Programme Specification

MSc Embedded Systems (2019-20)

This specification provides a concise summary of the main features of the programme and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if s/he takes full advantage of the learning opportunities that are provided.

Awarding Institution	University of Southampton
Teaching Institution	University of Southampton
Mode of Study	Full-time
Duration in years	1
Accreditation details	None
Final award	Master of Science (MSc)
Name of award	Embedded Systems
Interim Exit awards	Postgraduate Certificate in Higher Education
	Postgraduate Diploma in Higher Education
FHEQ level of final award	Level 7
UCAS code	N/A
Programme code	6117
QAA Subject Benchmark or other external reference	Master's Degrees In Computing 2011
Programme Lead	Basel Halak (bh1m10)

Programme Overview

Brief outline of the programme

Embedded systems are electronic systems specifically built for a particular task. The applications of these can be found in all sectors of the economy: consumer electronics, car industry, media and process industries and finally banking and commerce. Examples of everyday products based on embedded systems include digital cameras, media players, ATM machines and robotic surveillance tools. These applications require a high level of skill in hardware and software engineering and an understanding of the practical realities of real systems. They also require knowledge in specialist subjects including Digital Signal Processing (DSP), communications, real time computing and digital design.

The rapid growth of tools, techniques and application in this area has led to a significant skills shortage, particularly for engineers who have both hardware and software skills.

This MSc programme targets students with a first degree in electronic engineering, software engineering or computer engineering.

This course will equip students with the key skills required to design embedded systems, namely hardware

design and verification, real time computing and embedded processors, with extensive practical use of cutting-edge and industry-standard tools and methods. Students will be taken through the embedded system design process, from concept to implementation and testing.

Your contact hours will vary depending on your module/option choices. Full information about contact hours is provided in individual module profiles.

Learning and teaching

Learning and teaching methods are explained in the following sections covering programme learning outcomes.

Assessment

Assessment methods are explained in the following sections covering programme learning outcomes.

Special Features of the programme

N/A

Please note: As a research-led University, we undertake a continuous review of our programmes to ensure quality enhancement and to manage our resources. As a result, this programme may be revised during a student's period of registration; however, any revision will be balanced against the requirement that the student should receive the educational service expected. Please read our Disclaimer to see why, when and how changes may be made to a student's programme.

Programmes and major changes to programmes are approved through the University's programme validation process which is described in the University's Quality handbook.

Educational Aims of the Programme

The aims of the programme are to enable you to:

1) Develop original ideas and solve complex problems in new or unfamiliar environments, based on advanced knowledge of the principles and methodologies of Embedded Systems and related aspects of electronic engineering
2) Integrate knowledge and handle complexity in this area of electronic engineering, formulating sound judgements with incomplete or limited data
3) Communicate your conclusions and the underpinning knowledge and rationale clearly and unambiguously to specialist and non-specialist audiences
4) Develop your independent learning skills as required for continued professional development

Programme Learning Outcomes

Knowledge and Understanding

On successful completion of this programme you will have knowledge and understanding of:

A1. Demonstrate knowledge and understanding of the scientific and technological principles underlying your chosen specialisation

A2. Demonstrate an ability to analyse electronics systems

A3. Demonstrate knowledge and understanding of the design of electronic systems within your chosen specialisation

A4. Demonstrate the ability to acquire new knowledge and understanding through the critical reading of scientific and technical books and papers

Teaching and Learning Methods

The programme includes two modules from the third year of the MEng in Electronics, shown as level 6; the remaining modules are shared with the fourth year of the MEng in Electronics or are unique to the MSc programme and are designated as level 7. Level 6 courses are primarily taught using lectures. Level 7 courses are taught using a combination of lectures, small group teaching, directed reading and assignments. The group projects are entirely coursework. At the end of the taught part of the course you will undertake an individual project within a research group.

Assessment Methods

Your knowledge and understanding of each subject will be assessed through a combination of written examinations and coursework. The proportion of examinations to coursework varies between modules. Your individual project will be assessed by dissertation.

Outcomes A1 and A2 are primarily taught and assessed using level 6 lectures and examinations. A3 and A4 are taught through level 7 courses and the individual project and assessed by coursework and the MSc dissertation.

Subject Specific Intellectual and Research Skills

On successful completion of this programme you will be able to:

B1. Specify and design embedded systems for target applications

B2. Demonstrate an extensive insight into embedded system applications and requirements

B3. Model and simulate the behaviour of parts of systems and complete systems at an appropriate level of detail

B4. Verify a system design by constructing and applying appropriate tests

B5. Find, read, understand and explain scientific publications

B6. Undertake research into electronics design problems

Teaching and Learning Methods

Design skills are developed through the group design projects, individual research projects and the individual project. Modelling, simulation and verification are taught in various modules and applied in coursework and design projects. Similarly, the ability to assimilate technical and scientific knowledge is developed through assignments and in the individual project.

Assessment Methods

Design skills are assessed in examination questions and in coursework. Modelling, simulation and verification form a significant aspect of the coursework in the design projects and is assessed through the delivery of a documented design. The dissertation on the individual project will normally include a significant literature survey and this is one of the criteria for assessment of the dissertation.

Outcomes B1 to B6 are taught through level 7 courses and the individual project and assessed by coursework and the dissertation.

Transferable and Generic Skills

On successful completion of this programme you will be able to:

C1. Use conventional and electronic indexing and search methods to find technical information

C2. Present technical information in written and verbal forms

C3. Work as a member of a design team, managing both the overall task and your contribution to that task

C4. Work independently on a significant research project

Teaching and Learning Methods

A number of courses have a significant coursework element. This can range from design work through to presentations resulting from directed reading. The group design projects are intended to develop team working, project and time management skills. The individual project includes independent research, project management and report writing.

Assessment Methods

Coursework is generally assessed through written reports. The group design projects are assessed continuously through logbooks and at the end by delivery of a documented design. The individual project is assessed by a dissertation of up to 15,000 words.

Outcomes C1 to C4 are taught through practical work in level 7 courses and the individual project and assessed by coursework and the dissertation.

Subject Specific Practical Skills

On successful completion of this programme you will be able to:

D1. Demonstrated a comprehensive knowledge of leading-edge EDA (Electronic Design Automation) tools and techniques for embedded systems

D2. Create models of system components and use simulation software to check your models

D3. Use EDA tools to realise system functionality using hardware-software co-design approach

D4. Design experiments to evaluate designs and models

D5. Write software programmes to assist and demonstrate your understanding of design concepts

D6. Develop comprehensive verification methodologies for system functionality through hardware-software co-simulations

Teaching and Learning Methods

These skills will be developed through coursework and project work.

Assessment Methods

Machine-readable models and software will form part of the deliverable of a coursework assignment or a design project. The correct execution of these models and software will be part of the overall assessment of the assignment or project. Outcomes D1 to D6 are taught through practical work in level 7 and 6 courses and the individual project and assessed by coursework and the dissertation.

Programme Structure

The programme structure table is below:

Information about pre and co-requisites is included in individual module profiles.

Where optional modules have been specified, the following is an indicative list of available optional modules, which are subject to change each academic year. Please note in some instances modules have limited spaces available.

Part I

Programme details

This programme consists of eight taught modules, each worth 7.5 ECTS (15 CATS) credit points and an individual research project worth 30 ECTS (60 CATS) credit points. Four compulsory modules cover core material for Embedded Systems. Another compulsory module prepares you for your individual research project. Three optional modules can be selected to tailor the programme to your interests.

Most of the modules are shared with Master of Engineering programmes in Electronics. It should be noted that it may not be possible to run some optional modules if the number of students registered on the module is very small. It should also be noted that optional module choice can be restricted by the University Timetable, which varies from year to year: some optional modules may clash with other optional or compulsory modules. Please be aware that many modules are shared between different cohorts; the class size depends on cohort size, which varies from year to year.

Students who have successfully completed 30 ECTS (60 CATS) or 60 ECTS (120 CATS) at the level of the award may exit with a Postgraduate Certificate or Postgraduate Diploma, respectively.

The following is the normal pattern of study for a full-time student, completing the programme within 12 calendar months.

Semester 1:
Four modules, including those specified as compulsory for the MSc programme. Examinations are held in January.

Semester 2:
Four modules, including those specified as compulsory for the MSc programme. Examinations are held in May/June.

Summer/Semester 3:
Following the taught component of the programme, you will undertake a research project lasting 14 weeks, which is assessed by a 15,000 word dissertation.

The programme structure, including the compulsory and optional modules for each semester, is summarised below. Semester 2 modules may have a semester 1 pre-requisite, which can be checked in the module specifications, hence the choice of semester 1 options can affect the options available in semester 2.

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SEMESTER 1 - select one optional module

COMP3215 - compulsory
ELEC6236 - compulsory
ELEC6237 - compulsory
ELEC3221 - optional
ELEC6218 - optional

SEMESTER 2 - select two optional modules

ELEC6211 - compulsory
ELEC6234 - compulsory
ELEC6228 - optional
ELEC6229 - optional
ELEC6233 - optional
ELEC6242 - optional
COMP6239 - optional

SUMMER

COMP6200 - core
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Part I Compulsory

Code	Module Title	ECTS	Type
ELEC6236	Digital System Design	7.5	Compulsory
ELEC6234	Embedded Processors	7.5	Compulsory
ELEC6211	Project Preparation	7.5	Compulsory
COMP3215	Real-Time Computing and Embedded Systems	7.5	Compulsory
ELEC6237	Secure Hardware and Embedded Devices	7.5	Compulsory

Part I Core

Code	Module Title	ECTS	Type
COMP6200	MSc Project	30	Core

Part I Optional

Select one semester 1 module (7.5 ECTS/15 CATS) and two semester 2 modules (15 ECTS/30 CATS) from the following:

Code	Module Title	ECTS	Type
ELEC6229	Advanced Systems and Signal Processing	7.5	Optional
ELEC6228	Applied Control Systems	7.5	Optional
ELEC6242	Cryptography	7.5	Optional
ELEC3221	Digital IC and Systems Design	7.5	Optional
ELEC6233	Digital Systems Synthesis	7.5	Optional
COMP6239	Mobile Applications Development	7.5	Optional
ELEC6218	Signal Processing	7.5	Optional

Progression Requirements

The programme follows the University's regulations for ***Progression, Determination and Classification of Results : Undergraduate and Integrated Masters Programmes*** and ***Progression, Determination***

and Classification of Results: Postgraduate Master's Programmes as set out in the University Calendar: http://www.calendar.soton.ac.uk/sectionIV/sectIV-index.html

Support for student learning

There are facilities and services to support your learning some of which are accessible to students across the University and some of which will be geared more particularly to students in your particular Faculty or discipline area.

The University provides:

- library resources, including e-books, on-line journals and databases, which are comprehensive and up-to-date; together with assistance from Library staff to enable you to make the best use of these resources
- high speed access to online electronic learning resources on the Internet from dedicated PC Workstations onsite and from your own devices; laptops, smartphones and tablet PCs via the Eduroam wireless network. There is a wide range of application software available from the Student Public Workstations.
- computer accounts which will connect you to a number of learning technologies for example, the Blackboard virtual learning environment (which facilitates online learning and access to specific learning resources)
- standard ICT tools such as Email, secure filestore and calendars.
- access to key information through the MySouthampton Student Mobile Portal which delivers timetables, Module information, Locations, Tutor details, Library account, bus timetables etc. while you are on the move.
- IT support through a comprehensive website, telephone and online ticketed support and a dedicated helpdesk in the Hartley Library.
- Enabling Services offering support services and resources via a triage model to access crisis management, mental health support and counselling. Support includes daily Drop In at Highfield campus at 13.00 – 15.00 (Monday, Wednesday and Friday out of term-time) or via on-line chat on weekdays from 14.00 – 16.00. Arrangements can also be made for meetings via Skype.
- assessment and support (including specialist IT support) facilities if you have a disability, long term health problem or Specific Learning Difficulty (e.g. dyslexia).
- the Student Services Centre (SSC) to assist you with a range of general enquiries including financial matters, accommodation, exams, graduation, student visas, ID cards
- Career and Employability services, advising on job search, applications, interviews, paid work, volunteering and internship opportunities and getting the most out of your extra-curricular activities alongside your degree programme when writing your CV
- Other support that includes health services (GPs), chaplaincy (for all faiths) and 'out of hours' support for students in Halls and in the local community, (18.00-08.00)
- A Centre for Language Study, providing assistance in the development of English language and study skills for non-native speakers.

The Students' Union provides

- an academic student representation system, consisting of Course Representatives, Academic Presidents, Faculty Officers and the Vice-President Education; SUSU provides training and support for all these representatives, whose role is to represent students' views to the University.
- opportunities for extracurricular activities and volunteering
- an Advice Centre offering free and confidential advice including support if you need to make an academic appeal
- Support for student peer-to-peer groups, such as Nightline.

Associated with your programme you will be able to access:

There are systems for the support of student learning in ECS as well as available from central University facilities. You will receive a handbook with full details of course structures and module syllabuses.
In the School you will be able to access:

- The tutorial system – you will have a personal tutor whom you can meet on request for advice on your programme and choice of options, or for pastoral support
- The ECS Student Advisory Team who provide additional pastoral support
- ECS computer workstations, with a range of manuals and books
- Specialist project laboratories
- Personal email account and web access, including use of on-line collaboration tools
- Helpdesk (programming advisory)
- Post-graduate demonstrators who provide additional support for your design projects
- A web-site for each taught module, typically with teaching materials – these are also available, where appropriate, off-line on CD-ROM or as printed notes

Methods for evaluating the quality of teaching and learning

You will have the opportunity to have your say on the quality of the programme in the following ways:

- Completing student evaluation questionnaires for each module of the programme
- Acting as a student representative on various committees, e.g. Staff: Student Liaison Committees, Faculty Programmes Committee OR providing comments to your student representative to feed back on your behalf.
- Serving as a student representative on Faculty Scrutiny Groups for programme validation
- Taking part in programme validation meetings by joining a panel of students to meet with the Faculty Scrutiny Group

The ways in which the quality of your programme is checked, both inside and outside the University, are:

- Regular module and programme reports which are monitored by the Faculty
- Programme validation, normally every five years.
- External examiners, who produce an annual report
- A national Research Assessment Exercise (our research activity contributes directly to the quality of your learning experience)
- Institutional Review by the Quality Assurance Agency

Further details on the University's quality assurance processes are given in the *Quality Handbook.*

Career Opportunities

The rapid growth of tools, techniques and application in this area has led to a significant skills shortage, particularly for engineers who have both hardware and software skills.
Market analysis shows large demands for engineers with skills in embedded system design around the world especially UK, China, India, and Eastern Europe.
The demand for embedded systems engineers is expected to continue to rise in the coming years. This growth is driven by a rapidly growing global embedded system market

Southampton University, as one of the leading educational institutions, of electronics design is greatly positioned to supply the embedded system design industries with highly skilled engineers to support their growth.

This course will equip the students with the key skills required to secure employment in the area of design embedded systems. This includes hardware design and verification, real time computing and embedded processors, with extensive practical use of cutting-edge and industry-standard tools and methods. Students will be taken through the embedded system design process, from concept to implementation and testing.

External Examiner(s) for the programme

Name: Dr Christos-Savvas Bouganis - Imperial College London

Students must not contact External Examiner(s) directly, and external examiners have been advised to refer any such communications back to the University. Students should raise any general queries about the assessment and examination process for the programme with their Course Representative, for consideration through Staff: Student Liaison Committee in the first instance, and Student representatives on Staff: Student Liaison

Committees will have the opportunity to consider external examiners' reports as part of the University's quality assurance process.

External examiners do not have a direct role in determining results for individual students, and students wishing to discuss their own performance in assessment should contact their Personal Academic Tutor in the first instance.

Please note: This specification provides a concise summary of the main features of the programme and the learning outcomes that a typical student might reasonably be expected to achieve and demonstrate if s/he takes full advantage of the learning opportunities that are provided. More detailed information can be found in the programme handbook.

Appendix 1:

Students are responsible for meeting the cost of essential textbooks, and of producing such essays, assignments, laboratory reports and dissertations as are required to fulfil the academic requirements for each programme of study. In addition to this, students registered for this programme also have to pay for:

Additional Costs

Type	Details
Stationery	You will be expected to provide your own day-to-day stationary items, e.g. pens, pencils, notebooks, etc). Any specialist stationery items will be specified under the Additional Costs tab of the relevant module profile.
Textbooks	Where a module specifies core texts these should generally be available on the reserve list in the library. However due to demand, students may prefer to buy their own copies. These can be purchased from any source. Some modules suggest reading texts as optional background reading. The library may hold copies of such texts, or alternatively you may wish to purchase your own copies. Although not essential reading, you may benefit from the additional reading materials for the module.
Approved Calculators	Candidates may use calculators in the examination room only as specified by the University and as permitted by the rubric of individual examination papers. The University approved models are Casio FX-570 and Casio FX-85GT Plus. These may be purchased from any source and no longer need to carry the University logo.
Printing and Photocopying Costs	In the majority of cases, coursework such as essays; projects; dissertations is likely to be submitted on line. However, there are some items where it is not possible to submit on line and students will be asked to provide a printed copy.

In some cases you'll be able to choose modules (which may have different costs associated with that module) which will change the overall cost of a programme to you. Details of such costs will be listed in the Module Profile. Please also ensure you read the section on additional costs in the University's Fees, Charges and Expenses Regulations in the University Calendar available at www.calendar.soton.ac.uk.