COLLEGE OF ENGINEERING

UNDERGRADUATE STUDENT HANDBOOK

YEAR 3 (FHEQ LEVEL 6)

ELECTRONIC ENGINEERING WITH NANOELECTRONICS DEGREE PROGRAMMES

PART TWO OF TWO (MODULE AND COURSE STRUCTURE)

2017/18
DISCLAIMER

The College has made all reasonable efforts to ensure that the information contained within this publication is accurate and up-to-date when published but can accept no responsibility for any errors or omissions.

The College reserves the right to revise, alter or discontinue degree programmes or modules and to amend regulations and procedures at any time, but every effort will be made to notify interested parties.

It should be noted that not every module listed in this handbook may be available every year, and changes may be made to the details of the modules.

You are advised to contact the College directly if you require further information.

The 2017/18 academic year begins on 25 September 2017

**DATES OF 2017/18 TERMS**

25 September 2017 – 15 December 2017

08 January 2018 – 23 March 2018

16 April 2018 – 15 June 2018

**SEMESTER 1**

25 September 2017 – 26 January 2018

**SEMESTER 2**

29 January 2018 – 15 June 2018
We would like to extend a very warm welcome to all students for the 2017/18 academic year and in particular, to those joining the College for the first time.

The University offers an enviable range of facilities and resources to enable you to pursue your chosen course of study whilst enjoying university life. In particular, the College of Engineering offers you an environment where you can develop and extend your knowledge, skills and abilities. The College has excellent facilities, offering extensive laboratory, workshop and IT equipment and support. The staff in the College, many of whom are world experts in their areas of interest, are involved in many exciting projects, often in collaboration with industry. The College has excellent links with industry, with many companies kindly contributing to the College’s activities through guest lectures and student projects. We have close links with professional engineering bodies and this ensures that our courses are in tune with current thinking and meet the requirements of graduate employers. All the staff are keen to provide a supportive environment for our students and we hope that you will take full advantage of your opportunities and time at Swansea.

We hope that you will enjoy the next academic session and wish you every success.

**Professor Stephen GR Brown**  
*Head of the College of Engineering*

**Professor Cris Arnold**  
*Deputy Head of College and Director of Learning and Teaching*

**Professor Johann Sienz**  
*Deputy Head of College and Director of Innovation and Engagement*

**Professor Dave Worsley**  
*Deputy Head of College and Director of Research*

**ELECTRONIC AND ELECTRICAL ENGINEERING PORTFOLIO DIRECTOR:**
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Room B206, Engineering East

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**IET Staff Student adviser**
Dr Chris Jobling ([c.p.jobling@swansea.ac.uk](mailto:c.p.jobling@swansea.ac.uk))
Room B206, Engineering East

**ADMINISTRATIVE OFFICER:**
Should you require administrative support please visit the Engineering Reception, open Monday – Friday 8:30am – 5:00pm and speak with a member of the Student Information Team who will be happy to help.
IMPORTANT INFORMATION

IMPORTANT:
MODULE EG-353 is a core module and must be passed with a minimum of 40%. Failure to pass the module (worth 30 credits) will result in your degree NOT being Accredited by the IET.
### Year 3 (FHEQ Level 6) 2017/18

**Electronics with Nanotechnology**

BEng Electronic Engineering with Nanotechnology [H613]

MEng Electronic Engineering with Nanotechnology [H614]

**Coordinator:** Dr A Mehta

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**Total 120 Credits**
**EG-319 IC Design**

**Credits:** 10  
**Session:** 2017/18 Semester 2  
**Taught:**

**Module Aims:** To provide an overview of the BiCMOS and CMOS technologies and the concepts of designing analog and digital integrated circuits in the context of CMOS technology.

**Pre-requisite Modules:** EG-143; EG-240; EG-242

**Co-requisite Modules:**

**Incompatible Modules:**

**Format:**  
- Lectures 22 hours
- Example classes 8 hours
- Directed private study 70 hours

**Lecturer(s):** Dr P Igic

**Assessment:** Examination 1 (100%)  
**Assessment Description:** The examination is worth 100% of the module. It consists of four questions. Question one is compulsory, and is related to digital IC design, then the students will answer two from three of the remaining questions, related to analogue IC design. Each question answered will be worth 33.3% of the examination. The examination topics will be those presented directly in the lectures.

**Moderation approach to main assessment:** Second marking as sampling or moderation

**Failure Redemption:** If awarded - standard University provisions with marks capped. Any re-examination of this module will be by Repeat module only during the next academic year.

**Assessment Feedback:** For the examination the students will receive a generic form that tells the student what common mistakes were. It also lists the mean mark and the number of 1st class, 2:1 class, 2:2 class, 3rd class and fails achieved by the group. Individually the students can make appointments with the lecturer to receive specific individual feedback on the assignment or examination if this is wanted/needed.

**Module Content:**
- Introduction to Bipolar, MOS, BiCMOS and BCD technologies.
- Analogue CMOS Sub-circuits: MOS Switch, Active Resistor, Current Sources, Bandgap References.
- CMOS Operational Amplifiers: Design of CMOS Op Amps.
- Top-down digital circuit design: from VLSI architecture design to CMOS fabrication

This module develops a knowledge and understanding of:
- CMOS, BiCMOS and power IC technologies;
- MOSFET and BJT switch, active resistor;
- Fundamental building blocks of Analogue ICs (Common - Source/Drain/Gate amplifiers and current mirrors);
- Differential Amplifiers, CMOS Operational Amplifiers and Bandgap reference circuits.
- Digital IC design system and component aspects, design verification, VHDL and Verilog Code, signal integrity, clocking.

And develops an ability to:
- Apply large signal circuit analysis and interpret the results
- Analyse CMOS and bipolar analogue circuits by performing small signal analysis
- Understand top-down digital design approach focusing on CMOS technology
- Understand practical implications of different IC analysis methods
- Design more complex circuits by combining fundamental IC building blocks

**Intended Learning Outcomes:**

After completing this module you should be able to:
- Describe CMOS technology;
- Analyse the operation of Analogue/Digital CMOS circuits;
- Apply some aspects of the Computer-Aided Analysis Programs in the design process of CMOS circuits.

**Reading List:**  
Kaeslin, Hubert, Digital integrated circuit design : from VLSI architectures to CMOS fabrication / Hubert Kaeslin, Cambridge University Press, 2008.ISBN: 9780521882675  
Analysis and design of analog integrated circuits / Paul R. Gray ... [et al.], Wiley, c2009.ISBN: 9780470398777  

**Additional Notes:**
- AVAILABLE TO Visiting and Exchange students. Replaces module EG-354.
- Penalty for late submission of work: ZERO TOLERANCE.
**EG-340 Design Electronics**

**Credits:** 10  
**Session:** 2017/18 Semester 1 (Sep-Jan Taught)

**Module Aims:** The huge range of electronic devices available today are based on a limited number of circuit elements. For example, cellular mobile telephones use basic circuits such as oscillators, frequency synthesisers, frequency selective circuits, in addition to sophisticated digital components.

In this module, some of the key circuits are identified and discussed, including analogue multipliers, frequency selective networks, frequency synthesisers, and ADC/DAC techniques.

**Pre-requisite Modules:** EG-240

**Co-requisite Modules:**

**Incompatible Modules:**

**Format:**
- Lectures 20 hours
- Example classes 5 hours
- Directed private study 75 hours

**Lecturer(s):** Dr T Davies

**Assessment:** Examination 1 (100%)

**Assessment Description:** This module is assessed by means of a single 2-hour examination. The format of the exam is a choice of 3 questions from 4.

**Moderation approach to main assessment:** Universal second marking as check or audit

**Failure Redemption:** If a student is awarded a re-sit: Failure Redemption of this module will be by 100% written Examination only. Level 3 re-sits (Supplementary exams) are capped at 40%.

**Assessment Feedback:** Feedback will be in a standard format on the College of Engineering Intranet. Information provided includes average mark, maximum and minimum marks for the examination as a whole and for individual questions.

**Module Content:**
- Types of oscillators: relaxation, phase shift, tuned circuit and quartz crystal.
- Applications of RC networks, including the twin-T and Wein bridge.
- The Gilbert Cell as a circuit element.
- The Gyrator as a circuit element
- Applications of frequency synthesis. PLL type synthesisers. Direct digital synthesis.
- Types of ADC and DAC, including successive approximation, dual slope and flash.
- Circuit techniques for digital modulation.

**Intended Learning Outcomes:** After completing this module you should be able to:
- Choose the appropriate oscillator for a given application and quantify its operation;
- Describe the operation of frequency synthesisers;
- Discuss the advantages of different ADC and DAC techniques and quantify their operation;
- Identify the signal processing elements in communications circuits.


**Additional Notes:**
- AVAILABLE TO Visiting and Exchange students.
### EG-341 Microwave Circuits and Antennas

**Credits:** 10  
**Session:** 2017/18 Semester 2 (Jan - Jun Taught)

**Module Aims:** The module develops the analysis and synthesis of distributed circuits and the principles of microwave antennas.

**Pre-requisite Modules:** EGA207

**Co-requisite Modules:**

**Incompatible Modules:**

**Format:**  
- Lectures 20 hours  
- Example classes 5 hours  
- Directed private study 75 hours

**Lecturer(s):** Dr A Mehta

**Assessment:** Examination 1 (100%)

**Assessment Description:** This module is assessed by means of a single 2-hour examination. The format of the exam is a choice of 3 questions from 4.

**Moderation approach to main assessment:** Universal second marking as check or audit

**Failure Redemption:** If a student is awarded a re-sit: Any re-examination of this module will be by 100% written examination only. Standard University provision with marks capped at 40%.

**Assessment Feedback:** Feedback will be in a standard format on the College of Engineering Intranet. Information provided includes average mark, maximum and minimum marks, for the examination as a whole and for individual questions.

**Module Content:**

- Analysis of cascaded networks; the use of ABCD parameters and scattering parameters.  
- Theory of the Smith Chart and its practical application to transmission line problems.  
- Microwave circuit design, synthesis of microwave distributed filters, matching circuits and transformers.  
- Circuit realisation in microstrip.  
- Antenna theory - phased array and microwave antennas.

**Intended Learning Outcomes:** After completing this module you should be able to:

- Apply a Smith Chart to solve problems associated with distributed circuits.  
- Analyse a cascaded network of distributed components with ABCD- and S-parameters.  
- Synthesise microwave distributed filters.  
- Analyse the radiation patterns from microwave aperture and array antennas.

**Reading List:**  

**Additional Notes:**

- AVAILABLE TO Visiting and Exchange students.  
- PENALTY: zero tolerance for late submission
**EG-345 Power Electronics**

**Credits:** 10 Session: 2017/18 Semester 2 (Jan - Jun Taught)

**Module Aims:**
The module introduces circuit topologies and switching techniques for power electronics systems.

**Pre-requisite Modules:** EG-241

**Co-requisite Modules:**

**Incompatible Modules:**

**Format:**
- Lectures 22 hours
- Example classes / Laboratory work 4 hours
- Directed private study 74 hours

**Lecturer(s):** Dr Z Zhou

**Assessment:** Examination 1 (100%)

**Assessment Description:** This module is assessed by means of a single 2-hour examination. The format of the exam is a choice of 3 questions from 4. Each question totals 33.3% of the examination. The examination topics will be those presented directly in the lectures.

**Moderation approach to main assessment:** Universal second marking as check or audit

**Failure Redemption:** If a student is awarded a re-sit: Any re-examination of this module will be by 100% written examination only. Standard University provision with marks capped at 40%.

**Assessment Feedback:** Feedback will be in a standard format on the College of Engineering intranet. Information provided includes average, maximum and minimum marks for the examination as a whole and for individual questions. It also lists the mean marks and the number of 1st class, 2:1 class, 2:2 class and fails achieved by the group.

**Module Content:**
- AC/DC converters
- Single and three phase DC-AC converters
- Boost and Buck DC/DC converters
- AC-AC converters
- PWM switching strategies for real-time control of power electronics converters
- Semiconductor power device power losses and thermal analysis

**Intended Learning Outcomes:** After completing this module students should be able to:
- Understand, analyse and design power converters for power electronics applications.
- Choose, apply and analyse switching techniques for real-time control of power electronics converter systems.
- Evaluate semiconductor power device power losses and design heat sink.

**Reading List:**

**Additional Notes:**
- AVAILABLE TO visiting and exchange students.
- Penalty for late submission of work: ZERO TOLERANCE.
EG-353 Research Project

Credits: 30 Session: 2017/18 Semester 1 and 2 (Sep-Jun Taught)

Module Aims: The module involves the application of scientific and engineering principles to the solution of a practical problem associated with engineering systems and processes [EA2].

The student will gain experience in working independently on a substantial, individually assigned task, using accepted planning procedures. It will require and develop self-organisation and the critical evaluation of options and results, as well as developing technical knowledge in the chosen topic.

Pre-requisite Modules:

Co-requisite Modules:

Incompatible Modules:

Format: Formal Lectures 16 hours;
Directed private study (incl. meetings with supervisors 284 hours

Lecturer(s): Mrs RM Kerton, Ms NM Chartier, Mr GD Hill, Dr CP Jobling, Prof MJ Mcnamee, Mr AB Montgomery

Assessment:
- Assignment 1 (5%)
- Assignment 2 (0%)
- Assignment 3 (0%)
- Assignment 4 (5%)
- Assignment 5 (5%)
- Report (50%)
- Project (35%)

Assessment Description: The 'Engineer as a Practitioner and Scientist':

Project (35%)
- Oral examination: Presentation (10%) and defence (20%)
- Assessment of the conduct of the project evidenced by the log book (5%)

Report (50%)
- Preliminary feedback stage: First draft of research paper (10 pages) for formal review and feedback (formative)
- Final version of research paper (15%) is primarily an assessment of the quality of the presentation of the work by means of the camera-ready research paper. Note: SPLD Assessment Guidelines apply to all items in this category.
- Quality and contribution of project (35%) is an overall assessment of the quality of the outcomes of the research as evidenced by achievement of original or revised targets and the parts of the research paper (results, discussion and conclusions) that require critical and objective evaluation of the work and its contribution.

The 'Engineer as a Professional':

Coursework 1 (15%)
- Project Plan (5%)
- Risk Assessment (pass/fail)
- Ethics Assessment (pass/fail)
- Progress Report (5%)
- Employability related assessments (total 5%)

NB: Project Plan, Risk assessment, Ethical impact statement, progress report and Employability items will be assessed during the course of the project. All other components will be assessed in April/May.

Full assessment criteria will be on Blackboard accessible though "My Grades".

Items labelled 'pass/fail' are not awarded a grade but MUST be passed to in order to pass the module.

Moderation approach to main assessment: Universal double-blind marking

Failure Redemption: There is no failure redemption for this module. Failure in this module would normally result in an exit qualification due to insufficient credits having been attained.
Assessment Feedback:
Most feedback will be delivered via meetings with supervisors.

There will be a formal opportunity to submit a first draft of the project 10-page paper for preliminary review to
i) provide feedback to the student and
ii) provide the student with an opportunity to make modifications to the paper before final submission.

A formal feedback procedure for the research project will be developed by the College of Engineering and is likely to
take the form of a summary of the student's performance as measured against the formal assessment criteria with
comments from the supervisor and second marker. For efficiency, it it likely that this will be delivered orally at the
end of the formal viva.

Module Content: - The nature of the research project varies from one student to another. The allotted project may
involve survey of literature, theoretical or experimental studies and computational studies. Students will be offered the
opportunity to define the topic of their own research project. The academic staff of the College of Engineering will
produce a list of project descriptors and students will be given a chance to select a project over the summer before the
start of the academic year.

- Each student will be allocated an individual project and a supervisor. It is recommended that students meet their
supervisors at least once a fortnight to discuss progress. Each student must keep a logbook and this should be signed
by the supervisor at these meetings. It is the responsibility of the student to ensure that the logbook is signed.

- Briefings on risk assessment, project management, research techniques, record keeping, report preparation and
presentation skills will be given. Precise assessment criteria, deadlines, submission formats and instructions will be
disseminated via the Blackboard web site.

- A risk and ethical assessment for the project will be carried out in consultation with the supervisor.

- You will prepare a project plan with stated aims, an initial introduction to your research paper with key references,
and project targets. The project plan must be submitted by the published deadline. A progress report summarising your
progress against the plan, and including an extended introduction, list of references and final paper outline, is
submitted at the start of the second semester.

- A final report in the form of a Journal article (10 pages maximum) will be submitted for review before the end of the
spring term and final, "camera ready copy", taking account of reviewer's comments, must be submitted shortly after
the Easter vacation.

- Each student will attend an individual 30 minute viva voce examination at the end of the project period with 2
members of academic staff. A suitable presentation (10 minutes) should be prepared. At this time, the logbook will
also be inspected by the examiners.

- A full personal CV or LinkedIn profile must be completed with a reflective report on how the
dissertation has enhanced the student's employability will be prepared and assessed.
**Intended Learning Outcomes:** On successful completion of this module, students should, at a threshold level, be able to operate in each of these three modes:

**Engineer as Practitioner**
- define a project specifying the aims, objectives and realistic targets;
- construct a project schedule and work to that schedule;
- synthesize the various activities associated with the project;
- evaluate available options, including budgetary, sustainability and ethical considerations where relevant, and choose appropriate solutions;
- propose the development of a technical subject in some depth, largely on your own initiative and carry this out,
- prepare a journal article summarising your work and submitting it for review.

**Engineer as Scientist**
- write a technical report in the form of a short (10 page) journal article.
- compose an oral presentation (plus PowerPoint) on the progress of your project and the results obtained and defend it against critical appraisal;

**Engineer as Professional**
- perform a risk and ethical assessment for your project, create a project plan and report on progress;
- keep a log-book to record developments and progress;
- prepare for employment by writing a full personal CV and reflecting on the benefits of the project in enhancing your employability.

**Reading List:**
- Mike Ashby, How to Write a Paper, Engineering Department, University of Cambridge, 2005.
- Alisdair Montgomery (Academic Liaison Librarian), Giles Lloyd-Brown (Subject Librarian), Naomi Prady (Subject Librarian), Philippa Price (Subject Librarian), Library Support for Engineers.
- Avoiding Plagiarism (Cardiff University).
- Pears, Richard, Cite them right : the essential referencing guide / Richard Pears and Graham Shields, Palgrave
- Day, Robert A, How to write and publish a scientific paper / Robert A. Day and Barbara Gastel, Cambridge
- Davis, Marthabrary, Inc, Scientific papers and presentations Martha Davis ; illustrations by Gloria Fry, Academic

**Additional Notes:** Only available to students following an Engineering Degree Programme.

There are a number of compulsory submissions (a project plan; a risk assessment; an ethics assessment; evidence of preparation for employability; a progress report; an 10-page research paper and log book). In addition, attendance at a viva examination at which the project results will be presented and the research paper defended is a compulsory part of the assessment. The College of Engineering has a ZERO TOLERANCE penalty policy for late submission of coursework and continuous assessment.
EG-355 Quantum Devices

Credits: 10 Session: 2017/18 Semester 1 (Sep-Jan Taught)

Module Aims: To introduce and develop the design parameters and to evaluate a performance of state-of-the-art semiconductor devices based on quantum confinement and to consider methods to characterise the device properties.

Pre-requisite Modules: EG-142; EG-242

Co-requisite Modules:

Incompatible Modules:

Format: Lectures 22 hours
Example classes 11 hours
Directed private study 74 hours

Lecturer(s): Dr K Kalna

Assessment: Examination 1 (80%)
Class Test 1 - Coursework (20%)

Assessment Description: Assessment: Report from Device Modelling. A small group of 2-3 students will work together on modelling of semiconductor device with a deadline at the end of October (20%). Each group member will have to identify in the report his/her contribution to the common work.

Specific rules for passing this module:
This module is assessed by a combination of examination and assessment. In order for the assessment marks to count, you have to pass both the assessment (with at least 40%) and the exam component (with at least 40%). If you have less than 40% in the exam, then the module mark will be just the exam mark. Any resits are done by a supplementary exam. If you pass the exam but have failed the assessment, you will fail the entire module, so it is important to do the assessment (20%).

2 hour examination in January (80%)

Moderation approach to main assessment: Universal second marking as check or audit

Failure Redemption: If rules allow - standard University provision with marks capped at 40%. Any re-examination of this module will be by 100% written examination only.

Assessment Feedback: Feedback will be in a standard format on the College of Engineering intranet. Information provided includes extensive comments on your assessment report, average, maximum and minimum marks for the examination as a whole and for individual questions. There is also very important additional feedback given during the exercise classes.

Module Content: • Introduction to Quantum, Schrödinger's equation, concept of wave vector, k-space, confinement and tunnelling.
• Density of states, current transport.
• Application to quantum well, optical confinement, laser devices, high electron mobility transistor (HEMT), metal oxide semiconductor (MOS) structure, metal oxide semiconductor field effect transistor (MOSFET), ballistic model for nano-MOSFET, resonant tunnelling diode, and quantum cascade laser.
• Low dimensional systems (2D, 1D and 0D) including quantum wells, wires and dots. Device examples including quantum dot lasers.
• Advanced device design (need to include quantum effects).

Intended Learning Outcomes: After completing this module you should be able to:
• understand basic principles of the operation of semiconductor devices;
• explain typical fabrication processes used in semiconductor industry;
• analyse the suitability of semiconductor materials for device fabrication;
• explain the importance of bulk and interface properties in device operation;
• evaluate state of the art industrial and research techniques to characterise materials and devices;
• design simple quantum structures to produce laser diodes, high speed and digital transistors;
• discuss the need for miniaturisation and evaluate its effect on device characteristics;
• analyse the current concepts associated with future devices based on nanotechnology.

Additional Notes: • AVAILABLE TO visiting and exchange students.
• Penalty for late submission of work: ZERO TOLERANCE.

• Assessment: Report from Device Modelling. A small group of 2-3 students will work together on modelling of semiconductor device with a deadline at the end of October (20%). Each group member will have to identify in the report his/her contribution to the common work.

• Specific rules for passing this module:
This module is assessed by a combination of examination and assessment. In order for the assessment marks to count, you have to pass both the assessment (with at least 40%) and the exam component (with at least 40%). If you have less than 40% in the exam, then the module mark will be just the exam mark at a resit. Any resits are done by a supplementary exam. If you pass the exam but have failed the assessment, you will fail the entire module, so it is important to do the assessment (20%).

• 2 hour examination in January (80%)
Module Aims: This module will develop skills relating to the management of financial and human resources within the engineering sector. With respect to financial resources, the course will introduce the practice of accounting for transactions within a new business so as to give the student a good appreciation of the balance sheet, profit & loss and cash flow statements, which are essential components of a business plan. The course will also show students how to interpret financial statements and how best to allocate financial resources between competing engineering projects. With respect to human resources, the course will cover the basic concept of entrepreneurship before breaking down the essential elements of a business plan. The course will give the more entrepreneurial students guidance about how to go about commercializing their ideas and the less entrepreneurial students an understanding of what makes some of their colleagues tick. The learn by example approach adopted for this module guides the student through the complexities of financial and human resource management and encourages students to develop their own business plans. Students will also be introduced to the subject area of ethics within business.

Pre-requisite Modules:

Co-requisite Modules:

Incompatible Modules:

Format: Core Lectures 20 hours
         Discipline Specific Lectures 10 hours
         Private Study 70 hours

Lecturer(s): Dr M Evans, Dr CWH Dunnill, Prof MJ Mcnamee, Dr K Wada

Assessment:

Coursework 1 (30%)
Assignment 1 (35%)
Assignment 2 (35%)

Assessment Description: The core component is assessed via two time restricted Blackboard multiple choice/numeric based assignments (contributing 35% each to the module grade). The programme specific components are assessed through one piece of coursework that is programme specific (contributing 30% to the module grade).

Moderation approach to main assessment: Universal second marking as check or audit

Failure Redemption: Dependent on the students overall performance, additional coursework will be set over the summer.

Assessment Feedback: Students will receive feedback on their coursework, together with a model answer, within three weeks of submission.
Module Content:
Section A. Core Component

Unit 1: Accounting Principles and the Balance Sheet (Lectures 1 & 2).
Assets, liabilities, shareholders equity, the balance sheet equation, the fundamental principle of accounting, introduction to a new business venture (Crimebusters), European and British style balance sheets, double entry book keeping, the accruals basis, expenses, prepayments, the matching principle, depreciation, going concern and Crimebusters end of year balance sheet.

Unit 2: Constructing a Profit & Loss and Cash Flow Statement (Lecture 3).
Sales, Costs, Gross Profits, Operating profits, PBT, PAT, relation to Balance Sheet, Operating activities, Investing activities, servicing of finance, taxation and financing.

Unit 3: Ratio Analysis (Lectures 4 & 5).
Qualifications on profit maximisation, the underlying operation and the funding structure, trend analysis and benchmarking, return on capital employed, capital productivity, return on sales, gearing ratios: a lenders and shareholders perspective, return on equity, liquidity and some other ratios. The balance sheet explanation of the 2008 credit crunch.

Unit 4: Investment Appraisal (Lectures 6 & 7).
Cash flows, payback, compounding and discounting, net present values, internal rates of return and decision trees for capital budgeting.

Unit 5: Capital Budgeting methods (Lecture 8).
Linear programming for solving capital rationing problems: the objective function, the constraints, the mathematical statement, the feasible region, the optimal solution, extreme points and special cases.

Unit 6: Business Ethics. (Lecture 9 & 10).

Unit 7: Entrepreneurship: Teambuilding & Finance (Lecture 11 & 12).
Teambuilding and Entrepreneurial Finance.

Unit 8: Entrepreneurship: Business Startups (Lecture 13 & 14).
Risk and Reward. How to set up a new company.


Engineering, ethics and professionalism: on how to wear an engineering hat and a professional one. These lectures focus on the concept of professionalism in the business of engineering. Taking its cue from the Challenger disaster it discusses a number of issues that can arise in commerce that may undermine sound engineering judgement and professionalism.

Section B. Programme Specific Component

• There are four programme specific components: Civil, Chemical (including Environmental), Mechanical (including product design), Aerospace and Materials/Electrical/Medical Engineering.
Lectures 17 to 22.
Chemical Engineering. Lectures on project appraisal in the chemical industries.
Mechanical and Aerospace. Lectures on manufacturing processes and producing costing worksheets for specific processes.
Materials/Electrical/Medical Engineering. Lectures on modelling, simulating and then optimising manufacturing products and processes.

Intended Learning Outcomes:
After completing this module you should be aware of:
• some of the "tools" that assist in the efficient use of financial & human resources in manufacturing;
• how to construct, read and analyze financial data;
• how to make critical investment decisions;
• how to build financial statements for business plans;
• legal, human and economic aspects of entrepreneurship;
• the role of ethics in business.
**Reading List:**

**Additional Notes:**
Penalty for late submission of work: ZERO TOLERANCE.
The module is available to exchange students.
Notes, past papers and worked examples can be found on Blackboard.
EGA305 Nanoelectronics

Credits: 10 Session: 2017/18 Semester 2 (Jan - Jun Taught)

Module Aims: Nanoelectronics will soon succeed today's microelectronics technology and revolutionise the electronics industry. This cutting edge technology has major applications in both information and healthcare technologies, hence improving our quality of life. This module introduces the fundamental principle of nanoelectronics and its applications.

Pre-requisite Modules: EG-242

Co-requisite Modules:

Incompatible Modules:

Format:
- Lectures 20 hours
- Directed private study 80 hours

Lecturer(s): Dr KS Teng

Assessment:
- Examination 1 (100%)

Assessment Description: 100% Examination

Moderation approach to main assessment: Universal second marking as check or audit

Failure Redemption: If rules allow - standard University provision with marks capped at 40%. Any re-examination of this module will be by written examination only (100%)

Assessment Feedback: Students receive feedback from formal examination through College's intranet.

Module Content:
- Introduction on nanotechnology.
- Limitation in scaling down existing CMOS technology.
- Physical and electronic properties of low-dimensional nanoscale electronic materials.
- Characterisation on the nanoscale.
- Top-down and bottom-up nanofabrication techniques.
- Nanoelectronic devices such as carbon nanotube devices, single-electron transistors and molecular electronics for healthcare and information technology.
- Molecular electronics.

Intended Learning Outcomes: After completing this module the student should be able to
- evaluate the future of Moore's Law
- explain the limits on scalability in CMOS devices;
- explain the electronic properties of 2D well, 1D wire and 0D dot;
- explain and analyse the advantages, applications and limitations on the different nanoscale characterisation and fabrication techniques;
- explain and analyse the operational principle of nanoelectronics devices, such as single electron transistor, molecular electronics, and carbon nanotube transistor, logic gates and sensors etc.


Additional Notes:
- Notes and example sheets for the module are available on Blackboard.
Module Aims: This module aims to present fundamental aspects of energy generation using low carbon technologies. The module will describe the following:

- Description of the concept of "Hydrogen economy"; Hydrogen generation and purification;
- Energy generation using fuel cells: Proton exchange fuel cells (PEMs), solid oxide fuel cells (SOFCs), molten carbonate fuel cells (MCFCs), phosphoric acid fuel cells (PAFCs), alkaline fuel cells (AFCs); methanol fuel cells (MeFCs).
- Solar energy generation: Silicon-based photovoltaic cells, Gratzel and Organic photovoltaic cells; Perovskite solar cells;
- Definition and description of batteries: Rechargeable batteries: Li-ion, Li-ion polymer, Na-ion, Na-air, and NiMH batteries;
- Supercapacitors as energy generators. Wind and Tidal Energy generation; Geothermal Energy.

Pre-requisite Modules:


Hydrogen generation: general description of current industrial processes for hydrogen generation and related environmental implications.

Fuel cells: Introduction and principles of fuel cells. Definition of efficiency. Description of proton exchange fuel cells (PEMs), solid oxide fuel cells (SOFCs), molten carbonate fuel cells (MCFCs), phosphoric acid fuel cells (PAFCs), alkaline (AFCs) fuel cells, methanol fuel cells (MeFCs). Case studies.


Rechargeable batteries: Principles and theory. Introduction to Li-ion, Li-ion polymer and NiMH batteries. Supercapacitors. Case studies.

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**Additional Notes:** Available to visiting and exchange students.

The College of Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment.

Notes, worked examples and past papers for this module can be found on Blackboard.
### EGA333 Communications

**Credits:** 10  
**Session:** 2017/18 Semester 1 (Sep-Jan Taught)

**Module Aims:** Enabling students to secure strong understanding of the current communication technologies, both from the theoretical and experimental point of views.

**Pre-requisite Modules:**

**Co-requisite Modules:**

**Incompatible Modules:**

**Format:** 2 Lecture per week

**Lecturer(s):** Dr A Mehta

**Assessment:** Examination 1 (100%)

**Assessment Description:** The module is assessed by a 2 hour Examination; Answer 3 out of 4 questions.

**Moderation approach to main assessment:** Universal second marking as check or audit

**Failure Redemption:** If a student is awarded a re-sit, Failure Redemption of this module will be by Examination only (100%). Level 2 re-sits (Supplementary exams) are capped at 40%.

**Assessment Feedback:** Feedback will be in a standard format on the College of Engineering intranet. Information provided includes average marks, maximum and minimum marks for the exam as a whole and for individual questions.

Students are also encouraged to meet the academic for any specific feedback, if required.

**Module Content:**

- Fundamentals of analogue and digital signals
- Concept of modulation in amplitude, phase and frequency.
- Modulation and demodulation of analogue signals: AM, DSB, SSB and FM.
- Baseband digital signals: sampling quantization, spectra, aliasing.
- Modulation and demodulation of digital signals: ASK, FSK, QPSK, QAM.
- Analysis of the above rf signals in both time and frequency domains.
- Access technologies: CDMA, OFDM.
- Introduction to Modern Systems: GSM, CDMA, WIFI, WIMAX, 3G, 4G, MIMOs, UWB, GPS, RFID.

**Intended Learning Outcomes:** After completing this module you should be able to:

- Relate wavelength and frequency, and explain the usage of different parts of the radio spectrum.
- Compare the analysis in time and frequency of various amplitude modulations.
- Understand the parameters that control the bandwidth of FM signals.
- Understand sampling theory associated with baseband digital signals: quantisation error, aliasing etc.
- Determine the spectra of digital baseband and rf signals and the effects of encoding.
- Use of SNR and Bandwidth knowledge and calculations to design efficient practical communication links for satellite and wifi networks.

Also have an understanding of:

- transmission and reception of digital signals.
- cellular voice system and data (internet) systems.
- the application of communication technology for various modern applications, e.g. RFIDs and MIMOs.

**Reading List:**

- AVAILABLE TO visiting and exchange students
- Notes, worked examples and past papers for this module can be found on Blackboard.