COLLEGE OF ENGINEERING

STUDENT HANDBOOK

MSc ELECTRONIC AND ELECTRICAL ENGINEERING
FHEQ LEVEL 7

RESEARCH CENTRE: SPEC
THE SYSTEMS AND PROCESS ENGINEERING CENTRE

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
WELCOME

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

COURSE CO-ORDINATOR:  
Dr Petar Ijic ([p.ijic@swansea.ac.uk](mailto:p.ijic@swansea.ac.uk))  
Room B204, Engineering East
### Compulsory Modules

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| **EGIM16**  
Communication Skills for Research Engineers  
10 Credits  
Dr SA Rolland | **EGLM01**  
Wide Band-gap Electronics  
10 Credits  
Prof OJ Guy/Mr TGG Maffeis |
| **EGLM00**  
Power Semiconductor Devices  
10 Credits  
Dr P Igic | **EGLM03**  
Modern Control Systems  
10 Credits  
Dr CP Jobling |
| **EGLM02**  
Advanced Power Electronics and Drives  
10 Credits  
Dr Z Zhou | **EGLM05**  
Advanced Power Systems  
10 Credits  
Dr M Fazeli |
| **EGLM07**  
Power Systems with Project  
10 Credits  
Dr M Fazeli | **EGLM06**  
Energy and Power Electronics Laboratory  
10 Credits  
Dr Z Zhou |
| **EGTM71**  
Power Generation Systems  
10 Credits  
Prof I Masters |  |

### Research Project

**EG-D05**  
MSc Dissertation - Electrical Engineering  
60 Credits  
Dr P Igic

### Total 180 Credits

### Optional Modules

Choose exactly 10 credits

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<th>Code</th>
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<th>Lecturer(s)</th>
<th>Semester</th>
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<tr>
<td>AT-M51</td>
<td>Signals and Systems</td>
<td>Dr P Loskot</td>
<td>TB1</td>
</tr>
<tr>
<td>AT-M56</td>
<td>Digital Communications</td>
<td>Dr S Taccheo</td>
<td>TB1</td>
</tr>
<tr>
<td>AT-M80</td>
<td>Optical Communications</td>
<td>Dr KM Emnser</td>
<td>TB1</td>
</tr>
<tr>
<td>EGNM01</td>
<td>Probing at the Nanoscale</td>
<td>Dr RJ Cobley/Mr TGG Maffeis/Dr CJ Wright/..</td>
<td>TB1</td>
</tr>
</tbody>
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And

Choose exactly 20 credits

Choose exactly 20 credits from Options in TB2

<table>
<thead>
<tr>
<th>Code</th>
<th>Module</th>
<th>Lecturer(s)</th>
<th>Semester</th>
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<tr>
<td>AT-M49</td>
<td>RF and Microwaves</td>
<td>Dr A Mehta</td>
<td>TB2</td>
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<tr>
<td>AT-M76</td>
<td>Wireless Communications</td>
<td>Dr P Loskot/Dr S Taccheo</td>
<td>TB2</td>
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<tr>
<td>AT-M79</td>
<td>Optical Networks</td>
<td>Dr KM Emnser</td>
<td>TB2</td>
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<tr>
<td>EGNM04</td>
<td>Nanoscale Structures and Devices</td>
<td>Mr TGG Maffeis/Dr KS Teng</td>
<td>TB2</td>
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</tbody>
</table>
# AT-M49 RF and Microwaves

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

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

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<th>Pre-requisite Modules:</th>
<th>Co-requisite Modules:</th>
<th>Incompatible Modules:</th>
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**Format:**
- Lectures 24 hours
- Course work lab demonstration 11 hours
- Own directed private study 65 hours

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

**Assessment:**
- Examination 1 (75%)
- Coursework 1 (25%)

**Assessment Description:** Examination and Coursework:

 Examination (75%); 2 hour examination - Answer 3 out of 4 questions

 Coursework (25%): This is an individual piece of coursework. It focuses on writing a 1500 word report on the experimental investigations on single arm rectangular spiral antenna. The report should highlight the following:
- Measurement of the antenna input impedance at the frequency of 3.3 GHz
- Measurement of the reflection coefficient from 3-4 GHz
- Measurement of the radiation pattern at 3.3 GHz.
- How a VNA Works
- How the Satimo Near Field Antenna Measurement facility works

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

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

**Assessment Feedback:** Via internet with aid of college examination feedback system. Students are also encouraged to meet the academic for any specific feedback, if required.

**Module Content:**
- Modern applications of rf and microwaves
- Transmission lines
- Antennas
- Smart Antennas
- Waves
- Components (Waveguides, RF switches and RF sources)

**Intended Learning Outcomes:** After completing this module you should:
- Understand the application of communication technology for various modern applications, e.g. RFIDs, Satcoms, RAY Gun, and UWB Cancer detection techniques, GPS, 60 GHz radios, etc.
- Have an in-depth understanding of transmission line theory, associated equations, smith charts and line impedance transformation.
- Have a thorough understanding and analysis of different antenna types, their characteristics and their design parameters.
- Have a detailed understanding of the operation of the smart antenna (phase array antenna) and array factor.
- Understand the propagation of electromagnetic waves via various types of mediums.
- Understand various microwave components such as waveguides, mixers, switches, circulators, couplers etc.

**Reading List:**

**Additional Notes:**
- Notes, worked examples and related materials for this module can be found on Blackboard.
- The College of Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment.
## AT-M51 Signals and Systems

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

**Module Aims:** The module aims to introduce and strengthen the advanced engineering mathematical and numerical software skills as a prerequisite for other modules in the course. These skills are introduced through a systematic description of signals and systems by explaining their models and properties.

### Pre-requisite Modules:

### Co-requisite Modules:

### Incompatible Modules:

### Format:
- Lectures: 22 hours
- Directed private study: 78 hours

### Lecturer(s):
Dr P Loskot

### Assessment:
- Examination 1 (75%)
- Assignment 1 (25%)

### Assessment Description: Examination and Coursework:

Examination 75% - Standard examination of 2 hours. Answer 3 out of 4 questions. Each question carries 25 marks.

Continuous Assessment (Assignment) 25%: This is an individual piece of coursework to assess numerical software skills for a selected signal processing problem.

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

**Failure Redemption:** If rules allow - standard University provision with marks capped. Failure Redemption of this module will be by Examination (100%).

### Assessment Feedback:
Continuous feedback during lectures and by emails, general feedback after examination.

### Module Content:
- Continuous- and discrete-time deterministic signals in time and frequency domains.
- Continuous-time systems in time and frequency domains.
- Probabilities, random variables, and random processes.
- Basics of detection theory for binary digital communication systems.

### Intended Learning Outcomes:
After completing this module you should be able to:
- Understand mathematical modelling and analysis of signals and systems in time and frequency domains.
- Understand how to describe properties of random signals using probabilities, and other statistical evaluations.
- Use Monte Carlo simulations to evaluate system properties with random signals and to verify theoretical calculations.
- Be able to use mathematical models to solve problems in communications and other engineering disciplines.
- Understand the steps in the design process leading to algorithms and their implementation.

### Reading List:

### 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.
- Lecture notes, worked examples and past papers for this module can be found on Blackboard.
**AT-M56 Digital Communications**

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

**Module Aims:** This module presents the basic theory needed and used to implement most of the modern optical communication systems currently in use. It considers noise, optimum filtering, modulation formats and their optimal under various constraints and the design of an optimum receiver. The module also gives an exposure into formation theory, coding and coded modulation. It forms a good basis for communication system design and for possible exposure into more specialized advanced topics in communication.

Key focus will be on digital communications including optimum receiver design, synchronization, channel capacity, spread spectrum and error detection/corrections

**Pre-requisite Modules:**

**Co-requisite Modules:**

**Incompatible Modules:**

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

**Lecturer(s):** Dr S Taccheo

**Assessment:**
- Examination (80%)
- Coursework 1 (20%)

**Assessment Description:** Assessment: examination (80%) and continuous assessment (20%)

The examination is worth 80% of the module. 2 hour examination paper; Answer 3 out of 4 questions.

Coursework will be answer to general questions on the first part of the program (Lectures 1-6) during a 2 week window.

Note: coursework mark will not be used in case of resit.

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

**Failure Redemption:** If rules allow - standard University provision with marks capped. Failure Redemption of this module will be by Examination only 100%. Note: coursework mark will not be used in case of resit.

For other issues, following university policy (see below):

http://www.swan.ac.uk/registry/academicguide/assessmentissues/redeemingfailures/

**Assessment Feedback:** For the examination, students will receive feedback through an Examination Feedback Summary Sheet which provides both the statistics and analysis of each question.

Coursework mark and solutions will be provided within two weeks.

**Module Content:** Performance Metrics
- Comparison of Analog/Digital Communications
- Spectral Density and Statistic average
- Noise in Communications and Ideal Filters
- Information theory & channel capacity
- source coding
- maximum likelihood receiver
- The matched filter
- digital signalling through band limited channels

**Intended Learning Outcomes:** After completing this module you should be able to:
- Describe and identify the different binary transmission formats currently in use
- Explain the concept of a matched filter and compute bit error rates
- Evaluate and compare the performance of M-ary modulation schemes
- Analyse and interpret signals in vector spaces
- Design optimum receivers making use of likelihood concepts
- Design a digital communication system taking typical impairments into account such as noise and fading
- Describe the basic elements of information theory including entropy, coding and coded modulation.


Additional Notes:
• AVAILABLE TO 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
## AT-M76 Wireless Communications

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

**Module Aims:** The module introduces statistical signal processing. Specifically, one third is devoted to introduction of estimating random and non-random parameters. The second-third of the module introduces convex optimization. In the last part, signal processing techniques are illustrated on problems in optical wireless communications.

**Pre-requisite Modules:**

**Co-requisite Modules:** AT-M51; AT-M56

**Incompatible Modules:**

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

### Lecturer(s): 
Dr P Loskot, Dr S Taccheo

**Assessment:**
- Coursework 1 (15%)
- Examination (75%)
- Coursework 2 (10%)

**Assessment Description:**
- Coursework 1 10%: numerical experiments in estimation and convex optimization in Matlab
- Coursework 2 10% students will be divided in week 6 into three groups to survey one of the following topics
  - "Use of Optical Wireless as backbone in case of Natural Catastrophes"
  - "Use of drone-based optical wireless to cover rural areas"
  - "Optical Satellite Links"
- By week 9 each group will present their survey organizing a ppt presentation of 15 minutes made by all member of the group.
- Examination: 75% Answer 3 out of 4 questions
- Resit 100% Exam (coursework mark will not be used)

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

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

For other issues, following university policy (see below):
http://www.swan.ac.uk/registry/academicguide/assessmentissues/redeemingfailures/

**Assessment Feedback:** During dedicated lecture, via email and during office hours.

**Module Content:**
- Models of continuous and discrete time systems
- General parameter estimation
- Linear parameter and signal estimation
- Convex optimization
- Applications in optical wireless communications

**Intended Learning Outcomes:** After completing the module you should be able to:
- understand basics of signal processing with focus on parameter estimation
- understand estimation of random and non-random parameters and signals
- understand basic principles of machine learning
- understand how to recognize and solve some common optimization problems
- understand the principles of optical free-space propagation
- understand the components and the design of optical wireless links

**Reading List:**

**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.
### AT-M79 Optical Networks

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

**Module Aims:** This module presents the essential element of modern optical networks, both in backbone and broadband access scenarios. The module evaluates WDM, the most popular, bandwidth-rich contemporary approach and also others, including optical time multiplexing and photonic packet switching. Relevant client layers and principles of networking design and planning are covered. Key demonstrators and field hardened trials are also presented.

**Pre-requisite Modules:**

**Co-requisite Modules:**

**Incompatible Modules:**

**Format:** Lectures 20 hours; preparation for assignment 30 hours; directly private study 50 hours.

**Lecturer(s):** Dr KM Ennser

**Assessment:**
- Examination (75%)
- Other (25%)

**Assessment Description:** The module is based on Examination (75%) and Continuous Assessment (25%). Zero Tolerance Penalty for late submission of Continuous Assessment. Late submissions are given Zero (0%) mark.

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

**Failure Redemption:** If rules allow - standard University provision with marks capped. Failure Redemption of this module will be by Examination only (100%).

**Assessment Feedback:** The feedback is provided during lectures whenever possible or during office opening hours.

**Module Content:**
- Client layers of optical layer
- Network elements and topologies
- Local, Access and Metro Networks: Architecture and future trends
- Photonic Packet Switching: Optical time division multiplexing (OTDM), photonic switching node design, broadcast OTDM networks and testbeds.
- Testbed examples

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

- Understand different client layers
- Evaluate different WDM network elements and topologies including broadcast-and-select and wavelength routing networks
- Understand and design of optical local, access and metro networks
- Analyse photonic packet switching networks and time domain optical networking approaches
- Appraise the evolution of modern optical networks through the assessment of key network demonstrators and field implementations.

**Reading List:**

**Additional Notes:**
- AVAILABLE TO to Visiting and Exchange students.
- Notes, worked examples and past papers for this module can be found on Blackboard.
- The College of Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment.
AT-M80 Optical Communications

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

Module Aims: This module presents the essential element of modern optical communication systems based on single mode optical fibres from the core to the access network. The module concentrated on the fundamental properties of optical fibres and the principles of operation of systems including WDM based high capacity transport networks. The module provides an introduction to modern WDM systems and modulation formats. Laboratory activities are included.

Pre-requisite Modules:

Co-requisite Modules:

Incompatible Modules:

Format:
Lectures: 25h
Private Study: 75 h

Lecturer(s): Dr KM Ennser

Assessment:
Examination 1 (75%)
Other (25%)

Assessment Description:
Exam = 75% Continuous Assessment = 25%
Zero tolerance for late submission

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

Failure Redemption: If rules allow - standard University provision with marks capped. Failure Redemption will be by Examination.

Assessment Feedback: In the lectures and written reports on exam

Module Content:
- Introduction to optical fibre technology
- Enabling technologies: Laser sources and filters, couplers, isolators, circulators, optical multiplexers, optical amplifiers, dispersion compensators.
- Transmission systems: crosstalk, dispersion, fibre nonlinearities, noise and system sensitivity, link power budget, repeater spacing.
- Wavelength division multiplexing (WDM) systems and key components
- WDM amplifier and system design, coherent detection and polarisation multiplexing.

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

- Understand the optical fibre technology and fundamentals
- Evaluate the performance of various enabling technologies used in the modern optical networks
- Design optical transmission systems taking into account cross talk, dispersion, fibre nonlinearities and noises
- Evaluate transmission performance and link power budget
- Operate key components required to develop a basic optical communication systems, and conduct experiments to characterise their performance.


Additional Notes: The College of Engineering has a ZERO TOLERANCE penalty policy for late submission of coursework and continuous assessment
EG-D05 MSc Dissertation - Electrical Engineering

Credits: 60 Session: 2017/18 Semester 3 (Summer Taught)

Module Aims: The module aims to develop fundamental research skills. It comprises the development of supervised research work leading to a dissertation in the field of the Master's degree programme. The specific research topic will be chosen by the student following consultation with academic staff.

Pre-requisite Modules:
Co-requisite Modules:
Incompatible Modules:

Format: Typically 1 hour per week i.e 10-15 hrs total contact time. Each student is to be supervised in accordance with the University’s Policy on Supervision, with a minimum of three meetings held. A careful record should be kept, agreed between supervisor and student, of all such formal meetings, including dates, action agreed and deadlines set.

Lecturer(s): Dr P Igic
Assessment: Other (100%)

Assessment Description: The research project and dissertation forms Part Two of the Masters degree. Information about dissertation preparation and submission can be found at:


Additionally, students should refer to: http://www.swansea.ac.uk/academic-services/academic-guide

The word limit is 20,000. This is for the main text and does not include appendices (if any), essential footnotes, introductory parts and statements or the bibliography and index.

Each student is to submit two soft bound copies and an electronic copy of the dissertation (CD with dissertation in Pdf format) to the College Postgraduate Administration Team by the deadline of 30th September. Each copy must contain:

• a statement that it is being submitted in partial fulfilment of the requirements for the degree;
• a summary of the dissertation not exceeding 300 words in length;
• a statement, signed by you, showing to what extent the work submitted is the result of your own investigation.

Acknowledgement of other sources shall be made by footnotes giving explicit references. A full bibliography should be appended to the work:

• a declaration, signed by you, to certify that the work has not already been accepted in substance for any degree, and is not being concurrently submitted in candidature for any degree; and
• a signed statement regarding availability of the thesis.

The dissertation is marked by the supervisor and another member of staff and sent to an External Examiner for moderation. An Internal Exam Board is then held to confirm the mark. Finally, all marks are ratified at the University Postgraduate Taught Examination Board.

Moderation approach to main assessment: Universal double-blind marking

Failure Redemption: Candidates who fail the dissertation are given an opportunity to resubmit the dissertation within 3 months of the result of the examination if a full-time student or 6 months for part-time students. Such students will be given one formal feedback session, including written feedback on the reasons for failure, immediately following confirmation of the result by the University Postgraduate Taught Examination Board. The opportunity to resubmit will only be offered to students who submit a dissertation and are awarded a fail. Those candidates who do not submit a dissertation will not be offered a resubmission opportunity.

Assessment Feedback: Informal feedback will be given during regular meetings with supervisors. The supervisor will also provide an assessment of the project drafting skills during the planning of the dissertation. Work will be returned according to specified deadlines and accompanied by constructive comment.

A Feedback session will be given to any student who fails their dissertation and is permitted by the Award Board to resubmit their work.
**Module Content:** Study for the dissertation, which may be based on practical, industrial, or literature work, or any combination of these, is primarily carried out over a period of about 12 weeks, with the dissertation being submitted at the end of September. Preparatory work on the dissertation may take place during Part One of the programme but students will only be permitted to submit their dissertation following successful completion of Part One.

In conducting the research project and dissertation the student will be exposed to all aspects of modern information retrieval processes, the organisation and resourcing of research and the organising and presentation of experimental data. The student must make inferences on conclusions, based on the evidence provided and supported by the research work. Furthermore they must assess the significance of this work in relation to the field and make suggestions about how further work could improve or clarify the research problem. The results of the project will be disseminated in a substantial dissertation demonstrating the student's ability to research a subject in depth.

The student will meet regularly with the supervisor to ensure that the project is well developed and organised. Progress will be monitored.

**Intended Learning Outcomes:** On completion of this module, students should have the ability to:
- investigate a research topic in detail;
- formulate research aims;
- devise and plan a research strategy to fulfil the aims;
- carry out research work - undertake a literature search, a laboratory based or computer based investigation or a combination of these;
- gather, organize and use evidence, data and information from a variety of primary and secondary sources;
- critically analyse information;
- make conclusions supported by the work and identify their relevance to the broader research area;
- resolve or refine a research problem, with reasoned suggestions about how to improve future research efforts in the field; and
- produce a report (dissertation), with the findings presented in a well organised and reasoned manner.

**Reading List:**

**Additional Notes:** The College of Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment. If an extension is deemed appropriate a Postgraduate Taught Masters ‘Application for Extension to the Submission Deadline/ Period of Candidature’ Form will need to be submitted as follows:
- 31 August – deadline for Part Two students (non-resit students)
- 8 November – deadline for Part Two Students (students who had resits)
# EGIM16 Communication Skills for Research Engineers

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

## Module Aims:
Communication at a research level differs from that at the undergraduate level in that it is usually driven by an output or result rather than the requirement to show knowledge or understanding. The skill of a good communicator at research level lies in efficiently and rigorously conveying the ideas behind the theory and proof of the research output. Verbal, written, visual and group communication will be explored through a series of lectures and formative exercises.

## Pre-requisite Modules:

## Co-requisite Modules:

## Incompatible Modules:

## Format:
Lectures (10h), Exercises (20h), Reading / Private Study (30h), Preparation for Assessment (40h)

## Lecturer(s):
Dr SA Rolland

## Assessment:

- **Assignment 1 (10%)**
- **Assignment 2 (10%)**
- **Oral Examination (40%)**
- **Writing (40%)**

### Assessment Description:
The first sit assessment will consist of 4 assignments.

The first component will feature a small number (one to three) of tasks which are aimed to evaluate the student's understanding of the other ideas, beyond the written word and oral presentations, which are covered in the module. This will include the critical review of a written output. Other possible tasks include group meetings and the creation of a poster. The coursework may be done individually or in groups, this will be confirmed at the time of setting the work.

The second assessment component will be a short written piece, up to two pages long, which will test the students understanding of the concepts with respect to the written work and to allow feedback to the participants in the module prior to the final assessment. This is an individual piece of coursework.

The oral examination will involve the students presenting an example of the work they have undertaken in the past, typically a project, through an oral presentation. The target duration of the oral presentation will usually be between 8 to 10 minutes. The exact duration will be specified in the assignment descriptor. This is an individual piece of coursework.

The final, fourth, component will require the student to write a paper or equivalent. This paper will be between six to eight pages in length and will be written to a format described in the assignment descriptor. This is an individual piece of coursework.

The reassessment will consist of 2 assignments, details of which are provided in a later section.

### Moderation approach to main assessment:
Universal non-blind double marking

### Failure Redemption:
Candidates shall be given one opportunity to redeem a failure in the module during the summer supplementary period.

The reassessment will consist of up to two components that will be equivalent to the oral and second written assignment of the first sit. A pass mark will be required in both resit components in order for the module to be passed. A student will only be required to redeem any of the two components that were failed at the first attempt. The resit components are individual pieces of coursework.

### Assessment Feedback:
Blackboard will be used to provide individual feedback to the students on all the components that contribute to the final mark. For the first assessment component a class feedback document is also generally included on Blackboard.

As part of the practical sessions the students will receive verbal feedback on their performance. These sessions do not contribute to the final mark.
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<thead>
<tr>
<th>Module Content: Written Communication: [6 hours]</th>
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<tbody>
<tr>
<td>• The usual layout of reports, theses, journal &amp; conference papers.</td>
</tr>
<tr>
<td>• How to write a good abstract for a research output.</td>
</tr>
<tr>
<td>• What should be in the introduction?</td>
</tr>
<tr>
<td>• Contents of the main body of a research output.</td>
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<tr>
<td>• Effective conclusions</td>
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<tr>
<td>• Writing style</td>
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<tr>
<td>• Cross-referencing, captions, references</td>
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<tr>
<td>• Critical review of self and others</td>
</tr>
<tr>
<td>• Design concepts for research posters</td>
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<tr>
<th>Oral Communication: [6 hours]</th>
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</thead>
<tbody>
<tr>
<td>• The usual layout of a research presentation</td>
</tr>
<tr>
<td>• Slide design for a research presentation</td>
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<tr>
<td>• Delivery of a presentation, do's and don'ts</td>
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<tr>
<td>• Maintaining the audience’s interest.</td>
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<tr>
<th>Other topics: [3 hours]</th>
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<tbody>
<tr>
<td>• Attending &amp; chairing meetings</td>
</tr>
<tr>
<td>• Conferences – submissions and attendance</td>
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<tr>
<td>• Submission of papers and peer review.</td>
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<tr>
<th>Intended Learning Outcomes: By the end of this module the student will be able to:</th>
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<tr>
<td>• Write a paper or equivalent employing the structure and rigour required at research level (assessed by both the written assignments)</td>
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<tr>
<td>• Efficiently communicate the concepts associated with complex ideas (assessed by the first written assignment and the oral presentation)</td>
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<tr>
<td>• Critically evaluate a written output (assessed within the first assessment component)</td>
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<tr>
<td>• Verbally present a complex idea using the presentation structure, slide content and delivery techniques expected of a research engineer (assessed through the oral presentation)</td>
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<tr>
<td>• Demonstrate an awareness of the other modes of communication of ideas at a research level such as posters and group discussions (assessed in the first assessment component)</td>
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<tr>
<th>Reading List:</th>
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| Additional Notes: All lectures and course material will be provided on Blackboard. |

The College of Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment.
EGLM00 Power Semiconductor Devices

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

Module Aims: The construction of System-On-Chip is an ultimate goal of the electronics industry because of the significant cost-performance benefits that it offers. The aim of this module is to describe the increasing importance of power electronics technology in efficient energy management and reduction of the carbon emission. The operation of advanced power semiconductor devices, the technologies that facilitate their manufacture and applications in systems will be discussed.

Pre-requisite Modules:

Co-requisite Modules:

Incompatible Modules:

Format: Formal contact hours: 20 hours
Directed private study: 80 hours

Lecturer(s): Dr P Igic

Assessment:
Coursework 1 (30%)
Coursework 2 (70%)

Assessment Description: Module is laboratory based. Laboratory classes are compulsory. Students must attend at least 80% of the laboratory classes in order to be allowed to be assessed for the module. Assessment method includes coursework. Coursework has two components.

First component of 30% weighting relates to students undertaking desktop research and then preparing a written report on a particular topic related to renewable energy and/or energy efficient electronics.

Second component of 70% weighting is based on the student work in the semiconductor device and technology modelling laboratory. After finishing their modelling task, students are asked to produce a written report having at least 3 sections: Section 1 will discuss background physics of the device under investigation; Section 2 will present SILVACO input file used to accomplish the simulation task; Section 3 will present and discuss modelling results.

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

Failure Redemption: Module is laboratory based.
Laboratory classes are compulsory. Students must attend at least 80% of the laboratory classes in order to be allowed to be assessed for the module. Assessment methods may include laboratory reports, logbooks, practical demonstrations and oral examinations.

Failure redemption:
If a student attends the required number of laboratory classes, but he/she fails to submit the coursework or does not obtain a pass mark, he/she will be allowed to resubmit failed coursework components in August (submission deadline to be decided by the module lecturer).

If a student attends at least 40% of the laboratory classes, he/she will be asked to attend extra laboratory classes between 1 July and 15 August (the exact class dates/times to be announced by module lecturer before 1 July of the current academic year) and then he/she will be allowed to submit the coursework in August (the submission deadline to be decided by the module lecturer).

If student attends less than 40% of the laboratory classes, he/she will be asked to repeat the module in the next academic year (automatic fail).

Assessment Feedback: Students will receive a generic form that explains what common mistakes should be avoided in future. Positive practice will also be highlighted.
Individually, students can make appointments with the lecturer to receive specific individual feedback on assignments.
<table>
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<tr>
<th>Module Content:</th>
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<tbody>
<tr>
<td>• Power electronics and energy management in the New Millennium</td>
</tr>
<tr>
<td>• Semiconductor fundamentals</td>
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<tr>
<td>• Bipolar devices</td>
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<tr>
<td>• Power MOSFET</td>
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<tr>
<td>• TCAD and circuit oriented modelling of the semiconductor technology and power devices</td>
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<tr>
<td>• Power integrated circuit and system on Chip technologies</td>
</tr>
<tr>
<td>• RESURF and super-junction devices</td>
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<tr>
<td>• Power electronics applications</td>
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</tbody>
</table>

**Intended Learning Outcomes:** After completing this module students should be able to demonstrate a detailed knowledge and advanced understanding of:

- Bulk silicon and SOI power electronics technologies;
- Bipolar and unipolar semiconductor power devices;
- Breakdown voltage and ON-resistance of the semiconductor devices;
- Vertical and lateral power semiconductor device concepts;

An ability to:
- Perform FE numerical simulation of semiconductor devices and interpret results correctly;
- Analyse DC and transient characteristics of the device;
- Design electronic device suitable for System on Chip applications;
- Study independently; use library resources;
- Effectively take notes and manage working time.

**Reading List:**


**Additional Notes:** Power semiconductor technology is a key enabling technology leading to more efficient power conversion. Historically, the development of electronic power devices can be traced to the early 1950s when thyristors capable of operating at high current and voltages were introduced. In the years to come, the most important development has been the introduction of power devices with high-input-impedance gate such as VDMOSFETs and IGBTs. This allowed a large reduction in system size and cost, leading to many new application for power electronics in domestic appliances and automotive and aviation electronics, for example.
**Module Aims:** State-of-the-art materials and technology will be considered with emphasis on diamond silicon carbide & gallium nitride. The course will cover everything from materials growth through device processing technology, to devices and applications. Current commercial devices and anticipated devices will be highlighted and discussed. The semiconductor physics needed for devices simulation and an introduction to device simulation will be covered. Metal oxide wide band gap semiconductors and their applications in renewable energy generation will be discussed.

**Pre-requisite Modules:**

**Co-requisite Modules:**

**Incompatible Modules:**

**Format:**
- 26 h lecture
- 4 h pc lab

**Lecturer(s):** Prof OJ Guy, Mr TGG Maffeis

**Assessment:**
- Examination 1 (80%)
- Coursework 1 (10%)
- Coursework 2 (5%)
- Group Work - Coursework (5%)

**Assessment Description:** Examination: (Written examination) 80% and 20% Continuous Assessment (Coursework)

Examination: 2 Hour examination, Answer 3 questions out of 4. Each question worth 25 marks

Course work components:
- Coursework 1: (Dr. Maffeis) Problem sheet (exam type questions): Assessment in March - worth 10%. This is an individual piece of coursework.
- Coursework 2: (Prof. Guy) Problem sheet (exam type questions): Assessment in April - worth 5%. This is an individual piece of coursework.
- Groupwork Coursework: (Prof. Guy) Group presentations - powerpoint presentations given by small groups on course related topics: Assessment in April - worth 5%. This coursework is conducted and assessed in groups.

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

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

**Module Content:**
- Introduction to wide band-gap materials: structure and material properties of diamond, silicon carbide & gallium nitride
- Materials Growth
- Electronic properties and applications
- Basic requirements of power devices
- Types of wide bandgap devices
- Diodes: Schottky diodes & PiN diodes
- Field Effect Transistors (FETs): MOSFETs, MESFETs
- Device processing technology: Material analysis, Contact formation, Implantation, Dielectrics, Etching
- Semiconductor physics background
- Device testing & characterisation; State of the art device technology
- Electronic materials for renewable energy generation
- Solar power and photo-voltaics
**Intended Learning Outcomes:** After the completion of this module the student should be able to demonstrate detailed knowledge and advanced understanding of:

- The advantages and disadvantages of using new semiconductor materials.
- Techniques to verify the electronic properties of devices.
- Techniques for design and fabrication of devices.
- The energy efficiency advantages of using advanced materials.
- The semiconductor physics governing device behaviour.
- How new materials can be used in renewable energy generation.

An ability to (thinking skills):
- How to assess the worth of calculated or theoretically based solutions.
- Identify the key differences between simulation and experiment.
- How to design and fabricate devices.

An ability to (practical skills):
- Understand in great detail practical implications of different semiconductor materials on device performances, why and when they work, and fabricate and test basic devices.
- Integrate a device into a basic circuit and characterise its performance, having the ability to interpret and analyse the data.

An ability to (key skills):
- Study independently; use library resources; effectively take notes and manage working time.

Students should develop an advanced understanding of semiconductor materials & devices. An emphasis will be placed on the fabrication processes used to develop such electronic devices. Students will learn about 'state of the art' devices and processing techniques. Numerical simulation techniques for device design will be studied. Electronic materials such as plastic electronics will also be assessed. Renewable energy generation using solar and biofuels will be investigated.

**Reading List:**

**Additional Notes:**
- There is a zero tolerance towards late submission of coursework.

- Advanced semiconductor materials like diamond, silicon carbide and gallium nitrate are necessary to increase energy efficiency of electronic devices to reduce carbon emissions. These new materials are expected to replace silicon in aerospace, energy and automotive (hybrid electric vehicles) sectors in the near future.
EGLM02 Advanced Power Electronics and Drives

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

Module Aims: This module introduces advanced circuit topologies of power electronics systems for high power applications; the power quality issues will also be addressed by covering passive and active power filters, front end active circuit topologies and harmonic standards. An introduction to modern variable speed ac and dc drives for industrial applications will also be introduced.

Pre-requisite Modules: 
Co-requisite Modules: 
Incompatible Modules:

Format: 
- Lectures: 22 hours
- Example classes: 4 hours
- Directed private study: 74 hours

Lecturer(s): Dr Z Zhou

Assessment: 
- Assignment 1 (20%)
- Examination 1 (80%)

Assessment Description: Assessment: examination (80%) and continuous assessment (20%)

The examination is worth 80% of the module. 2 hour examination paper; Answer 3 out of 4 questions. Each question answered will be worth 33.3%. The examination topics will be those presented directly in the lectures.

The continuous assessment is worth 20% of the module. This is based on an assignment related to analysis of power electronics circuits for high power applications.

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

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

Assessment Feedback: For the examination the students will receive an examination feedback summary sheet giving details of the common mistakes that were identified from the assessed exam scripts. It also lists the maximum, minimum and mean marks for each question and the number of students attempting it. Feedback specific to each question is additionally provided to aid the students.

For the continuous assessment, the students will receive feedback giving details of the common mistakes that were identified from the submitted coursework. Individually students can make an appointment with the lecturer to receive individual feedback on the assignment if this is required.

Module Content:
- Power converter circuit topologies for renewable energy systems
- Multi pulse rectifiers
- Multi level converters for high power applications
- Power quality issues at the Point of Common Coupling (PCC)
- Harmonic Standards, IEEE-519 and ER G5/4 recommendations
- An introduction to grid interface of power electronics converters as well as ac and dc drives

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

Design:
- Power electronics circuit topologies for medium power applications including renewable energy systems and electrical ac/dc drives
- Multi-pulse rectifiers and multi-Level inverters for high power applications as well as design grid interface of power electronics converters.

Analyse:
- Power electronics circuit topologies for medium to high power applications including renewable energy systems and ac/dc drives
- Harmonic content of systems and compliance to International standards
| Additional Notes | • AVAILABLE TO visiting and exchange students |
EGLM03 Modern Control Systems

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

Module Aims: This module introduces ideas in modern control systems and their applications.

Pre-requisite Modules:

Co-requisite Modules:

Incompatible Modules:

Format: Formal contact hours: 30; Reading/private study: 50; Preparation for assessment: 20

Lecturer(s): Dr CP Jobling

Assessment: Coursework 1 (10%)
Coursework 2 (15%)
Coursework 3 (5%)
Examination 1 (70%)

Assessment Description: Coursework 1 is a Simulink Modelling Exercise to be done in pairs. Coursework 2 is a Control Systems Design Problem to be tackled in groups of 4-5 using Matlab, the Control Systems Toolbox and Simulink with a submission of a report. Coursework 3 is the development of multiple choice questions in PeerWise which are to be used to support peer teaching, peer learning and peer collaboration. The June Examination will be a standard engineering paper consisting of 3 questions from 4 at 25 marks per question. The exam is worth 70% of the module marks.

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

Failure Redemption: If rules allow - standard University provisions with marks capped. Normally this would be by examination, although if no contribution has been made to the continuous assessment components, a repeat module decision may be required.

Assessment Feedback: In class feedback is used throughout the course both with audience response systems and PostIt notes for queries and questions. There is also a discussion board on Blackboard that can be used to elicit information from the lecturer. Feedback on the modelling exercise is done using video screencasting supported by the Rubric Tool and the individual feedback feature of the Blackboard grade centre. Feedback on the Group Design Exercise is via Blackboard and makes use of the rubric tool and the grade centre individual feedback feature. Feedback on the PeerWise assessment is exclusively peer feedback, the mark for this exercise simply rewards "engagement". Feedback on the examination is via the standard engineering examination feedback form which will be posted on Blackboard and the College Intranet. The Blackboard announcement tool is used for general feedback on all aspects of the formal and informal feedback for the module.

Module Content: This module will be focused on the study of a particular control problem:
• Modelling: single-input single output (SISO) systems, revision of transfer functions, state-space modelling, nonlinear systems, multiple-input multiple-output (MIMO) systems.
• Simulation: simulation as a design tool, continuous systems simulation, discrete event systems, simulation of digital systems, simulation of mixed continuous and discrete systems.
• Design: Control system performance specification and achievement of performance specification by dynamic compensation.
• Digital systems and the z-transform. Digital compensation: digital to continuous equivalence, direct digital design.
• State space methods: modelling, transformations, pole-placement methods of control, construction and use of observers. Linear Quadratic Regulator.
• Applications (study for project work): motor drives, mechatronics, aerospace flight control, process monitoring and control.
Intended Learning Outcomes: At the end of the course student should be able to:

• Model a system in the electrical engineering domain and run simulations.
• Analyse the linearized models for such systems and devise a control strategy based on conventional or state-space methods.
• Implement such control systems as digital controllers.

The following AHEP 3 Programme Learning outcomes (see https://www.engc.org.uk/education-skills/accreditation-of-higher-education-programmes/) at C.Eng (m) and Partial C.Eng by Further Learning (fl) are partially addressed by this module:

* Science and Mathematics: SM1m, SM3m, and SM3fl are addressed by the advanced study, modelling and simulation of dynamic systems (electrical, mechanical, electromechanical). SM2m, SM5m and SM1fl are addressed in the study of and application of matrix methods, complex numbers, Laplace transforms, Z-transforms.
* Engineering analysis; aspects of all of the learning outcomes (EA1m-EA6m and EA1fl-EA3fl) are addressed.
* Design: experience related to dealing with incomplete information (D3m and D1fl); comprehensive knowledge of design processes and methodologies and the ability to apply them (D7m and D2fl); and demonstration of the ability to innovate (D8m and D3fl)
* Engineering Practice: Team Work (EP11m and EP4fl)

For the most part the Science and Mathematics learning outcomes are assessed via the exam. The remaining are assessed via the coursework.


Control Systems.
Dr Chris P. Jobling, Control Systems Design (Handout).
Prof. Bill Messner at Carnegie Mellon, Prof. Dawn Tilbury at the University of Michigan, Control Tutorials for Matlab and Simulink.
Calculus.
Linear Algebra.
Signals and Systems.
Digital Signal Processing.

Additional Notes:
• AVAILABLE TO visiting and exchange students.
• This module makes full use of the e-learning support tools provided by Blackboard.
• The College of Engineering has a ZERO TOLERANCE penalty policy for late submission of coursework and continuous assessment.
**EGLM05 Advanced Power Systems**

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

**Module Aims:** This module will study Power Networks control including active power-frequency control, voltage-reactive power control and fault analysis. Integration of Renewable resources (including wind and solar) within the grid will be also discussed, which leads to the introduction of distributed generation, microgrids and smart grids.

**Pre-requisite Modules:** EG 241; EG 342

**Co-requisite Modules:**

**Incompatible Modules:**

**Format:**  
- Lecture 20-22 Hours  
- Example 4-6 Hours  
- Private Study 72 Hours

**Lecturer(s):** Dr M Fazeli

**Assessment:** Examination (100%)

**Assessment Description:**
- A single 2 hour closed-book written examination.

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

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

**Assessment Feedback:** Feedback will be given to the class after the examinations on the standard College Examination Summary Sheet.

**Module Content:**  
- Introduction: Synchronous generators, Per Unit calculations  
- Symmetrical component and faults calculation  
- Protection systems in a power network  
- Stability studies  
- Voltage and frequency control  
- Integration of renewable generation, challenges and opportunities

**Intended Learning Outcomes:** At the end of the course the student should be able to:

- Describe power systems operation under abnormal conditions  
- Calculate fault currents for different types of unbalanced faults using symmetrical components  
- Explain the difference between steady state and transient stability  
- Explain and drive swing equation  
- Use swing equation to discuss the steady state stability  
- Explain equal area criterion and use it to analyse the transient stability  
- Use equal area criterion to calculate critical clearing time and angle  
- Explain the different protection systems required for power networks  
- Explain and drive the relationships between voltage/frequency and active/reactive powers for both inductive and resistive networks.  
- Explain the difference between grid-connected and islanded operation of distributed generations and the most common methods of control in each mode.  
- Discuss and explain different methods of controlling/supporting voltage and frequency in islanded and grid-connected modes of a distributed generation.  
- Explain the opportunity and challenges of distributed generation, micro-grids and smart grids.

**Reading List:**

**Additional Notes:**
- AVAILABLE TO visiting and exchange students.
- This module makes full use of the e-learning support tools provided by Blackboard.
- The College of Engineering has a ZERO TOLERANCE penalty policy for late submission of coursework and continuous assessment.
Module Aims: The module covers main aspects of Engineering Applications for the MSc students in electrical &
electronics engineering. It includes preparation, performance and reporting on a structured series of experiments
supporting the taught modules at this level and gives the hands-on experience of electrical machine and renewable
energy system operation, practice in using IT packages to assist with the laboratory work and report writing.

Pre-requisite Modules:

Co-requisite Modules:

Incompatible Modules:

Format: Laboratory work 22 hours
         Directed private study 74 hours

Lecturer(s): Dr. Z Zhou

Assessment: Assignment 1 (30%)
             Assignment 2 (20%)
             Assignment 3 (15%)
             Assignment 4 (20%)
             Assignment 5 (15%)

Assessment Description:

Students will be assessed on the following components: PV system modelling and simulation, PV system experiment,
induction machine modelling and simulation, induction machine experiment as well as dc machine experiment.

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

Failure Redemption: The failure redemption is only available to students who have at least 80% attendance at
laboratory classes during the teaching semester.
Students with less than 80% attendance, unless with valid extenuating circumstances, will have to repeat the module
between 15 July - 15 August in the current academic year.

Assessment Feedback: Students will receive feedback from the module lecturer during the designate feedback
session.

Module Content:

• Induction machine operation including various starting techniques.
• Control and operation of DC machines.
• Characteristics of photo-voltaic power generation system.
• Applications of power electronics and modern control techniques.

Practical work includes:
• The preparation for the experiment.
• The use of software tools for system design and simulation.
• Construction of experimental system and circuits.
• Use of modern test equipment including advanced digital oscilloscopes, function generators, a system multi-meters,
electronics loads, real-time controllers, power system test bed and real-time power system simulator to assist the
experiments.
• Information recording and analysis.
• Practice in using IT packages to assist with report writing and presentations.

Intended Learning Outcomes:

After completing this module you should be able to demonstrate:
• The practical skills of electrical machine control and operation.
• The skills of using power electronics technique for real-time control of electrical machine.
• The skills of modern control theory for practical applications of electrical systems.
• The advanced skills of using modern test equipment including advanced digital oscilloscopes function generators, a
system multi-meters, electronics loads, real-time controllers, power system test bed and real-time power system
simulator.
• The advanced skills of using a combination for software simulation tools and practical design rules to meet the
design specifications.
• The skills of working as a team and assigned task management.
• The ability of identifying the sources of error due to equipment/component tolerance and measurement.
• Knowledge of health and safety issues of electrical systems.

Reading List:
Additional Notes:

• AVAILABLE TO limited number of Visiting and Exchange Students due to number restriction.
• LABORATORY CLASSES ARE COMPULSORY. Students must have at least 80% attendance at laboratory classes in order to be allowed to be assessed for the module.
• Students with less than 80% attendance, unless with valid extenuating circumstances, will have to repeat the module between 15 July -15 August in the current academic year.
• The College of Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment.
### EGLM07 Power Systems with Project

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

**Module Aims:** This module aims to introduce the component of a Power Network and discuss their operation in both balanced and unbalanced conditions. The students are required to self-study Load Flow analysis using the provided lecture notes (and other sources). Load Flow analysis will be assessed by a project (not in the final exam), which is 25% of the final mark.

**Pre-requisite Modules:**

**Co-requisite Modules:**

**Incompatible Modules:**

**Format:** This module is lecture based and will include examples classes  
Lecture 20-22 Hours  
Example 4-6 Hours  
Private Study 72 Hours

**Lecturer(s):** Dr M Fazeli

**Assessment:**  
- Project (25%)  
- Examination (75%)

**Assessment Description:** 75% Final Examination (will not include Load Flow Analysis)  
25% Coursework (Project) on Load Flow Analysis.

**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 average mark, maximum and minimum marks for the examination as a whole and for individual questions

**Module Content:**  
- Self-study: Load Flow analysis  
  - Introduction: 3-phase systems, Electromagnetism  
  - 3-phase transformers, Scott transformers, Open-delta transformers, and phase shifting transformers  
  - Transmission lines  
  - Synchronous generators  
  - Per Unit Calculations  
  - Symmetrical component and fault calculations

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

- Explain different configurations of 3-phase transformers and their effect of line voltages and currents  
- Explain the operation and application of Scott, open-delta, and phase shifting transformers  
- Explain the operation of a synchronous generator and its equivalent circuit  
- Explain active and reactive power contribution from a synchronous generator connected to the grid  
- Explain and draw the phasor diagrams for over-and under-excited synchronous generator and synchronous compensator  
- Draw the operating chart of a synchronous generator  
- Use the operating chart of a synchronous generator to calculate active and reactive powers, power factor, etc. for different operating points  
- Use Per Unit calculation to analyse power systems for both 1-phase and 3-phase systems  
- Calculate the sequence impedances for different equipment such as: transmission lines, loads, transformers, and machines.  
- Draw the zero sequence networks for different structures of 3-phase transformers  
- Constitute sequence networks for power systems  
- Demonstrate, and draw equivalent symmetrical networks for different types of unbalanced faults  
- Calculate fault currents for different types of balanced and unbalanced faults using symmetrical components  
- Understand the importance and the know-how of Load Flow analysis (assessed through the project)

**Reading List:**
Additional Notes: AVAILABLE TO visiting and exchange students provided they know the pre-requisites modules. Zero Tolerance for late submission.
EGNM01 Probing at the Nanoscale

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

Module Aims: This module provides an introduction to the analysis techniques used in nanotechnology, and general surface science, including scanning probe microscopy, electron and diffraction techniques.

Pre-requisite Modules:
Co-requisite Modules:
Incompatible Modules:

Format:
- Lectures: 17 hours
- Revision classes: 3 hours
- Laboratory: 6 hours
- Directed private study: 24 hours
- Personal revision: 50 hours

Lecturer(s): Dr RJ Cobley, Mr TGG Maffeis, Dr CJ Wright

Assessment:
- Examination 1 (50%)
- Assignment 1 (30%)
- Assignment 2 (20%)

Assessment Description: Examination and Coursework
- Written final exam: 50%
- Assignment 1: SPM lab report: 30%. This is an individual report, completed after the practical laboratory sessions.
- Assignment 2: STM, STS and AFM data analysis assignments: 20%. These are both individual pieces of coursework.

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

Failure Redemption: If rules allow - standard University provisions with marks capped. Any re-examination of this module will be by written examination only (100%) unless inclusion of the previously submitted coursework is of benefit to the student.

Assessment Feedback:
- Written final exam: standard university examination feedback forms
- SPM lab report and lab diary: marked assignments returned to students
- STM, STS and AFM data analysis assignments: mark returned to students

Module Content: A general introduction to nanotechnology including the principles of operation and useful applications of a variety of scanning probe microscopy (SPM) techniques, including atomic force microscopy (AFM), scanning tunnelling microscopy (STM), scanning near field optical microscopy (SNOM) and Kelvin probe force microscopy (KPFM). Consideration is given to their appropriate use, data analysis and benefits over conventional microscopy. In addition, novel SPM techniques are explored. Traditional surface science techniques such as x-ray photoelectron spectroscopy (XPS), auger electron spectroscopy (AES) and secondary ion mass spectroscopy (SIMS) are also covered within this module.

Intended Learning Outcomes: After completing this module you should be able to:
- Understand the demands and requirements of measuring, characterising and manipulating materials and devices at the nanoscale
- Explain a variety of different analysis tools used at this length scale, including scanning probes, diffraction and electron microscopy techniques.
- Apply the scientific principles behind nanoscale analysis to explain the different analysis techniques used
- To bring together all the above to design an experiment based on the required measurement, cost, accuracy level, device limitations and other requirements, across a range of materials and devices spanning semiconductors, metals, oxides and biological materials.
- To analyse data, extract physical quantities and assess a material or device with potentially incomplete data sets, and to use the literature to supplement missing knowledge.
- To operate and use scanning probe microscopes and be exposed to a wider range of analysis tools within the department, to collect, analyse and interpret data and to undertake a risk assessment exercise prior to using the laboratories.
- To critically assess the results in terms of information resources and communicate the importance of the data and results and produce a report based on this information.


Additional Notes: Support material and past exam questions available on blackboard.
EGNM04 Nanoscale Structures and Devices

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

Module Aims: To provide the student with an understanding of the basic quantum mechanics and techniques required to model the properties of particles and materials on the nano-meter scale.

Pre-requisite Modules:

Co-requisite Modules:

Incompatible Modules:

Format: Lectures: 20 hours; Laboratory: 5 hours; Directed private study: 60 hours

Lecturer(s): Mr TGG Maffeis, Dr KS Teng

Assessment: Examination 1 (65%)  
Report (20%)  
Presentation (15%)

Assessment Description:  
2 hour Exam: Answer 3 questions out of 4; 25 marks each  
Lab report: written in the form of a publication  
Presentation: 10min + 5min of questions based on a selected publication

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

Failure Redemption: If rules allow - standard University provisions with marks capped.

Assessment Feedback: Feedback provided on the feedback form

Module Content:  
• Nanoscale Structures - Nanowires, Quantum Dots, Bucky balls and Carbon Nanotubes: their physical and electronic properties, fabrication and applications.

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

• critically describe the properties, and applications of nanostructures
• critically describe the top-down and bottom-up approaches for the fabrication of nanostructures, their advantages, applications and limitations
• explains the physical implications of nanoscale objects for real and next-generation devices

have an ability to (thinking skills):
• understand how the physical and electronic properties change with dimension and how this affects devices
• analyse and critically review information resources (journals, internet, talks, etc.)
• understand physical, chemical and biological concepts and how they apply to nanotechnology

have an ability to (practical skills):
• conduct, analyse and document experiments with minimum help
• apply statistical analysis to experimental data
• use analytical instruments for the characterisation of nanostructures

have an ability to (key skills):
• research and present a chosen topic professionally
• evaluate specific experimental results or research papers and place them in a wider context
|-------------------|--------------------------------------------------------------------------------------------------|

**Additional Notes:**
- Failure to sit an examination or submit work by the specified date will result in a mark of 0% being recorded.
- Practical work: Growth of nanostructures; Nanostructures studied by SEM
- All lectures and Course Material will be provided on Blackboard.
EGTM71 Power Generation Systems

**Module Aims:** This module will provide a detailed introduction the technology, politics and economics of power generation and its distribution, with an emphasis on the UK network. The main topics include power for transport applications and electricity generation. Case studies of existing power plant (including coal, oil, gas, nuclear) will be followed by an assessment of low carbon technologies which may offer sustainable energy supplies into the future (wind, wave, tidal, solar, biomass).

**Pre-requisite Modules:**
**Co-requisite Modules:**
**Incompatible Modules:**

<table>
<thead>
<tr>
<th>Format</th>
<th>Lectures and directed private study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecturer(s)</td>
<td>Prof I Masters</td>
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<tr>
<td><strong>Assessment</strong></td>
<td>Examination 1 (100%)</td>
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<tr>
<td><strong>Assessment Description:</strong></td>
<td>Formal Exam. 100% Questions based on course notes and the &quot;Energy Plans&quot; given in the textbook &quot;Sustainable energy without the hot air&quot;.</td>
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<td><strong>Moderation approach to main assessment:</strong></td>
<td>Universal second marking as check or audit</td>
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<td><strong>Failure Redemption:</strong></td>
<td>A supplementary examination will form 100% of the module mark</td>
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<tr>
<td><strong>Assessment Feedback:</strong></td>
<td>Standard college exam feedback form.</td>
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**Module Content:**
- Definitions of energy, work and power; energy conversion
- Steam engines, internal combustion and diesel engines; aeroengine variants, low emissions vehicles
- Conventional power generation: Fundamentals and nuclear reactor types
- Hydroelectric, geothermal, wind, solar, biomass, wave, tidal and other energy sources
- UK energy policy
- Changing patterns of energy requirements in the UK and the world; climate change

**Intended Learning Outcomes:** After completing this module you should be able to demonstrate:
- Comprehensive knowledge of existing power generation systems
- Awareness of future energy requirements, constraints and emerging generation systems
- Power generation systems for transport and electricity supply.

An ability to (thinking skills): Evaluate alternative power systems in light of social, economical and environmental concerns.

An ability to (key skills): Present a coherent (even personal) view of energy requirements, supply and use on regional, national and international scales.

These learning outcomes map to the following MEng AHEP3 criteria:
- D2 Investigate and define the problem, identifying any constraints including environmental and sustainability limitations; ethical, health, safety, security and risk issues; intellectual property; codes of practice and standards
- EL2 Knowledge and understanding of the commercial, economic and social context of engineering processes
- EL4 Understanding of the requirement for engineering activities to promote sustainable development and ability to apply quantitative techniques where appropriate

These learning outcomes map to the following MSc AHEP3 criteria:
- EL9M Awareness that engineers need to take account of the commercial and social contexts in which they operate.
- EL11M Awareness that engineering activities should promote sustainable development and ability to apply quantitative techniques where appropriate


**Additional Notes:** The College of Engineering has a ZERO TOLERANCE penalty policy for late submission of all coursework and continuous assessment

**AVAILABLE TO visiting and exchange students.**