MEng Integrated Engineering

Programme (Scheme of Study) Specification

Introduction

This Programme (Scheme of Study) Specification is a concise summary of the main features of the MEng (Hons) Integrated Engineering at Cardiff University and of the learning outcomes that a typical student might reasonably be expected to achieve if she/he takes full advantage of the learning opportunities that are provided. More detailed information on the learning outcomes, content, and the teaching, learning and assessment methods for each module can be found in the Module Catalogues and the Student Handbook.

1. Awarding Institution: University of Wales
2. Teaching Institution: Cardiff University
3. Programme Accredited by:
   - Institution of Mechanical Engineers (Last visit: 2001)
   - Institution of Electrical Engineers (Last visit: 2000)
   - Institute of Energy (Last visit: 2000)
4. Final Award: MEng Integrated Engineering
5. Programme/Scheme: Integrated Engineering
6. UCAS code: H113, H114, H115
7. Relevant QAA benchmark: Engineering
8. Date of production: November 2001
   Revision: November 2002

9. Programme (Scheme) Aims

The three principal aims are:
- To develop graduates in engineering who are educated in a wide range of fundamental engineering disciplines, and the integration of these disciplines, to address the demand within contemporary industry for engineers who are capable of integrating different technologies to produce and to improve complete, complex systems and products.
- To prepare students for employment as professional engineers.
- To enable students to attain the educational requirement to become Chartered Engineers.

More specifically the Programme (Scheme) aims to:
- To provide students with the opportunity to acquire the necessary knowledge and understanding of a wide range of fundamental engineering disciplines; namely mechanical, electronic, electrical, materials, manufacturing and software engineering
- To prepare students with the necessary skills to specify, design, develop, implement, operate, maintain and improve complex systems and products
- To encourage students to develop the habit of intellectual inquiry and independent learning through exploration of texts, active participation in discussion with experts, and independent experimentation.
- To encourage students to be innovative and creative, whilst employing formal methodologies and quality engineering in designing new products and systems and in solving problems in general.
- To give students experiences which lack a well-defined outcome or which has a wide range of possible answers.

10. Programme (Scheme) Outcomes

The Programme (Scheme) Outcomes have been informed by the Engineering Benchmark Statement and also by the requirements of the Institution of Mechanical Engineers, the Institution of Electrical Engineers and the Institute of Energy.
Students who gain the award will have demonstrated achievement of the following Learning Outcomes, as set out under A, B, C, D, below.

A  Knowledge and understanding

Intended Outcomes: Upon completion of the scheme a typical student will be able to:

- understand the basic principles of science, mathematics, technology and management which are fundamental to engineering;
- describe the principles, theory, philosophy and practice of a wide range of fundamental engineering disciplines; namely mechanical, electronic, electrical, manufacturing and software engineering;
- describe more advanced concepts in some of the above subjects according to the option modules selected;
- describe the basic properties of materials and their use in design and manufacture;
- describe concepts and methods of System Integration;
- demonstrate an appreciation of modern quality engineering techniques and how they relate within an overall quality management framework;
- apply a broad understanding of formal/systematic design engineering methodologies with particular emphasis on British Standards and on quality engineering at all stages in the design process;
- demonstrate an understanding of operations management and its application to the effective management of manufacturing systems as an example area of application;
- demonstrate an understanding of advanced computing techniques such as CAD/CAM and Artificial Intelligence and their application in engineering;
- demonstrate an understanding and practical experience of industrial computer control systems, robotics and automation, incorporating mechanisms, instrumentation, microprocessors and control strategies;
- show a knowledge of fundamental business and management techniques with particular reference to engineering;
- communicate effectively with lawyers and accountants, understand why they work in the way they do and when they may be of help in the work of an engineer;

Teaching, and Learning Strategies and Methods
Core knowledge and understanding are acquired via lectures, laboratory sessions, tutorials and guided study. Some lectures, especially those given to smaller classes in advanced/specialist Year 3 and 4 modules, are given in the form of seminars. Some lectures are given in the form of examples classes whereby model answers to examination style questions are presented. Some laboratory sessions have been developed into the form of workshops.

More advanced knowledge and understanding are acquired by directed reading from the wider academic literature, independent study, computer aided learning and through substantial pieces of coursework and individual and team project work.

Assessment
Summative assessment is by means of unseen written examinations, laboratory and coursework reports, design exercises and oral presentations. Years 1 and 2 also have formal 50 minute tests. Typically, these are in modules that are not continuously assessed, and they have a weighting of 10% in the module assessment. Formative feedback is provided during laboratory sessions and workshops, tutorials and oral presentations and through the prompt return of marked reports and test scripts.
**B Intellectual Skills**

**Intended Outcomes:** Upon completion of the scheme a typical student will be able to:

- think in a highly objective, problem focussed and practical manner whilst still being creative and innovative;
- solve engineering problems requiring the application and integration of knowledge from more than one fundamental or ‘specialist’ engineering discipline;
- design a system, component or process to meet a need, by utilising design engineering methodologies and with due consideration for relevant standards and quality engineering;
- evaluate alternative solutions from a holistic or system’s point of view;
- address problems which lack a well-defined outcome or which have a wide range of possible solutions;
- present, analyse and interpret experimental results and other data;
- plan, conduct and report on an individual research assignment;
- understand and apply computer science practices such as Object Oriented Programming and Artificial Intelligence.

**Teaching, Learning Strategies and Methods**

Intellectual Skills are promoted via lectures, tutorials, workshops, coursework assignments, and substantial individual and group projects. Problem solving, presentation and project planning skills, etc. are developed at all levels. For example, at Level 1 the students undertake a substantial design, make and test exercise in teams. At Levels 2 and 3 Product Design requires the students to address design problems both individually and as teams. At Level 3 the students undertake a substantial individual project worth 30 credits, and at Level 4 there is the 40 credit group project. Creativity and innovation is encouraged in these exercises. For example, the students are given ‘briefs’ at the start of their individual and group projects and some of their Product Design exercises. It is for them to derive a more precise project specification. This gives them the opportunity to be creative and innovative from the very beginning in devising the very nature of the solution they aim to provide. It also gives them experience of tackling work which lacks a well-defined outcome and which has a wide range of possible answers. This process is carried out with guidance and supervision appropriate to the abilities and performance of the individual student. The evaluation of alternative solutions and taking a holistic approach is inherent to this work, and addressed explicitly in the Level 4 Systems Behaviour module where, for example, soft analysis is introduced to compare different points of view.

Advanced computer science is a particular feature of the Level 3 and 4 modules.

**Assessment**

Summative assessment is by means of unseen written examinations, coursework reports, project reports, oral presentations and oral examinations. Feedback is provided via tutorials and project and coursework supervision.

**C Discipline Specific, including Practical Skills**

**Intended Outcomes:** Upon completion of the scheme a typical student will be able to:

- integrate different ‘specialist’ engineering disciplines/technologies to provide solutions to engineering problems;
- apply formal product design engineering methodologies, with reference to relevant British Standards;
- demonstrate the basic practical engineering skills required to satisfy the EA1 (engineering applications 1) requirements of the relevant professional engineering bodies;
- use a range of computer aided engineering tools, including an industrial standard CAD/CAM package;
- use laboratory and workshop equipment to undertake experiments systematically and safely;
- write well designed computer programs in at least one commonly used high level language, and an assembly language (PIC programming).
Teaching, Learning Strategies and Methods

Practical Skills are promoted through laboratory sessions, coursework exercises, design exercises and individual and group projects.

Integration skills are taught explicitly in lectures allotted to the task at Levels 1 and 2. At Levels 3 and 4, they are developed in the individual and group projects and in the taught modules that are inherently concerned with the integration of different fundamental disciplines and demonstrate applications of integrated engineering, e.g. robotics and industrial control systems.

Assessment

Practical skills are summatively assessed through laboratory and coursework reports, as well as supervisor observation during projects.

Integration skills are assessed explicitly in some coursework exercises and in the individual and group projects at Level 3 and 4 respectively. They are assessed inherently by the unseen examinations and laboratory exercises used at Levels 3 and 4 in taught modules that are inherently concerned with integration, e.g. robotics.

Formative feedback is provided orally during laboratory sessions and in regular and adhoc tutorials held in support of coursework exercises and projects. Written formative feedback is provided in returned laboratory and coursework reports.

D  Transferable Skills

Intended Outcomes: Upon completion of the scheme a typical student will be able to:

- apply systems thinking concepts to solving problems;
- communicate ideas, principles and theories effectively by oral, written and practical/physical means;
- work effectively in a team and as an individual;
- use IT effectively;
- perceive what constitutes quality in a product or a process;
- demonstrate a commitment to Lifelong Learning and Continuing Professional Development through learning independently about concepts from many areas including those outside engineering.

Teaching, Learning Strategies and Methods

The communication of ideas and team work are an integral part of several modules spanning all Levels. Promotion of basic IT skills is via scheme–wide compulsory computing modules at Levels 1 and 2, and at Levels 2 and 3 further IT skills development is both explicit and implicit to modules which use IT. Tutors provide support for Personal Development Planning through regular meetings. Quality is taught at Levels 2, 3 and 4 and as an integral part of Product Design in Levels 2 and 3. The teaching of systems thinking is inherent throughout the Levels, with the Product Design and Manufacturing threads being particularly strong in this area. Systems thinking is taught explicitly in the Level 2 module in Systems Integration and Engineering Applications 1 and the Level 4 module in Systems Behaviour.

This scheme is multi-disciplinary and includes non-engineering topics. As such it develops the students ability to learn and understand concepts from many areas including those outside engineering. Furthermore, a stipulation of the MEng individual project is that the student should integrate a discipline not covered in the taught modules.

Assessment

Assessment of presentation skills is through laboratory, coursework and project reports and oral presentations. Team working is assessed in the group project and within other modules, especially
Product Design. It is used widely across the syllabus so it is explicitly or implicitly part of most continuous assessment exercises – it is also assessed by unseen examinations.

Students have the opportunity to attend University approved courses, provided by both the Careers Service and the Students Union, which focus on transferable skills.

11. Programme (Scheme) structure and requirements, courses and awards
Details of the Programme (Scheme) structures and requirements, courses and awards are available in the Student Handbook.

The Programme (Scheme) is full-time for 4 years (plus an additional year if the sandwich/Year in Europe option is taken) – students choose modules to the value of 120 credits in each year. Performance in Year 3 and 4 both contribute, with equal weighting, to the final degree classification. The degree of difficulty of the modules progresses as the Level increases. For example, Level 3 modules are more challenging than those at Level 2. Year 4 consists of modules at Levels 3 and 4, as the 4th year of study for the MEng degree aims to broaden and deepen the student’s knowledge.

Summative assessment takes place at the end of each semester. Details of the criteria used to assess student work are to be found in the Student Handbook. The different Learning Outcomes demonstrate the increasing demands at each Level and hence student progression through the Programme (Scheme).

Formative assessment is given within the first week, via a mathematics diagnostics test, and then right through until the very end of the course during the project oral presentations and examinations. A strong personal tutor system, with compulsory weekly tutorials for 1st years, combined with an overall review at week 6 of each semester, underpins close monitoring of students’ performance. The weekly ‘Monday morning’ unseen test system and returned marked laboratory and coursework reports provide detailed feedback at the subject level. Tutorials also help in providing model solutions to examination style questions attempted by the students. Close supervision of Year 3 and 4 project students provides detailed feedback. For the industrial project in Year 3 this is supported by a more formal week 6 project review when the students give an oral presentation and submit their Project Specification for assessment. The supervisor and 2nd examiner are able to give more formal feedback at this time.

12. Other Features
The distinctive features of the Programme (Scheme) include:

- The opportunity for students to learn in subject areas which were graded ‘Excellent’ in the last TQA and in a research-based environment graded 5A in the 2001 RAE.
- The involvement of research-active staff in the Programme (Scheme) design and delivery.
- The variety of modules on offer.
- The emphasis on independent learning in a research-led environment.
- The emphasis on acquisition of high quality practical skills and the development of innovative ideas.
- Exemption from the education requirements of a Chartered Engineer, and membership of a professional engineering institution.
- Flexibility, permitting graduates to pursue professional careers as integrated engineers, as well as a wide range of other careers, including postgraduate research.
- The opportunity for students to work in association with the award winning and superbly resourced Manufacturing Engineering Centre, a WDA Centre of Excellence.
Additional Information
Criteria for admission to the Programme (Scheme) are reviewed at least annually and are made available on the web:
  http://engin.cf.ac.uk/teaching/undergrd/integrat/index.html
  file://nprdcf3s/engin00/shared/adminwww/regs/appenda.doc
Information about assessment regulations: see Scheme Regulations,
  http://engin.cf.ac.uk/teaching/undergrd/integrat/index.html
  file://nprdcf3s/engin00/shared/adminwww/regs/mengfsy.doc
Methods for evaluating and improving the quality and standards of learning include:
  Annual Review of Scheme (report made public in the School);
  Periodic Review;
  Academic Validation of Schemes of Study;
  External Examiners Reports (made annually);
  Accreditation Reports;
  Student Module Evaluations (each student makes an anonymous evaluation on each of his/her modules, and results are made public in the School);
  Student/Staff Sub-groups (with minutes made public in the School);
  Student Representatives on Sub-Board of Studies;
  Staff Appraisal;
  Staff Peer Review of Teaching.