Contents

Important Information

Semester Dates

Autumn Semester (Semester 1)

29 September – 12 October 2014	2 weeks	Induction Work
13 October – 19 December 2014	10 weeks	Teaching
20 December 2014 – 18 January 2015	4 weeks	Christmas vacation
19 January - 8 February 2015	3 weeks	Non EEE Exams and Project work

Spring Semester (Semester 2)

9 February – 21 March 2015	6 weeks	Teaching/project
22 March – 12 April 2015	3 weeks	Easter vacation
13 April – 24 April 2015	2 weeks	Teaching
25 April - 25 May 2015	4 weeks	Revision
26 May - 13 June 2015	3 weeks	Examination Period

Summer Semester (16 June - 4 September 2015)

The only activity scheduled for this period is the individual project and poster presentation. Details of the deadlines for submission etc. will be outlined at a later date.

Introduction

Welcome

. This handbook is intended to provide basic information to students studying for the degree of M.Sc. Whilst some of this information is known already to you, it will act as a ready source of valuable information. The contents are not comprehensive but web addresses are provided where appropriate to guide you to more detailed information. In addition we will provide you with extra information at times when you might need it as appropriate throughout the year. We will use either e-mail or handouts to disseminate this information.

If you are an MSc Data Communications student, you will also be given a copy of the Computer Science M.Sc. Courses Handbook. You should read this document, as some aspects of the detailed procedures used in Computer Science may not be covered here.

The information in this handbook is divided into five main sections

- **You and Safety**-a short section outlining key safety issues
- **You and the Department**-information about how the department works, what facilities we offer and who to contact for help with problems
- **You and the University**-information about the facilities and services provided by the university both for your academic and for your personal benefit
- **You and your Studies**-offers information and guidance on how to approach your studies, what the department expects from you and what you can expect from department.
- **You and your Project** – about fourth year projects
- **You and Assessment -** explains the examination and coursework assessment process and the conditions you must satisfy for progression.

and these are followed by a number of appendices giving factual information that may be useful to you during your time here.

Every effort has been made to ensure that the information in this booklet is accurate. If you notice any errors or omissions or have any suggestions at all for improvement, please speak to Dr Luke Seed.

PLEASE READ THIS HANDBOOK – THE INFORMATION IN IT IS IMPORTANT. WE WILL ASSUME THAT YOU HAVE READ IT.

You and Safety

Fire Regulations

- If the fire alarm sounds continuously, you must vacate the building and proceed to St. George's Churchyard. This is the assembly point for Mappin, Portobello, Stephenson Buildings and Regents Court.

- You should familiarise yourself with the procedure to be followed if a fire is discovered; this is given on the blue notices next to fire extinguishers.
- We strongly advise that you should read the EEE Departmental Safety information (http://hercules.shef.ac.uk/eee/local/safety/index.html**)** and make yourself aware of the safety advice and procedures contained in it. You should familiarise yourself with at least two means of emergency escape (one may be blocked in the event of a fire) from all the workplaces that you use in the course of your studies.
- In the event of evacuation, do not loiter outside the main Mappin Street entrance – go straight to the churchyard, taking care when crossing the road. Loitering around the entrance, or on Mappin Street, blocks the escape route for other people and increases the risk of traffic accidents.

* ***Note that*** **on the days that the University is officially closed all members of the Department (Staff or Student) require the written permission of the Head of Department to enter the building.**

Safety Rules

To reduce the risks of serious accidents, it is essential that you do not work alone or without anyone knowing where you are.

When in the laboratories you must abide by the safety rules which are on display.

A separate EEE Safety Handout should be available soon. In the meantime you can visit: http://hercules.shef.ac.uk/eee/local/safety/index.html for comprehensive safety information.

All accidents that occur to EEE students on University premises must be reported to Mrs Dianne Webster, EEE Departmental Safety Officer (room: E150, internal phone number 25859, e-mail : d.webster@sheffield.ac.uk). She will, in turn, inform the Safety Services Office.

In the event of an emergency requiring assistance dial the University Emergency Control Centre (Internal Number **4444**) to summon help. The centre will require the exact location of the incident (e.g. room number), the nature of the incident, any hazards (e.g. chemicals) and the number of casualties (if any). The Emergency Centre will call for Ambulance, Fire or Police assistance as required in addition to the relevant University Team attending.

You and the Department

About the Department

The Department of Electronic and Electrical Engineering consists of approximately 300 undergraduate students, 120 MSc students, 115 research students studying for a PhD degree, 50 postdoctoral research assistants, 36 technical / administrative support staff and 44 academic staff of whom around 35 are active in teaching. The Department is internationally renowned for its first class research, and our teaching has been classed as excellent by external reviewers now for well over a decade and all of our BEng and MEng degrees are accredited by the IET. According to the latest NSS (National Student Survey 2014), 93% of our students were definitely or mostly satisfied with our degree programmes.

The Head of Department, Professor Geraint Jewell, is in overall charge of Departmental activities. Academic staff are divided into research groups and research group leaders encourage the research activity in their groups. Teaching is managed by two people. Dr Luke Seed is the Director of Teaching and Learning and he is responsible for managing the day to day execution of the teaching programme. Dr Lee Ford is the Director of Teaching Strategy and his responsibilities lie in the areas of teaching policy, new programme initiatives and new teaching methods.

The main Departmental decision making bodies are the executive committee which meets once per fortnight and the staff meeting which meets once per term. Both the Director of Teaching Strategy and the Head of Teaching report to the executive committee and the staff meeting; matters of policy must be approved by a staff meeting before being implemented.

Your Personal Tutor

At the start of the year you will be assigned a personal tutor (who may be either from Electronic & Electrical Engineering or Computer Science if you are a Data communications student). You should make every effort to keep him/her informed of any issues that may affect your studies. If there are matters which you feel you cannot discuss with your tutor you may approach any other member of staff in confidence.

If you require a reference for a job you should see your tutor (or your project supervisor). You have a reasonable expectation that your project supervisor/tutor will write a reference for you. However, you must discuss and agree this with each member of staff **before** you make any applications (including the number of

applications you intend to make). Your supervisor/tutor should not just refuse to write a reference for you if you ask but there may well be reasons why a member of staff does not feel able to write a reference for you and if this is the case then they must supply you with a good reason. If you encounter any problems then please contact the PGT Director.

Small Group Tutorials

Five small group tutorial sessions with your personal tutor are held fortnightly during Semester 1 of the academic year. These sessions cover a variety of topics and skills relevant to the course. Your tutor will keep you informed of the details of each session.

Your Course Academic Management

The MSc courses are overseen by the PGT Director (Dr M Benaissa) and by individual Course Directors (see list below)..The Course Director is responsible for the day to day running of your MSc programme and is the most appropriate person to ask for any academic related issues with your MSc. . The project tutor is responsible for project allocation and is your first point of contact for project related problems that you do not wish to raise with your supervisor

The MSc Course Directors for 2014-15 are:

Dr. M. Benaissa	Data Communications and MSc Computer Vision
Dr. S. Khamas	Electronic and Electrical Engineering
Dr. K. Atallah	Avionic Systems Course Director
Prof. T. Wang	Semiconductor & Photonics
Prof. T O'Farrell	Wireless Communications
Prof. Q Zhu	AMPERE

The MSc Project Tutor is **Dr K. Groom**.

Female Student Contact Person

For female students, who wish to seek assistance or advice which they would prefer not to discuss with their tutors, the Department has appointed Dr Jo Shien Ng (room E149, internal phone number 25173, e-mail j.s.ng@shef.ac.uk) and Hilary Levesley (room: E133, internal phone number 25367, e-mail: h.j.levesley@sheffield.ac.uk). You can talk to Jo Shien/Hilary in confidence and she will be pleased to help, advise and/or to seek assistance for you, according to your wishes.

Harassment

If you suffer any form of harassment, racial, sexual, physical, etc., please report this immediately to Alison Bertie (room F165d, internal phone number 25382, e-mail a.bertie@sheffield.ac.uk). Your contact with Alison is confidential - she will not reveal either your identity, that of your harasser or the nature of your problem without your consent. The university takes harassment very seriously and has a network of harassment officers to assist with such matters.

International Student Advisor

The Department has appointed Prof John David as the International Student Advisor. Prof David maintains contact directly with the University Central Support and Welfare and acts as the Department's focus for matters of particular concern to international students. Prof David's office is room F165c, his internal phone number is 25185 and his e-mail address is j.p.david@sheffield.ac.uk.

Student-Staff Committee

Meetings are held twice per term to allow staff and students to discuss Departmental matters and course difficulties. There is a core agenda of items closely related to day-to-day issues affecting students but other items can be added on request or raised at meetings.

At the beginning of the year, students are asked to volunteer for the role of course representative. Candidates are given time to talk for a few minutes in front of their peers. This is an opportunity to put forward relevant skills for the job and to canvas support. There is then a vote, and two representatives are elected. It is intended that the committee should provide useful and timely feedback to staff on matters affecting students and vice versa. Requests for agenda items should be made to Natasha Partt in the Student Support Office (room E133).

There is also a Faculty of Engineering Student Forum that has representatives from all the departments in the Engineering Faculty. Student-staff committee members elect representatives to the Faculty Student Forum from amongst their number.

Departmental Engineering Society

The Departmental Engineering Society is run solely by students in the Electronic and Electrical Engineering Department. Some years see more activity than others and this depends upon students being willing to run the society and organise activities.

Engineering without Borders (EWB)

This is an organisation devoted to applying simple technology to solve third world problems. Many students find involvement with EWB a very rewarding experience that also helps them develop as engineers. EWB Sheffield is a student-run society that gives you the opportunity to make engineering count. EWB aims to alleviate poverty through the design and implementation of appropriate technologies, student placements in the third world and education. If you want to see how engineering can help realise humanity's potential and enrich lives – **get involved!** They have projects with local and international applications that give hands on experience. Plus it's a great chance to make friends and take part in fun events. Email them at ewb@shef.ac.uk, see their website http://ewb.union.shef.ac.ukor look out for their events.

Questionnaires

As part of the Department's commitment to high quality undergraduate teaching, towards the end of each semester you will be asked to complete a questionnaire on each module you have studied that semester and on more general aspects of your academic life at Sheffield. The results are collated and then scrutinised by the Head of Department, the Director of Learning and Teaching and the Student-Staff Committee and any appropriate action taken. Although this cannot retrospectively change the course that you have taken, it is important feedback that helps the Department to improve its procedures and provide better courses. The feedback provided by you helps the year that follows you just as you benefit from the feedback of those who went before you … SO PLEASE FILL IN YOUR QUESTIONNAIRE.

Occasionally matters arise, particularly in regard to lectures, where more rapid feedback is required than is possible through the questionnaires. In such circumstances the class or the year representative should make a direct approach to the staff concerned so that any difficulties can be aired and hopefully resolved. If this procedure does not achieve the desired results, then you or your year representative should contact Dr Luke Seed, Director of Learning and Teaching, or Professor Geraint Jewell, the Head of Department.

Complaints

If you have a complaint about any aspect of the course, the best person to consult is your personal tutor. General problems can be discussed with your course representative who can bring it to the attention of the Student-Staff Committee. Again, if you feel you cannot discuss or make the complaint to your tutor you may approach any other member of staff in confidence. If you wish to complain to the University about the Department, talk to the Students' Union advice team or SSiD.

Communication

We communicate with you using

E-mail - the preferred method by which the Department communicates with you on urgent matters. **We will use your University e-mail address** so you should check this regularly – **preferably on a daily basis**. We will not send any sensitive information to a non-University email address.

Lectures - some announcements may be made in lectures and printed material is often distributed in this way.

Notice Boards - are used for non-urgent general information that may be of interest to students; seminars, meetings, vacation employment opportunities, timetables etc. Most of the boards of interest to students are on the E floor corridor in the vicinity of E133.

Letters - these are used for formal notifications and will usually be sent both to your home address and your Sheffield address. It is therefore important to ensure that the Department is informed of any change of your address in Sheffield or at home. You can change your address online by accessing your personal records (see section How to check your Personal Record).

Pigeon holes - these are sited outside room E135 and are for personal messages, external mail and library notices. It is important that you check your pigeon hole regularly.

Messages for members of staff can be e-mailed or left in the staff pigeon holes in E133. Any suggestions you may have can be given to the student support staff in E133 or given to your supervisor.

Illness

In case of illness or accident which may affect your attendance, you should complete a special circumstances form which should also be signed by a doctor or health professional and take it to the Student Support Office (room E133) or Student Services in University House. Self-certification should be used for minor illnesses of up to seven days (special circumstances forms are available from SSID or can be downloaded from the SSID website). For prolonged or more serious illness and for **ANY** illness during examinations or assessed work, (even if you are ill for only a day), you must seek medical help and a special circumstances form/medical note giving an opinion on the likely effect of your illness. This should be handed in to the Student Support Office. You should always keep your project supervisor informed of any illness that affects your studies and you should do this even if you think the effect is small. We recognise that it is sometimes difficult to get a doctor's appointment, quickly, at UHS. In

this case, please attend the NHS Walk-In Centre on Broad Lane (this is only 100m away from the Faculty buildings).

- **A medical note from a GP is essential for any illness during the examination periods, or missed assessed exercises/labs**

Disability

The University provides a wide range of support services for students with disabilities, covering accommodation, access, finance, examinations, etc. Mr Neil Powell is the Departmental contact person. If you think you may be entitled to additional support because of a disability, then **you must ask for assistance**. Initial enquiries should be made via Hilary Levesley (room E133, internal telephone 25367, e-mail h.j.levesley@sheffield.ac.uk) who will then provide information on access to the support services. Mr Neil Powell can give further advice when necessary.

You and the University

About the University

The University of Sheffield is a member of the "Russell Group" of Universities – a loose grouping that includes the top 19 research led institutions in the country – and is ranked in the top 100 world Universities[1]. The University has around 17,700 undergraduate students and 7,000 graduate students spread across 50 departments in 5 faculties.

The University enjoys a good relationship with, and endeavours to play a full and constructive role in, the local community. As a student of the University, your behaviour influences the opinions that the local population have of the institution so we expect you to behave responsibly. Many of you will at some stage live in private rented accommodation in the community. Your neighbours may have young children or may have to get up early for their work so avoid making excessive noise and be a good citizen. Some students choose to use some of their spare time in voluntary community work (there are several organisations promoting such work - the students' union is one example) while others prefer to concentrate on study.

If you behave in an irresponsible way that causes annoyance to others and brings the University into disrepute there are internal discipline procedures that the University can and will apply.

You can find out more about the University from its home web page (www.shef.ac.uk/) and more about what is expected of you in the Student Charter (www.shef.ac.uk/ssid/ourcommitment/charter/). Discipline procedures are described at (www.shef.ac.uk/ssid/procedures/discipline/)

The rest of this section is devoted to the key services provided for you by the University.

University Health Service

While you are a student at the University you can register with the University Health Service. The University Health Service offers all the facilities that one would normally find in a GP practice but as you might expect, the doctors and nurses who work there are particularly familiar with the types of medical problems encountered by students. The Health Service address is 53 Gell St and it can be found on the corner of Gell St. and West St. above a Chemist's shop and Pharmacy.

[1] QS World University Rankings 2013

The opening hours are 8.45am to 6.00pm from Monday to Thursday, with slightly earlier closing on Fridays and during vacations. Normal appointments must be made a few days in advance but if you need to be seen urgently, you can be seen on the same day.

- **If illness affects any of your exams in any way go straight to the health service, tell them that your exam is being disrupted by the illness, and you will be seen. Make sure you ask the doctor who sees you to send a note to the department confirming that you were ill and giving his opinion as to the effect of your illness on your exams.**

You should consult the health service about any medical issue that affects your studies for more than a few days and, preferably, ask them to inform the Department (by writing either to Dr Luke Seed or to Miss Liz Woodward in the Student Support Office) of the effects that your problem is likely to have on your studies. More details of the services offered by the University Health Service are available on www.shef.ac.uk/health.

University Counselling Service

Counsellors are consulted on a wide range of issues that are of concern to people. These include anxiety, depression, bereavement, abuse, phobias, academic problems, relationship difficulties, stress and so on. The service, which is confidential, is staffed by trained counsellors, and is available to both students and staff of the University.

The University Counselling Service is open between 9.00 am - 12.30 & 2.00 - 4.00 pm Monday to Friday during term time to make appointments. Times may vary during vacations. Appointments may be made in person, by telephone or requested in writing.

Counselling may be described as a process through which one person encourages another to explore the dilemma in which he or she finds him or herself and to seek out alternative strategies with which to tackle them. A session lasts 50 minutes and hopefully facilitates purposeful conversation in an understanding atmosphere. Sometimes several sessions are necessary. You may ask for a male or female counsellor.

The Service also runs regular group sessions, e.g. coping with stress, study skills, examination preparation and other workshops for staff and students.

The service is located at 36 Wilkinson Street

Telephone : (0114) 222 4134 (internal 24134)

Email :UCS@sheffield.ac.uk

Website: www.shef.ac.uk/ssid/contacts/counselling

Nightline

Nightline is the University of Sheffield's confidential listening and information telephone service. It is run by trained student volunteers and operates from 8 p.m. to 8 a.m. every night during term time. It offers students everything from the phone number of a 24 hour taxi company, to exam dates, times and locations, and information about every issue that can be encountered within student life. It provides a vital support network for all students, so whatever you need to say, Nightline is listening and can be called free from phones in Halls of Residence. If you think you would like to volunteer for Nightline, contact nightline@shef.ac.uk for more information.

Listening line: 222 8787 Information line: 222 8788

Library Facilities

The Library is here to support you in your studies. There is a wealth of material available; over 1,400,000 printed volumes and an extensive range of electronic resources including subject databases, ebooks and ejournals. Many resources are accessible from anywhere via the internet.

Sites & services

There are four Library sites for you to choose from:

The Information Commons (IC) – holds 100,000 core texts found on module reading lists. This is a 24 hour facility with 1300 study spaces and over 500 PCs. It has bookable group study rooms, a cafe and is wireless enabled.

St. George's Library – based in a modern building on Mappin Street, this Library contains material relating to engineering, computer science, economics and information studies. It has access to the wireless network throughout and is convenient for Engineering students based in the St. George's area.

Western Bank Library – this Library contains lots of material particularly in the fields of arts, humanities, science, architecture, social sciences and East Asian studies. It has a superb Reading Room, long opening hours, and has a quiet study atmosphere. There is access to the wireless network in most of the building.

Health Sciences Library – based in the Medical School at the Royal Hallamshire Hospital, with a satellite at the Northern General Hospital. This newly-refurbished site specialises in medicine, dentistry and health related subjects.

A valid UCard is needed to gain entry to all Library sites and to borrow books. You will also need your UCard to use photocopying, printing and scanning facilities.

StarPlus

StarPlus, the University of Sheffield Library catalogue, gives you personalised access to the University's online and print resources.

- find all the resources you need such as books, ejournals, ebooks and databases
- request material you can't find and notify you when it's ready for collection
- view details of your Library account, including a list of your current loans
- save the details of useful books, journals and articles to your eShelf so you can refer to them later
- add your own reviews and tags

myResourceLists

The library produces online reading lists for your modules, which are accessible via your MOLE course, from the StarPlus homepage or from the myResource (Library) link in MUSE.

Sources of help & guidance

Staff are on hand at each site to offer advice and assistance. If you have problems, for example, finding books in the Library, accessing electronic resources, or need help with your Library account please don't hesitate to ask any member of staff.

The following librarians can offer subject-specific guidance, (see www.sheffield.ac.uk/library/libstaff/sllist.html for a full list):

Helen Moore is the Faculty Librarian for Engineering - email h.moore@sheffield.ac.uk or telephone 0114 222 7309.

Emily Stock is the Liaison Librarian for Engineering – email e.stock@sheffield.ac.uk or telephone 0114 222 7307.

Caterina Sciamanna is the Information Assistant for Engineering – email c.sciamanna@sheffield.ac.uk

The Library web pages at http://www.sheffield.ac.uk/library offer extensive information about making the best use of resources and services.
The Library offers help and advice on academic skills such as searching for resources, referencing and plagiarism:

- Information Literacy pages (http://www.sheffield.ac.uk/library/infolit)
- Information Skills Resource (http://www.librarydevelopment.group.shef.ac.uk/)

For further information about your specific subject area see http://www.sheffield.ac.uk/library/liaison/eng

Keeping up-to-date

Students in the Faculty of Engineering receive an electronic newsletter on a regular basis containing all the latest Library news. In addition, find out about new engineering resources on the Science and Engineering blog (scan the code on the right or see http://unisheffieldlib-scieng.blogspot.co.uk/).

Follow Library news via Twitter @Eng_Librarian and @UniSheffieldLib

Contact the Library
By telephone 0114 222 7200
By email library@sheffield.ac.uk
Web www.sheffield.ac.uk/library

Computing Facilities

Corporate Information and Computing Services (CICS) provide networked computers for undergraduate use, including PCs and Apple Macs together with associated printing and plotting services. The nearest facility to the EEE Department is the St George's I.T. Centre which is open from 9.00am to midnight. The Information Commons building at the bottom of Brook Hill, also an IT centre, is open 24 hours a day, 7 days a week. On registering with CICS, new student users will be supplied with a pack of information, a user-name and an allocation of disk space. A comprehensive selection of software is available. CICS staff are available in the Information Commons building Monday to Friday, 9.00am (10.00am) Friday) to 7.00pm to register users and give advice. You must have a U-card to register. The Department also has its own computing facilities which are used for some taught courses and projects, using software that may not work on the campus network or involving access to additional hardware, and will be introduced at the appropriate time.

You must not reveal your university computer account password to anyone and you should take reasonable care to ensure that your University computer account password cannot be easily guessed by someone with whom you may share other passwords.

The University Careers Service

For students in all years, the University's Careers Service is a vital source of information and assistance in securing a good graduate job or a place to do further postgraduate study. Use the Careers Services' web site at www.shef.ac.uk/careers for more information.

The Careers Service is situated at 388 Glossop Road (on the corner of Glossop Road and Durham Road, next to the Students' Union), phone 20910 (internal) 0114 2220910 from outside the University, and is open 09.00 to 17.00 Monday to Friday (open from 11.00 on Tuesdays) in Semesters and most vacation periods,

though times may alter in vacation. The information desk is staffed all the time the Service is open.

A careers advisor is available for brief discussions and can guide you to other sources of help or information. The careers library contains a wealth of information on employers, occupations, graduate study options that will be useful to you as you decide what you want to do after your degree is completed. The Service makes available on its website vacancy information and has an extensive events programme including a large number of employers coming to the campus for recruitment, presentations, drop-in sessions, etc. Call in to see what is available.

Further details on the facilities offered by the Careers Service can be found on their website (www.shef.ac.uk/careers/index/html).

Student Services information Desk (SSiD)

This is located in the Union of Students Building and provides a key central point for general information on many University services and on-line access to the University database for updating your own personal records. You can access much of the material by visiting the SSiD Web pages.

In addition to letting you access your record, SSiD's web pages contain virtually all the information you are likely to need as you progress through your undergraduate years. It is well worth spending an hour exploring their pages so that you are aware at first hand what is there and how to find it. SSiD's home page is at (www.shef.ac.uk/ssid).

How to check your Personal Record

To access your personal record you will first need to log into MUSE (My University of Sheffield Environment) which provides secure access to online university resources from anywhere in the world. Select 'Log in to MUSE' from the top of the University homepage (www.shef.ac.uk) and enter your username and password (issued after initial registration). Once logged into MUSE select **myRecord** from the list of services.

This will show you, amongst other details, what modules you are currently registered for. It will also show you how to update your address and other personal details.

Please note:
It is your responsibility to ensure that your address details are correct. The University and we may need to contact you with important information at short notice.

You and Your Studies

Structure of Academic Year

Each academic year is divided into two semesters, semester 1 or "autumn semester" and semester 2 or "spring semester". Each semester consists of twelve teaching weeks followed by three weeks period set aside for examinations or other activities. In the case of semester 1, the twelve teaching weeks occur in one block from late September to mid-December and the three week exam period begins in mid-January, after the Christmas vacation. In semester 2 the Easter vacation divides the twelve teaching weeks in a varying position, depending on the timing of Easter, and the examinations follow immediately after the twelve teaching weeks.

Your degree programme consists of 180 "credits" (120 of taught material and 60 for a major project). A credit can be thought of as a unit of academic endeavour. The 120 taught credits are made up of eight 15 credit taught modules..

Importantly, the modules run by us (EEE6*xxx*) are scheduled to run across semesters 1 and 2 and occupy 18 teaching weeks (two hours of lecturing per week). Teaching on these modules will commence at week 3 (with an add/drop period running to the end of week 5 – allowing you to change optional modules). This late start will give you time for induction activities.. Additionally, teaching will end around week 8 of Semester 2, giving you some revision time before your exams. With respect to exams, these 15 credit modules will have a 3 hour exam in May/June or some form of intermediate assessment that takes place during the teaching period and a 2h hour exam in May/June. Obviously, the non-EEE modules that you take will be taught in semesters and will probably be assessed with the semester in which they are taught. However, most of our assessment will take place in the May/June exam period.

Aims and Objectives for all MSc Courses

The Department of Electronic and Electrical Engineering aims to fulfil the University's mission to provide high quality education for students from a wide variety of educational and social backgrounds. This is carried out in a research-underpinned environment with staff working at the frontiers of academic enquiry. The Department believes that it fulfils this role based upon the following aims and objectives

Aims

A1. to provide access to undergraduate and graduate Engineering degree courses for students with a suitable level of academic ability

A2. to provide a range of degree courses accredited by professional institutions and with a level of internal choice in the later years, to cover a diversity of students' aspirations

A3. to provide teaching that is underpinned by the research attainment and scholarship of the staff

A4. to test students' competencies and skills by use of appropriate assessment methods

A5. to prepare students for a professional career in the field of Engineering, including the provision of suitable interpersonal skills

A6 to upgrade the knowledge and skills of graduates appropriately beyond first-degree level

Objectives

Uupon completion, the students should have developed:

O1. the ability to gather, organise and critically evaluate information needed to formulate and solve problems

O2. a thorough understanding of the subject area which is aligned with the current requirements of the professional institutions, leading to eligibility for 'Chartered' status for those achieving a 1st or 2nd class degree

O3. the ability to apply acquired knowledge effectively and efficiently to all work in the relevant areas of Engineering

O4. skills in oral and written communications appropriate for the presentation of technical information

O5. abilities in observation, measurement and the design and conduct of experiments through practical experience in the laboratory

O6. the ability to work independently on technical problems, demonstrating in a major item of individual work

O7. the ability to work collaboratively with others through the development of team skills

O8. The ability to apply advanced techniques to the solution of problems at the frontiers of knowledge

O9 an extended range of professional knowledge and management skills

O10 a deep knowledge and advanced understanding in specialist areas

Degree Programmes

The Department provides 7 MSc courses, all listed below.

- Computer Vision Engineering
- Data Communications
- Electronic and Electrical Engineering
- Semiconductor Photonics and Electronics
- Avionics Systems
- Wireless Communications Systems
- Advanced Electrical Machines, Power Electronics and Drives (AMPERE)

Courses Structure

Computer Vision Engineering

Programme Outline

Of the 180 credits, 135 are from core modules and 45 are from choice modules consisting of various application areas and alternative software tools. The organisation of the programme is listed in the following table.

Code	Title	Credits	Semester	Assessment
COM6509	Machine Learning	15	1	Exam + Coursework
EEE6218	Visual Information Processing	15	1+2	Exam + Coursework
EEE6219	Computer Vision	15	1+2	Exam + Coursework
EEE6085	Selected Topics in Computer Vision Engineering	15	1+2	Continuous
EEE6225	Systems Design	15	1+2	Continuous
EEE6602	MSc Individual Project	60	2+Summer	Dissertation/Oral

One of the following

Code	Title	Credits	Semester	Assessment
EEE6207	Advanced Computer Systems	15	1+2	Exam + Coursework
EEE6208	Advanced Integrated Electronics	15	1+2	Exam + Coursework

EEE6209	Advanced Signal Processing	15	1+2	Exam + Coursework
EEE6221	Data Coding Techniques for Communications and Storage	15	1+2	Exam

One of the following

Code	Title	Credits	Semester	Assessment
COM6503	3D Computer Graphics	15	1	Exam + Coursework
COM6516	Object Oriented Programming and Software Design	15	1	Exam + Coursework

Thirty credits from the following

Code	Title	Credits	Semester	Assessment
COM6471	Foundations of Object Oriented Programming	15	1	Exam + Coursework
INF6060	Information Retrieval: Search Engines and Digital Libraries	15	1	Continuous
MAT6750	Bio-Photonics and Bio-Imaging	15	2	Exam + Coursework
PSY6310	Brain Imaging	15	1	Exam + Coursework

Data Communications

Programme Outline

The course comprises compulsory core modules worth 75 credits and choice modules from which each student is required to select 45 credits.

Code	Title	Credits	Semester	Assessment
COM6063	Network and Inter-Network Architectures	15	1	Exam + Coursework
COM6515	Network Performance Analysis	15	2	Exam
EEE6221	Data Coding Techniques for Communications and Storage	15	1+2	Exam
EEE6222	Advanced Communication Principles	15	1+2	Exam
EEE6224	Mobile Networks and Physical Layer Protocols	15	1+2	Exam

units to the value of *fifteen* credits from the following

Code	Title	Credits	Semester	Assessment
COM6471	Foundations of Object-Oriented Programming	15	1	Exam + Coursework
COM6516	Object-Oriented Programming and Software Design	15	1	Exam + Coursework

units to the value of *thirty* credits from the following

Code	Title	Credits	Semester	Assessment
COM6501	Computer Security and Forensics	15	2	Exam + Coursework
COM6503	3D Computer Graphics	15	1	Exam + Coursework
COM6510	Software Development for Mobile Devices	15	1	Continuous
COM6514	JAVA E-Commerce	15	2	Continuous
EEE6085	Selected Topics in Computer Vision Engineering	15	1+2	Continuous
EEE6209	Advanced Signal Processing	15	1+2	Exam + Coursework
EEE6223	Antennas, Propagation and Satellite Systems	15	1+2	Exam
EEE6217	Optical Communication Devices and Systems	15	1+2	Exam

EEE6218	Visual Information Processing	15	1+2	Exam + Coursework
EEE6219	Computer Vision	15	1+2	Exam + Coursework
EEE6431	Broadband Wireless Techniques	15	1+2	Exam + Coursework
EEE6432	Wireless Packet Data Networks and Protocols	15	1+2	Exam + Coursework
EEE6225	Systems Design	15	1+2	Continuous

One of the following

Code	Title	Credits	Semester	Assessment
COM6910	MSc Data Communications Project	60	2+Summer	Dissertation/Oral
EEE6600	MSc Data Communications Project	60	2+Summer	Dissertation/Oral

Electronic and Electrical Engineering Course Structure

Programme Outline

This programme is designed to give students a solid understanding of an area of Electronic and Electrical Engineering of their choice.

Of the 180 credits, students are required to take 60 compulsory credits (a project) and 120 elective credits, choosing modules from the full range that we offer.

Code	Title	Credits	Semester	Assessment
EEE6602	MSc Individual Project	60	2+Summer	Continuous

units to the value of *one hundred and twenty* credits from the following

Code	Title	Credits	Semester	Assessment
EEE6085	Selected Topics in Computer Vision Engineering	15	1+2	Continuous
EEE6200	AC Machines	15	1+2	Exam

Code	Title	Credits	Semester	Assessment
EEE6201	Advanced Control of Electric Drives	15	1+2	Exam
EEE6202	Energy Storage Management	15	1+2	Exam
EEE6203	Motion Control and Servo Drive Systems	15	1+2	Exam
EEE6204	Permanent Magnet Machines and Actuators	15	1+2	Exam
EEE6205	Power Electronics Converters	15	1+2	Exam
EEE6206	Power Semiconductor Devices	15	1+2	Exam + Coursework
EEE6207	Advanced Computer Systems	15	1+2	Exam + Coursework
EEE6208	Advanced Integrated Electronics	15	1+2	Exam + Coursework
EEE6209	Advanced Signal Processing	15	1+2	Exam + Coursework
EEE6212	Semiconductor Materials	15	1+2	Exam + Coursework
EEE6213	Principles of Semiconductor Device Technology	15	1+2	Exam + Coursework
EEE6214	Packaging and Reliability of Microsystems	15	1+2	Exam + Coursework
EEE6215	Nanoscale Electronic Devices	15	1+2	Exam + Coursework
EEE6216	Energy Efficient Semiconductor Devices	15	1+2	Exam + Coursework
EEE6217	Optical Communication Devices and Systems	15	1+2	Exam
EEE6218	Visual Information Processing	15	1+2	Exam + Coursework
EEE6219	Computer Vision	15	1+2	Exam + Coursework
EEE6220	Electronic Communication Technologies	15	1+2	Coursework
EEE6221	Data Coding Techniques for Communications and Storage	15	1+2	Exam
EEE6222	Advanced Communication Principles	15	1+2	Exam
EEE6223	Antennas, Propagation and Satellite Systems	15	1+2	Exam

Code	Title	Credits	Semester	Assessment
EEE6224	Mobile Networks and Physical Layer Protocols	15	1+2	Exam
EEE6225	Systems Design	15	1+2	Continuous
EEE6431	Broadband Wireless Techniques	15	1+2	Exam + Coursework
EEE6432	Wireless Packet Data Networks and Protocols	15	1+2	Exam + Coursework

You may not be able to make an arbitrary choice of these modules due to the timetabling constraints and the need to meet the IET's outcomes (required for accreditation).

Semiconductor Photonics and Electronics

Programme Outline

This MSc course is broken down into a number of 15/30 credit taught modules, listed below. All taught modules are compulsory .

Code	Title	Credits	Semester	Assessment
EEE6212	Semiconductor Materials	15	1+2	Exam + Coursework
EEE6213	Principles of Semiconductor Device Technology	15	1+2	Exam + Coursework
EEE6214	Packaging and Reliability of Microsystems	15	1+2	Exam + Coursework
EEE6215	Nanoscale Electronic Devices	15	1+2	Exam + Coursework
EEE6216	Energy Efficient Semiconductor Devices	15	1+2	Exam + Coursework
EEE6217	Optical Communication Devices and Systems	15	1+2	Exam
EEE6395	Compound Semiconductor Device Manufacture	30	1+2	Continuous
EEE6602	MSc Individual Project	60	2+Spring	Dissertation/Oral

Avionic Systems

Programme Outline

This MSc course is broken down into a number of 10/15 credit taught modules, listed below. All taught modules are compulsory .

Code	Title	Credits	Semester	Assessment
ACS335	Real Time Embedded Systems	10	1	Exam + Coursework
ACS410	Flight Dynamics and Control	10	2	Exam
ACS424	Multi-Sensor Data Fusion	10	2	Exam
COM6506	Testing and Verification in Safety-Critical Systems	15	1	Exam + Coursework
EEE6220	Electronic Communication Technologies	15	1+2	Continuous
EEE6223	Antennas, Propagation and Satellite Systems	15	1+2	Exam
EEE6210	Aerospace Actuation	15	1+2	Exam
EEE6205	Power Electronics Converters	15	1+2	Exam
EEE6211	Avionic Technologies	15	1+2	Exam + Coursework
EEE6602	MSc Individual Project	60	2+Summer	Dissertation/Oral

Wireless Communication Systems

Programme Outline

The course is designed for students with an Electronic Engineering or a related Bachelors degree background. Of the 180 credits, 90 are compulsory taught modules, 60 are for the prtoject and 30 are from choice modules. The organisation of the programme is listed in the following table.

Code	Title	Credits	Semester	Assessment
EEE6209	Advanced Signal Processing	15	1+2	Exam + Coursework
EEE6222	Advanced Communication Principles	15	1+2	Exam
EEE6223	Antennas, Propagation and Satellite Systems	15	1+2	Exam
EEE6224	Mobile Networks and Physical Layer Protocols	15	1+2	Exam
EEE6431	Broadband Wireless Techniques	15	1+2	Exam + Coursework
EEE6432	Wireless Packet Data Networks and Protocols	15	1+2	Exam + Coursework
EEE6602	MSc Individual Project	60	2+Summer	Dissertation/Oral

units to the value of *thirty* credits from the following

Code	Title	Credits	Semester	Assessment
EEE6085	Selected Topics in Computer Vision Engineering	15	1+2	Continuous
EEE6207	Advanced Computer Systems	15	1+2	Exam + Coursework
EEE6208	Advanced Integrated Electronics		1+2	Exam + Coursework
EEE6217	Optical Communication Devices and Systems	15	1+2	Exam
EEE6218	Visual Information Processing	15	1+2	Exam + Coursework
EEE6219	Computer Vision	15	1+2	Exam + Coursework
EEE6220	Electronic Communication Technologies	15	1+2	Coursework
EEE6221	Data Coding Techniques for Communications and Storage	15	1+2	Exam
EEE6225	Systems Design	15	1+2	Continuous

AMPERE

Programme Outline

The course consists of 90 credits of compulsory taught modules, 60 credits are for a project and 30 credits of choice from a range of other 15 credit modules offered by the department.

Code	Title	Credits	Semester	Assessment
EEE6200	AC Machines	15	1+2	Exam
EEE6201	Advanced Control of Electric Drives	15	1+2	Exam
EEE6202	Energy Storage Management	15	1+2	Exam
EEE6203	Motion Control and Servo Drives	15	1+2	Exam
EEE6204	Permanent Magnet Machines and Actuators	15	1+2	Exam
EEE6205	Power Electronics Converters	15	1+2	Exam
EEE6602	MSc Individual Project	60	2+Summer	Continuous

units to the value of *thirty* credits from the following

Code	Title	Credits	Semester	Assessment
EEE6206	Power Semiconductor Devices	15	1+2	Exam + Coursework
EEE6207	Advanced Computer Systems	15	1+2	Exam + Coursework
EEE6208	Advanced Integrated Electronics	15	1+2	Exam + Coursework
EEE6209	Advanced Signal Processing	15	1+2	Exam + Coursework
EEE6214	Packaging and Reliability of Microsystems	15	1+2	Exam + Coursework
EEE6220	Electronic Communication Technologies	15	1+2	Coursework
EEE6221	Data Coding Techniques for Communications and Storage	15	1+2	Exam
EEE6225	Systems Design	15	1+2	Continuous

Assessed Work - Unfair Means

The basic principle you must follow in preparing assessed work is that

All work submitted must be your own

We insist you attach a standard Departmental declaration form to all submitted work confirming that the work submitted is indeed your own.

If you use material from other sources, this must be acknowledged and properly referenced. No-one objects to you discussing your work with others indeed we encourage you to learn from each other - but having explored ideas together you must, as individuals, prepare your work for submission independently. The University has a set of strict regulations on "unfair means" and it is important the you understand the issues involved.

Copying of software or cutting-and-pasting information from the WWW is very easy and tempting. However, it is relatively easy for the Department to detect this and every year a number of cases are reported to the University Discipline Committee which can impose a range of penalties up to, and including, expulsion.

The University defines various forms of unfair means:

1. **Plagiarism (either intentional or unintentional)** is the stealing of ideas or work of another person (including experts, and fellow or former students). Plagiarism may take the form of cutting-and-pasting text, illustrations, graphs and other material from books, articles, internet sites or any other source, and submitting them for assessment. Although referencing information is perfectly legitimate, you must write any ideas/facts/results in your own words. Exact copying a whole sentence or more is regarded as plagiarism. Note that plagiarism can be unintentional – it can be the result of poor study skills.
2. **'Laundering'** is copying a passage from a source, making minor, insignificant changes (e.g. changing "many" to "most") and then presenting this as your own work. The result is not your work - it is someone else's work with minor changes. Laundering is regarded as plagiarism.
3. **Submitting bought or commissioned work (**for example, from internet sites, essay "banks" or "mills") is an extremely serious form of plagiarism. This may take the form of buying or commissioning either a whole assignment or part of it, and shows a clear intention to deceive. The University also takes an extremely serious view of any student who sells, offers to sell or passes on their own assignments to other students.
4. **Double submission (or self plagiarism)** is resubmitting work previously submitted for another assignment (without proper acknowledgement). This may take the form of copying either the whole assignment or part of it. Normally credit will already have been given for this work.

4. **Collusion** is where two or more people work together to produce a piece of work, all or part of which is then submitted by each of them as their own individual work. There is an important difference between discussing work with fellow students (which is encouraged) and collusion: If students follow a discussion by going on to jointly produce a single piece of work which each student then submits as their own, this is collusion and is treated as unfair means. Recall: all work submitted must be your own. Collusion also includes giving your work to another student so they can submit it as their own work. In cases of collusion, the Department will take action against all students involved.

5 **Fabrication** is submitting work (for example, practical or laboratory work) any part of which is untrue, made-up, falsified or fabricated in any way. This is regarded as fraudulent and dishonest, and is a very serious offence.

In other words, you are guilty of unprofessional unfair conduct if:

1. You get someone else to write up/dictate the whole or part of your work;
2. You copy the whole or part of someone else's work, with or without their knowledge and consent (this includes other students' reports or programs);
3. You work together with others on assessed work to produce an agreed text, and then copy it up for individual submission;
4. Your assignment contains more than a few sentences of other people's written work, whether acknowledged or not;
5. You quote ***any*** material without attributing it to its source by means of a numbered reference naming author and source (this includes material from the WWW). **In fact you should not use direct quotes unless you are critically analysing a statement and the particular wording is crucial. Engineering students almost never get involved in such critical semantics.**

It is a normal aspect of group working to discuss matters with the rest of the group and it is normal for friends to discuss common interests which may, in a university environment, include work. It is acceptable for friends or group members to criticise a piece of work that you intend to submit but they must not do any resulting corrections or modifications for you if the work is being submitted under your own name for assessment. Most assignments require you to certify that the work conforms to the above guidelines.

Downloading from the WWW, or scanning of diagrams, etc. from text books or other printed material, for use in assignments, is not acceptable.

Proper Referencing Style

If you use information from other sources, you will usually want to acknowledge its source by referencing. Departmental advice on proper referencing style is available at:

http://hercules.shef.ac.uk/eee/teach/resources/index.html.

The Library also provides an excellent tutorial on IEEE-style referencing at http://www.librarydevelopment.group.shef.ac.uk/shef-only/referencing/engineering_ieee.html.

Quotations

In engineering, it is very rare to need to quote material, that is reproduce the exact words in quote marks and with a numbered reference. For example:

> The company claims that "all devices will operate reliably at temperatures up to 500K" [1]. However, it was found that …

Experience has shown that students often abuse quotations to include information that they should have written in their own words. Consequently:

Quotations are not allowed in coursework in EEE and will be treated as plagiarism if detected.

The only exceptions are in project work and even then you will need to get permission from your tutor/supervisor. See:

http://hercules.shef.ac.uk/eee/teach/resources/index.html

for specific information.

Detection of Unfair Means

You will generally be required to submit an electronic version of your assignments to the TurnItIn system which compares your work against a database of previously submitted student work (from all over the world) as well as the internet and other sources. (Similar software is used to identify similarities in student C programs in first year.)

TurnItIn highlights any matches longer than a couple of words together with the source of the material. The software can also detect 'laundered' passages, those to which minor changes have been made. Any matches are scrutinised by a committee of staff who make a judgement on whether there has been plagiarism. Recall again that plagiarism is the copying of a sentence or more so matches to

common English phrases such as “it can be seen from the graph that...” will not be treated as plagiarism.

If plagiarism is detected, the Department can impose penalties ranging from mark deductions through failure of the assignment, to referral to the University Discipline Committee for more serious action.

Electronic Submission of Assignments to the TurnItIn Plagiarism Detection Software

In addition to submitting assignments in the black box outside E133complete with a bar-coded assignment cover sheet, you will also need to submit an electronic copy of certain assignments *direct* to the TurnItIn plagiarism detection website. If you do not submit an electronic copy your mark will be deferred (*i.e.* assumed to be zero).

You should receive an email from JISC explaining that "You have been added as a student" to the JISC PDS Service. This should also tell you your password[2] – keep this safe as this will be your TurnItIn password for the remainder of your course! (Alternatively, for returning students you will have been told your password in an earlier year – keep using the same password.)

To submit your assignment in electronic form, login to:

`http://submit.ac.uk`

For your login name use *exactly* the same email address to which the JISC email mentioned above was sent. It will be of the form `john.smith@sheffield.ac.uk`. In particular, do **not** shorten "`sheffield.ac.uk`" to "`shef.ac.uk`" – you must type “`sheffield`” in full.

Once logged in you will be able to select your class group (*e.g.* "eee-ug1-2014" for first year undergraduates) and then the assignment you are submitting (*e.g.* "Passive Networks Report".) Your report can be uploaded as a Word file or as a PDF file.

Some students become concerned that the ‘Due Date’ shown in TurnItIn does not correspond to the submission deadline they have been given by the member of staff responsible for the assignment. Owing to the limitations of the TurnItIn software, the ‘Due Date’ is often rather arbitrary. Do not be guided by TurnItIn – **always follow the advice of the relevant member of staff**. TurnItIn classes will be set up to accept submissions *after* the ‘Due Date’.

The maximum size of file you can submit is currently limited to 10MB, which in most cases is not a problem. Project reports containing large numbers of diagrams and images may exceed this 10MB limit in which case you will need to delete

[2] The TurnItIn system does allow you to change your password to something more memorable than the random jumble of letters and numbers that the system issues by default. See the user documentation on exactly how to do this.

sufficient pictures and diagrams (although not their captions!) to reduce the file size to below the 10MB limit.

A more comprehensive Student User Guide to TurnItIn is available on the departmental web site:

http://hercules.shef.ac.uk/eee/teach/resources/info/jisc_plagiarism_detection_service-student_user_guide.pdf

IF YOU FORGET/LOSE YOUR PASSWORD…

If you forget or lose your password, select the "Forgot your password?" link from the TurnItIn logon page and follow the instructions. This is the **only** way to recover a password.

"I CAN'T LOGIN…"

Long experience shows there are only ever two reasons why students are unable to login to TurnItIn:

1) Because they are trying to abbreviate "`sheffield`" or otherwise using the wrong email address. See the instructions above.
2) Rather than using the web address given above, they have used Google (or some other search engine) to search for "TurnItIn". This returns the web address of the US TurnItIn site, not the UK site above. Unsurprisingly, students are then unable to login to this! Use the correct site given above.

Where you are in any doubt about whether you are using unfair means, you should ask the staff member in charge of the assignment for advice.

University advice can be found at http://www.shef.ac.uk/ssid/exams/plagiarism

The University's Discipline procedures can be found at:
http://www.shef.ac.uk/ssid/procedures/discipline

Further advice on study skills can be obtained from the Library which provides online tutorials at:
http://www.shef.ac.uk/library/services/infoskills.html

A further source of advice is the English Language Teaching Centre (ELTC) which operates a Writing Advisory Service which is available to all students, both native and non-native speakers of English. Students can make individual appointments to discuss a piece of writing. See:
http://www.shef.ac.uk/eltc/languagesupport/writingadvisory

Personal Development Planning (PDP)

PDP aims to offer a means by which you can monitor, reflect and plan your own personal development. By pausing to reflect on your learning, performance and achievements from time to time you will be able to identify areas requiring further attention. This kind of activity can be especially useful in the execution of an extended project. You can than make plans for future educational and personal development. Conducting PDP can help improve both your educational and future career prospects. Professional bodies encourage Engineers to carry out PDP throughout their professional careers. The Department offers various opportunities for you to carry out PDP during the year, particularly through the personal tutorial system. Your tutor will act as a facilitator to help you conduct PDP. Numerous resources to help you develop your PDP skills are provided on the Department's PDP page:

http://www.peter-judd.staff.shef.ac.uk/pdp/index.html

Mr. Peter Judd acts as the Department's PDP 'Champion'.

Study Advice

The University expects you to spend 1200 hours studying for a 120 credit year – ie., 150 hours per 15 credit module. Typically, 36 hours of this is timetabled contact, a further 18 to 36 hours is guided personal study and 3 hours is examination so around 75 hours is allowed for private study. In approximate terms this means that **you are expected to spend 3 to 4 hours per week per module on private study**. Private study typically involves reading through lecture notes and reading relevant parts of text books. Guided personal study involves attempting to solve the problems given out in the lectures. It is vital that you spend this time evenly throughout the semester – only then will you identify issues that you don't understand in time to get your ideas straight.

It is important to attend all lectures in order to obtain notes and handout sheets. It is not enough to copy up notes. Hearing an explanation and making your own comments will aid your understanding.

- **If anything in your life adversely affects your studies, make sure you tell your supervisor. He/she will be able to advise you or put you in contact with someone else who can.**

Attendance

- **The academic year consists of two 15 week semesters, (12 teaching weeks followed by 3 examination weeks). The project period is over the summer months and the academic year ends in September on a date of which you will be advised. You should be in attendance at the University for the whole of the academic year and we plan our activities on that basis. We cannot make special arrangements for individuals who find the published dates inconvenient.**

You are expected to attend all timetabled activities. If you know in advance that for some reason you must be absent from a timetabled activity, let the module teacher know. If you miss a lecture for unforeseen reasons, see the teacher as soon as possible after you return. The project work is in part continually assessed so it essential that you do your project work in the Department and NOT at home.

Attendance Monitoring

To help ensure that you make full use of the learning opportunities that are available, the Department will be monitoring the attendance of students at twelve or more sessions throughout the year. The monitoring will be carried out using systems that have been developed by the University specifically to help departments identify and support students who are having difficulty with their study programme. Within this Department, the monitoring will be carried out at project supervisory meetings.

Accreditation

In common with all other UK university engineering departments which wish to provide accredited courses, we satisfy the requirements of UKSPEC published by the Engineering Council and interpreted in the context of Electronic and Electrical Engineering by our Professional Institution, the IET. Under UK-SPEC, successful completion of an accredited one year accredited MSc degree course will meet the educational requirements for ultimately becoming a Chartered Engineer (C.Eng.) when combined with an accredited BEng degree – taken first.

Taking on Paid Work while Studying

Many of you will choose to, or have to, take paid employment to reduce the amount of money you need to borrow or reduce the financial burden on relatives who are supporting you. Paid employment during term-time competes for your time with academic work and can leave you worn out when your mental faculties should be in top thinking form. The University recommends a limit of 16 hours per week of paid work as being a reasonable compromise. If you feel driven to work more than this, it is worth discussing the issue with your tutor.

International students have a paid work limit set by their visa conditions.

Book Lists

There is a Departmental list of books recommended for each lecture course. All of the books are available in the library, many with multiple copies, one of which is usually on the reserved book list and cannot be removed.

You should not expect the library to provide you with texts of which you need to make frequent use. You will almost certainly need to buy text books; it is important to look at these before purchasing to make sure that you like the format and find it easy to follow. In general, one book per course is sufficient. The lecturers may suggest several and it is likely that you will find one that suits. If you have any doubts about the suitability of a prospective purchase, consult the lecturer concerned. The book list can be found on the EEE Departmental Teaching Resources website at the following web address:

http://hercules.shef.ac.uk/eee/teach/resources/info/4th_year_booklist.pdf

New books can be expensive but there are a number of sources of second hand books such as the Student's Union shop, some of the Bookshop chains, the web, the Oxfam shop on West St. and other charity shops. In addition, second hand books are often advertised on departmental notice boards by existing students who have finished with them.

Postgraduate Study Opportunities

You may be considering the possibility of continuing your studies and registering for a research degree. Please consult Prof M M De Souza who is in charge of postgraduate admissions or discuss the possibilities with your tutor or project supervisor. There are various events held within the Department throughout the year to publicise research opportunities so be on the lookout for notice of these. It is always best to make enquiries as early as possible in the academic year.

Online Teaching Resources

The EEE Teaching Resources contain a lot of useful information that you will need as part of your studies. A large part of this consists of teaching material for the different modules you take, including past exam papers and solutions, and student feedback.

Some lecturers also include lecture notes and other information that you will find useful, although this may also be found on MOLE (https://vle.shef.ac.uk/)

To access the EEE teaching resources, go to:
http://hercules.shef.ac.uk/eee/teach/resources/index.html

If you are off campus, you will need to use VPN to access them - details on VPN and how to set it up can be found at:
http://www.sheffield.ac.uk/cics/vpn

Recording Lectures

Some students would like to make recordings of lectures (audio or video) for future reference. With respect to this issue, it has been agreed that students may make their own **audio** recordings of lectures providing.

- there is no recording made available to them by lecturers - if there is, students should use the recording made available to them and not make their own
- the recording is made and used solely for the purpose of students' personal study
- students seek the permission of the lecturer before recording (this is to ensure that staff know the recording is being made, to ensure that any confidential material can be omitted from the recording, and also to protect the privacy of other students where appropriate)

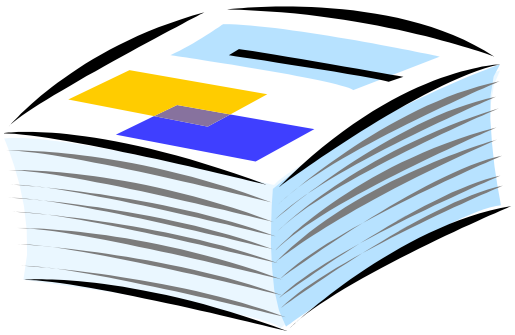
To be clear the right to make audio recordings does not extend to making video recordings. If you do wish to make an video recording of a lecture then you should, in all cases, seek the lecturer's permission, being specific about what you intend to record. If you are found to have been making a video recording after permission has been reasonably refused then this might constitute a disciplinary infraction.

In all cases, you should recognise that any such recording is for personal use and should not be copied, distributed or made widely available without the lecturer's express permission. Again, to do so might constitute a disciplinary infraction.

You and Your Project

Projects

Introduction



For the main project, students can choose from a range of possibilities in many different environments and projects are designed to be industrially relevant. Each student will have a personal academic supervisor to guide them during this period.

It should be remembered that the report is a key component of your M.Sc. You should ensure your results and discussion are presented as clearly as possible in order to maximise the mark you are likely to obtain for your project. With this in mind, you (particularly if you are not a native speaker of English) should consider using the facilities made available through the English Language Teaching Centre (see Chapter on University Facilities).

The following is a broad description of the Project system used. Details of each stage, which may change slightly from the description below, will be circulated at appropriate times during the year.

Project Allocation

A list of Individual Project titles will be available towards the end of October/early November. Students will select their project choices in November and the final project allocation will take place in December.

Project Timetable

During the second semester students are expected to prepare the groundwork for their project and perform the initial studies, such as a literature survey, initial design/theory and project planning. The results for this should be submitted as an interim report and will also be presented to your second marker. The deadline for this is expected to be set around late May.

After completing their examinations, students are expected to spend the summer semester working intensively on their project, and writing their project dissertation.

The project dissertation should be handed into the EEE Student Support Office by early September.

A poster session will be held in early September, where students are expected to present their work to any interested parties and their assessors. Marks contribute towards the final project mark and a prize will be awarded for the best poster on display.

Project Submissions

Interim Report

One copy of the interim report should be submitted to the EEE Student Support Office by late May (date to be confirmed). Furthermore, students must also submit electronic copies of their report to the online marking system and to Turnitin (plagiarism detection programme) by the deadline.

The report should be approximately 20 pages long (this may seem very long, but parts of the interim report - such as the literature survey - can be re-used in the final dissertation).

The importance of the interim report cannot be over-stressed. The duration of the full-time project period is rather short (12 weeks), so it is essential that you are adequately prepared. The interim report aims to ensure that you understand the project area, have mastered the relevant literature and have a realistic time plan; you should then be in a position to 'hit the ground running' at the start of the project period.

A suggested form for the interim report is given below:

Abstract: A short (two or three paragraph) summary of the aims and objectives of the project, the approach taken and the achievements so far.

Introduction: This should start with a couple of paragraphs which outline the topic area, followed by a description of the aims and objectives of the project. What does the project propose to do? How does the project relate to the area of Engineering for which you are studying as a whole? What is the reason for the project? Finish with a brief description of the contents of the remaining sections of the report.

Review of previous work: Many dissertations suffer from poorly written literature surveys, so it is important to get the style of the review right at an early stage. Start the chapter with a single paragraph which outlines the structure of the literature survey. The following points should be considered when writing this part of the report:

⇒The literature survey should be focused and concise. Only references that are directly relevant to the project work should be reviewed.

⇒A literature review is not undertaken for its own sake; it is included in a dissertation because it allows you to demonstrate that you have a good understanding of the background theory to the project.

⇒References should not be reviewed simply by listing each one in turn and writing a short paragraph about it; this does not indicate any understanding. Rather, the themes and relationships between reference sources should be identified; that is, the literature review should be organised in a useful and meaningful way.

⇒The literature survey should be up-to-date. There should be some evidence that the student has read recent literature in the relevant field.

⇒It is important not just to describe previous work, but to criticise it (and to justify the criticisms). Which ideas identified by the literature review are useful and can be applied to the project? Which ideas are not useful, and why not?

Methods and relevant theory:

Discussion and time plan: It is essential that the interim report contains a detailed time plan for the main project period. A good way of illustrating the time plan is to draw a Gantt chart. The following points should be considered in this section:

⇒Has the project changed direction from the initial outline? If so, why?

⇒What difficulties may arrise? How will they be resolved? (Risk assessment)

⇒Is the time plan realistic?

⇒Is the scope of the project reasonable, or is too much being attempted?

⇒Has sufficient time been allocated for writing up the dissertation?

Conclusions: A summary detailing what you believe are the key issues and what you hope to achieve during your project.

References. The final section of the interim report should be a complete list of references. A number of possible referencing styles could be used (numbering, labels and so on), and any of these is acceptable so long as the referencing is consistent. You are recommended to use one of the recommended styles for the dissertation itself (see Appendix 3)

Final Dissertation

Two copies of the dissertation should be handed in to the EEE Student Support Office with a completed, printed copy of the electronic Front Sheet and a completed hand-in form by early September (date to be confirmed). Furthermore, students must also submit electronic copies of their report to the online marking system and to Turnitin (plagiarism detection programme) by the deadline.

Extensions will only be granted in cases of serious illness.

If you fail to hand in a dissertation by the deadline and do not have a valid extension, then up to **5 marks per working day** will be taken from your project mark as a late submission penalty.

It is your responsibility to prepare two copies of your dissertation. Two bound copies must be submitted to the Student Support Office and will be distributed to the supervisors and second markers. Details on binding will be provided nearer to the time. An electronic copy must be submitted to "Turnitin" for plagiarism checking and to the department (so that it may be included in the Project Library).

Output should be from a word processor, with a letter quality printer. You are responsible for your own printing.

Full details of the format of the dissertation are given in Appendix 4. You should ensure you comply rigorously with those rules.

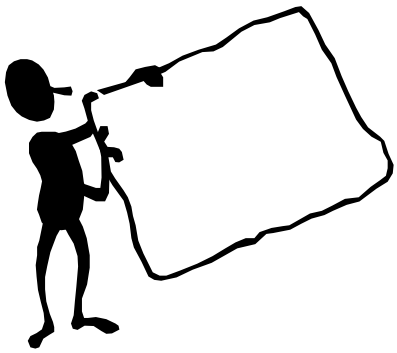
Copies of the declaration that you must submit as part of your dissertation and the hand-in form are included in Appendix 5.

Extension of Deadlines.

Extension of the deadlines may only be granted if a student is unable to work because of illness, and obtains a valid medical note. The student must inform their supervisor and / or the M.Sc. Course Director as soon as possible that they have been ill, or unable to work due to other circumstances. Medical notes should be handed in to the EEE Student Support Office.

You are welcome to use your own computing equipment for the project, but you should give a disk containing a backup copy of all your work to your supervisor at each meeting. Any loss of information due to failure of your computing equipment is not our responsibility, and will not be considered grounds for extending the project hand-in deadline.

Poster Presentation



All students will have a poster presentation on their dissertation in the two weeks following the submission of the dissertation. You will be notified of the time and place of the presentation, either by email or by a notice placed on the M.Sc. notice board, as soon as is possible.

In addition to yourself, the project supervisor and second marker will both be present. Any industrial supervisor will also be given the opportunity to attend. The poster presentation provides the opportunity to your supervisor and second marker to examine your understanding of your work. You should therefore make use of the poster session to highlight the key results from your work and demonstrate your understanding.

Project Assessment

Interim Report

The interim report is marked according to the following categories. Categories A and B are assessed by your supervisor, whereas category C is assessed by your second marker.

ASSESSMENT CRITERIA
A1) Literature review (40%)-*Is there an adequate & relevant literature review setting work into context?*
A2) Project plan (40%)-*Is the time plan well constructed, sufficiently detailed and realistic? Is risk assessment/mitigation critically considered?*
A3) Overall presentation (20%)-*Is the report well structured? Is the standard of writing adequate? Is IEEE standard referencing used?*
B: Project module continuous assessment
B1) Performance to date (5%)-*Has the student demonstrated motivation, self-reliance and initiative? Any progress made towards the project objectives?*
B2) Theory/methodology (5%)-*Has the student understood the required theoretical foundation and methodologies?*
C1: Students grasp of the material (50%0
C2: Presentation (50%)

Dissertation

The individual project is examined by a dissertation, based on the project work, and a poster presentation. The project work, dissertation, and poster presentation are all taken into account in the assessment.

The supervisor and the second examiner will mark the final dissertation independently. Any significant discrepancy in these marks will be investigated by a third marker. **A marking guide is provided in Appendix 5.**

After the Poster Presentation/dissertation deadline:

You will not be informed of the result of the dissertation until after the relevant Board of Examiners meeting has been held.

If your dissertation is accepted by the Board and as long as you have returned all your library books, technical manuals and any other departmental property then one copy

of the dissertation will be returned to you. Once you have successfully passed all facets of the degree and returned all departmental property, you will be given a letter stating that a recommendation has been made to Faculty that you be awarded the degree. After the next Faculty Board meeting, the Examinations Office will normally write to you about the degree congregation ceremony.

What to do if things start to go wrong

If things start to go wrong, for whatever reason, it is very important that you talk to one of the following as soon as possible: your project supervisor, your tutor or project 2nd Marker, the Course Director of your chosen M.Sc., the PGT Director (Dr. M. Benaissa) or the Director of Learning and Teaching (Dr Seed). The sooner you tell us about your problem, the sooner we can help you.

If you have a problem that cannot be resolved to your satisfaction by any of the above people you can approach the Head of Department (Prof. Jewell). The Student Services Information Desk and/or the Students' Union may also be able to advise you in such circumstances.

Facilities Available for projects

There are a variety of resources available in the Departments to assist you in the Development of your Project. In the Department of Electronic and Electrical Engineering the following are available:

Workshop Facilities

Where appropriate, you are encouraged to make your own hardware. There are two workshops in the Department:

The Mechanical Workshop (contact the Head of the Mechanical Workshop, Mr. I. Lyne for advice) has facilities for students to use.

The Electronics Workshop can assist with simple design and help with computer problems. Stores, located next to the Electronics workshop, has a wide variety of electronic components available.

For jobs which you require to have items made by one of the workshops, you must discuss your design with your supervisor before submission to the workshop.

Requisitions for parts for projects

Requisitions for ordering parts for your project, other than the small components normally stocked in Stores, can be obtained from Stores. After completion, the requisition should be returned to Lindsay Nash, the Stores technician. If Lindsay is on annual leave requisitions should be returned to Ian Lyne in the EEE machine workshop.

Deliveries of orders to EEE are made to the Departmental Stores, who will advise you of their arrival via email. It is therefore very important that you supply your email address on the requisition form and check your email account regularly.

Equipment from other labs

If you wish to borrow equipment from other labs, or benches, please establish first of all, to whom it belongs or who is currently using it. You should contact them and request to borrow the equipment. Do not disconnect or remove the equipment without obtaining this sort of clearance.

The Micro Unit (F137) and Project Room (F166)

The Microelectronics Systems Unit and Project Room are Departmental Specialist Computing facilities within Electronic & Electrical Engineering, which consists of a suite of PCs supporting everything from programming through PCB, CAD to VHDL FPGA system design. Many facilities are available for you to use:

Circuit diagram and board design

CAD tools are available for creating circuit diagrams. Design of PCB's including multi-layer boards and auto routing tools.

Programming

The following languages are available: C, C++, and soon JAVA.

Programmable logic devices

There are design, simulation and programming tools to support a wide range of devices including: PALs (small scale) and PLDs (medium scale).

Microcontrollers

Design and writing of software for and debugging of circuits containing certain devices from Intel, Motorola, Siemens and Microchip (PIC).

FPGAs

(Field Programmable Gate Arrays). Design and programming of devices from Xilinx. Tools include schematic entry and simulation or full VHDL simulation and synthesis.

Circuit design and simulation tools.

Tools exist to support Analogue, Microwave and Digital system design.

MATLAB.

Matlab tools are available.

Advice

Help can often be offered with problems in areas such as programming, digital system design, P.C. technical support, purchasing of PC's, software and peripherals.

How to gain access to these facilities

First please discuss your needs with the Technician, Mr James Screaton (j.screaton@ or visit him in the Electronic Workshop F146). You should do this early to avoid problems such as committing a design to a particular route only to discover later that F137 and F166's tools cannot support your particular needs.

In order to register to use the computers in this room see the Department's web pages, in particular the page related to "Information for Staff / Students" (http://www.shef.ac.uk/eee/info) then select the link "EEE Teaching Computers Registration". For access to the room a swipe card system operates using your UCard - Once registered to use the computers, UCard access is usually enabled within a few days. Other than when needed for teaching, the facilities are available Monday to Friday 09.00 to 17.00. Students are not permitted access outside of these times and should always leave at 17.00.

Project Safety

Introduction

You must read the EEE Safety Booklet, which is issued to all students, thoroughly before commencing project work. The safety issues outlined here are some that are particularly applicable to project work and supplement those in the safety booklet.

Students working in the Department of Computer Science during their project should familiarise themselves with any relevant Safety Regulations with their project Supervisor, prior to commencement of the work.

Laboratory Safety Rules

You must not work alone in a laboratory during normal working hours without first obtaining permission and advice from your supervisor and the relevant technical staff.

Outside normal hours you may work in the labs. only if you have the written permission of your supervisor for the activities you wish to do, and you DO NOT WORK ALONE. Proof of permission and a Risk Assessment must be lodged with the EEE Departmental Safety Officer.

You must also have attended the relevant fire and out-of-hours safety training courses. Please note that on days that the University is officially closed (usually Christmas and national holidays) you will need further written permission from the Head of Department, or Departmental Safety Officer, for access to the building.

Responsibilities

You have a responsibility both in law (Health and Safety at Work Act) and by University regulations, to take care of your own health and that of others. You must ensure that your work poses no hazard to you or anyone else. Be sure to discuss all safety matters with your supervisor before commencing work.

Risk Assessment

In order to meet your responsibilities, you and your supervisor should make an assessment of risks for the work you will do. If it is likely to be hazardous, you should discuss any precautions needed or any alternative which may be safer. When evaluating risks you should consider:

Electrical hazards

These include shocks, burns and fire. All circuits pose some hazard. Circuits utilising mains voltages must always be considered a risk. However, circuits apparently using only small voltages can still pose significant hazards, especially if they contain large value capacitors or inductors. You must consider whether hazards may exist at each stage of your work and take appropriate action to prevent danger.

Insulation:

All conductors/connectors/ components which might reach hazardous levels (including during fault conditions), must be enclosed so no one can touch them.

Earthing

All exposed metal work should be earthed.

Possible fault conditions

How high might fault conditions be? How may they safely be interrupted (fuses circuit breakers etc.)? Will the conductors /connectors handle these currents until the safety device operates?

If, after discussion with your supervisor, it is necessary for you to work on exposed conductors, you must first talk to the EEE Departmental Safety Officer for advice before attempting any work.

Isolating switches

Consider inserting emergency switches in the supply. Identify these clearly, so that others can quickly isolate your work should a fault occur.

Unattended Equipment

NEVER leave equipment running unattended without permission from your supervisor on each occasion and if permission is granted place warning signs to warn others of the situation. Refer to the Departmental Safety Booklet for further information.

Very high voltages (Over 650V AC or DC)

Specialist precautions are required - please discuss with your Supervisor.

Harmful Substances

Some substances are clearly harmful, while others which might appear to be quite innocuous can, under certain circumstances be hazardous, e.g. vapours can be absorbed not only via the lungs, but also via the skin. Even inert gases can cause asphyxia when in an enclosed space. Dust, even wood dust, can pose a hazard especially if inhaled over long periods. Sometimes repeated exposure can cause a cumulative build up, the effects of which may not appear until long after exposure has ceased.

Anyone proposing the use of chemicals or other substances should first seek advice from their supervisor.

Ordering Hazardous Items

It may, sometimes, be necessary on your project to order items that are deemed to be hazardous. In this context, a hazardous substance is any material that has the capacity to kill, injure, cause illness or discomfort to anybody who comes into contact with it. Examples of hazardous substances might be: chemicals (e.g. caustic, acidic, volatile),

powders, adhesives, known allergens. Clearly, some judgement is required and consequently, if there is a suspicion that something that you want to order might be hazardous then in all such cases:

- the purchase must be discussed with and agreed with your supervisor;
- A COSHH (Control of Substances Hazardous to Health) form must be completed or provided from elsewhere (the manufacturer of the substance, for example). You should seek advice from Dianne Webster (d.webster@sheffield.ac.uk, x25859, the Departmental Safety Officer).
- Mrs Webster can arrange for the COSHH form to be assessed and when deemed acceptable, the COSHH form must be authorised by your supervisor;
- The order form should be taken, along with COSHH form, to the storekeeper who can assess the safety, delivery and handling arrangements necessary for the order.

- All procedures involving chemicals, no matter how trivial, must, by law, have been COSHH assessed prior to attempting them.

All information and forms can be found here:
http://hercules.shef.ac.uk/eee/local/safety/coshh.html

Faulty Equipment

If you discover equipment which is faulty, do not try to rectify the fault. You should ensure that the item is removed from service, marked clearly that it is not to be used, and report it to the electronic workshop staff on F floor, room F146.

Do not just put the equipment back. By doing so you may be endangering the safety of the next person who attempts to use it. If an accident occurred in such circumstances your failure to report the fault may lead to you being held legally responsible.

Dangerous Practices

If you see anyone performing work that you consider dangerous, or equipment that appears hazardous, politely inform the person of the risk. If the practice continues, make the Departmental Safety Officer aware.

Where to go for more help

First you should talk with your supervisor, secondly if you are concerned about the safety of existing appliances, see the electronic technicians in the electronics workshop, room F146. If you are building a new piece of equipment, ask for a guidance sheet from the technical staff. Finally, the Departmental Safety Officer has a general responsibility for all Safety Issues.

IF IN DOUBT, SEEK ADVICE.

You and Assessment

Examinations

The are two examinations periods during the year: semester 1 examinations are in January; semester 2 examinations are in May/June. However, in EEE we generally schedule the exams in May/June. For a 15 credit EEE module, the assessment usually takes the form of:

- a 3 hour paper in which you must answer four out of the six questions posed;
  or
- a 2 hour paper in which you must answer three out of the four questions posed and some intermediate assessment (worth circa 25%) during the teaching of the module.

For a 10 credit half modules, the examination usually takes the form of a 2 hour paper in which you must answer three out of the four questions posed.

The style of a question paper is usually consistent from year to year but obviously the questions will change. Unfortunately, this is the first year during which we are running 15 credit modules in MSc programmes and we have re-organised virtually all of the modules at this level.

To help you prepare, past examination papers and solutions are provided on the web at:

http://hercules.shef.ac.uk/eee/teach/resources/fourth.html

and from there select the module of interest. Given the re-organisation of the curriculum, these examinations will be less relevant in this year than in other years. However, lecturers should provide trial or prototype exam papers/questions to allow you to practice.

We have also put on the web a feedback report from the exam marker that outlines the commonest mistakes and misconceptions exhibited by the class that took the exam. We publish this report primarily as feedback for those who took the exam but it may also help you when you prepare for your exams. The material is restricted to internal university users but is accessible from outside if you are connected by a VPN.

Past papers/trial questions should provide you with a guide to the level and form of questions to expect. It is a good idea to try out the questions when you have covered the relevant material in lectures. Don't look at the solutions until you have tried the questions!

What are the examiners looking for?

The examiners will be looking for evidence of 'knowledge', 'skill', 'understanding' and 'creativity'.

Knowledge	the factual information imparted in the course;
Skill	the ability to execute relevant analytical procedures so that the knowledge can be used
Understanding	an internalisation of the ideas as evidenced by being able to apply this knowledge and skill to situations similar to, but not identical with, those covered in the lectures or tutorial questions;
Creativity	the ability to use the knowledge, skill and understanding in situations which are beyond those covered directly in the course.

Other Information

We will provide further detailed information on examinations and progression towards the end of the autumn semester.

Examination Arrangements

General

All candidates should familiarise themselves with the OFFICIAL UNIVERSITY REGULATIONS, which can be found inthe Student Handbook or on the University web pages (www.shef.ac.uk/calendar or in more digestible form, www.shef.ac.uk/ssid/exams). The description below is an outline of the procedures.

The examination timetables will be posted on SSiD's web pages. **Revisions may be made and it is essential to check the final version shortly before the start of the exams. Also, check the exam venue.**

You should arrive at the exam in plenty of time. Desks are identified using a letter for the row and a number for the individual place. A list will be posted outside the exam room, detailing the blocks of desks assigned to your exam and you may sit anywhere within this block.

You will be allowed into the hall 5 minutes before the start of the exam in order to find your place. It is your responsibility to see that you sit the correct paper. Ensure that all pages are present in your exam paper and then complete the attendance form. Once this has been completed, you may begin as soon as you wish. Read the instructions on the front page of the examination paper and do not answer more than the required number of questions: marks may be lost if you do. **If the instructions say that you should only answer 4 questions and you answer 5 then we will only mark the first four answers in the order in which**

they occur in the answer book – unless any of the answers are clearly crossed out. After 30 minutes no-one is allowed to enter the hall. You may not leave the hall during the first 40 minutes of the exam or in the last 10 minutes. If you need to leave the room during the exam you will be accompanied by a member of staff.

If you require clarification of a question, suspect an error or need any other form of assistance, you should ask an invigilator for assistance. Attract the invigilator's attention by raising your hand - on no account must you communicate with any other candidate. If the lecturer who set the paper is not present, the invigilator should have a contact number and seek help.

Illness

- **A medical note from a GP or the University Health Service is essential for any illness during the examination periods.**
- **If you are ill before or during an examination, you should go immediately to Student Health, or if necessary, call a GP.**

We will want confirmation from a doctor that you were unfit to take the exam and **this means in most cases that you must see the doctor at the time of your illness**. If you cannot get an appointment to see your doctor, at short notice, then you should attend the NHS Walk-In Centre, on Broad Lane (100m from the Faculty). If you are delayed for any other reasons, we advise you to go to the examination (even if more than 30 minutes late) it may still be possible to recover the situation.

If you wish to notify the departmental examiners of any extenuating circumstances, please ensure that you hand in the relevant paperwork (eg. special circumstances form) to the Student Support Office no later than:-

Semester 1 – 12.00 on 3rd March 2015

Semester 2 – 12.00 on 6th July 2015

Disability and Special Needs

If you have any disability (such as dyslexia or chronic back pain, for example), which you think might compromise your examination performance, you should contact the Departmental Examinations Officer (Prof Mark Hopkinson) and Student Health. If possible, this should be done well in advance of the examinations so that your needs can be assessed and special arrangements can be made.

Religious Observance

Those of you who would prefer to avoid certain days / dates for examinations for religious reasons should fill in the religious observance request form available from exams office or the following SSiD web page; (www.shef.ac.uk/ssid/forms/exindex.html). It is important to complete this form well before the examination period.

Permitted items

Calculator (if approved), ruler, pens, pencils, eraser, drawing implements. Bags, cases, etc. must be left elsewhere. Small containers such as pencil cases are allowed, but may be searched.

Calculators

All calculators to be taken into exams must be approved by the Faculty. Most graphics calculators and those with programmable memories are not allowed. To get yours approved, take it to the Student Services Information Desk, where you will be given a sticker bearing the University crest. In the examinations, the invigilators are free to check for this seal of approval and confiscate any that are unmarked for the duration of the examination. The approved seal must be obtained before the examinations, it cannot be given in the exam hall.

- **Using a prohibited calculator in an examination is regarded as a form of "unfair means" and may lead to disciplinary action.**

Mobile Phones

Mobile phones should not be taken into an examination. If you do have a mobile phone with you, it should be switched off and placed in an envelope on your desk. **If you are found with a mobile phone on your person during the exam, and it is switched on, we will construe this as an attempt to use unfair means and this may result in a mark of zero being awarded for the examination. If the phone is found to be switched on after visiting the toilets then this WILL result in a mark of zero being awarded for the examination**.

Dictionaries

If you are an overseas student then you may be permitted to take an approved dictionary into an examination. **If the dictionary is found to have any hand-written notes in it we will construe this as an attempt to use unfair means and this may result in a mark of zero being awarded for the examination**. Excuses such as 'I bought it from another student and did not know it had notes in it' will not be accepted.

Revision Notes

Please ensure that your pockets and pencil case are clear of all revision notes before you enter an exam room. Invigilators are entitled to ask to see the contents of your pockets and **if you are found to have any notes on you during an examination then we will construe this as an attempt to use unfair means and this may result in a mark of zero being awarded for the examination**. Excuses such as 'I was revising on the tram and I forgot that they were in my pocket' will not be accepted.

Passing Your Exams

Each module carries a total of 15 credits and each half module carries 10 credits. Each unit is assessed by either an examination at the end of the teaching period, continuously during it, or some combination. Each unit is assessed on a 100-point scale (described in Appendix F). Credits are only awarded for units assessed at the pass grade or above.

Full information on the regulations governing examinations and the award of degrees can be found on the Web pages of SSiD or in the Student Handbook given to you at registration. We will also give you more detailed advice as the exams approach.

Graduation

A brief description of the rules for MSc programmes is given below.

- If you gain an overall average of 49.5%, gain at least 165 credits and have no hard fails (a hard fail is where you fail a module with a mark below 40%) you will pass the MSc degree
- If you gain an overall average of 59.5%, gain at least 165 credits, of which 90 credits have a mark of 60% or above, and have no hard fails you will gain a merit

- If you gain an overall average of 69.5%, gain at least 165 credits, of which 90 credits have a mark of 70% or above, and have no hard fails you will gain a distinction
- If you fail to gain an MSc then there are two other exit routes:
    - If you gain at least 105 credits (taught material) and no hard fails then we can award a PG Diploma
    - If you gain at least 60 credits we can award a PG Cerificate

Appendices

Appendix 1

Module Aims, Objectives and Outline Syllabi

EEE6085 Selected Topics in Computer Vision Engineering

Aims

This unit is concerned with facilitating student learning in basic and emerging topics in computer vision engineering (CVE) with a predominantly application point of view. It aims to introduce practical aspects of selected topics in CVE, introduce and practice relevant research methods and scientific techniques, to provide hands on experience in software and hardware design and implementation of simple CVE systems, provide the opportunity to work independently or collaboratively within small groups and provide oral and written communication skills appropriate for the presentation of technical information.

These aims will be achieved by combination of lectures, laboratory sessions and independent studies. Every year 3 topics are chosen and delivered via these means considering the opportunities for problem/enquiry based learning and research led teaching within each topic. This module is continuously assessed by means of course works associated with the selected topics.

This unit aims to

1. Provide understanding of state-of-the-art and emerging computer vision engineering topics in an application point of view.
2. Introduce research methods and scientific techniques relevant to computer vision engineering.
3. Provide hands on experience in software and hardware design and implementation of simple computer vision engineering systems.
4. Provide the opportunity to work independently or collaboratively within small groups.
5. Provide oral and written communication skills appropriate for the presentation of technical information.

Outline Syllabus

Three topics will be chosen from the following areas related to computer vision engineering

1) Image and video processing
2) Computational vision
3) Visual Information Engineering

The topics will be different from year to year.

Objectives

By the end of the unit, a successful candidate will be able to

1. Understand the basic and emerging topics in computer vision engineering.
2. Review the latest research in selected topics.
3. Design and implement simple software systems suitable for computer vision engineering applications.
4. Design and implement simple hardware systems suitable for computer vision engineering applications.
5. Analyse and evaluate the performance of the implemented systems
6. Produce and deliver written presentation of technical information.
7. Produce and deliver oral presentation of technical information

EEE6200 AC Machines

Aims

1. To introduce the principle of operation of conventional AC machines.
2. To provide an insight into the operating characteristics of synchronous and induction machines.
3. To introduce the principle of operation of synchronous and switched reluctance machines, and discuss their operating characteristics.

Outline syllabus

Introduction to AC machines: magnetic circuits, properties of soft magnetic materials, flux linkage, inductance and energy, determination of forces and torques. **Polyphase rotating machines:** two-axis three-winding machine, general multi-winding machine, matrix form, electromagnetic torque, synchronous machine topology, induction machine topology, phase and dq axis transformations. **Sinusoidal windings:** single layer windings, double layer windings, fractional-slot windings. **Synchronous machines:** modeling and equivalent circuits, steady state and transient performance and operating characteristics of non-salient pole machines, effects of rotor saliency and steady state operating characteristics of salient pole machines. **Induction machines:** modeling and equivalent circuits, steady state and transient performance and operating characteristics. **Synchronous reluctance machines:** principle of operation, modeling and equivalent circuits, steady state and transient operating characteristics. **Switched reluctance machines:** principle of operation, steady state and transient performance and operating characteristics.

Objectives

By the end of this module successful students will be able to:

1. Demonstrate an understanding of the principle of operation of conventional synchronous and induction machines.
2. Demonstrate an understanding of the modelling techniques employed in synchronous and induction machines.
3. Predict and demonstrate an understanding of the steady state and transient operating characteristics of conventional synchronous and induction machines.
4. Demonstrate an understanding of the principle of operation of synchronous and switched reluctance machines.
5. Predict and demonstrate an understanding of the steady state and transient operating characteristics of synchronous and switched reluctance machines.

EEE6201 Advanced Control of Electric Drives

Aims

Building upon the "Motion Control Systems" unit, this module explores advanced modelling and modern control strategies of electric drive systems with a focus on induction (IM) and permanent magnet synchronous machines (PMSM). The main aims of the unit are:

1. To understand the components of modern drive systems including power electronics, sensors and real-time controllers.
2. To analyse the dynamics of IM and PMSM and understand their transient behaviour.
3. To analyse in details the design, operational constraints and dynamic performance of vector and direct torque control strategies for electric drives.
4. To develop an understanding of advanced control methodologies and open research issues including sensor-less drive operation.
5. To effectively understand and use computer modelling for dynamic simulation of electrical drives and design of control algorithms.

Outline Syllabus

Introduction to the control of electric drive systems: Components of a drive systems, sensors and real time control. **Dynamic modelling of AC machines**: Review of reference frame transformations, dynamic models of induction and permanent magnet brushless DC and AC machines. **Vector control of AC machines**. Speed and current control loop design. Operating regions of AC drives, voltage and current limitations, flux weakening control. **Direct torque and flux control of AC machines. Speed and position sensorless control of IM and PM machines. Computer modelling and simulation of electrical drives and control systems.**

Objectives

By the end of this module successful students will be able to:

1. describe and select components for an electric drive system.
2. demonstrate detailed understanding of the dynamic behaviour of IM and PMSM.
3. use computer modelling for drive system analysis and control design.
4. display in-depth knowledge of vector and direct torque control strategies used in modern drive systems.
5. display a knowledge of advanced and open research topics in electrical drives systems.

EEE6202 Energy Storage Management

Aims

1. To introduce fuel cell systems as a clean and efficient alternative energy source.
2. To provide a basic understanding of the principles of operation and characteristics of fuel cell systems.
3. To discuss recent development and applications of fuel cell technology.
4. To introduce battery energy storage systems and Supercapacitor storage
5. To provide basic understanding of the operation and characteristics of different battery chemistries and how Supercapacitors differ from batteries
6. To introduce single phase interfaces for bidirectional energy storage
7. To introduce mechanical energy storage in terms of flywheels / compressed air.

Outline Syllabus

Fuel cell systems: Principles of operation, different fuel cell structures, open circuit voltage and efficiency, fuel cell irreversibilities, operational characteristics, electrical dynamic behaviours, recent development and applications in electric and hybrid vehicles and energy storage. **Battery / Supercapacitor Energy storage:** Principles of primary / secondary cell operation, different battery chemistries used in energy storage in electric vehicles / hybrid electric vehicles (EV / HEVs) and in energy storage systems (ESS). Comparison of batteries and Supercapacitors. Charging of batteries / ESS interfaces at single phase for distributed energy storage. Wireless charging for vehicles. Vehicle to grid (V2G). **Mechanical Energy storage:** Principles of mechanical energy storage, flywheels / compressed air. Mechanics of energy storage, precession torques and counter-rotating systems for vehicles. Examples of energy storage.

Objectives

By the end of the module a successful student will be able to

1. Describe the principles of operation, basic characteristics and recent developments of different forms of fuel cell systems.
2. Use appropriate techniques for modeling fuel cell behavior.
3. Discuss the potentials and limitations of fuel cell systems as static and mobile electric energy sources.
4. Explain the principles of battery and Supercapacitor operation.
5. Construct a basic model of a battery system.
6. Discuss distributed ESS interface operation at single phase level.
7. Describe the principles, advantages and disadvantages of V2G systems at domestic level.
8. Describe the principles of mechanical energy storage, including flywheels and compressed air systems.

EEE6203 Motion Control and Servo Drives

Aims

This unit builds upon the second year unit EEE223, "Electrical Energy Management and Conversion", to investigate in more detail the performance and operational characteristic of both modern a.c. and d.c. variable speed drives and actuation systems, as well as their applications in electric/hybrid vehicle traction. To introduce d.c. drives and permanent magnet brushless a.c. drives.

1. To examine in more detail the operational requirements of induction motors at variable speeds under scalar and vector controlled modes of operation.
2. To introduce power electronic inverters and develop control strategies and switching schemes for inverter fed drives.
3. To develop techniques for modelling the performance of drive systems and for their control system design.
4. To introduce electric and hybrid drive-trains and their components.
5. To demonstrate the need for modelling and simulation in order to assess the benefits of a particular component and/or drive

Outline Syllabus

Introduction to servo drive systems: Drive system configuration, characteristics of mechanical loads, velocity profiles, matching motor and load, and criteria for selecting drive components. **D.C. machine drives**: Review of d.c. servo drive characteristics (4 quadrant operation), speed control, development of transfer function for both motor and drive subsystems, design techniques for current and speed control loops, power electronic converters for d.c. drives, supply considerations. **Permanent magnet brushless a.c. drives**: Rotating magnetic field of AC windings, operational characteristics of permanent magnet brushless motors, d-q axis transformation, and modelling and field-oriented control of permanent magnet a.c. machines. **Voltage source Inverters**: Inverter topology, review of operation, sinusoidal PWM modulation, switching harmonics, over modulation and six-step operation, space vector modulation and their implementation in a digital controller. **Induction motor drives**: Review of operation, development of phasor diagram and lumped circuit model, operational characteristics, speed control, scalar and vector control schemes. **Electric Traction**: Electric and hybrid drive-trains, modelling of drive-train components, vehicle kinematics, assessment of drive-train performance and efficiency, driving cycles and simulation.

Objectives

By the end of this module successful students will be able to

1. Describe alternative drive technologies for motion control systems.
2. Demonstrate detailed understanding of the operational characteristics of variable speed drive systems.
3. Use standard techniques for drive system modelling and control system design.
4. Display in-depth knowledge of power electronic converters/inverters used in modern drive systems, and their modulation schemes and control strategies.
5. Explain the principles of electric and hybrid drive-train architectures and their components.
6. Model the components of electric and hybrid drive-trains.
7. Calculate the losses and efficiency of electric and hybrid drive-trains.
8. Assess the performance of vehicles equipped with electric and hybrid drive-trains.

EEE6204 Permanent Magnet Machines and ActuatorAims

The aims are:

1. To develop an understanding of the relationship between dimensions and rating of machines.
2. To develop techniques for the design of permanent magnet machines.
3. To introduce the topologies of different permanent magnet machines and actuators.
4. To develop an understanding of the relationship between power losses and thermal management.
5. To introduce winding arrangement and calculate representative winding reactances.

Outline Syllabus

Machine Ratings: leading dimension of machines, electric and magnetic loadings, thermal design considerations. **Windings:** special types of windings for permanent magnet machines, their design, choice of winding arrangements, harmonic effects, winding reactance. **Permanent Magnets:** types of magnet, magnetic circuit, demagnetization, analysis and design of PM devices. **Machine and actuator topologies**: electromagnetic torques, Brushless AC/DC, fractional slot, switched/transvers flux permanent magnet machines, etc. **Thermal management**: types of losses, thermal phenomena, thermal modeling using lumped parameter and finite element.

Objectives

On completion of the module successful students will be able to

1. Calculate the leading dimensions of a machine subject to the specified design constraints.
2. Develop winding layouts and calculate the harmonic content of their MMF or of the EMF induced in the windings by a rotating field.
3. Suggest the choice of an appropriate permanent magnet material and its main dimensions when used in an electric machine.
4. Introduce different topologies of modern permanent magnet machines and actuators.
5. Calculate the copper and iron losses as well as temperature distribution within permanent magnet machines.
6. Calculate the reactance of a winding or components of the reactance from the dimensions of a machine and relate these to equivalent circuit models developed in earlier years of the course.

EEE6205 Power Electronics Converters

Aims

This unit introduces power conversion principles, defines the terminology and analyses operational principles, modulation methods and control of selected power converters topologies for industrial applications. The aims of the module are to understand:

1. Main operational principles of power electronic converters
2. Current-source and voltage-source converter requirements and restrictions
3. Multi-level modulation and control strategies for standard multilevel converters
4. Operation of load resonant, resonant-switch and resonant dc-link converters
5. Challenges in control of matrix converters

Outline Syllabus

Introduction to power conversion: Structure of power converters, main characteristics and requirements, elementary commutation cells, overview of switching power devices, overview of thermal management and packaging. **Two-level voltage source and current source converters**: Requirements on the switches, standard modulation strategies, implementation in a digital controller and analysis of output voltage harmonics, power factor control and active damping control of current source rectifiers. **Multilevel voltage source converters**: Multilevel modulation strategies and capacitor voltage balancing approaches for the cascaded symmetrical and asymmetrical H-bridge multilevel converter, diode clamped multilevel converter and flying capacitor multilevel converter, control of multilevel converters for power quality improvements. **Matrix converters**: Main requirements and restrictions on the switches, input filter and converter operation, overview of direct and indirect modulation and control methods. **Resonant converters**: Basic resonant circuit concept and main classification of resonant converters, analysis of load-resonant, resonant-switch and resonant dc-link converters.

Objectives

By the end of this module successful students will be able to

1. master standard modulation and control techniques for two-level current/voltage source converters
2. demonstrate detail understanding of multilevel modulation strategies and capacitor voltage balance issues for standard multilevel power converter topologies
3. design controllers for multilevel power converters for power quality improvements
4. understand matrix converters operation principles, major restrictions and requirements
5. display in-depth knowledge of resonant power electronics converters

EEE6206 Power Semiconductor Devices

Aims

1. Introduce and develop an understanding of power semiconductor devices - physics, technologies, design, fabrication and characterization.
2. Evaluate suitability of various semiconductor device concepts for specific power electronic applications.
3. Device integration concepts such as device assembly, packaging and thermal constraints.

Outline Syllabus

Introduction to power semiconductor devices. Review of basic semiconductor device physics, structures, design and fabrication technologies and moving towards power semiconductor architectures. **Scaling effects of breakdown voltage**, material limits of breakdown voltage, on-state resistance and switching; techniques to overcome these physical limits (electric field shaping / wide band gap device materials (SiC, GaN)), where do bipolar device technologies sit, etc) **Power device packaging techniques.** Current packaging techniques for power semiconductor devices, thermal constraints and how it affects power device ratings, wire bonding and press-pack packaging techniques and reliability. **How to read datasheets.** Linking between semiconductor device parameters and the datasheet to choose the correct device technology. **Power device measurement techniques**. Practical experience of common measurement techniques used for un-packaged/packaged power devices. The practical experience will illustrate the difficulties in measuring device characteristics, capacitance voltage characteristics of power diodes and MOSFET/IGBT structures to illustrate input/output and reverse transfer capacitance and their physical processes. Transient device characterisation will be covered showing the influence of test circuitry upon measured energy loss and the considerations for voltage and current measurement probes. **TCAD modelling techniques for power semiconductor devices**. Practical experience of TCAD modelling of power semiconductor devices. This unit will use worked examples to explain TCAD techniques for process, device and mixed mode simulations. The practical experience will illustrate fundamental device physics such as depletion enhancement, electric field crowding and junction recovery processes. Advanced modeling techniques will also be discussed such a three-dimensional device modeling and illustrate the difficulties in building simulations of wide band gap power device technologies.

Objectives

By the end of this module successful students will be able to:

1. Demonstrate understanding of voltage/current/switching related issues in power device technologies and fundamental physical limits to these devices.
2. Show an awareness of power ICs, discrete and intelligent power modules.
3. Describe a range of new power device technologies are being used to increase power density ratings.
4. Demonstrate knowledge of non-silicon based technologies and how these can improve on silicon power semiconductor technologies.

5. Show an awareness of future device technologies which would overcome current limitations.
6. Demonstrate an understanding of TCAD modelling techniques.
7. Link datasheet parameters to physical device performance with measurements and understand ratings for specific applications.
8. Show an awareness of measurement techniques used to populate datasheets and to extract specific parameters and see how they link to specific power electronics applications

EEE6207 Advanced Computer Systems

Aims

This module looks at modern computer systems from operating systems down to the underlying computer architectures to provide a coherent view of how such systems work and how their performance can be improved, looking, in particular, at parallelism

1. To provide students with an understanding of the structure of modern multi-tasking operating systems.
2. To identify the links between systems and the underlying architectures.
3. To equip the student with an understanding of high-performance processing system architectures.
4. To introduce the concepts of parallelism as a means of enhancing system performance.

Outline Syllabus

System Organisation. Historic introduction and origins of the operating system. Elements of the multi-user operating system - Hardware considerations, memory protection, system mode operation, time slicing. **Processes:** Scheduling, process synchronisation, inter-process communication. **Threads:** Comparison with heavyweight processes. **Deadlocks:** detection, avoidance and recovery. **File systems. Memory Systems :** virtual memory, memory hierarchies, locality, coherence, address translation, paging/segmentation, memory management. **Processor Classifications**. **Pipelining:** speed-up constraints, static/dynamic pipelines, reservation tables and collision vectors. **Pipelined Processors:** architecture, constraints, interlock and register forwarding/scoreboarding, stalling, branching, superscalar, VLIW. **Parallel Processors:** array processors, loosely-coupled processors, tightly-coupled processors, vector processors. **Connection Networks :** structures, complexity, performance, limitations, memory organisation and interleaving, multi-processing caches. **Task partitioning :** compute/IO bounds.

Objectives

On successful completion of this module students will be able to

1. Describe the key elements and functionality of a modern computer operating system.
2. Demonstrate an understanding of computational processes and their interaction, particular process interactions and synchronisation.
3. Demonstrate an appreciation of the issues surrounding the management of resources such as: memory, disk space and the CPU.
4. Understand the interaction between an operating system and the underlying hardware, and the hardware extensions which facilitate key functionality in a modern operating system.
5. Identify the crucial importance of memory system design in high performance computer systems,
6. Analyse/estimate the performance of a given memory system and to evaluate the design options and alternatives.
7. Identify appropriate forms of parallelism (temporal and spatial) for particular problems/application, to analyse the effect on system performance and evaluate the costs/benefit.

8. Describe various structures and issues which are important to the design of parallel processors, identifying their strengths and weaknesses and to analyse the likely performance of key components.

EEE6208 Advanced Integrated Electronics

Aims

This course advance students' understanding of analogue and digital VLSI design, such that they can:

1. Understand the issues that define the limits of what is possible using VLSI.
2. Understand techniques that will allow circuits to be analysed from a variety of perspectives.
3. Design multistage VLSI signal amplifiers & model their performance using SPICE
4. Design D to A and A to D converters.

Outline Syllabus

Test: Testing aims. Test techniques: Design for testability; structured approaches; scan path; signature analysis and BIST. JTAG. **Interconnect:** trends and problems. **Power consumption**: dynamic and static power; trends. **Non-CMOS Logic:** Dynamic logic, Pass-Transistor Logic. **Circuit Layout:** standard CMOS processing. **Amplifiers:** review of 2 stage op-amp design. Folded cascode op-amps, feedback, frequency response. **SPICE:** using high level MOSFET models. **Converters:** mixed signal systems, principles of DAC and ADC operation.

Objectives

By the end of this unit successful students will be able to:

1. Understand the importance of interconnect as a limit to performance and the effect that it has on power consumption;
2. Calculate the power consumption of circuits and be able to estimate the performance of larger systems;
3. Understand the importance of testing and testability and be able to devise testing strategies for circuits;
4. Design dynamic and pass-transistor logic gates based on an understanding of the required logic and the behaviour of the technology. Students should also be able to estimate the performance of these gates (power, speed, area).
5. Design a CMOS folded-cascode op-amp and use realistic SPICE MOSFET models to assess its performance.
6. Analyse the frequency response and assess the stability of a range of amplifier designs.
7. Use feedback to stabilise amplifier circuits.
8. Design DAC and ADC circuits and model their performance using SPICE.

EEE6209 Advanced Signal Processing

Aims

This unit focuses on introducing advanced signal processing methods and technologies and their applications. The aims are:

1. Provide an understanding of advanced filter design concepts and applications.
2. Extend filter design into scenarios where sampling rate conversions, filter bank and adaptive filtering are required.
3. Develop the concept of transforms.
4. Develop the concept of random signals and their analysis and apply them to the area of adaptive filtering with various applications.
5. Introduce the general area of array signal processing and study basic techniques for beamforming.

Outline Syllabus

Multi-rate signal processing, filter bank theory, signal transforms, random signal analysis, adaptive filtering theory and array signal processing. The coursework component of this unit aims to provide an understanding of using software tools, such as MATLAB, in solving problems and implementing simple signal processing algorithms.

Objectives

By the end of the unit, a candidate will be able to demonstrate the ability to:

1. Carry out filter design and implementation for sampling rate conversions including decimation (d), interpolation (i), and a rational factor (i/d).
2. Understand the polyphase representations of filter banks, formulate different filter bank design provide the corresponding solutions and application of designing wavelet transforms.
3. Understand the concept of transforms, design, implement and use signal transforms in various applications.
4. Perform simple analysis and compute statistics of random signals.
5. Understand the Wiener filter solution and the least mean square type adaptive algorithms and apply them to solve adaptive filtering problems.
6. Have a general knowledge about the area of array signal processing and understand some basic beamforming techniques.
7. Use MATLAB in designing and implementing the above concepts and using them in suitable applications.

EEE6210 aerospace actuation

Aims

4. To introduce d.c. drives and permanent magnet brushless a.c. drives.
5. To examine in more detail the operational requirements of induction motors at variable speeds under scalar and vector controlled modes of operation.
6. To introduce power electronic inverters and develop control strategies and switching schemes for inverter fed drives.
7. To develop techniques for modelling the performance of drive systems and for their control system design.
8. To introduce state of the art hydraulic actuation systems.
9. To introduce Electro hydrostatic and electromechanical actuation.

Outline syllabus

Introduction to servo drive systems: Drive system configuration, characteristics of mechanical loads, velocity profiles, matching motor and load, and criteria for selecting drive components. **D.C. machine drives:** Review of d.c. servo drive characteristics (4 quadrant operation), speed control, development of transfer function for both motor and drive subsystems, design techniques for current and speed control loops, power electronic converters for d.c. drives, supply considerations. **Permanent magnet brushless a.c. drives:** Rotating magnetic field of AC windings, operational characteristics of permanent magnet brushless motors, d-q axis transformation, and modelling and field-oriented control of permanent magnet a.c. machines. **Voltage source Inverters:** Inverter topology, review of operation, sinusoidal PWM modulation, switching harmonics, over modulation and six-step operation, space vector modulation and their implementation in a digital controller.

Induction motor drives. **Induction motor drives:** Review of operation, development of phasor diagram and lumped circuit model, operational characteristics, speed control, scalar and vector control schemes. **Hydraulic actuation systems:** principle of force generation, the role servo valves, control schemes, operational characteristics, Electro hydrostatic actuation. **Electromechanical actuation:** principles of rotary to linear motion conversion, modelling of electromechanical actuators, control schemes, operational characteristics, advantages and limitations, case study of an aircraft electromechanical actuation system.

Objectives

1. Describe alternative drive technologies for motion control systems.
2. Demonstrate detailed understanding of the operational characteristics of variable speed drive systems.
3. Use standard techniques for drive system modelling and control system design.
4. Display in-depth knowledge of power electronic converters/inverters used in modern drive systems, and their modulation schemes and control strategies.

5. Understand the principle of operation of hydraulic actuation systems.
6. Understand the principle of operation of electromechanical actuation systems.
7. Demonstrate the ability to model electromechanical actuators.

EEE6211 avionics technologies

Aims

1. To introduce avionic systems and highlight their role and importance in modern aircraft.
2. To discuss system reliability, failure detection, redundancy and failure survival configurations.
3. To introduce Fly-By-Wire flight control and discuss the trends towards Power-By-Wire in the more-electric aircraft.
4. To introduce navigation systems.
5. To introduce gas turbine principle of operation and state-of-art controls.
6. To introduce aircraft certification.

Outline syllabus

Avionic systems: systems interfacing directly with the pilot, aircraft state sensor systems, navigation systems, external world sensor systems, task automation systems**. Reliability:** Failure detection, redundancy and failure survival configurations; **Flight control systems:** Fly-by-wire flight control system, Power-by-wire concepts, the more-electric aircraft. **Air navigation:** flight planning, electronic navigation aids. **Gas turbine:** principle of operation, Full Authority Digital Engine Control (FADEC); **Aircraft certification;**

Objectives

1. To understand the role and importance of avionic systems in modern aircraft and to be aware of the avionic environment.
2. To appreciate the importance of reliability in airborne systems and understand the methods employed for estimation of system reliability and the concepts of redundancy and failure survival.
3. To understand the role of flight control systems, such as fly-by-wire and be aware of the trends towards the more-electric aircraft.
4. To understand state of the art navigation systems.
5. To understand the principle of operation of gas turbines and their control.
6. To be aware of the steps and requirements of aircraft certification.

EEE6212 Semiconductor Materials

Aims

This module describes the basic physical properties (structural, optical, electrical) of semiconductor materials used in the electronic and opto-electronic industries, and in semiconductor based research. The aim is to equip the students with a comprehensive background understanding of the physical, structural, optical, electronic properties of semiconductor materials used in modern electronic and opto-electronic devices.

Objectives

On successful completion of this module the students should be able to:

1. Understand the role and used of different semiconductor materials in different types of devices.
2. Understand relevant crystal structures, the reciprocal lattice, and x-ray diffraction.
3. Have knowledge of the role of the crystal structure in defining the thermal, optical, and electrical properties of the semiconductor, and describe the role of defects, dislocations and doping on these properties.
4. Understand the electronic band-structure in defining the electronic properties (e.g. carrier mobilities, intrinsic doping) and optical properties of the semiconductor (e.g. direct and indirect transitions, density of states)
5. Demonstrate an understanding of the different optical transitions and carrier relaxation processes.
6. Gain knowledge on excitonic effects, and the role of free carriers on the band-structure.
7. Understand electrical conduction processes for intrinsic and doped materials and the formation of p-n junctions.
8. Have knowledge of the effects of quantum confinement on the electronic and optical properties of the semiconductor materials
9. Demonstrate practical knowledge of the characterization and analysis of semiconductor materials.

EEE6213 Principles of Semiconductor Device Technology

Aims

The unit describes the basic structure of materials and their relationship to the requirements of semiconductor devices for future applications, leading to methods of crystal growth, fabrication, modelling and characterization. The course will have an assignment component which will allow students to gain experience of modelling devices relevant to future CMOS on the nanohub (Purdue). The aims are as follows:

This course aims to give students an understanding of semiconductor properties and processing, crystal and semiconductor growth and characterization and aspects related to device modelling. By the end of this course students should understand the principal device processing steps and the way in which they are implemented to model and produce simple device structures. The students will achieve hands-on experience with device modelling which will enable them to correlate what they have learnt with respect to basic material properties to industry requirements.

- Develop an understanding of crystal structure and its relationship to properties of materials ie semiconductors, conductors and insulators. The relationship to bandstructure and effective mass in relation to the requirements of future CMOS will be highlighted.
- Develop an understanding of crystal growth techniques and their requirements for both microelectronic and solar cell applications.
- Develop an understanding of deposition methods such as CVD, MBE, MOCVD. This will be accompanied by lab visits to the National Centre to reinforce lectures.
- Develop an understanding of device structures (MOSFET and TFET) and their relationship to circuit requirements.
- Develop an understanding of modelling methods which will facilitate a link between bandstructure and effective mass and device performance. This will be reinforced by a Modelling assignment on the nanohub.
- Develop an understanding of basic characterization methods (physical and electrical).
- Develop an understanding of the basic process flow for CMOS and BJT.
- Develop an understanding of gettering processes and yield.

Outline Syllabus

Historical perspective and overview. **Properties of Semiconductors, metals, insulators, semi-metals** : basic electrical, optical and structural characteristics including impurity effects, the Miller index notation and crystal defects. **Bulk Crystal Growth** : preparation of bulk Si and GaAs ingots and slices; Czochralski, floating zone, LEC and Bridgman growth. **Epitaxial Layer Growth** : CVD, MOCVD and MBE methods. **Semiconductor Characterisation Methods** : TEM, SEM, SIMS, AFM, SPM. **Oxidation and Etching** : dry, wet and deposited layers. **Lithography** : optical and e-beam methods, mask alignment. **Ion Implantation** :

equipment, ion damage, annealing, dopant diffusion. **Gettering** : internal, external. **Metallization and Silicides** : metal deposition, ohmic contact and interconnect formation. **Device Processing Integration** : CMOS and bipolar device fabrication with resistors and capacitors, device packaging, failure and reliability issues. **Basic Mosfet and Tunnelfet:** Device Principles and characteristics **Modelling Methods**: Semiclassical versus NEGF.

Objectives

By the end of the module, successful students will be able to

1. demonstrate good understanding of the properties and preparation of semiconducting materials.
2. display knowledge of modern device processing practices.
3. design a process flow to produce a simple device.
4. demonstrate ability to model MOSFET and TFET devices.

EEE6214 Packaging and Reliability of Microsystems

Aims

The unit describes the methods used to fabricate microsystems from electronic, opto-electronic and micro-electromechanical (MEMS) devices. It also introduces and develops an understanding of the reliability and failure mechanisms in the devices and resulting microsystems.

The aims are as follows:

Develop an understanding of the key aspects of microsystem packaging at three levels: individual component; circuit board and complete system. Emphasis will be on practical industrial solutions to modern microsystem packaging challenges.

Model the thermal behavior of microsystems.

Understand the thermal, mechanical, electrical and chemical degradation mechanisms that affect the reliability of microsystems.

Use statistical techniques to model reliability.

Appreciate microsystem test and characterization techniques.

Outline Syllabus

Résumé of electronic device evolution. General packaging principles. Component packaging (including integrated circuits, opto, MEMS, RF and power devices). Substrates (including printed circuit boards). Interconnection (including solder technologies). System-level packaging. Electrical and thermal considerations (including finite element thermal modelling). Test strategies. Reliability modelling. Degradation and failure mechanisms: thermal, chemical, electrical and mechanical. Characterization techniques.

Objectives

On completion of the module, successful students will be able to:

- Describe the range of technologies available for microsystem manufacture and design and select appropriate methods for given industrial scenarios.
- Assess the needs of a particular design – being able to choose and justify packaging options (both technologically and economically).
- Model the thermal, electrical, optical signal behavior of various component / interconnect / substrate combinations.
- Identify and explain the various types of defect in microelectronic devices.
- Identify and explain the degradation and failure mechanisms in electronic and optoelectronic devices and systems.
- Apply appropriate statistical models to analyze reliability data.
- Interpret the results from the common characterization techniques used in reliability and failure analysis of electronic and optoelectronic devices.

EEE6215 Nanoscale Electronic Devices

Aims

The course aims to provide students with an understanding of the science and technology which underpins modern electronic device technology, with an emphasis on integrated electronic devices at the nanoscale. The course begins with a discussion on the need for advanced electronic devices and systems, the present-day commercial application sectors and future perspectives. Following a short resume on semiconductor electronic properties the course will introduce basic transistor device types including the bipolar junction transistor, the metal-semiconductor FET and the metal-oxide FET; describing their structure, fabrication method and electronic characteristics. The high speed/high power performance capabilities of these approaches will be described. The use of semiconductor heterojunctions to create advanced bipolar and FET devices will be discussed. The course goes on to describe integrated circuits based on CMOS technology, discussing the historical scaling of device size, the current state of the art in device structure and properties and the challenges faced for future high speed IC developments. The course finishes with a discussion of the present state of the art in advanced devices including the physical properties, technological realization and potential future developments for semiconductor devices at the nanoscale.

Course Objectives

On successful completion of this module the students should be able to:

1. Understand the major application areas of modern electronic devices and have knowledge of the present market and future technological needs.
2. Have knowledge of the basic structural, electronic and optical properties of semiconductor materials of relevance to transistor operation
3. Describe the basic structure, physical operation and the device characteristics of various transistor types
4. Demonstrate an understanding of the performance, systems capability and limitations advanced electronic devices
5. Gain knowledge on how advanced materials and advanced device geometries may be used to create high speed or high power electronic devices.
6. Have knowledge of the principles behind Integrated Circuit development and of device scaling, including an understanding of the key scientific and technological issues at present.
7. Understand modern CMOS technology and its application in different sectors (eg: CPU, MCU, memory, image sensors)
8. Discuss other types of semiconductor electronic devices used in high performance circuits.
9. Gain knowledge on how photonic devices may play a role in future high speed electronic systems
10. Have an understanding of the current state of the art and of future trends in high-speed electronic device development.

EEE6216 Energy Efficient Semiconductor Devices

Aims

The efficient use of energy is of critical importance to future growth and well-being, providing a mechanism to reduce global emissions and to offset the impact of increasing fuel costs. Semiconductor devices can play can crucial role in this key global challenge, providing options which can both improve energy efficiency and also means for renewable energy generation. The course describes four key sectors where semiconductor devices are making considerable impact on energy efficiency. Current approaches for **Solid state lighting** using light emitting diodes are described which provide an efficient means to light our future living and working environments. A major focus of this sub-module will be the development of gallium nitride materials from research through to the mass-production of lighting systems. The current status of organic LED materials will also be discussed. A second segment discusses modern **Display Technologies** focusing on new and emerging approaches such as LED backlit LCD displays, full LED panels, projection displays and the opportunities for laser displays. Semiconductor approaches for **Energy Generation** are described in a third section. This will focus on the important role of semiconductor in photovoltaics (solar cells), but will also discuss thermal energy recovery and the use of semiconductor devices in photo-electrolysis. A final section describes **Energy Efficient Semiconductor Devices,** looking at various approaches to reduce the power consumption of electrical and photonic devices and systems and also the use of semiconductor detectors in remote thermal and environmental sensing to assist the achievement of energy efficient devices and systems.

Course Objectives

On successful completion of this module the students should be able to:

1. Understand the need for energy efficiency and its context against ever increasing global energy demands.
2. Understand that semiconductor devices can play a crucial role in reducing energy consumption and describe the major areas of future impact.
3. Understand the fundamentals of solid-state lighting, form materials to lighting systems, with particular emphasis on GaN LED technology.
4. Have knowledge of present-day energy efficient display technologies and introduce possible future developments utilizing full-colour LED and laser technology
5. Describe the basic operation of semiconductor solar cells and gain knowledge over different device and system approaches. Understand the importance of semiconductor photovoltaics within in a range of renewable energy options.
6. Understand alternative energy generation methods, such as thermo-photovoltaic and photo electrolysis methods
7. Understand the fundamental issues and present-day technological approaches being taken in electronics and photonics to achieve future energy efficient devices. Understand the potential impact of this within the communications, computer processing and power conversion sectors

8. Gain knowledge of the use of semiconductor detectors for thermal sensing to assist energy efficiency. Develop a wider understanding of the use of a range semiconductor sensors in environmental sensing applications

EEE6217 Optical Communication Devices & Systems

Aims

The course examines the behaviour of the components in a communications system and the way in which their design and individual performance is determined by that of the system requirements. The course is delivered as a set of 30 one hour lectures and includes a visit to the Central Facility. Copies of incomplete OHP transparencies are distributed to students and these are supplemented by additional notes taken during the lecture. The module aims are

1. To study the characteristics of the device components used in optical fibre communication systems and to examine their dependence on design.
2. To study the dependence of the system performance on device design.

Outline Syllabus

Introduction to optical fibre communications.

Optical fibres; structure, fabrication, ray and wave optics, attenuation and dispersion, bit-rate, bit-error-rate, acceptance angle, NA. Optical mode, single-model fibres, multimode fibres, modal dispersion, cutoff. Graded index fibres. Fibre amplifiers. Eye diagram. Fibre optical sensor. Visible light communication. Non line-of-sight communication. System design and power budget. Loss and Dispersion Limits for System. Detailed System Analysis. Network Architecture WDM systems and components

III-nitride semiconductors, LEDs including white LEDs, spontaneous emission, surface and edge emitters, linewidth and speed, internal quantum efficiency, extraction efficiency, radiative recombination, non-radiative recombination, recombination life-time.

Semiconductor lasers; structure, material growth, device fabrication, gain and feedback, materials, heterostructures, carrier and optical confinement. Threshold gain and Fabry-Pérot mode separation. Dependence of gain on n, λ and T, lasing emission spectrum. DBR and DFB, VCESL, I_{th}, turn-on delay, dynamic response. Advanced laser structures. Advanced semiconductor growth technologies.

Detectors; photoconductor, pin diodes, responsivity, absorption, Si photodiodes. Quantum efficiency, transit-time, current gain, structure. APD, impact ionisation, field dependence, multiplication, noise and breakdown. APD design.

Objectives

By the end of the module successful students will be able to

1. Understand the major application areas of modern optical communication
2. Understand the present market and future development in optical communication
3. Have knowledge of the basic structural and optical properties of semiconductor materials of relevance to optical communication
4. Understand the principles of semiconductor LEDs, lasers, detectors and optical fibres.
5. Describe the basic structure and electronic properties of solid-state devices

6. Understand each component and its operation mechanism
7. Appreciate the dependence of device performance on design.
8. Understand how device design and performance feeds through into system performance.
9. Understand the principles of semiconductor light emitting diodes, lasers, detectors and optical fibres and apply this knowledge to the design of a lightwave system.
10. Calculate the limits to bandwidth distance product in a fibre-optic system and recognize methods to improve system operation.
11. Calculate the light collection and data transmission properties of a fibre-optic system.

EEE6218 Visual information Processing

Aims

This unit focuses on theoretical and practical aspects for visual information processing methods and algorithms. It will start with signal processing concepts and extend them to multi-dimensions for image and video processing. It will introduce signal filtering and transform techniques and emphasise their use in compression, enhancement, denoising and scaling applications for visual content. The students will get a realistic notion of the acceptable complexity of these algorithms and learn about their performance with respect to characteristics of the human visual system. The coursework component of this unit aims to provide an understanding of using software tools, such as MATLAB, in solving problems and implementing simple image/video processing algorithms.

This unit aims to

1. Introduce concepts of filtering, signal transform and multi-resolution techniques in image and video processing;
2. Provide an understanding of video/image processing functions in a modern video applications;
3. Introduce the concepts of image and video compression;
4. Present an overview of various video processing algorithms for picture quality assessment and improvement;
5. provide hands-on experience in image and video processing

Outline Syllabus

Filtering and Transform concepts: filters, filter banks, 2D transforms and wavelet transforms in video/image processing, multi-resolution (MR) analysis and MR domain processing, **Image and video processing**: Digital imaging concepts, image/video enhancement, image/video restoration, image/video compression and image fusion: **Algorithm evaluation:** algorithm implementation in MATLAB, complexity and picture quality assessment.

Objectives

By the end of the unit, a successful candidate will be able to

1. demonstrate the understanding of the theory on signal transforms, wavelet theory and multiresolution analysis (MRA).
2. use the MRA techniques for image/video processing and analysis applications.
3. demonstrate the understanding of the image/video compression techniques
4. design simple algorithms for visual information engineering
5. implement simple algorithms for visual information engineering using software tools.
6. Demonstrate an understanding of algorithm evaluation in terms of picture quality and algorithm complexity

EEE6219 Computer Vision

Aims

This unit focuses on introducing current approaches for computer vision with the main emphasis on a layered approach to image and video analysis problems and associated probabilistic modelling. These methods are exploited in simple detection and recognition tasks. The outline syllabus includes motion estimation and picture rate conversion, image feature detection, description and representation, early vision, mid-level vision and high-level vision. The coursework component of this unit aims to provide an understanding of using hardware/software tools in solving practical computer vision problems.

The unit aims to...

1. introduce current approaches to computer vision
2. emphasise a layered approach to image and video analysis problems
3. explore true motion estimation and its applications to picture rate conversion
4. introduce image modelling and representation techniques
5. exploit methods in simple object and action recognition tasks

Outline Syllabus

Motion estimation and picture rate conversion, Image feature detection, description and representation, early vision, mid-level vision and high-level vision

Objectives

On successful completion of this module students will be able to

1. Describe the key elements and functionality of a visual recognition system.
2. Demonstrate an understanding of how true motion estimation works and its differences to motion estimation for video compression.
3. Demonstrate an understanding of popular feature extraction and representation techniques for both images and video sequences.
4. Describe the key components of simple object detection and recognition algorithms.
5. Describe the key components and procedure of face detection and recognition algorithms.
6. Identify the differences between object recognition and action recognition.
7. Describe how an action recognition algorithm works and the differences between global and local representations for action recognition.
8. Design a simple visual recognition algorithm and implement it using a programming language such as Matlab.

EEE6220 Electronic Communication Technologies

Aims

This module aims to provide students with a range of skills that are required when designing circuits at high frequencies covering topics such as circuit interference mechanisms and design techniques, circuit layout, filtering, screening, transmission lines, S-parameters, Smith charts, radio frequency (RF) device design, and measurement techniques.

1. To provide an introduction to the fields of electromagnetic interference, control and compatibility, including nomenclature and methodology.
2. To review the relevant legislation, in particular the EU emc directive.
3. To provide an appreciation of the causes and potential remedies for emi through good design practice and case studies.
4. To introduce the concept of a distributed system and how to handle and model it using high frequency transmission line theory. This will involve vital concepts such as reflection coefficient, insertion loss, transferred impedances and impedance matching.
5. To show how parasitic elements dominate the behaviour of devices at high frequency and to introduce the idea of "S" parameters, used by manufacturers to specify component behaviour, and how to use them in the design process.
6. To introduce an awareness of the various RF devices available and their relative merits, and of the impact that circuit layout and substrate dielectric quality have on circuit performance including the idea of skin depth and its significance for conduction losses in interconnects.
7. To discuss importance of linearity and the related issues of intermodulation in RF power devices and the way these parameters are specified and also to discuss noise and noise figure and ways of minimising both.
8. To introduce the specialist measurement equipment - network analysers, spectrum analysers, signal sources, power meters etc - commonly used in a high frequency design/test environment and outline the principles behind their operation.

Outline Syllabus

The need for emc. engineering. Basic model for emi. Radiated and conducted coupling. Filters and shields. Emc. legislation and compliance. High frequency transmission lines. Device characteristics at high frequency. High power amplifiers. Measurement techniques.

Objectives

1. Understand the nature and scope of electromagnetic interference (emi) in modern electronic and electrical systems and the need for electromagnetic compatibility (emc).
2. Understand the broad principles of combating emi both at the equipment design stage and during its testing, commissioning and use.
3. Design circuits to minimise electromagnetic emissions
4. Use filtering, screening and appropriate circuit design to minimise sensitivity to emi

5. Display a working knowledge of basic high frequency transmission line behaviour by solving quantitative problems based on reflection coefficient and insertion loss.
6. Use a Smith chart to design RF circuits.
7. Recognise the different forms in which a transmission line may appear.
8. Describe the various forms of active device and subsystems available for RF designs and their relative advantages and disadvantages.
9. Demonstrate knowledge of the high frequency equivalent circuit of both passive and active devices and the ability to use passive device equivalent circuits to predict performance.
10. Use "S" parameters to design simple RF circuits.
11. Use noise specifications to make quantitative estimates of the noise performance of simple RF systems.
12. Understand the terms used to specify linearity in power amplifiers

EEE6221 Data Coding Techniques for Communication and Storage

Aims

Processing techniques to enable transmission and storage of data with reliability and security are a key element in nearly all of modern communication systems. This course deals with data coding techniques required for reliable and secure data transmission and storage; it covers various aspects of digital communication tying in elementary communication theory with practical solutions to problems encountered. The aims of this course are :

1. To make students aware of the various techniques available for transmitting binary data, and the situations where each might be appropriate.
2. To look at problems that are associated with signal distortion and the limitations that these impose on a data channel.
3. To examine ways of reliably transmitting information in the presence of non-ideal communication channels.
4. To examine ways of securely transmitting and receiving information over insecure communication channels.
5. To outline various communication architectures in use, referring to practical solutions.
6. To make students aware of some of the communication standards that exist.

Outline Syllabus

Asynchronous Communication : RS232, timing constraints, character framework, standards, UARTs, error checking, modems. **Synchronous Serial Communication :** How it differs from asynchronous communication, biphase codes, Miller codes, ternary codes, advantages, uses, bandwidth requirements, constraint lengths and self clocking ability. **Data Compression:** lossless compression, lossy compression, DCT, JPEG. **Data Integrity:** Error detection, parity check, cyclic redundancy checking, theory and hardware implementation. Error correction, distance, coding gain, BER, soft-decision decoding, Galois fields, algebraic and non-algebraic decoding of block codes. Hamming codes, BCH codes, Reed Solomon codes, software and hardware implementation issues. Covolutional codes, Viterbi decoding, implementation issues. Practical configurations, cross-interleaving, multi-stage coding, serial and parallel concatenation, product codes; introduction to Turbo codes and LDPC codes. **Data Security**: security functions and definitions; private key primitives (stream ciphers, AES); public-key primitives (RSA, ECC). Hashes and Random number generators.

Objectives

By the end of this module successful students will be able to

1. make sensible choices about the type of communication system that will be required in a given situation, and the type of channel coding that will be best suited to the given environment.
2. display awareness of the sorts of problems that will arise as a result of the design choices made in their solution.

3. demonstrate a working knowledge of the techniques available for combating errors in a given system, and the sorts of errors they will encounter.
4. demonstrate a working knowledge of the techniques available for data compression (both lossy and lossless).
5. show an awareness of some of the communications standard that are provided.
6. describe the basis of data security and be aware of the techniques that exist to encrypt/decrypt data.
7. design a simple error control codec.

EEE6222 Advanced Communication Principles

Aims

This course considers the mathematical foundations and the derived theories and techniques used by a wide range of communication systems, particularly the more recent digital systems. The aim of this course is to

1. Provide the very mathematical foundation for understanding modern communication systems.
2. Present the structure of modern communication systems and the basic issues at each stage in the system.
3. Create a theoretical background that applies to all communication systems and is not affected by any particular technology.

Outline Syllabus

Components of a typical communication system. Discrete-time samplimg and frequency domain representation. Random signals. Power Spectrum Estimation. Formatting and source encoding. Information and entropy. Channel capacity. Hartley-Shannon law. Probability of error in transmission. M-ary signalling. Types of transmission channel and their limitations. Maximum Likelihood receiver. Matched Filter. Methods of Transmission. Methods of synchronisation. Multiplexing and multiple access. Spread spectrum objectives and techniques.

Objectives

By the end of this module students will be able to

1. Understand that communication is the process of exchanging information.
2. Understand the key basic mathematical concepts underpinning communication systems
3. Understand the function of the key building blocks of a generic digital communication system and the main techniques used for each block calculate the information content and coding efficiency of a message and where possible, reduce (or compress) the average code length of the message.
4. Display familiarity with techniques that maximise spectrum utilisation.
5. Understand how noise limits the information rate and to be aware of techniques that maximise signal detection in the presence of noise.
6. Appreciate the fundamental nature of the trade-off between error performance and bandwidth in a communications system.
7. Describe current technological advances and show how they allow a closer approximation to theoretical information capacity limits.

EEE6223 Antennas, Propagation & Satellite Systems

Aims

1. To bridge the gap between fundamental electromagnetic theory and its practical implementation in basic antenna analysis.
2. To analyse the performance of canonical wire, array, aperture and printed antennas with regard to input impedance, directivity and radiation pattern.
3. To provide an introduction to macroscopic HF and VHF propagation phenomena.
4. To understand the fundamental principles underlying the design of satellite communication systems.

Outline Syllabus

Review of electromagnetic theory for antenna analysis. Metrics used for quantifying antenna performance: radiation pattern, gain, input impedance. Half wave, full wave dipole antennas, monopole antennas. Image theory. Antenna arrays: isotropic source, two-element array, uniform linear array. Polarization: linear, elliptical, axial ratio. Aperture theory: Fourier transformation between aperture field and radiation pattern, rectangular and circular aperture, effective aperture. Microstrip antennas. Antenna radiation hazards: SAR and body interactions with antenna near fields. Propagation in a plasma: critical frequency, refractive index. Ionospheric propagation of HF radio waves: ionospheric layers, ionospheric refraction, multi-hop skip distances, MUF, ionosonde. Tropospheric propagation of VHF/UHF waves: refraction and ducting. Outline of numerical antenna analysis techniques: moment and finite difference methods.

Noise in communication systems. Basic satellite principles. Satellite orbits. Satellite communications systems. Earth stations – types and performance. Satellite transponders – amplifiers, redundancy, tramsmitters, frequency translation. Multiple access systems.

Objectives

By the end of the unit a successful student will be able to

1. Demonstrate understanding of the basic principles behind the operation of the various types of antenna employed in practice.
2. Analyse the performance of antennas in well-defined situations.
3. Display awareness of propagation phenomena and their impact on communication systems.
4. Assess the suitability of antennas for specific deployment scenarios such as in terrestrial cellular networks or satellite communications.

EEE6224 Mobile Networks and Physical Layer Protocols

Aims

1. To give an overview of how cellular mobile communications networks operate, with specific examples of UK systems.
2. To describe the radio technology used over the air interface.
3. To describe physical layer protocols used in GSM, 3G and 4G networks.

Outline Syllabus

Description and demonstration of current UK cellular mobile networks with historical perspective. Antenna design for the RF interface, including handset, vehicle and base station antennas. EMC / health related issues of mobile handsets. GMSK, QPSK, QAM, OFDM modulation. GSM (incl. GPRS, EDGE etc.) protocol. WCDMA 3G UMTS (incl. HSDPA etc.) protocol. 4G LTE protocol. Propagation issues, diversity gain, Rake reception. MIMO. Link budgets. Cellular design strategies (femto, pico, micro, macro, umbrella etc.). Appreciation of metrics used in handset Engineering Field Test mode.

Objectives

By the end of this module successful students will be able to

1. Understand the physical layer structure of 2G, 3G and 4G terrestrial mobile networks.
2. Understand system level components such as air interface logical payload channel and frame structures and carrier modulation techniques.
3. Contribute at a professional level to cellular planning in the enhancement and roll out of future mobile networks.
4. Show awareness of the contextual significance and constant evolution of mobile technology in society.

EEE6225 System Design

Aims

This unit is concerned with the management of complexity in system design. To learn the basics of structured approach to design of complex systems, students undertake a design project that requires the application of state of the art design tools that help to achieve appropriate error free design structures. The unit is continually assessed at various stages in the design process and these assessments combine to give a grade for the unit.

1. To demonstrate the importance of structured design for complex systems.
2. To provide a working understanding of a standard Hardware Description Language (HDL) which is an aid to structured, error-free design.
3. To provide an appreciation of the special restrictions imposed when using an HDL to design a realisable digital system via synthesis.
4. To give practical exposure to the refinement of a specification through partitioning and design to simulation against a defined set of constraints.

Outline Syllabus

Design Cycle : requirements, specification, design, simulation, implementation, test and integration. **Simulation :** functional v. circuit, concepts, advantages and disadvantages. **Description and Simulation Languages :** Verilog, VHDL & SystemC. **Verilog** : concepts, syntax, behaviour and structure, hierarchy, portability, standards. **Verilog for Synthesis:** The synthesisable subset, standard methodologies, register transfer level (RTL) design. **Design Exercise.**

Objectives

By the end of the module successful students will have demonstrated

1. the specification, design and simulation of a complex digital system using FPGA technology.
2. working in a design team responsible for managing the HDL based design of a digital system.
3. the ability to gather a range of information and literature on a specific algorithm (AES) and prior implementations and to use those to inform the design and implementation of a digital system.
4. the use of industry standard design techniques and design tools.

EEE6431 Broadband Wireless Techniques

Aims

This module will give an understanding of the most up to date communication techniques used in the design and operation of broadband wireless systems based on OFDM technology such as WiFi, WiMAX and LTE. The module will explore the physical (PHY) layer, medium access control (MAC) and radio resource management functionalities of broadband wireless systems. The outline syllabus will include an introduction to broadband wireless systems; the principles of OFDM, OFDMA and TDD/FDD multiple access; bit interleaved convolutional and turbo channel coding/decoding for OFDM systems; adaptive coding and modulation; frequency selective fading, channel estimation and equalisation; MIMO techniques; and network architectures.

Outline Syllabus

1. Broadband wireless systems concepts;
2. OFDM, OFDMA and TDD/FDD multiple access;
3. FEC coding, modulation and rate adaptation in OFDM/A;
4. Frequency selective fading, channel estimation and equalisation;
5. MIMO techniques;
6. Broadband wireless network standards (LTE or WiFi).

EEE6432 Wireless Packet Data Networks and Protocols

Aims

The aim of this module is to give an understanding of the functionality of packet switching protocols at different layers of a wireless system and to appreciate how these protocols achieve reliable data delivery in wireless communication systems. An outline of the syllabus includes an introduction to packet switching in wireless networks; radio link protocols, CRC, ARQ and hybrid-ARQ; MAC protocols; packet scheduling and differentiated quality of service; routing, IP protocol, mobile IP, wireless TCP and end-to-end quality of service; radio resource management, network planning and optimisation; network examples – WiFi, HSPA or LTE.

This unit aims to introduce and provide an understanding of:

1. Packet switching in wireless networks;
2. Radio link protocols, CRC, ARQ and hybrid-ARQ;
3. MAC protocols, packet scheduling and differentiated quality of service (QoS);
4. Routing and end-to-end quality of service;
5. Radio resource management (RRM),
6. Network planning and optimisation;
7. Network examples – WiFi, HSPA or LTE

Outline Syllabus

- Lectures 1-3: Packet switching principles in wireless networks and OSI model;
- Lectures 4-9: Radio link protocols, CRC, ARQ and hybrid-ARQ;
- Lectures 10-12: MAC protocols, packet scheduling and differentiated quality of service (QoS);
- Lectures 13-15: Routing and end-to-end quality of service;
- Lectures 16-18: Radio resource management (RRM),
- Lectures 19-21: Network planning and optimisation;
- Lectures 22-24: Network examples – WiFi, HSPA or LTE.

Objectives

By the end of the module a successful student will be able to:

1. Appreciate packet switching principles in wireless networks;
2. Understand the fundamentals of reliable packet exchange;
3. Understand and analyse prevailing channel access protocols;
4. Appreciate internet routing and end-to-end QoS procedures;
5. Analyse and design RRM policies for wireless networks;
6. Plan wireless network deployments;
7. Understand & appreciate prevailing network architectures.

EEE6600 Industrial Research Project

Aims

To provide a structured individual project to enable the student to carry out practical and/or theoretical work which underpins his/her academic studies and allows for the acquisition and demonstration of a wide range of practical skills.

Objectives

At the end of the project, students should have:-

1. A detailed appreciation of the methodology of application of science or engineering principles to the solution of problems or realisation of systems in a topic related to the subject of the MSc degree.
2. Experience of the effective collection and use of data to evaluate physical principles, making conclusions and developing their own work based on them.
3. The ability effectively to communicate complex technical ideas both orally and in writing.
4. Experience of working at the forefront of knowledge.
5. The experience of project management, record keeping, technical planning and time scheduling.

EEE6602 MSc Investigative Research Project

Aims

This unit aims to provide a structured individual project to enable the student to carry out practical and/or theoretical work which underpins his/her academic studies and allows for the acquisition and demonstration of a wide range of practical skills.

Objectives

At the end of the project, successful students will have:-

1. A detailed appreciation of the methodology of application of science or engineering principles to the solution of problems or to the realisation of systems in a topic related to the subject of the MSc degree.
2. Experience of the effective collection and interpretation of data to evaluate physical principles, making conclusions and developing their own work based on them.
3. The ability effectively to communicate complex technical ideas both orally and in writing.
4. An extensive awareness of the state of the art as portrayed in the literature in the general area of their project.
5. Experience of working at the forefront of knowledge.
6. The experience of project management, record keeping, technical planning and time scheduling.

Appendix 2

Staff List

Name	Tel. No.	email	Room No.
Abhayaratne, Dr G C K	25893	c.abhayaratne@	P/C11
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Tan, Dr C H	25144	c.h.tan@	E151
Tennant, Dr A	25438	a.tennant@	P/C38
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Walther, Dr T	25891	t.walther@	E149
Wang, Prof J B	25817	j.b.wang@	F151a
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Appendix 3

Useful Phone Numbers / Contacts

Name/Address	Email	Ext.
EEE Department		
Address: Sir Frederick Mappin Building, Mappin Street, Sheffield, S1 3JD		
Head of Department: G. W. Jewell	g.jewell@	25845
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Mechanical Workshop: I. Lyne	i.lyne@	25805
EEE Computer Room F137: J. Screaton	j.screaton@	25872

To contact a number direct from outside the University the number is

0114-22 and then the extension number

Organisation or Service	Address	Telephone No.
EEE Department	Department of Electronic & Electrical Engineering University of Sheffield Sir Frederick Mappin Building Mappin Street Sheffield, S1 3JD	222 5355
The University of Sheffield	Western Bank, Sheffield, S10 2TN	222 2000
Accommodation & Campus Services	The Edge, 34 Endcliffe Crescent Sheffield, S10 3ED	222 8800
Careers Service	388 Glossop Road, Sheffield, S10 2JA	222 0910
Counselling Services	36 Wilkinson Street, Sheffield, S10 2GB	222 4134
Students' Union	Western Bank, Sheffield, S10 2TG	222 8500
University Health Service	53 Gell Street, Sheffield, S3 7QP	222 2100
U Sport Goodwin Sports Centre	Northumberland Road, Sheffield, S10 2TZ	222 6999
National Rail Enquiries		08457 48 49 50
Traveline - Local Tram, Bus and Rail Services		0871-2002233
Blackwell's University Book Shop	Mappin Street, Sheffield, S1 5SS	278 7211

Note: Any University 5-digit internal telephone number beginning with a 2 may be dialled directly from an external telephone by adding 22 as a prefix. eg. to ring the Department from an internal phone dial 25355 and from an external phone dial 2225355.

Appendix 4

Final Dissertation Format Rules and Advice

1) Output should be from a word processor, with a letter quality printer. You are responsible for your own printing.
2) The dissertation format must meet the following specifications:

It should be

a) left and right justified

b) single sided

c) no longer than 60 A4 pages (including appendices etc.)

It should have:

d) a font size of 12 pt for standard text and 10 point for figure captions.

e) single line spacing

f) a 1.5 inch margin on the left hand side (to allow for binding)

g) a 1 inch margin on the right hand side

h) a 0.75 inch margin top and bottom

i) the page number bottom centre and top right on each page including the appendices

j) a header, centred on each page (for example, "Chapter 3. Specification").

3) Diagrams should preferably be produced using a computer package, provided that this does not compromise the quality due to the limitations of the software. For hand produced diagrams, they should be done in Indian ink and captioned using transfer letters or word processor output. Captioning should not be hand written.
4) The general contents of the dissertation should follow the guideline;

Front Sheet (see note 5 below)

Abstract (no longer than ½ page of A4)

Acknowledgements

Contents

Plagiarism Declaration (see Appendix 5)

Chapter 1: Introduction -- What are the objectives and constraints and a description of the problem

Chapter 2: Review of previous work where appropriate

Chapters 3 to n: Describing the work done

Chapter n+l: Conclusions and evaluation

References

Appendix 1: Diary of when major milestones were achieved

Appendix 2 to m: Any detailed material which is not relevant to the general reader. e.g. design documentation test results or user manuals.

5) The Front Sheet should have the following format:
Example copy only.

The University Of Sheffield.

Department of Electronic & Electrical Engineering

MSc Electronic Engineering Dissertation 2014/15

Type the Title of your Project Here

Student: **TYPE FAMILY NAME HERE,** Type First Name Here
Registration: **Type Registration Number Here**
Date: **Type Submission Date Here**

Supervisor: **Type Name of Your Supervisor Here**
Second Marker: **Type Name of Your Second Marker Here**

This dissertation is a part requirement for the degree of MSc in Electronic Engineering.

Students are recommended not to leave the write-up to the last minute but to write up what they can as soon as they can. In many cases the literature review in the interim report will form the basis of one of the chapters of the final dissertation. Maintain your list of references as you work rather than try and assemble it at the end. The Diary (Appendix 1) can easily be kept up to date. The Diary should include details of important project meetings and meetings the student has with their departmental supervisor. These should be at regular intervals and some should take place at the company if possible. Students on external placement are usually difficult to contact so it is vital that you find some way of keeping in touch between meetings with your supervisor. Email is best but letter or fax will do. At least telephone your supervisor every two weeks.

Don't forget, you are all handing in at the same time. Allow yourself enough time to produce the finished document.

7) Hints on style and presentation.

   i) Do not use the first person singular. Thus you should not write "I wrote a program...", but rather "A program was written...".

   ii) It is important to make clear which points are original and which parts are taken from the literature.

   iii) Write in clear, readable English, avoiding the two extremes of either writing notes, or long winded sentences with lots of subordinate clauses. Don't use "don't"!

   iv) Clarity will be aided by a careful division into numbered chapters and sections (with headings) and then into paragraphs.

   v) If the External Examiner or a “chairman” attends the viva (see section 8.5 regarding the procedure for the viva) then please note that he/she is likely to have only received your abstract, introduction and conclusion so ensure that they are compatible and not too long.

   vi) The abstract should only be about ½ a page long.

   vii) **DO NOT** include hard copy of all the program code. A disc of code or any other background material required by your supervisor may be attached to the dissertation and some examples of code may be included in either the main body of the report or in Appendices if they are relevant to the dissertation.

8) Copies of Dissertations from past M.Sc. students, may be borrowed from the Student Support Office E133 or found online. These will give a hint of the format required although there will be generally no indication of the standard achieved on them.

   Potentially relevant copies of Dissertations from past M.Sc. students are kept in the Computer Science Department library and may be borrowed. Once again

remember that there is no indication of the standard achieved on them. The barely acceptable dissertations are mixed in with the good ones. The Library index notes students who were awarded degrees with distinction but it may not be complete. From 1990/1 onwards, students who presented excellent dissertations have this recorded on the title page in most cases and may be relied on as models. Note, however, that in the past Computer Science students were allowed to submit longer dissertations. **You will not be allowed to exceed the 60 page limit.**

9) If you use abbreviations or acronyms they should be expanded when first used, e.g., "TLA (Three Letter Abbreviation)" and if such TLAs are extensively used throughout the dissertation, a glossary should be provided as an Appendix.

References may follow any generally recognised format providing the style is consistent throughout the dissertation.

The IEEE (see http://www.librarydevelopment.group.shef.ac.uk/shef-only/referencing/engineering_ieee.html and the Harvard (author/year) styles (see http://www.librarydevelopment.group.shef.ac.uk/shef-only/referencing/engineering_harvard.html) are probably the two most common

Appendix 5

Dissertation Hand-in Form and Declaration

In Appendix 4 you will find a copy of the hand-in form which will act as your receipt, when you submit your final dissertation.

In the front of one of your two bound dissertation copies you must have a bar code cover sheet included in the finished bound project. The Bar Code Coversheet has a tick box which will act as your declaration stating that all work submitted is your own and once scanned, you will also receive an electronic receipt to confirm submission of your work. These must be submitted with your project report.

The Bar Code Cover Sheet

All students in the Faculty of Engineering must supply a bar code cover sheet with all assignments/ project reports & final dissertations etc that are handed into the Department for marking. The coversheets must be printed from the Faculty of Engineering Assignment Database, which can be found at the following website (where you can also download student access instructions):

http://www.cpe-electronics.group.shef.ac.uk/bcstudent/

You will need to log into this system with your CICS username and password. Please print the coversheet for the relevant module code (check it is the correct coversheet, as some modules will have more than one piece of work to be handed in) and staple to the front of the course work which you are submitting.
This should then be placed into the large black box outside E133. The box will be emptied on a daily basis. When the bar code has been scanned, you will receive an electronic receipt. DO NOT worry if you do not receive this email the same day. Often, submissions are scanned over a 24hr period. If you do not receive this email within 48hrs, please contact the Student Support Office (E133).

Electronic Submission (TurnItIn Plagiarism Detection Software)

In addition to submitting assignments with a bar code coversheet to the Student Support Office (E133), you will also need to submit an electronic copy of certain assignments *direct* to the TurnItIn plagiarism detection website.

You should by now have received an email from JISC explaining that "You have been added as a student" to the JISC PDS Service. This should also tell you your password* – keep this safe as this will be your TurnItIn password for the remainder of your course! (Alternatively, for returning students you will have been told your password in an earlier year – keep using the same password.)

To submit your assignment in electronic form, login to: http://submit.ac.uk

For your login name use *exactly* the same email address to which the JISC email, mentioned above, was sent. In particular, do **not** shorten "sheffield.ac.uk" to "shef.ac.uk" – you must type "sheffield" in full.

Once logged in you will be able to select your class group (*e.g.* "eee-ug1-2011" for first year undergraduates) and then the assignment you are submitting (*e.g.* "SHIPS Visit Report".) Your report can be uploaded as a Word file or as a PDF file.

Some students become concerned that the 'Due Date' shown in TurnItIn does not correspond to the submission deadline they have been given by the member of staff responsible for the assignment. Owing to the limitations of the TurnItIn software, the 'Due Date' is often rather arbitrary. Do not be guided by TurnItIn – **always follow the advice of the relevant member of staff**. TurnItIn classes will be setup to accept submissions *after* the 'Due Dates'.

The maximum size of file you can submit is currently limited to 10MB which in most cases is not a problem. Project reports containing large numbers of diagrams and images may exceed this 10MB limit in which case you will need to delete sufficient pictures and diagrams (although not their captions!) to reduce the file size to below the 10MB limit.

A more comprehensive Student User Guide to TurnItIn is available on the departmental web site:

http://hercules.shef.ac.uk/eee/teach/resources/info/jisc_plagiarism_detection_service-student_user_guide.pdf

Electronic Submission (Online Marking System)

You must upload your project report. To do this please go to this website ..

http://quagmire.shef.ac.uk:8080/UGprojects/

Please fill in the form with all the details requested and check that they are correct. Once you have done that click on the "Submit" button.

Next click on the "Browse" button and select the file your report is contained in. Note that you may only upload .DOC , .DOCX , .PDF and .ZIP files up to a maximum size of 30MB. Once you have selected your file click on the "Open" button and finally on the "Submit" button.

Note that this web page is not accessable from the general internet and to reach it you must either be on the Sheffield University campus network or be using a PC with a VPN (Virtual Private Network) into it.

IF YOU FORGET/LOSE YOUR PASSWORD…

If you forget or lose your password, select the "Forgot your password?" link from the TurnItIn logon page and follow the instructions. This is the **only** way to recover a password.

Long experience shows there are only two reasons why students are unable to login:

1) Because they are trying to abbreviate "sheffield" or otherwise using the wrong email address. See the instructions above.

2) Rather than using the web address given above, they have used Google (or some other search engine) to search for "TurnItIn". This returns the web address of the US TurnItIn site, not the UK site above. Unsurprisingly, students are then unable to login to this! Use the correct site given above.

*The TurnItIn system does allow you to change your password to something more memorable than the random jumble of letters and numbers that the system issues by default. See the user documentation on exactly how to do this.

Department of Electronic & Electrical Engineering

MSc Project Receipt

University of Sheffield

Department of Electronic and Electrical Engineering

M.Sc. Dissertation Hand-in Form

Please complete all parts of this form and hand it in with two bound copies of your dissertation to the Student Support Office (E133).

Name:

Reg.No:

Sheffield address:

Phone number:

Date when expect to leave Sheffield:

Address where you can be contacted after leaving Sheffield:

Phone number:

Course:

Supervisor:

Title of Dissertation:

Date handed in:

This portion must be date stamped and signed and retained by the receiving staff member - proof that two full copies of the dissertation have been handed in.

The student should retain this portion date stamped and signed as proof of handing in two copies of the dissertation.

Name:

Reg. No:

Course:

Date of entry to course (month/year):

Title of Dissertation:

Date handed in:

Appendix 6

M.Sc. Project Marking Guidelines

MSc Dissertation

Dissertation marks (out of 100) will be combined with poster marks (out of 10) and a contribution (out of 10) from continuous assessment scores provided in the interim report mark sheet. This score (out of 120) will then provide the final percentage mark.

ASSESSMENT CRITERIA
D1) Products: Mark out of 20 *The results of the work. The mark should take account of the difficulty of the task, and the degree of success achieved.*
D2) Processes: Mark out of 20 *The processes involved in the development of the project work, including initial analysis of the problem with its theoretical foundations and design and testing processes used.*
D3) Evaluation: Mark out of 20 *The student's own evaluation of the project in terms of how well objectives were satisfied, the possible further directions of study and the relationship with other people's work.*
D4) Use of sources and resources: Mark out of 20 *The use of available literature, tools and methodologies.*
D5) Presentation: Mark out of 20 *Readability and presentation of report: sensible notation, consistent use of fonts, diagrams, layout, references etc.*
Total marks for dissertation: Out of 100
Poster presentation: Mark out of 10 *Is the poster well presented and used as a viable tool to aid discussion of the students work?*

	Mark scale					
Criterion	**0 - 7**	**8 - 9**	**10 - 11**	**12 - 13**	**14 - 15**	**16 - 20**
D1) Products	Minimal or no achievement - all or most objectives missed without reason	Work was done but it failed to meet aims. Experiments comprom-ised by failure to plan. Many excuses offered.	Reasonable progress - will have met some objectives but parts incomplete	Good progress at meeting objectives - most difficulties overcome - some creativity	Very good progress - objectives met or exceeded - any difficulties overcome	Excellent progress - problems overcome - extra objectives created and met.
D2) Processes	Has failed to grasp major aspects of the work - limited ability even with guidance	Very superficial understanding of the project aims and substance. Needed guidance on virtually all issues but did not develop .	Reasonable analysis and understanding of most parts - competent design and testing but limited justification of design choices or explanation of experimental processes.	Good analysis and understanding of most aspects - some originality - appre-ciates consequences of decisions.	Very good analysis and interpretation with original parts and full awareness of the effects of decisions. All design decisions and experimental methods fully justified.	Expert analysis and understanding - can educate supervisor - highly original and publishable work.
D3) Evaluation	No attempt at interpretation of the few (if any) results - discussion absent, naive or irrelevant.	Superficial attempt to explain results, measurements and theory probably for different conditions - nothing quite properly tied up.	Reasonable interpre-tation but some flaws - reasonable further work suggested. Perhaps experimental results not compared with theory or design performance not compared with spec.	Interpretation makes full use of results - good further work suggested - critical evaluation compared to initial objectives.	Evidence based argum-ents and imaginative further work sugge-stions presented. Achievements evaluated critically against objectives or specs.	Excellent critical evaluation of project. Suggestions for further work imaginative and perceptive. Work of publishable standard.
D4) Use of sources and resources	Poor use of relevant literature, available computing and/or experimental tools.	No evidence of under-standing of literature. Weak in application of computational and experimental tools	Adequate methodology - available tools have generally been used properly.	Competent use of available tools and sound methodology	Very good and creative use of tools and resources. Sound and well justified methodologies	Excellent and probably innovative use of tools and, perhaps, creation of new tools.
D5) Presentation	Report hard to read - no structure - poor use of language - poor referencing - very poor quality diagrams.	Report readable but no sensible formatting or structure, poor diagrams that missed the point	Readable and coherent report - reasonable diagrams, structure and referencing.	Readable and interesting - good diagrams, structure and referencing.	Well written and structured, easy to read and informative. Diagrams relevant and of good quality.	Excellent presentation - concise and informative. Structure, diagrams, referencing, use of English all outstanding
	1 - 3	**4**	**5**	**6**	**7**	**8 - 10**
Poster	Non - attendance or minimal effort. Disorganised layout; cannot explain poster contents	Poor poster layout, font too small, diagrams illegible, answers attempted but difficult to understand	Reasonable poster layout - able to answer some questions	Some good features in poster layout. Questions mostly answered in a comprehensible way.	Very good poster layout. Questions answered at an appropriate level in a clear and concise way.	Excellent poster layout. Masterful performance in answering questions and talking around the subject.