in the laboratory work, and via blackboard practice tests and in-class quizzes.

INDICATIVE READING LIST OR OTHER LEARNING RESOURCES
1. Recommendations for purchase by students
N/A
2. Books
* Bentley, J. P.(2004). Principles of Measurement Systems, 4th Edition, Longman, ISBN-10: 0130430285
* Clayton, G. B. (2003). Operational Amplifiers (EDN Series for Design Engineers), Pub: Newnes; 5 edition (3 Mar 2003) ISBN-10: 0750659149
* Sedra, A. S. (2003). Microelectronic Circuits, Oxford University Press USA; 5 edition, ISBN-10: 0195142527
3. Journal Articles
N/A
4. Journals and Newspaper Titles
N/A
5. Databases and Websites
* IEEEXplore database
6. Any Other Resources
N/A

OUTLINE SYLLABUS
Operational Amplifiers
Operational amplifier applications as applied to instrumentation signals, active filter circuits and instrumentation amplifiers. Operational amplifier stability considerations including phase margin, bode diagrams, and compensation methods (dominant pole and lag-lead).

Sensors
Temperature, strain and light sensor systems looking into the devices needed and the signals they provide. Additional sensors considered may also include slot encoders, accelerometers and hall effect devices.

Instrumentation
Amplifiers and signal conditioning will be covered to demonstrate the ability for signals to be converted and used in real world environments. Operational amplifiers will be expanded upon with the design of the instrumentation amplifier to highlight the performance improvements. Noise analysis will be introduced to show how instrumentation techniques reduce this phenomenon.

Discrete Electronics
Operational amplifiers are made from discrete elements; these building blocks include the Bipolar Junction Transistors (BJTs) and the Field Effect Transistor (FET). Biasing and amplifier design for these will be shown, with more advanced introduction to performance analysis using Monticarlo simulations. Transistor applications may include current sources, current sinks, and differential input stages.

AIMS OF MODULE
This module aims to show instrumentation and sensor systems and how analogue signals can be conditioned, amplified and then measured within a control or monitoring system. The module then looks in more depth at the analogue parts of instrumentation amplifiers and then into discreet elements that can make up the amplifier.

LEARNING OUTCOMES
The student will be able to:

1. Demonstrate the application of knowledge in the design of instrumentation, and sensor systems with reference to real world problems. (UKSPEC

US1, US2, D4)

2. Mathematically model system-level and circuit solutions for instrumentation and analogue electronic systems (UKSPEC E2, E4)

3. Simulate, build and test circuitry using simulation and practical lab equipment (UKSPEC P3, P2)

4. Analyse the specification and performance requirements necessary for sensors, instrumentation and general circuit operation within a regulator framework (UKSPEC S4, P4)

PRE-REQUISITE(S)
None

CO-REQUISITE(S)
None

DISTANCE LEARNING DELIVERY
N/A

LEARNING AND TEACHING STRATEGY
The module will be delivered via a combination of lectures, workshops, and directed and independent learning. Moreover, it will include eLearning in the form of blackboard content and some screencam video material to aid learning.

Lectures will include formative feedback quizzes and interactive case studies, and will consist of more problem based activities than a traditional lecture. Workshops will also be interactive with formative tests based on the lab work to provide the student with feedback.

ASSESSMENT AND FEEDBACK STRATEGY
a Summative assessment and rationale for tasks

Summative assessed will include an in-class laboratory test paper (30%) and an end of year final exam (70%). The end of year exam will cover all the theoretical material and aspects of learning from the laboratory sessions.

b. Additional formative assessment - detail of process and rationale

This will take the form of: quizzes in the lectures and some use of case studies in the lecture to promote a more interactive learning environment; formative testing in the workshops to provide regular opportunities for the student to assess their own learning.

c. Indication of how students will get feedback and how this will support their learning

Verbal feedback will be provided during the workshop (laboratory) sessions. Written feedback will be provided on the laboratory report. Examination feedback will be provided following the normal processes to show generically where the cohort has a strong or a weaker answer to the examination.

IMPLICATIONS FOR CHOICE
EN0625 Design and Manufacturing Analysis
EN0631 Industrial Instrumentation and Modern Control Systems

EN0565 C Programming and Digital Systems (CORE, 20 Credits)

SYNOPSIS OF MODULE
This module aims to further develop the fundamental digital and C programming knowledge and design concepts established at level 4. This will involve the design of digital decoder and multiplexers, synchronous counters and an introduction to Finite State Machines (FSM). These are covered with the intent of using a Hardware Description Language (HDL) and associated CAD tools to enhance student understanding of circuit design, operation and testing. The C programming language will be used to program a microcontroller to perform hardware control as an alternative to using digital hardware. CAD tools will be used to develop and simulate the C programs, as well as the programming of a microcontroller to implement given specifications. In this way the student will learn how modern electronic systems can be programmed for both hardware and software based solutions to meet a range of applications.

Assessment comprises an unseen closed book examination (50%) at the end of the year along with a practical assignment (50%), the latter being based upon the work done in the laboratory sessions. The assignment will provide the student with the opportunity to carry out practical design and evaluation activities. Formative feedback is provided in both the seminar and laboratory sessions.

INDICATIVE READING LIST OR OTHER LEARNING RESOURCES
1. Recommendations for purchase by students
N/A
2. Books
* Holdsworth, B. (2002). Digital Logic Design, Butterworth
* Floyed, T.(2003). Digital Fundamentals, Prentice Hall 9th ED. ISBN 0-13-197255-3
* Minns, P.D., and Elliott, I.D. (2008). FSM based Digital design using Verilog HDL. Wiley Pub. ISBN 978-0-470-06070-4
* Parchizadeh, H., Vuksanovic, B. (2009). PIC Projects - A Practical approach. Wiley Pub. ISBN 978-0-470-694619
* Wakerly, J. F. (2006). Digital design: principles and practices, Prentice Hall 4th Edition Pub. ISBN 0-13-186389-4
3. Journal Articles
N/A
4. Journals and Newspaper Titles
N/A
5. Databases and Websites
* IEEEXplore database
6. Any Other Resources

N/A

OUTLINE SYLLABUS
Digital Electronics

Revision of Boolean Algebra, Digital Decoders and Multiplexers. How Decoders can be used to develop memory mapping schemes for a microprocessor. Bit Banging external memory to a microcontroller. Propagation delay in decoders and multiplexers and their effect on memory mapping schemes. Effect of hazards in digital systems and how to remove them by identifying static 0 and static 1 hazards. Effects of Dynamic hazards on a digital system.

Programmable Logic Devices - Simple PLD (SPLD) architecture and the PLD design cycle.

Complex PLD (CPLD) architecture and design. Low-voltage and low power CPLD technologies. Using schematic entry and hardware description language to capture a digital CPLD design. Rapid prototyping and testing.

Introduction to the fundamental aspects of a standard hardware description language (Verilog/VHDL) - describing simple digital logic such as gates, flip-flops and net-lists. Simulation at the functional level to verify correct operation. Describing logic by means of Boolean equations and expressions (data-flow style). Synthesis and Implementation of a HDL design using a PLD.

Introduction to synchronous counters. How to design a synchronous counter and implement it in a HDL using either T Type Flip Flops (TFF) or D type Flip Flops (DFF). Design of synchronous counters to a given specification. Design of bit slice parallel loading counters and shift registers for implementation in PLD devices. Introduction to simple FSM design and how in some cases they can be used to simplify a system design by not using a microcontroller.

Computing in C on a microcontroller

Introduction to the microcontroller; program memory, ram memory, special function registers, I/O ports, control and status registers. Using the C language to program a microcontroller, limitations of a C program using a microcontroller.

Typical microcontroller circuits to read digital inputs and output to digital outputs using the C programming language. Use of C language bit masking to control output bits in a microcontroller system. Use of bit masking in C to read digital inputs in a microcontroller system. Controlling peripheral devices in a microcontroller; such as an Analogue to digital converter (ADC), a Hardware Timer, using serial I/O in a microcontroller. Identifying bit range in ADC devices as well as estimating signal to noise limits in particular applications. Developing microcontroller applications for particular specifications such as a Traffic Lights controller, a Home Alarm system, a system to determine object distance using an Ultrasonic transmitter and receiver.

AIMS OF MODULE
This module develops digital electronics and programming knowledge. Within digital electronics we introduce techniques for the design of decoders, multiplexers, synchronous counters and simple Finite State Machines (FSM). Computer programming techniques are exemplified through digital electronics (for example FSMs).

LEARNING OUTCOMES
The student will be able to:

1. Design digital hardware to a specific requirement and analyze their fitness for purpose using a HDL. (UKSPEC US1, US2, E1, E2, P1, P2)

2. Design C programs to execute on a microcontroller to a specific requirement and analyze their fitness for purpose using a C programming IDE. (UKSPEC E2, E3, E4, P2 P3, P4)

3. To make use of CAD tools and languages to simulate and implement digital designs using PLDs (Programmable Logic Devices). (UKSPEC E2, E3, E4, P2, P3, P4)

PRE-REQUISITE(S)
None

CO-REQUISITE(S)
None

DISTANCE LEARNING DELIVERY
N/A

LEARNING AND TEACHING STRATEGY
The module will be delivered via a combination of lectures, directed learning and independent learning and workshops (laboratories).

Lectures and laboratories are a key component in the learning process and are designed to reinforce theory and practice and will make use of problems and their solutions to highlight the key aspects of the work.

Multi Choice Questions (MCQs) will be used to provide feedback to both the lecturer and the student on learning outcome understanding.

ASSESSMENT AND FEEDBACK STRATEGY
a Summative assessment and rationale for tasks

This module will be assessed by an assignment (50%) and an end of year examination (50%). The assignment will be designed to assess the student's ability to develop microcontroller based solutions to engineering problems using C computer programs. The examination will be designed to test the long term retention of the work covered in the Digital Electronics part of the module.

b. Additional formative assessment - detail of process and rationale

This will take the form of oral feedback in lectures and workshops (laboratories) as well as MCQ tests during workshop periods.

c. Indication of how students will get feedback and how this will support their learning

Verbal feedback will be provided in lectures and workshops. Written feedback will be provided on the assignment work. There will be written feedback on the exam paper scripts returned to the students. In addition, examination feedback will be provided following to show generically where the cohort has a strong or a weaker answer to the examination.

IMPLICATIONS FOR CHOICE
EN0627 Embedded Systems

EN0566 Communication Systems (CORE, 20 Credits)

SYNOPSIS OF MODULE
This module aims to show the methods used in modern communications. It examines the technology for the communication of digital data networks and introduces practical aspects of high speed transmission links using optical fibres.

Assessment of the module is via an unseen closed book examination (100%). Formative feedback is provided in both the lecture and seminar sessions.

INDICATIVE READING LIST OR OTHER LEARNING RESOURCES
1. Recommendations for purchase by students
N/A
2. Books
* Keiser, G. (2003). Optical Communications Essentials, Mcgraw-Hill, ISBN 0071412042
* Stallings, S.J. (2007). Data and Computer Communications, Prentice Hall, ISBN 0132433109
3. Journal Articles
N/A
4. Journals and Newspaper Titles
N/A
5. Databases and Websites
* IEEEXplore database
6. Any Other Resources
N/A

OUTLINE SYLLABUS
DIGITAL SIGNALLING
Spectra of rectangular waveforms, definitions of bit rates and baud rates, relationship between bandwidth and digital recovery. ISI, line codes and shaping.

ANALOGUE MODULATION
Amplitude Modulation; comparison of various forms of AM, demodulation, frequency and phase insertion errors, examples and applications. Frequency modulation; NBFM, WBFM, spectra and bandwidth, examples and applications.

DIGITAL MODULATION
ASK, FSK, PSK, generation and demodulation, spectrum and bandwidth. Comparison of bandwidth and power. Quadrature carrier systems.

DIGITAL DATA NETWORKS
OSI reference model. Asynchronous and synchronous networks. The serial data link. Protocols. FDM and TDM multiplexing. Parity and CRC principles and implementation. Networks. IP addressing.

OPTICAL SYSTEMS
Optical sources; structure, performance and frequency response. Detectors. Fibres; modes, dispersion, optimum wavelength, coupling and splicing.

RADIO SYSTEMS
AM transmission and reception circuits, modulator and mixer design. Asynchronous and synchronous detection.

FM transmission and reception circuits, FM modulators, FM demodulators, and limiter circuits. Attenuation in radio systems.

AIMS OF MODULE
The module aims to introduce the student to communication theory and to provide the student with the ability to appraise communication systems.

LEARNING OUTCOMES
The student will be able to:

1. Apply mathematical principles to both analogue and digital communications

2. Analyse basic Analogue and Digital Communication Systems

3. Simulate and develop communication systems using computer software

4. Design and develop communication systems and define the required sub-systems

5. Compare and contrast different communication technologies

PRE-REQUISITE(S)
None

CO-REQUISITE(S)
None

DISTANCE LEARNING DELIVERY
N/A

LEARNING AND TEACHING STRATEGY
The module will be delivered via a combination of lectures, seminars, and directed learning and independent learning, and will include a formative assessment. The seminars will support the lecture material with work using MATLAB, Mathcad and Labview software.

ASSESSMENT AND FEEDBACK STRATEGY
a Summative assessment and rationale for tasks

This module will be assessed by an unseen formal examination (100%) at the end of the year.

b. Additional formative assessment - detail of process and rationale

e-learning self-assessment tests will be provided via blackboard. MCQ tests will be used within lectures. Feedback will also be provided on seminar work.

c. Indication of how students will get feedback and how this will support their learning

Students receive feedback via by the blackboard self-assessment tests. Verbal feedback will be provided on the seminar work.

Examination feedback will be provided following to show generically where the cohort has a strong or a weaker answer to the examination.

IMPLICATIONS FOR CHOICE
None

EN0567 Power Machines and Renewable energy (CORE, 20 Credits)

SYNOPSIS OF MODULE
This module aims to develop the student's knowledge the principles of the operation of electrical machinery, power electronics, power systems, renewable energy and considers the interaction between these.

This module is assessed via a closed book unseen examination (70%) and through a coursework report on laboratory work. Formative feedback is provided in seminar and laboratory sessions.

INDICATIVE READING LIST OR OTHER LEARNING RESOURCES
1. Recommendations for purchase by students
N/A
2. Books
* Chapman, S.J. (2002). Electric Machinery and Power System Fundamentals, McGraw Hill, 2002. ISBN 007112179X
* Rashid, M.H. (2004). Power Electronics: Circuits Devices and Applications, Prentice Hall, 2004. ISBN 0131228153
* Twidell, J., & Weir, T. (2006). Renewable Energy Resources, 2nd edition, Taylor & Francis, ISBN 0419253203
* Wildi, T. (2006). Electrical Machines, Drives and Power Systems, 6th ed., Prentice Hall, ISBN 0131776916
3. Journal Articles
N/A
4. Journals and Newspaper Titles
N/A
5. Databases and Websites
* IEEEXplore database
6. Any Other Resources
N/A

OUTLINE SYLLABUS
ROTATING MACHINES
D.C. machines: principles and construction of permanent magnets, separately excited, shunt and series types. Equivalent circuit. Torque-speed curves, starting and speed control.

Induction machine: Principles and construction. Expressions for speed of rotating field and slip. Rotor power balance, equivalent circuit, and torque-slip curve. Speed control and starting of cage-type and wound rotor type. Modern control techniques.
Introduction and principles of synchronous motors.

POWER ELECTRONICS
Single-phase and three-phase controlled rectifiers: Basics, types, performance with R and R-L Load.

D.C. power control: basic chopper circuit, mark/space ratio, ripple current, buck and boost converters.

A.C. power control: phase and integral cycle control; Application to R, RL and motor loads; Power factor

Inverters: Principles, basic circuit and operation.

POWER SYSTEMS
Transformers: principles of single and three-phase transformers, construction, equivalent circuits, referring of impedances, losses, efficiency and regulation. Open and short circuit tests. Connections of 3-phase transformer, vector groups and parallel operation.

Complex power. basics of active and reactive power flow through an impedance.

P.U. system. Fundamentals of balanced fault level calculations.

RENEWABLE ENERGY
Overview of electricity generation technologies from new and renewable energy, current contributions and future prospects.

Operating principles, types, characteristics and comparison of features for hydro, photovoltaics, wind, combined heat and power, fuel cells, tidal and marine power plants.

Applications of rotating machines (generators) and power electronics converters in new and renewable energy conversion systems. Maximum power point trackers, a.c./d.c. conversion, d.c./a.c. conversion and grid interface for photovoltaic and wind energy conversion systems.

AIMS OF MODULE
This module aims to develop the student's knowledge the principles of the operation of electrical machinery, power electronics, power systems, renewable energy and considers the interaction between these.

LEARNING OUTCOMES
The student will be able to:

1. Describe the fundamental theory and operating principles of electrical machinery power systems, power electronic equipment and the interaction between these

2. Design and evaluate simple systems involving combinations of the module components and identify the safe working practices needed

3. Explain the principles of the emerging technologies of new and renewable energy resources and the integration of these into the electricity grid.

PRE-REQUISITE(S)
None

CO-REQUISITE(S)
None

DISTANCE LEARNING DELIVERY
N/A

LEARNING AND TEACHING STRATEGY
The module will be delivered via a combination of formal lectures, seminars, laboratories, group work, directed learning and independent learning and will include formative assessment. The use of appropriate IT will be included as appropriate.

The theory and analysis of electrical power engineering and renewable energy will be thoroughly investigated in formal lectures. In seminar and laboratory classes, practical problems will be examined and analysed. In addition, examples of real system design and analysis will be introduced. The assignment will enhance the student theoretical knowledge and expose them to the practical work and new technologies.

ASSESSMENT AND FEEDBACK STRATEGY
a Summative assessment and rationale for tasks

This module will be assessed by a report (30%) and a closed book unseen examination (70%).

The report will be based on two pieces of laboratory based work, including the use of power system design and analysis software. The report will describe the work conducted, the results obtained, their analysis and the conclusions drawn.

b. Additional formative assessment - detail of process and rationale

Formative feedback will be provided on seminar and laboratory exercises.

c. Indication of how students will get feedback and how this will support their learning

Verbal formative feedback is provided in the seminar and laboratory sessions. Written feedback will be provided on the written report.

Examination feedback will be provided following the normal processes to show generically where the cohort has a strong or a weaker answer to the examination.

IMPLICATIONS FOR CHOICE
EN0310 Power Systems

EN0580 Engineering Product Development (CORE, 20 Credits)

SYNOPSIS OF MODULE
The module aims to equip the student with the knowledge and skills necessary to design, implement and manage projects associated with the development of modern electrical products within a global context.

The product development cycle will be covered from market identification through to production, evaluation and presentation. Students will work in teams to develop an electrical product. Each team may also have the opportunity to outsource some of the work to other teams to simulate a global design team.

Assessment of the module will be via a group planning presentation (20%) and a group report (80%). Formative feedback will be provided in the laboratory sessions.

Summative feedback for the group planning presentation during semester 1 workshop sessions and written feedback will be provided for the group report, together with the opportunity to arrange discussion with the academic.

INDICATIVE READING LIST OR OTHER LEARNING RESOURCES
1. Recommendations for purchase by students
N/A
2. Books
* Asakura, R. (2000). Revolutionaries at Sony: The Making of the Sony Playstation and the Visionaries Who Conquered the World of Video Games, McGraw-Hill, ISBN 0071355871
* Haskell, B. (2004). Portable Electronics Product Design and Development for Cellular Phones, PDA's Digital Cameras, Personal Electronics and More, McGraw-Hill, ISBN 0071416390
* Stark, J. (2004). Product Lifecycle Management: 21st Century Paradigm for Product Realisation, Springer-Verlag UK, ISBN 0133942899
* Ward, T. and Angus, J.A.S. (1996). Electronic Product Development, Taylor & Francis. ISBN 074875170X
* Smith, N.J. (2008). Engineering Project Management, Blackwell Publishing. ISBN 1405168021
3. Journal Articles
N/A
4. Journals and Newspaper Titles
N/A
5. Databases and Websites
IEEEXplore database
6. Any Other Resources
N/A

OUTLINE SYLLABUS
* Project management, product life cycle, obtaining product funding. Project costing
* Market identification. Horizontal and vertical business models
* Design, development and analysis. Design specifications, and standards and legal issues. Introduction to design for manufacture/assembly. Introduction to schematic capture & PCB design. Market and technical risk assessment. End-of-life considerations
* Global engineering. Ethical aspects of engineering. Social impact of engineering. Environmental impact and susceptibility
* Quality and reliability

Typical group work

Students will work together in groups acting as an industrially based development team. Team members will take up roles such as circuit designer, PCB designer, software engineer, costing & marketing investigators, technology developers and team leader. The team will produce a working prototype within specified constraints and may also have the opportunity to outsource some elements of the work to other teams to simulate a global design team.

Typical titles for the product development projects would be:-

* PC Temperature Management
* Guitar Amplifier
* Energy saving product

AIMS OF MODULE
The module aims to equip the student with the knowledge and skills necessary to design, implement and manage projects associated with the development of modern electrical products within a global context.

LEARNING OUTCOMES
The student will be able to:

1. Investigate an engineering design problem taking into account constraints including environmental, social and legal issues.

2. Apply key engineering principles to solve engineering problems.

3. Work effectively as a team to manage the engineering design process and evaluate outcomes.

4. Identify and manage cost drivers and understand the commercial and economic context of engineering design.

5. Convey information by written report and oral presentation.

PRE-REQUISITES
EN0414 Research, Analysis and Presentation or equivalent knowledge

CO-REQUISITES

None

DISTANCE LEARNING DELIVERY
N/A

LEARNING AND TEACHING STRATEGY
The module will be delivered via a combination of lectures and laboratories. Group work, project work, and directed learning and independent learning will be used in the module. Formative feedback will be provided in the laboratory sessions. The module will include the use of IT as appropriate.

IMPLICATIONS FOR CHOICE
None

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MEng Electrical and Electronic Engineering: Year 3 Modules

CM0567 CEIS Professional Placement (CORE, 0 Credits)

SYNOPSIS OF MODULE
This module is designed to represent all programmes within the School of Computing, Engineering and Information Sciences with an option to take a one year sandwich placement as part of their route structure. Learners also have the opportunity to gain the work based qualification, City & Guilds Licentiate (LCGI).

The aim of this module is to use the placement experience to develop and enhance as far as possible appropriate areas specified in the relevant QAA Code of Practice as well as accreditation bodies: BCS, IET, IME and CGI within the appropriate working environments. The aims are general because of the wide range of placement opportunities offered by the School of Computing, Engineering and Information Sciences for the Professional Placement. It is the policy of the School of Computing, Engineering and Information Sciences to encourage its students to take advantage of the Professional Placement.

This module is designed to promote personal development and a range of interpersonal, intellectual and practical (functional) skills based around and demonstrated through a significant individually negotiated Professional Placement. It seeks to raise the learner's awareness of the workplace as a learning environment and extend their capability and enhance their individual effectiveness, employability and business competitiveness. It will seek to develop professional skills in the chosen subject area within the working environment. Being able to manage own placement development i.e. managing tasks; working with and relating to others, applying knowledge, applying initiative in work problems. Learners will be expected to reflect on the learning derived from the Professional Placement.

INDICATIVE READING LIST OR OTHER LEARNING RESOURCES
Various guides:
* Introduction to Professional Placement
* Student guide to Professional Placement
* Assessment Guide
* Student guide to City & Guilds Licentiateship

It is usual for the learner to follow a basic induction programme when they join their placement organisation. This will typically include aspects of Safety, Working Practices and any Legislation that is specific to the activities of the organisation.

OUTLINE SYLLABUS
The subject of the Professional Placement and the specific aim(s) and learning outcomes arising from it, will be unique to each individual learner. Learners will negotiate with their employer the subject and scope of your role; specific aims and learning outcomes method by which the outcomes will be achieved; how the placement will develop the learners capability in respect of their effectiveness, employability and/or business competitiveness; the resources needed including materials, equipment, time and support; Major progress review points.

Opportunity to apply for the City and Guilds Licentiateship award (LCGI), using portfolio as evidence.

AIMS OF MODULE
1. To enhance the learners individual effectiveness, employability and/or business competitiveness by locating the learning and development in a real work environment.

2. To extend the learners capability, promote personal development and a range of interpersonal, intellectual and practical (functional) skills and knowledge based around and demonstrated through an individually negotiated portfolio.

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

1. Identify, negotiate and manage tasks which addresses own personal goals and organisational/professional requirements[Assessed by Quarterly Reflective Reports]
2. Draw on, apply and review considerable prior knowledge and new learning to changing situations [Assessed by Monthly Activity Reports, Quarterly Reflective Reports]
3. Extend a wide range of specialised technical, creative and/or conceptual skills that apply to his/her work in order to make informed judgements [Assessed by Monthly Activity Reports, Quarterly Reflective Reports]
4. Plan and manage Professional Placement within an agreed framework, dealing with unpredictable situations, using initiative, making informed judgements and managing dilemmas, which include those that impact outside the immediate work area. [Assessed by Monthly Activity Reports, Quarterly Reflective Reports].
5. Make recommendations for own professional development and propose a strategy for implementation and deployment [Quarterly Reflective Reports].

6. Ability to work with and relate to others as a member of a team on real-life projects. Making effective contributions to meetings and group activities. [Assessed by Monthly Activity Reports, Quarterly Reflective Reports, End of Placement Report].
7. Communicating clearly and efficiently [Assessed by Poster, Monthly Activity Reports, Quarterly Reflective Reports, End of Placement Report, Graduate CV].

PREREQUISITES
* Learners would normally have completed a year of study at level 5 at Northumbria University.
* Be employed in an organisation, working at an occupational level within the organisation that will enable them to undertake learning which is at least equal to the level of work they are pursuing
* Have the support of their employer or the organisation in which the professional placement is located, in the form of time, resources and advice
* Identify and have access to a work based supervisor who is able to help, advise and support the learner and to critically comment on the progress and outcomes of work undertaken.

COREQUISITES
N/A

LEARNING AND TEACHING STRATEGY
Placement period will normally be full-time for 48 weeks.

Prior to placement commencing, placement briefing session is provided. During this session the placement experience and assessment is discussed more in depth. Learners are informed of how to access 'on placement' documentation and advice within the e-learning platform. Hard copies of Guidelines about Placement, Assessment and option to apply for the City and Guilds Licentiateship are also provided. Each learner is allocated a Visiting Tutor who is able to provide academic and pastoral support. This support is backed up by the Placement Tutor(s).

The teaching and learning strategies adopted in this module will be unique to individual learners and will be agreed with the Placement Tutor / Visiting Tutor, when negotiating the professional placement. For example short courses, directed learning, informal training by work based supervisors, Self study.

The work based supervisor will supervise the learner on a weekly basis, in addition some organisations also offer the opportunity for the learner to have a mentor. An academic member of staff will normally visit the learner two times over the course of a one-year placement period. During the visits the performance of the learner will be discussed with the supervisor and the learner's programme reviewed in light of their general progress and performance.

During visits the performance of the learner will be discussed with the work based supervisor and the learner's programme reviewed in light of their general progress and performance. A record will be kept to include each visit made by the visiting member of academic staff.

Each learner is required to keep a record of their activities with reflections and by the end of the placement period will have produced a portfolio which can be used when applying for employment upon graduation. The portfolio will contain monthly activity reports, quarterly reflective reports, graduate curriculum vitae, poster and end of placement report. Within the portfolio all general aspects of the organisation as well as technical details of their projects and activities carried out during the placement period.

ASSESSMENT STRATEGY
Formative assessment and rationale for tasks

1. Formative assessment
* The work based supervisor provides informal formative assessment on weekly / monthly basis depending on the placement provider and period during professional placement. More formalised formative assessment will usually occur on a quarterly basis.
* The visiting tutor provides formative assessment during placement visits. Formative assessment may also occur in between visits.

2. Rationale for tasks
* Monthly reports are a log of activities for which the learner has engaged in during each month of their placement. This is to assist learner in remembering what they have done, the time spent on particular types of activities and also be able to use for reflection. When content is agreed work based supervisor normally signs off report as a true record.
* Quarterly reports enable learner to reflect on the activities within the respective monthly reports, check they are meeting performance criteria. They provide a purposeful guide during the quarterly meetings the work based supervisor to discuss progress and agree on activities for the following 3 months. When content is agreed work based supervisor usually validates report as a true record.
* End of year placement report enables learner to reflect on their overall experience using monthly and quarterly reports for assistance. Being able to review the whole placement helps learner to realise their achievements, skills, knowledge and experience gained.
* The Poster provides information on the placement provider and role the learner has undertaken. This enables returning students to communicate their experience to L5 learners searching for a placement at the Poster Event during Induction week.
* Graduate CV enables learner to begin applying for graduate positions. Previous tasks enable learner to summarise the skills, knowledge and experience gained during placement.

b. Feedback strategy

Feedback on learner's performance will normally be provided by the Visiting Tutor during visits. Feedback will also be provided by the work based supervisor usually at quarterly meetings and normally completes a feedback questionnaire near the end of the professional placement period.

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MEng Electrical and Electronic Engineering: Year 4 Modules

EN0310 Power Systems (CORE, 20 Credits)

SYNOPSIS OF MODULE

This module aims to study the components and operation of modern power systems, highlighting the principles of operation, design, economics of power generation, frequency and voltage control, quality of supply, performance limits and protection from abnormal conditions.
Assessment is made in the module thought an unseen closed book examination and an assignment. Formative assessment is made during the seminar sessions to guide the student thought the module.

INDICATIVE READING LIST OR OTHER LEARNING RESOURCES

WEEDY, B.M. and CORY B.J. "Electric Power Systems" (Wiley) 1998. ISBN 0471916595

GRAINGER J. J. and STEVENSON W. D. "Power System Analysis", McGraw-Hill 1994. ISBN 0070612935.

WRIGHT A. and CHRISTOPOULOS C. "Electrical Power System Protection" 2nd edition, Kluwer academic publishers 1999. ISBN-10: 0412817608.

HIGORANI N.G. and GYUGYI L. " Understanding FACTS: Concepts and Technology" IEEE Press, 2000. ISBN 0780334558

El-Hawary M.E. "Electrical Power Systems, Design and Analysis" IEEE Press 1995. ISBN 078031140X

NASAR S.A. "Electric Power Systems", (McGraw-Hill), 1999. ISBN 0070459177

OUTLINE SYLLABUS

Synchronous Machines:
Cylindrical-rotor type: Construction, machine mmfs, synchronous reactance, equivalent circuit, motor and generator treatment. Excitation requirements. Operation in parallel with a large system, Synchronisation. Power-angle equation and Power chart.
Salient-pole type: Construction. Two-axis theory, power-angle relationships.
The reactance of a synchronous machine. Current-time variation of synchronous generator current following a 3- phase short circuit.

Transmission Lines:
Short, medium and long transmission line representation. Surge Impedance Loading. Use of shunt and series reactive power compensation.

Load Flow Analysis:
Active and reactive power flow: basic relationships. Control and power chart. Improvement of voltage levels by the injection of VArs. Numerical methods and use of computer software to determine power flow and voltage distribution in electric power networks.

Fault current calculations:
Fundamentals of symmetrical fault-level calculations.
Symmetrical components theory. Calculation of currents and voltages in simple networks for unbalanced faults. Effect of transformer connections on the flow of zero sequence currents. Fault current limitation.

System Stability:
Distinction between steady state, dynamic and transient stability. Power limits during steady-state and transient operation. Generator rotor dynamics, swing curve and the equal area criterion. Methods of increasing stability limits.

System Control and economic operation:
Operating principles of governors. Control of frequency in power networks. The role of the digital computers in system control.
Load sharing in a group of generators running in parallel. Incremental cost.

Reliability and Quality of supply:
Load characteristics. Security of supply and Security Recommendations. Voltage fluctuations and control. Pollution of supply by harmonics, effects, solutions and statutory requirements.

Power System Protection and Switchgear:
Detection and clearance of faults. Protective current and voltage transformers. Over-current, differential and distance protection. Protection of generators, transformers and feeders. Comparison of unit and non-unit types of protection.
Circuit breakers: Short-circuit current. Recovery voltage, Restriking transient. Rating.
Reclosing. Types.

Emerging technologies in power systems
Fundamentals of Flexible A.C. Transmission System (FACTS); Custom Power Technology; Embedded Generation; Renewable Energy resources and photovoltaic systems.

AIMS OF MODULE

1. To develop knowledge, understanding and the ability to analyse the components of a modern power system including embedded generation, FACTS and custom power technology.
2. To enable the student to analyse the performance of an integrated power system in both the steady-state and following system disturbances. Abnormal conditions such as faults are highlighted and means for protection against them are investigated.
3. To extend the student's knowledge of the important concepts of stability, active and reactive power control, reliability of a power system and quality of supply.

LEARNING OUTCOMES

The student will be able to:
1. Demonstrate an evaluate of the theory of operation, control and the properties of alternators, transmission lines, switchgear and protection systems,
2. Perform fault-level calculations for a power system enabling the correct switchgear to be selected,
3. Formulate numerical methods and use software packages to determine power flow and voltage levels in a power system,
4. Critically analyse how power systems are controlled with respect to the flow of active and reactive power, voltage levels, and economic load dispatching,
5. Summarise the principles of power system stability and methods for improving it, including the use of FACTS devices,
6. Analyse disturbances in power systems, their effects on the quality of supply and recommend appropriate solutions.

PREREQUISITES

EN0215 Power, Machines and Instrumentation or equivalent knowledge

COREQUISITE(S)

None

DISTANCE LEARNING DELIVERY

None

LEARNING, TEACHING AND ASSESSMENT STRATEGY

The theory, analytical and design procedures of power systems will be thoroughly investigated in formal lectures. In seminar classes and assignment, practical problems will be examined and analysed. In addition, examples of real system design will be introduced and performed on a small scale. The assignment will enhance the student theoretical knowledge and expose them to the new technologies in computer-aided design and analysis of power systems.
Recommend books for the unit (see below) will be used to support the learning process.

This module will be assessed by an assignment (20%) and an unseen closed book examination (80%).
The assignment includes the design and analysis of a small power network by using an industry standard software package. The assignment is a prime example of early formative feedback to students in preparation for the examination. Furthermore, the seminar session are used to provide formative feedback to the student throughout the module.
The examination is a sectioned paper with 8 questions set and student has to attempt 5 with minimum of 2 from each section.

IMPLICATIONS FOR CHOICE

None

EN0625 Design and Manufacturing Analysis (CORE, 20 Credits)

SYNOPSIS OF MODULE
The module is structured to provide the students with the opportunity to develop design analysis skills in the preparation of electronic circuit designs using Monticarlo and worst case analysis. Moreover, broad coverage of issues addressing keys electronic manufacturing, manufacturing yield predictions, electronic systems reliability and availability and electronic waste management are covered. Students' knowledge of practical aspects of electronic manufacture will be extended with emphasis on the characteristics of counterfeit electronic identification, environmental legislations and lean manufacturing practice.

Assessment will be carried out through an unseen closed book examination carrying 100% weighting. The examination will consist of two questions from circuit design and three questions from manufacturing analysis.

INDICATIVE READING LIST OR OTHER LEARNING RESOURCES
1. Recommendations for purchase by students
None
2. Books
SEDRA and SMITH: 'Microelectronic Circuits 5e'. Oxford University Press 2004. ISBN 0 19 514252 7

A. V. Ferris-Prabhu, Introduction to Semiconductor Device Yield Modelling, Artech House, 1992.

SR-332, (2005), "Reliability Prediction Procedure for Electronic Equipment", Telcordia Technologies, Issue 2.0.

Operational Availability Handbook, A Practical Guide for Military Systems, Sub-Systems and Equipment, June 2003, Pages: 98.

Electronic Waste Management, Edited by R.E. Hester and R.M. Harrison, Published by the Royal Society of Chemistry 2009.
Lean Thinking: Banish Waste and Create Wealth in Your Corporation, 384 pages, Publisher: Free Press; 7 July 2003; ISBN-10: 0743231643.
Spence R, Singh Soin R, 'Tolerance Design of Electronic Circuits'. Addison Wesley 1988. ISBN 0 201 18242 4
Schaumann R, Van Valkenburg Mace "Design of Analog Filters", Oxford University Press 2001, ISBN 0019 5118774
Huelsman L P 'Active and Passive Analog Filter Design'. McGraw-Hill. ISBN 0 07 030860 8

The Challenge of Sustainability, Global Environment Facility. Washington, D.C: World Bank, 2008.
3. Journal Articles
N/A
4. Journals and Newspaper Titles
N/A
5. Databases and Websites
IEEE Xplore Digital Library, accessed on 23-2-2011 (repository for all IEEE, IET journal and conference papers, available on campus university access)
6. Any Other Resources
NA

OUTLINE SYLLABUS
The module will cover the following themes:

Electronics Manufacturing Yield - the performance of electronic yield predictions

Reliability in Electronics Manufacturing - electronic reliability under the factors of cost, performance availability

Waste Management in Electronic Components - green electronic issues and legislation which affect both electronic product design and manufacturing aspects

Lean Manufacturing - in manufacturing technology illustrating the philosophy of lean manufacturing

Circuit design (typically filters or oscillators) with consideration of the circuit performance when non-ideal components are used.

Sensitivity analysis applied to active filters and other simple circuits.

Tolerance analysis, both worst-case and non-worst-case.

AIMS OF MODULE
The aim of this module is to cover in depth design analysis estimating worst case performance of a design towards manufacture. Moreover this theme of manufacturability is addressed in depth looking into reliability of a manufactured product and aspects of current legislation.

LEARNING OUTCOMES
Upon completion of the module the student will be able to:

1. Predict manufacturing yields by structured methods, understand the principles of electronic reliability, system availability analysis and lean manufacturing practices. (UKSPEC E1, E2),
2. Judge the End-of-life and understand the effect by electronic waste globally as well as taking considerations of the environmental legislations imposed by the government in product development. (UKSPEC S3, S4 P6)
3. Critique the effects of non-ideal components and predict manufacturing yields by structured methods, (UKSPEC E2, E3)
4. Design and validate selected circuits using real components (UKSPEC D1, D5)

PRE-REQUISITES
None

CO-REQUISITES
None

DISTANCE LEARNING DELIVERY
N/A

LEARNING AND TEACHING STRATEGY
Formal lectures and seminars are used to communicate syllabus content supported by real world examples through the use of tutorials. Students are required to carry out directed studies (typically a research paper) in addition to material placed on eLP (blackboard) which is examined.

ASSESSMENT AND FEEDBACK STRATEGY
a Summative assessment and rationale for tasks

Assessment will be carried out through an unseen closed book examination carrying 100% weighting. The examination will consist of a sectioned paper from circuit design and manufacturing analysis.

b. Additional formative assessment - detail of process and rationale

Formative assessment is made during the seminar sessions to provide feedback to the student throughout the module.

c. Indication of how students will get feedback and how this will support their learning

Feedback on students learning will take the form of verbal feedback during seminars. Examination feedback will be provided following the normal process to show generically where the cohort has a stronger or a weaker answer to examination questions.

IMPLICATIONS FOR CHOICE
None

EN0626 Digital Signal Processing Systems (CORE, 20 Credits)

SYNOPSIS OF MODULE
This module aims to make use of the knowledge and analytic skills developed throughout the course to design modern digital signal processing systems. This module will introduce the concepts of digital signals, systems and filter designs. Additionally this module aims to provide students with practical experience of designing and realising real-time digital signal processing algorithms. The student will use a CAE package to supports theoretical considerations of the systems design process to make performance predictions. A hardware DSP environment with supporting assembly

and debugging software will be used to produce a real-time implementation of the FIR/IIR filter algorithm being studied.

The module is assessed using two closed book examinations; Examination Part 1 at the end of Semester 1 and Examination Part 2 at the end of Semester 2. Summative feedback will be provided for Examination Part 1 at the beginning of Semester 2, while for Examination Part 2 it will be after the results are released at the end of the academic year. The examinations will cover all the theoretical material and aspects of learning from the workshop sessions. Formative feedback is provided on the laboratory work.

INDICATIVE READING LIST OR OTHER LEARNING RESOURCES
1. Recommendations for purchase by students
N/A
2. Books
* IFEACHOR, E. C. & JERVIS, B. W. (2001) Digital signal processing : a practical approach, 2nd edn. Harlow, Prentice Hall.

* LATHI, B. P. (1998) Signal processing and linear systems, New York, Oxford University Press.

* LYONS, R. G. (2011) Understanding digital signal processing, 3rd edn. Upper Saddle River, NJ, Prentice Hall.

* MITRA, S. K. (2011) Digital signal processing : a computer based approach, 4th edn. New York London, McGraw-Hill Higher Education ; McGraw-Hill distributor.

* TERRELL, T. J. & SHARK, L.-K. (1996) Digital signal processing : a student guide, Basingstoke, Macmillan.
3. Journal Articles
N/A
4. Journals and Newspaper Titles
N/A
5. Databases and Websites
* www.ti.com, accessed on 23-2-2011, online electronic repository of software and hardware tools associated with the DSP boards used.
* IEEEXplore database
6. Any Other Resources
* Matlab software with sptool and simulink
* Texas Instrument TMS320VC5416 DSK and Code Composer Studio.

OUTLINE SYLLABUS
Signal processing fundamentals: Analogue and discrete time signals, A/D and D/A converters, sampling theorem, anti-aliasing, Fourier and Laplace transform, z-transform, DTFT, transfer functions, difference equations. (Semester 1 and 2)

Filter Design: Finite Impulse Response (FIR) filters, Infinite Impulse Response (IIR) filters and pole zero maps in the z domain, design by pole-placement. (Semester 1 and 2)

FIR Filters: Linear phase, symmetric and anti-symmetric impulse response, frequency sampling method. Use of window functions, quantisation and finite word-length effects. (Semester 1 and 2)

IIR Filters: Approximation techniques based on differences, impulse invariance and bi-linear z-transformation. Design by pole placement method. (Semester 2)

An introduction to the appropriate aspects of the DSP CAE software for filter design such as Matlab and Texas Instrument Code Composer with Digital Signal Processing Kit. An overview of the DSP hardware architecture with specific focus on task related issues. An overview of the DSP software environment. DSP assembler focusing on task related instructions. (Semester 1)

A typical exercise will involve the design and implementation of a digital filter. The CAE software will be used to design the filter and predict it's performance. The performance of the realisation will be measured and compared with the predicted response. (Semester 1)

AIMS OF MODULE
The aim of this module is to provide advanced understanding in digital signal processing, namely in filter design and their implementation on a hardware platform. The student, upon completion of the module, will be able to design and implement digital filters based on the specifications, by using a suitable methodology.

LEARNING OUTCOMES
Upon completion of the module the student will be able to:

1. Demonstrate the understanding of key DSP principles in the design of DSP systems application for real world problems. (UKSPEC US1, US2, E1, D4)
2. Mathematically model DSP system to characterise and critically evaluate its theoretical and practical performance. (UKSPEC E2, E4, P1, P2, P7)
3. Simulate test signals and DSP systems using simulation tool and practical lab equipment (UKSPEC P2, P3)
4. Critically evaluate the practical limitations of hardware in filter designs and appreciate the need for low cost practical implementation. (UKSPEC S4, P3, P6)

PRE-REQUISITES
None

CO-REQUISITES

None

DISTANCE LEARNING DELIVERY
N/A

LEARNING AND TEACHING STRATEGY
The module will be delivered via a combination of lectures, workshops, directed and independent learning. Moreover it will include materials in the eLearning portal to aid learning.

There will be 2-hour lectures every week for the whole year. In addition there will be a 2-hour workshop on practical simulation tool and DSP systems every fortnight for the first semester supported by alternate week 1-hour seminars in the second semester.

The laboratory work in the workshop will provide formative student feedback.

ASSESSMENT AND FEEDBACK STRATEGY
a Summative assessment and rationale for tasks

Summative assessment is via TWO closed book examinations; Examination Part 1 at the end of Semester 1 and Examination Part 2 at the end of Semester 2. The weighting for each examination is 50% (hence 100% of the assessment for the module will be via examination). The examinations will cover all the theoretical material and aspects of learning from the workshop sessions.

b. Formative assessment - detail of process and rationale

Formative assessment will take the form of laboratory scripts in the fortnightly workshop and some use of case studies in the lecture to promote a more interactive learning environment.

c. Indication of how students will get feedback and how this will support their learning

Feedback on students learning will take the form of verbal feedback during the workshop sessions.

Examination feedback will be provided following the normal processes to show generically where the cohort has a strong or a weaker answer to the examinations. Feedback will be provided for Examination Part 1 at the beginning of Semester 2, while for Examination Part 2 it will be after the results are released at the end of the academic year.

IMPLICATIONS FOR CHOICE
None

EN0631 Industrial Instrumentation & Modern Control Systems (CORE, 20 Credits)

SYNOPSIS OF MODULE
This module aims to provide advanced understanding in industrial instrumentation and modern control design techniques using namely the state-space. Upon completion of the module, the student will be able to design instrumentation and control systems, and, implement and evaluate them using computer aided design packages. The module is delivered through formal lectures, supported by seminars and laboratories. The module will be assessed using a closed-book examination and an assignment.

INDICATIVE READING LIST OR OTHER LEARNING RESOURCES
1. Recommendations for purchase by students
N/A
2. Books
Bentley J P, "Principles of Measurement systems". 4th Edition. Longman Aug 2004. ISBN-10: 0130430285.

Bhuyan M, "Intelligent Instrumentation: Principles and Applications" 1st Ed. CRC Press 2010. ISBN-10 1420089536.

Franklin et al "Digital control of dynamic systems". 3rd Edition. Addison-Wesley 1998.

Klassen K B, "Electronic Measurement and Instrumentation. Cambridge University Press 1996. ISBN-10 0 521 47729 8.

Levine W S, Control Systems Fundamentals, CRC Press 2000.
3. Journal Articles
N/A
4. Journals and Newspaper Titles
N/A
5. Databases and Websites
IEEE Xplore digital electronic library, accessed 23-2-2011, (online access granted though university campus systems only)
6. Any Other Resources
Matlab 7.10/Simulink 7.5 Modelling package (The Mathworks 2010).

OUTLINE SYLLABUS
Revision of classical control design and analysis
PID control and pole placement methods, Bode and Nyquist plots, Laplace transforms and z-transforms.

State feedback control
State-space representation of systems, linear controllability and observability and rank condition. Linear feedback control design.

Stability

Asymptotic and global asymptotic stability, Lyapunov stability and Lyapunov equation. Estimation: Luenberger observer design.

Digital control

Different equations, sampling effect in computers, ADC, DAC, ZOH, Z-transfer function, compensator design, stability analysis.
Simulations

Use of Simulink and Matlab for simulation of control algorithms.

Systems representation of instrumentation systems.

Detailed modelling of measurement systems including the effects of sensor

Range, span, nonlinearity, sensitivity, hysteresis, resolution, ageing effects. Dynamic modelling of sensors using transfer functions and state space methods. Signal conditioning: loading effects, bridge circuits, correction of nonlinearity, effects of feedback, amplifier limitations. Noise and interference in instrumentation systems and estimation of errors. Signal recovery from noise interference. Computerised data acquisition systems including ADCs and a range of modern instrumentation protocols such as 1-wire, I2C, GPIB, CAN bus, SPI, PCI, Ethernet/LAN, USB. Use of microcontrollers and inversion techniques. Simulations: use of Simulink and Matlab for simulation of plant and instrumentation systems.

AIMS OF MODULE
The module aims to provide advanced understanding in industrial instrumentation and modern control; using the state-space approach for control and instrumentation design and system analysis. In addition, the module aims to provide an understanding in the design and evaluation of instrumentation and control systems using computer aided design packages.

LEARNING OUTCOMES
1. Determine which control algorithms fit better to a particular control problem. (UKSPEC US1, US2, D4)

2. Apply appropriate design procedures to design a particular control system based on design specifications. (UKSPEC B1, B2)

3. Predict and appraise the performance of the control algorithms using appropriate simulation tool or software. (UKSPEC B2, US2, D4)

4. Propose from the specification of an instrument system a practical solution. (UKSPEC B1, B2, D4)

5. Analyse the accuracy of measurement systems. (UKSPEC US1, US2, B3)

6. Recognise the limitation of measurement systems. (UKSPEC US1, US2, B3)

PRE-REQUISITES
EN0564 Analogue Electronics and Instrumentation
Or equivalent knowledge

CO-REQUISITES
None

DISTANCE LEARNING DELIVERY
N/A

LEARNING AND TEACHING STRATEGY
This module will be delivered using a combination of formal lectures/seminar classes. The theoretical basis of the subject will be presented in the lectures and seminar sessions. The module will be taught mainly on a problem-driven basis. Students will be provided with information through lectures, computed aided learning strategies and example instrumentation solutions. This information will be applied through practical work in developing programs. Students will be supported in the laboratory on an individual or group tutorial basis.

The seminars will be given in a computer based environment and used to:

1. Familiarise the students with the CAD and IT packages to be used on the module
2. Design, simulate and evaluate complete instrumentation and control systems
3. Provide an opportunity for formative assessment.

Directed learning will involve the use of handouts, CAD and IT facilities to simulate a number of practical instrumentation problems through the design, implementation and evaluation cycle. Independent learning will involve the student in using: HTML and Adobe Acrobat documentation provided within the school, the library facilities and access to the World Wide Web.

ASSESMENT AND FEEDBACK STRATEGY
a Summative assessment and rationale for tasks

The module will be assessed through a combination of a formal report and a closed book examination. The formal report will be based on a quantity of computer modelling appropriate to this level.

b. Additional formative assessment - detail of process and rationale

Formative assessment is made in both the seminar and laboratory sessions to provide feedback to the students.

c. Indication of how students will get feedback and how this will support their learning

Written feedback will be provided on the report. Examination feedback will be provided following the normal processes to show generically where the cohort has a strong or a weaker answer to the examination.

Formative assessment is made in both the seminar and laboratory sessions to provide feedback to the students.

IMPLICATIONS FOR CHOICE
None

EN0624 Individual Engineering Project (, 40 Credits)

SYNOPSIS OF MODULE
The module aims to provide the student, as an individual, an opportunity to carry out an extended study in a specific application of electrical and electronic techniques. The module also aims to enable to student to develop their analytical, practical and communication skills.

The module will be assessed by two components: a planning report during semester 1 and a final report at the end of semester 2.

Formative feedback will be given though fortnightly meetings with project supervisors.

INDICATIVE READING LIST OR OTHER LEARNING RESOURCES
1. Recommendations for purchase by students
N/A
2. Books
Smith, Nigel J., Engineering Project Management, 3rd Edition. ISBN: 978-1-4051-6802-1. December 2007, Wiley-Blackwell
Stark, John, Product Lifecycle Management: 21st Century Paradigm for Product Realisation, Springer-Verlag UK, 2004, ISBN 0133942899
3. Journal Articles
4. Journals and Newspaper Titles
5. Databases and Websites
The IET Final Year Project Toolkit: http://www.theiet.org/students/resources/final-year-project-synopsis.cfm

The IET guide to technical report writing: http://www.theiet.org/students/resources/tech-report-writing.cfm

The IET guide to units and symbols: http://www.theiet.org/students/resources/units-symbols.cfm

6. Any Other Resources
Engineering Project Guide (Internal Document)

OUTLINE SYLLABUS
The student will select a project and in association with the supervisor draw up a project specification defining the aims, objectives and envisaged endpoint. The student together with the supervisor will then prepare a project plan giving the project background, sourcing previous work and associated theory/simulation and develop a Gantt chart to indicate that the theoretical base of the project is sound and that the aims and objectives are achievable. In addition students must perform a risk assessment identifying potential risks or hazards associated with the project work. The student will then follow the defined project plan to complete the project. This will involve the application of appropriate theory and simulations leading to the production of prototype designs.

The design cycle will be completed by testing and redesign if necessary. Students are encouraged to monitor their progress based upon the project plan and where necessary readjust timescales. The student will be required to submit a final project report towards the end of the module and to present the project verbally to the supervisor, second markers and peers. The student must maintain contact with the supervisor on a regular basis to discuss and assess progress and to obtain advice.

AIMS OF MODULE
The module aims to develop the student's ability to work independently and promote self-reliance. The module provides the student with the ability to source information and assess the appropriateness of this information. One of the key aims of the module is to allow the student to apply a range of theoretical and analytical techniques to allow them to solve an engineering problem, from initial design to final conception and appraisal. The module also aims to develop the student's communication skills in both verbal and written form.

LEARNING OUTCOMES
Upon completion of the module the student will be able to:

1. Undertake an engineering problem from initial design to final completion, whilst critically appraising the need for cost and planning of the project. (UK-SPEC US2, US3, E1, D3, D6)
2. Apply their existing engineering knowledge to identify the correct methods to solve a specific engineering problem. (UK-SPEC US2, US3, E1, D1)
3. Apply a range of analytical, practical and manufacturing skills to a given engineering problem (UK-SPEC US2, P2)
4. Consider the wider aspects of an engineering problem, including environmental, health and safety and risk assessment issues. (UK-SPEC D1)
5. Ability to convey technical information to a third party, including presentation skills both written and oral (UK-SPEC D2, S2)

PRE-REQUISITES
None

CO-REQUISITES
None

DISTANCE LEARNING DELIVERY
N/A

LEARNING AND TEACHING STRATEGY
The module will be delivered via a combination of introductory lectures and progress review meeting with supervisors. The introductory lectures will focus on providing students with advice and guidance on general aspects of project management and report writing skills.

Supervision of the project involves regular meetings with the project student. These meetings allow the student to receive guidance and formative feedback in order to steer them to successful completion of the project. These meetings also provide the student with an opportunity to develop their verbal communication skills.

ASSESSMENT AND FEEDBACK STRATEGY

a Summative assessment and rationale for tasks

This module is summative assessed by two components: a project planning report; and a final report at the end of semester 2, encompassing a presentation/viva.

b. Additional formative assessment - detail of process and rationale

Formative assessment will take the form of regular meetings with the supervisor.

c. Indication of how students will get feedback and how this will support their learning

Students will receive feedback during regular meetings with their supervisor. This will help guide the student in the correct direction and highlight and issues. Feedback will also be provided on the project planning report and on the final project report, including the presentation/viva.

IMPLICATIONS FOR CHOICE
None

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MEng Electrical and Electronic Engineering: Year 5 Modules

EN0750 Engineering Technology Management (CORE, 20 Credits)

SYNOPSIS OF MODULE
This module is intended to broaden the knowledge and understanding of technical students to appreciate wider business and management considerations.

The first semester uses the strategic analysis of a business to explore the commercial, competitive, legal and global environment a business operates in as well as the processes, philosophies, and systems of management.

The second semester concentrates on risk and project management using the previous business understanding as the context for discussing appropriate theories and techniques.

There will be two assessments. The first consisting of the business and competitive analysis of a specific company. The second based of the preparation of a business report and recommendations relating to a management issue

INDICATIVE READING LIST OR OTHER LEARNING RESOURCES
1. Recommendations for purchase by students
Due to the broad nature of the material covered in this module there is no one essential text.
Directed reading will be given as appropriate but the two most recommended books are:
* Robinson, Dixon, Preece & Moodley (2007) Engineering, Business and Professional Ethics, Butterworth-Heinemann
* Association for Project Management (2006) APM Body of Knowledge, APM
2. Books
* Association for Project Management (2006) APM Body of Knowledge, APM
* Baase S (2009) A Gift of Fire 3rd edition, Pearson Education
* Bainbridge D (2008) Introduction to Information technology Law 6th edition, Longman
* Baura, Gail (2006) Engineering Ethics An Industrial Perspective, Elsevier Academic Press
* Bentley C (2009) PRINCE2 Revealed 2nd edition, Butterworth-Heinemann
* Bergland, S. And Cox, J. (2010) Velocity: Combining Lean, Six Sigma and the Theory of Constraints to Accelerate Business Improvement, The Free Press
* Bott, Frank (2005) Professional Issues in Information Technology, BCS Swindon
* Bowen, W.Richard (2009) Engineering Ethics Outline of an Aspirational Approach, Springer-Verlag London
* Dyson, John (2010) Accounting for non-accounting students. Prentice Hall
* Goldratt & Cox (2004) The Goal, Gower
* Greene & Stellman (2009) Head First PMP 2nd edition, O'Reilly
* Kloppenborg, T.J. (2009) Project Management A Contemporary Approach, South-Western Cengage Learning
* Laudon and Laudon (2009) Management Information Systems: Managing the Digital Firm. Prentice Hall
* Magal & Word (2009) Essentials of Business Processes and Information Systems. Wiley
* Martin, M and Schinzinger, R (2010) Introduction ot Engineering Ethics 2nd Edition, McGraw-Hill
* Oakland, J. and Morris, P. (1998) TQM: a pictorial guide for managers, Butterworth-Heinemann
* Office of Government Commerce (OGC) (2010) Management of Risk - Guidance for Practitioners , TSO (The Stationery Office)
* Parkes, Peter (2011) NLP for Project Managers, BCS
* Project Management Institute (2008) A Guide to the Project Management Body of Knowledge (PMBOK Guide) 4th edition (or earlier), Project Management Institute (PMI)
* Quinn, Michael J (2009) Ethics for the Information Age 3rd edition, Pearson
* Reiss, G and Leigh, G (2004) One Project Too Many, Project Manager Today
* Robinson, Dixon, Preece & Moodley (2007) Engineering, Business and Professional Ethics, Butterworth-Heinemann
* Slack, Chambers & Johnston (2010) Operations Management 6ths edition, Prentice Hall
* Thompson and Strickland (2009) Strategic Management: Concepts and Cases (14th - 17th Editions). McGraw Hill
* Wagner & Monk (2009) Concepts in Enterprise Resource Planning. Boston: Course Technology Cengage Learning
3. Journal Articles
Stephan, K.D. (2001) 'Is engineering ethics optional?', Technology and Society Magazine, 20(4), pp. 6-12.
Van Der Vorst, R. (1998) 'Engineering, Ethics and Professionalism', European Journal of Engineering Education, 23(2), pp171-179
4. Journals and Newspaper Titles
IEEE Technology and Society
IET Engineering and Technology
Royal Academy of Engineering Philosophy of Engineering
International journal of project management
Project management journal
Project manager today
5. Databases and Websites
N/A
6. Any Other Resources
Royal Academy of Engineering Statement of Ethical Principles

OUTLINE SYLLABUS
Strategic Business Analysis including
* Establishing company direction through the analysis of financial information, strategic vision, mission and objectives;
* Analysing the external competitive position using techniques such as Porters' five forces of industry competition
* Evaluating internal strengths and competitive capabilities; and weaknesses and resource deficiencies using techniques such as SWOT analysis.
* Analysis of internal and external value chains and systems.

* Issues associated with managing international companies operating on a global scale
Business Processes and Philosophies including
* Standard business processes for Fulfilment, Procurement and Production
* Application of Information Systems including MRP & ERP and the implications of an integrated information system.
* Management Philosophies such as Total Quality Management, Business Process Engineering, Lean, Six Sigma, etc
* Operations management, planning and managing inventories and supply chain.
* Legal, Ethical and Social frameworks for business management
Project Management Principles and Theories including
* Project Management in Context
* Planning the Strategy
* Executing the Strategy
* Techniques
* Business and Commercial
* Organisation and Governance
* People and the Profession
Risk Management Principles and Theories including
* Context and Principles of Risk Management
* Risk Identification
* Risk Assessment
* Risk Responses
* Risk Monitoring
Professional Issues
* Professional Bodies, Codes of Conduct and professional behaviour
* Awareness of Ethical Dilemmas

AIMS OF MODULE
1) To develop students' understanding of the commercial and economic context of engineering processes
2) To develop understanding of the Legal, Professional and Ethical frameworks, implications and consequences of management decisions and the need for a high level of professional and ethical conduct in engineering.
3) To understand management techniques and the environment influencing them for managing:
i) Projects
ii) Risk
iii) Day to day operations

LEARNING OUTCOMES
1) Critically analyse the commercial and economic environment facing a business and the strategic options available.
2) Critically discuss the methods, processes, practices and limitations relating to the management of projects, risk and day to day operations within a business.

PRE-REQUISITES
Students are expected to have a basic understanding of Project planning and management on an individual basis (e.g. creation of work breakdown, activity list and monitoring of progress against defined milestones). This is expected to come from work done for the level 6 project.

CO-REQUISITES
None

DISTANCE LEARNING DELIVERY
N/A

LEARNING AND TEACHING STRATEGY
The material will be delivered using lectures supported by seminars and directed learning.
The nature of the seminars will vary depending on the material being covered each week.
In Semester 1 the seminars will closely match the lecture material for that week. The seminars will discuss example business analysis and case studies that will relate to the activities required as part of the assignment. Opportunities for formative feedback on the individual tasks will be timetabled in.

The first semester will concentrate on analysis of the business environment and strategic options; business processes; the use of information systems and technology for competitive advantage; and management philosophies and techniques.

The second semester will concentrate on Project and Risk management. The module will look at wider principles and bodies of knowledge rather than specific methodologies and techniques.

Legal, Ethical and Professional issues will be embedded, highlighted and discussed during both semesters.

ASSESSMENT AND FEEDBACK STRATEGY
a Summative assessment and rationale for tasks
There will be two pieces of assessment
* Assignment 1 will require the production of a report relating to the individual business analysis of a chosen company including operational, competitive environment, resources, systems in use, and ethical and legal issues. This assignment will be built up as a series of tasks during the first semester. These tasks will closely relate to the taught material and seminar exercises at the time.
* Assignment 2 will focus on management considerations for project and risk management. This assignment will comprise the production of an executive management summary report relating to a management problem or issue.
The marking scheme for the module will include an element for demonstrated professional behaviour.

b. Additional formative assessment - detail of process and rationale
In addition to formative seminar exercises and case studies there will be opportunities for peer feedback during the preparation of assignment 2.

c. Indication of how students will get feedback and how this will support their learning
Opportunities for formative feedback will be timetabled into taught sessions to provide feedback on individual tasks before the submission of the assessment. Written feedback will be provided on the assessed reports.

IMPLICATIONS FOR CHOICE

None

MS0702 Applied Engineering Statistics (CORE, 20 Credits)

SYNOPSIS OF MODULE
This module develops and applies the statistical techniques required for the analysis and modelling of engineering systems.
It incorporates two statistical modelling case studies focussing on regression analysis and operational research.
In Semester 1 the module is delivered through a series of lectures, with accompanying seminars, on requisite material, followed in Semester 2 by group work associated with the above case studies, assessed either by a written report, PowerPoint or poster presentation.
Students will receive on-going formative feedback during seminars, with both written and verbal feedback of their group work.

INDICATIVE READING LIST OR OTHER LEARNING RESOURCES
Recommendations for purchase by students
None

Books
Edwards, D. & Hamson, M. (2001) Guide to Mathematical Modelling, Palgrave
Berry, J. & Houston, K. (1995) Mathematical Modelling, Edward Arnold
Dobson,A.J. (2002) An Introduction to Generalised Linear Models, Chapman and Hall.
Montgomery, D.C. and Peck, E. (2001) Introduction to Linear Regression Analysis, Wiley.
Ratkowsky,D.A. (1990) Handbook of nonlinear regression models. New York
Brockwell PJ and Davis RA (2002) Introduction to Time Series and Forecasting, Springer.
Chatfield C (2004) The Analysis of Time Series: An Introduction, CRC.
Taha,H.A. (2007) Operations Research: An Introduction, Prentice Hall.

Journal Articles
As appropriate.

Journals and Newspapers Titles
As appropriate.

Databases and Websites.
As appropriate.

OUTLINE SYLLABUS
Mathematical Modelling
Modelling techniques, development, appraisal and modification.

Statistical Methods
Generalised linear and non linear models. Curvilinear and non linear regression models. Analysis of variance and linear logistic model. Testing of model suitability.

Operational Research and Time Series
Time series characteristics. Trends, moving averages and stationarity. Autocorrelation and tests of randomness. Queuing theory and its application.

Use of appropriate statistical software (e.g. SPSS).

AIMS OF MODULE
1 To apply statistical techniques to the modelling of engineering problems

2 To develop the skills to choose and apply appropriate modelling techniques and provide awareness of the limitations of such techniques.

3 To give experience of working in a group and presenting in a professional manner.

LEARNING OUTCOMES
After completing the module students will be able:

1 To identify and quantify statistical trends and time behaviour of engineering data and systems

2 To develop linear and non linear models of engineering systems.

3 To develop, test and adapt models, using various approaches and to critically appraise model suitability.

PRE-REQUISITES
CG0037 Level 5 Advanced Engineering Mathematics
or
MS0264 Level 5 Further Engineering Mathematics
or
equivalent

CO-REQUISITES
None

DISTANCE LEARNING DELIVERY
N/A

LEARNING AND TEACHING STRATEGY

The material will be delivered by lectures and computer laboratory- based workshops in the first semester. In semester 2 the students will work together in small groups on two statistical modelling case studies. The composition of the groups will vary for each problem. Although students will work in independent groups, group work will be overseen by the lecturer and may require discussion periods. Each group will present its findings for each case study in the form of a written report, a poster presentation or a PowerPoint presentation.

ASSESSMENT AND FEEDBACK STRATEGY
a Summative assessment and rationale for tasks

In Semester 2, group work associated with two case studies is assessed by a written report, PowerPoint or poster presentation, giving students requisite graduate and transferable skills.

b. Additional formative assessment - detail of process and rationale

Students will receive on-going formative feedback during seminars to support their learning and modelling skills.

c. Indication of how students will get feedback and how this will support their learning

Students will receive both written and verbal feedback from the tutor after each modelling case study.

IMPLICATIONS FOR CHOICE
None

EN0751 Interdisciplinary Engineering Project (, 40 Credits)

SYNOPSIS OF MODULE
This module provides the opportunity for the student to demonstrate an integrated approach to the application of both their specialist and non-specialist knowledge and skills within an industrial or research based project.
The student will work in a team around a substantial interdisciplinary (e.g. electrical, mechanical and control engineering) project involving the development of a product, from concept to design and fabrication through to critical evaluation and redesign. Within this interdisciplinary team project students apply appropriate research techniques and methodologies, develop and incorporate design specifications, apply simulation CAD tools, fabricate their designs, and then critically analyse their design to the original design goals. Moreover, effective application of fundamental knowledge will be exemplified in new unfamiliar situations and with regard to commercial, ethical, social and ecological constraints. Within the context of an unfamiliar environment, the student will develop team leadership attributes.
Assessment will be by the submission of a group report and presentation, and an individual written reflection on the project process, including an element of peer review. Formative feedback is provided in project tutorials with the group, during presentations and summative written feedback provided on the reports.

INDICATIVE READING LIST OR OTHER LEARNING RESOURCES
1. Recommendations for purchase by students
N/A
2. Books
* Beer, DF. McMurrey, DA (2009) A guide to writing as an engineer, 3rd ED. Wiley
* Houp, KW. (2002) Reporting technical information, 10th ED. Oxford
* Stasinopoulos P, Smith MH, Hargroves K, Desha C. (2009) Whole System Design - an integrated approach to sustainable engineering. Earthscan
3. Journal Articles
Due to the diverse and innovative nature of the projects the supervisors will guide each group in the identification of specialist resources which are likely to include the International Journal for the History of Engineering & Technology.
4. Journals and Newspaper Titles
Due to the diverse and innovative nature of the projects the supervisors will guide each group in the identification of specialist resources
5. Databases and Websites
IEEE Xplore Digital Library, accessed on 23-2-2011 (repository for all IEEE, IET journal and conference papers, available on campus university access)
CES software available on Engineering specialist image and 'take away' version available for student home for installation at home.
Technical guides produced by equipment and component suppliers as determined by each project.
6. Any Other Resources
The following publications of the Royal Academy of Engineering;
* Humans in Complex Engineering Systems (2004)
* Engineering for Sustainable Development: guiding principles (2005),
* Creating systems that work: principles of engineering systems for the 21st century (2007)
* Statement of Ethical Principles (2007),
* Engineering Values in IT (2009),
* Infrastructure, Engineering and Climate Change Adaptation - ensuring services in an uncertain future (2011),
These publications are available on-line at
www.raeng.org.uk/news/publications/default.htm

OUTLINE SYLLABUS
Each group will be directed by an appointed supervisor who will support the group in defining their project design specification and oversee the group's determination of their allotted resource allocation.
The projects will provide a wide range of opportunities for the application of learning, for example through the application of research techniques and methodologies, development of design and technical specifications, use of CAE tools, prototyping and performance evaluation.
Groups will self manage and reflect upon a process of specification, research, selection and application of theory, analysis, concept testing, review and revision proposal as is required by their specific project aims.
Groups will be required to identify and consider social, ethical, environmental, risk and regulatory factors appropriate to their project.
An overall consideration of fitness for purpose and systems approach will be applied allowing diverse activities to be undertaken within each project as determined in discussion between the students and supervisor which will determine the schedule of activities within each group.

AIMS OF MODULE
This module provides students' the opportunity to take an integrated approach to the application of both their specialist and non-specialist knowledge and skills within an industrial or research based project. The student will work in a team around a substantial interdisciplinary (e.g. electrical,

mechanical and control engineering) project involving the development of a product, from concept to design and fabrication through to critical evaluation and redesign.
This project will give enhanced preparation for professional practice, integrate technical expertise with business, commercial, ethical and social concerns and provide experience of working across engineering disciplines. The student will also have the opportunity to develop team leadership attributes.

LEARNING OUTCOMES
The student will be able to;
1. formulate and verify the application of fundamental scientific principles and engineering methodologies in complex and unfamiliar situations.
2. plan and manage of an interdisciplinary group engineering project incorporating justification of project objectives within the constraints of wider commercial, ethical, social and ecological contexts,
3. demonstrate the application of research; such as evaluation, experimentation, testing and presentation of technical information within the context of an interdisciplinary group project,
4. justify a process of technological innovation undertaken as a collaborative project between engineering disciplines and drawing upon an appreciation of the fundamental principles of those disciplines,
5. determine and manage the allocation of resources, financial and technical, to support the delivery of a complex project.

PRE-REQUISITES
None

CO-REQUISITES
None

DISTANCE LEARNING DELIVERY
N/A

LEARNING AND TEACHING STRATEGY
The module tutor will allocate members to groups (5 to 6 members) and introduce a selection of potential projects to the groups, in a time-limited familiarisation exercise each group will bid to undertake their selected project.
As a 'capstone' project the lead will be taken by the students with guidance provided, where needed, by a supervisor. In addition each group will have a capital resource allocated, monetary and human (consultancy), for which they will be responsible for allocation across the project.

ASSESSMENT AND FEEDBACK STRATEGY
a. Summative assessment and rationale for tasks
Assessment will be by the submission of a group report and presentation (40%), and an individual written reflection on the project process, including an element of peer review (60%).
b. Additional formative assessment - detail of process and rationale
Regular formative conversations with the supervisor will be combined with feedback from peer review of group function and technical competence. During the two semesters there will be opportunity for students to receive feedback upon their response to previous feedback in a progress of continuous improvement.
c. Indication of how students will get feedback and how this will support their learning
Formative feedback will be derived from the process of undertaking the project. Written feedback will be provided on the summative assessment.

IMPLICATIONS FOR CHOICE
None

EN0550 Photovoltaic System Technology (OPTION, 20 Credits)

SYNOPSIS OF MODULE
This module introduces the student to the principles of photovoltaic system design, operation and application. It includes consideration of the system components and the design and configuration of the solar array, together with examples of stand alone, grid connected and space applications. The module will provide the student with an appreciation of the implementation of photovoltaic systems.

It will be assessed by formal written examination (60%), and a report based on a design project (40%). Formative feedback will be provided in seminar sessions.

INDICATIVE READING LIST OR OTHER LEARNING RESOURCES
1. Recommendations for purchase by students
There is no requirement for the purchase of books for this module. All recommended literature is available via the library or on the internet.
2. Books
* Messenger, R., & Ventre, J. (2010). Photovoltaic Systems Engineering, 3rd edition, Taylor & Francis
* Wenham, S. (2011). Applied Photovoltaics, 3rd edn., Earthscan
3. Journal Articles
Due to the range of coverage of this module, individual journal articles are not specified. Current research in the topic area can be found in the journal titles below.
4. Journals and Newspaper Titles
* Progress in Photovoltaics
* Renewable Energy
* Various IEEE journals relating to electrical engineering
5. Databases and Websites
* IEA PV Power Systems Programme (www.iea-pvps.org)
* European Photovoltaic Industries Association (http://www.epia.org/home/)
* PVGIS web site (http://re.jrc.ec.europa.eu/pvgis/)
6. Any Other Resources
* Measurement data from system trials
* PVSyst software (currently available in EB E open access area (3rd floor)

OUTLINE SYLLABUS

Basic systems design
Photovoltaic (PV) arrays, support structures
Electrical Connections and wiring issues
BOS components
Stand alone and grid connected systems
System sizing

Stand alone systems
Applications
Performance assessment and sizing
Standards and regulations

Grid connected systems - electrical
Inverter systems and electrical supply issues
Grid connection regulations
Harmonic content, reactive power, and wiring issues

Grid connected systems - large scale
Design of large scale systems
Case studies

Grid connected systems - building integrated
System design and sizing
Energy in buildings and building components
Installation and operation
Case studies

Concentration systems
Design of concentrator systems
Operation and maintenance

Monitoring and performance analysis
Monitoring specifications
Yield and performance ratio, and MTBF
Operational issues and maintenance

Standards and regulations
Standards for construction and operation
Regulations governing system design and operation
Health and safety issues

Space systems
Array configurations
Quality control and assessment
Design of systems
BOL and EOL design tradeoffs

AIMS OF MODULE
This module will introduce the student to the principles of photovoltaic system design, operation and application. It will include consideration of the system components and the design and configuration of the solar array, together with examples of stand alone, grid connected and space applications.

LEARNING OUTCOMES
The student will be able to:

1) Design, and develop a PV system evaluating complex and contradictory customer needs in relation to an application
2) Critically evaluate the performance of a PV system in contrast to a theoretical model of such a system, calculating yields and efficiencies
3) Analyse the main system losses and compare methods for minimising these for various system designs
4) Assess the system requirements for both grid connected and stand alone applications.

PREREQUISITES
None.

COREQUISITE(S)
None

DISTANCE LEARNING DELIVERY
N/A

LEARNING AND TEACHING STRATEGY
The module is delivered in the form of lectures, seminars, directed learning and independent study. Where possible additional guest lectures will be provided from industry and research organisations

ASSESSMENT AND FEEDBACK STRATEGY

a Summative assessment and rationale for tasks

This module will be assessed by a report based on a design project (40%) and an examination (60%). The examination is intended to determine the student's understanding of the course material, while the report on the design project is intended to assess the student's ability to apply their knowledge.

b. Additional formative assessment - detail of process and rationale

Formative feedback will be provided on the seminar exercises.

c. Indication of how students will get feedback and how this will support their learning

Verbal formative feedback is provided in the seminar sessions. Written feedback will be provided on the report.

Examination feedback will be provided following the normal processes to show generically where the cohort has a strong or a weaker answer to the examination. In addition, written feedback will be provided on the examination scripts.

IMPLICATIONS FOR CHOICE
None

EN0711 Wind Energy Conversion Systems (OPTION, 20 Credits)

SYNOPSIS OF MODULE
Wind power is now one of the most popular and economically viable renewable energy sources in the UK and other countries. The purpose of this module is to present the current practices and technological advances in design, control, modelling, and performance optimization of modern Wind Energy Conversion Systems (WECS). The module will provide an opportunity to the student not only to gain a comprehensive theoretical knowledge and understanding of the main concepts and future development of WECS, but will also allow them to further improve their computing and practical skills.

It will be assessed by formal written examination (60%) and an assignment report (40%) based on experimental work and computer simulations. Formative feedback will be provided in the seminar sessions.

INDICATIVE READING LIST OR OTHER LEARNING RESOURCES
1. Recommendations for purchase by students
N/A
2. Books
* Ackermann, T. (2005). Wind power in power systems, John Wiley and Sons Ltd. ISBN: 0470855088
* Blaabjerg, F., and Chen, Z. (2006). Power electronics for modern wind turbines, Morgan & Claypool Publishers. ISBN: 978-1598290325
* Burton, T., Sharpe, D., Jenkins, N., and Bossanyi, E. (2001). Wind Energy Handbook, John Wiley and Sons Ltd. ISBN: 978-0471489979
* Fox, B., Flynn, D., Bryans. L., and Jenkins, N. (2007). Wind power integration: connect and system operational aspects, Peter Peregrinus Ltd. ISBN: 978-0863414497
* Hau, E. (2005). Wind turbines: fundamentals, technologies, application, economics, Springer-Verlag Berlin and Heidelberg GmbH & Co. K. ISBN: 978-3540242406
* Heier, S. (2006). Grid Integration of Wind Energy Conversion Systems, John Wiley and Sons Canada, Ltd. ISBN: 978-0470868997
* Manwell, J. (2002) Wind Energy Explained: Theory, Design and Application, John Wiley and Sons Ltd. ISBN: 978-0471499725
* Mathew, S. (2006). Wind Energy: Fundamentals, Resource Analysis and Economics, Springer. ISBN: 978-3540309055
3. Journal Articles
N/A
4. Journals and Newspaper Titles
N/A
5. Databases and Websites
* IEEEXplore database
6. Any Other Resources
N/A

OUTLINE SYLLABUS
Wind Energy Resource
Introduction to wind energy: history, resource, sites; Weibull distribution; Wind mean power; Betz' law; Power density; Power curves; Power coefficient; Annual energy output.

Operating principles of wind turbines
Main structural components; Aerodynamics: lift and stall; Rotor blades; Power control; Yaw mechanism; Towers; Size of wind turbines; Safety aspects.

Wind generators
Synchronous machines (wound rotor and permanent magnet); Induction machines (cage and slip ring); Doubly-fed machines: conventional solutions (e.g. DFIG) and emerging technologies (brush-less designs - reluctance and induction machine types); Fixed and variable speed systems; Comparative analysis of existing WECS topologies; Power electronic converters and control of variable speed WECS.

Turbine design
Load considerations; Horizontal/Vertical axis and upwind/downwind configurations; Number of rotor blades; Optimisation criteria; Noise issues.

Manufacturing
Nacelles; Blade testing; Towers; Welding and installing towers; Offshore foundations; Main manufacturers of wind turbine generators.

Research and development (R&D)
R&D in wind energy; offshore wind power research; Foundations at sea; Concrete caissons; Steel gravity foundations; Mono pile foundations; Tripod foundations; Latest advances: floating offshore foundations.

Grid-connected and stand-alone applications
Wind energy variations (seasonal and annual); Power quality; Wind farms.

Environment
Landscape and turbines; Aerial markings; Sound from turbines; Energy payback periods; Birds and wind turbines; Shadow casting/variations from wind turbines.

Economics
Turbine costs; Turbine installation; Operation and maintenance (O&M) costs; Income from wind energy; Wind energy and electrical tariffs; Investment in wind power; Economics of wind energy; Economics of offshore wind; Employment prospects.

AIMS OF MODULE
This module will consider the current practices and technological advances in the design, control, modelling and performance optimisation of modern Wind Energy Conversion Systems (WECS). The student will gain theoretical knowledge and understanding of the main concepts and future developments in this field.

LEARNING OUTCOMES
The student will be able to:

1. A comprehensive understanding of the basic principles of design, operation and control of WECS and related disciplines such as electric machines and drives, power electronics and computing
2. Fundamental knowledge to investigate, new and developing alternative wind turbine generator topologies to the existing WECS solutions
3. A comprehensive knowledge and understanding, and ability to evaluate advantages and limitations, of mathematical models for computer simulations of WECS performance
4. Wide knowledge and thorough understanding of control design methodologies and their software implementation for analysis of variable speed WECS
5. Knowledge to make cost analysis, and general evaluation of associated commercial risks, of various WECS configurations
6. A thorough understanding of current practice in WECS development, and an appreciation of future technologies.

PREREQUISITES
None

COREQUISITES
None

DISTANCE LEARNING DELIVERY
N/A

LEARNING AND TEACHING STRATEGY
The theory of, and the analytical and design procedures related to, wind energy conversion systems (WECS) will be thoroughly investigated in formal lectures. Seminars will be used to explore problems related to the theory.

The assignment will enhance the student's theoretical knowledge as well as their laboratory skills, and will expose them to the new technologies in computer-aided design and analysis of WECS.

ASSESSMENT AND FEEDBACK STRATEGY
a Summative assessment and rationale for tasks

This module will be assessed by an assignment (40%) and a closed book unseen examination (60%). The assignment will be a report based on the design and analysis of a small system using an industry standard software package, with associated experimental work and a computer simulation.

b. Additional formative assessment - detail of process and rationale

Formative feedback will be provided on the seminar exercises.

c. Indication of how students will get feedback and how this will support their learning

Verbal formative feedback is provided in the seminar sessions. Written feedback will be provided on the written report.

Examination feedback will be provided following the normal processes to show generically where the cohort has a strong or a weaker answer to the examination.

IMPLICATIONS FOR CHOICE
None

EN0769 Power Electronics and Drive Systems (OPTION, 20 Credits)

SYNOPSIS OF MODULE
This module aims to provide students with knowledge of new concepts and technologies in electrical power engineering with emphasis on power electronics and electric drives. Advanced control techniques as applied to these systems will also be covered.

The module will be delivered through lectures and knowledge will be consolidated in seminar and laboratory sessions. Assessment of the module will be via an assignment (40%) and a closed-book unseen examination (60%). Exam feedback will provided individually and also generically to indicate where the cohort has a strong or a weaker answer to examination questions. Written feedback will be provided on the assignment. Formative feedback will be provided in the seminars and laboratories.

INDICATIVE READING LIST OR OTHER LEARNING RESOURCES
1. Recommendations for purchase by students
N/A
2. Books
* Erickson, R.W. and Maksimovic, D. (2001), Fundamentals of Power Electronics, 2nd ed. Springer. ISBN 0792372700
* Krishnan, R., Kazmierkowski, M. P., and Blaabjerg, F. (2002), Control in Power Electronics: Selected Problems, Academic Press in Engineering. ISBN 0124027725
* Leonhard, W. (1997), Control of Electrical Drives, Springer Verlag. ISBN 3-540-59380-2
* Mohan, N., Robbins, W. P., and Undeland, T. M. (2003), Power Electronics: Converters, Applications and Design, John Wiley & Sons. ISBN 0471226939
* Novotny, D.W., and LIPO, T.A. (1996), Vector Control and Dynamics of AC drives, Oxford University Press. ISBN 0-19-856439-2
* Trzynadlowski, A.M. (2010),Introduction to Modern Power Electronics, John Wiley & Sons. ISBN 928-0-470-40103-3
3. Journal Articles
N/A
4. Journals and Newspaper Titles
IEEE Transactions on Power Systems.
5. Databases and Websites
IEEE Electronic Library, IEL. Available online:http://ieeexplore.ieee.org. Accessed 28-01-2013
6. Any Other Resources
N/A

OUTLINE SYLLABUS
Power electronics and control
Devices for power electronics and all power conversion types, including AC-to-DC uncontrolled/controlled rectifier, AC-to-AC voltage controller, DC-to-DC converter and DC-to-AC inverter.

An overview of pulse width modulation (PWM) and closed-loop PWM control methods. Discussion on PI (Proportional-Integral) controller, the parameter tune methods, control parameter optimisation and their applications in converters in order to achieve desired output performance.

Practical switching power converters, such as forward converter, fly-back converter, isolated Cuk converter, push-pull converter, and load-resonant converters.

Power quality and harmonics analyses in a variety of power conversion circuits and harmonics reduction techniques.

Power electronics and control applications in clean energy systems including solar energy systems, wind energy systems, fuel cell energy systems and electric and hybrid vehicles etc.

Electric drive systems
The principles of electro-mechanical energy conversion, its structure, and the main components and requirements for electric drive systems.

DC drives and electronically-commutated motor drives.

Introduction to AC machines and space vectors. Modern control techniques as applied to electric drives.

Vector and field-oriented control of high-performance induction motor drives. Reluctance and permanent-magnet machine drives.

Applications and energy efficiency of electric drives.

AIMS OF MODULE
This module aims to provide students with knowledge of new concepts and technologies in electrical power engineering with emphasis on power electronics and electric drives. Advanced control techniques as applied to these systems will also be covered.

LEARNING OUTCOMES
The student will be able to:

1. Critically evaluate the theory for the control of different electric machines, and be able to apply this in the design of common drive systems
2. Analyse the principles of a variety of power converters and design and evaluate power conversion systems incorporating these devices
3. Design and mathematically model power electronic circuits using appropriate software (for example Simulink)
4. Evaluate and deploy the appropriate design procedures to develop a control system and conduct a preliminary performance analysis
5. Appreciate the wider context to power conversion, including both the technical and non technical problems and their solutions.

PRE-REQUISITES
None

CO-REQUISITES
None

DISTANCE LEARNING DELIVERY
N/A

LEARNING AND TEACHING STRATEGY
Lectures are used in this module as the main delivery mechanism, exploring analytical and design procedures of power electronics and drive systems. Directed learning is used in conjunction with lectures to guide the student to specific topics or chapters within the lecture material or towards texts in the indicative reading list. Seminars and laboratory sessions are provided to reinforce theory, and to provide a platform for formative feedback to the students.

ASSESSMENT AND FEEDBACK STRATEGY
a Summative assessment and rationale for tasks

This module will be assessed by a closed-book unseen examination (60%) and a computer-based assignment (40%). The assignment will involve a computer-aided design, modelling and simulation work. It will provide the student with an opportunity to enhance their knowledge of new technologies in computer-aided design and the analysis of power electronics control systems. The examination will assess the student's ability to apply, and

demonstrate understanding of, the techniques introduced via the lectures to practical problems.

b. Additional formative assessment - detail of process and rationale

Formative feedback will be provided on the seminar exercises and in the laboratories.

c. Indication of how students will get feedback and how this will support their learning

Verbal feedback will be provided on formative assessment during seminar sessions. Exam feedback will provided individually and also generically to indicate where the cohort has a strong or a weaker answer to examination questions. Written feedback will be provided on the assignment.

IMPLICATIONS FOR CHOICE
None

EN0770 Smart Grids (OPTION, 20 Credits)

SYNOPSIS OF MODULE
This module will allow the student to study existing electrical power distribution networks and to consider new concepts and technologies for future 'smart grid' power networks with emphasis on the integration of electric vehicles and renewable energy resources, enabling technologies and the quality of supply. Advanced power electronics controllers and ICT techniques as applied to the smart grid will also be covered.

The module will be delivered through lectures and knowledge will be consolidated in seminar and laboratory sessions. Assessment of the module will be via an assignment (40%) and a closed-book unseen examination (60%). Exam feedback will provided individually and also generically to indicate where the cohort has a strong or a weaker answer to examination questions. Written feedback will be provided on the assignment. Formative feedback will be provided in the seminars and laboratories.
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INDICATIVE READING LIST OR OTHER LEARNING RESOURCES
1. Recommendations for purchase by students
N/A
2. Books
* Ekanayake, J., Liyanage K., Wu J., Yokoyama, A. and Jenkins, N. (2012), "Smart Grid: Technology and Applications", John Wiley & Sons, Ltd. ISBN: 9780470974094
* Weedy, B. M., Cory, B. J., Jenkins, N., Ekanayake, J. and Strbac, G. (2012), "Electric power systems", John Wiley & Sons, Ltd. ISBN: 9780470682685
* Jenkins, N., Ekanayake, J. and Strbac, G. (2010), "Distributed Generation", IEE Renewable Energy series, London, UK. ISBN: 9780863419584
* Bollen, M. H. J. (2000), "Understanding power quality problems: voltage sags and interruptions" IEEE Press, ISBN 0780347137
* Hingorani, N. G. and Gyugyi, L. (2000), "Understanding FACTS: concepts and technology of flexible AC transmission systems" IEEE Press, ISBN 0780334558
3. Journal Articles
* Putrus G.A., "Power Electronics for the Smart Grids", The IET annual course on High Voltage Engineering & Testing (HVET), September 2011, Newcastle upon Tyne, UK
* Putrus G.A., "Integration of Low Carbon Technologies in Power Networks Impacts, Challenges and Opportunities" Keynote speech, EFEA 2012 conference, June 2012, Newcastle upon Tyne, UK
* Putrus G.A., Wijayakulasooriya J.V. and Minns P., "Power Quality: Overview and Monitoring", Invited paper, International Conference on Industrial and Information Systems (ICIIS 2007), 8-11 August 2007, Peradeniya, Sri Lanka
4. Journals and Newspaper Titles
N/A
5. Databases and Websites
IEEE Electronic Library, IEL. Available online:http://ieeexplore.ieee.org. Accessed 28-01-2013
6. Any Other Resources
N/A

OUTLINE SYLLABUS
Power distribution networks
Distribution system analysis: Active and reactive power. Control of power flow and voltage levels in distribution networks. Fault level calculations. Load Flow Analysis.
Reliability and quality of supply. Regulations, problems and solutions.

Smart Grids
Existing and future power networks: Drivers for change, vision and concept.
Distributed generation (DG): grid connected and stand-alone systems. Benefits and main challenges.
Grid connection of DG and renewable energy systems: types, power electronic interface devices, cost considerations and connection standards.
Electric transport: challenges and opportunities. Electric vehicles (EV) and Plug-in Hybrid Electric vehicles (PHEV). Energy storage, battery technologies and range extenders. Modes of charging and charging infrastructure.
Integration of EVs and renewable energy sources into power networks: impact, control and protection of power networks with EV and DG.

Enabling technologies
Information and Communication Technologies (ICT): data communication, standards, information security, and smart metering.
Power electronics for the smart grid: characteristics and operating principles of main power electronic devices and systems for distribution networks.
Operating principles, characteristics and design of the main FACTS (Flexible A.C. Transmission Systems) devices. High-voltage direct current (HVDC) transmission.
Energy storage, active network control and demand side management.

AIMS OF MODULE

This module will allow the student to study existing electrical power distribution networks and to consider new concepts and technologies for future 'smart grid' power networks with emphasis on the integration of electric vehicles and renewable energy resources, enabling technologies and the quality of supply. Advanced power electronics controllers and ICT techniques as applied to the smart grid will also be covered.

LEARNING OUTCOMES
The student will be able to:

1. Explain the theory and control methods of different parts of electrical power distribution systems
2. Describe the principles of FACTS and power electronic controllers and design and analyse simple power networks incorporating these devices
3. Design modern power networks that are legislation compliant, incorporating electric vehicles and different types of distributed generators, analysing their performance.
4. Evaluate appropriate procedures to design a particular data network system for smart grids
5. Demonstrate an understanding of the research underpinning the need for high quality of supply and problems that can effect this and their solution.

PRE-REQUISITES
None

CO-REQUISITES
None

DISTANCE LEARNING DELIVERY
N/A

LEARNING AND TEACHING STRATEGY
The theory, analytical and design procedures of existing and future power networks will be thoroughly investigated in formal lectures. Seminars will use case studies and typical problems to exemplify theory. Lab sessions will provide students with the opportunity to gain practice with software tools and develop their computer modelling skills. Guided reading will be provided to support the learning process.

ASSESSMENT AND FEEDBACK STRATEGY
a Summative assessment and rationale for tasks

Summative assessment of the module will by an assignment (40%) and a closed book unseen examination (60%). The examination will cover all aspects of the module and assess students' abilities to solve new and unseen problems in the subject area. The assignment will include some aspect of laboratory work and the design and analysis of a small system using an industry standard software package (for example, Eracs).

b. Additional formative assessment - detail of process and rationale

Examples and case studies will be used regularly to augment theoretical concepts thus providing students with opportunities to assess their own learning.

c. Indication of how students will get feedback and how this will support their learning

Formative verbal feedback on students learning will be provided in the laboratory sessions (computer modelling) and seminars (case studies). Students will also receive written feedback on the coursework assignment. Feedback on examination performance will be provided both generically and individually to enable students to identify areas of strength/weakness helping them to rectify areas of weakness.

IMPLICATIONS FOR CHOICE
None

Please note: the information in this document is correct at the time of printing (22/05/2013) but may be subject to change.
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