Programme Specification

European Masters in Embedded Computing Systems (2017-18)

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	Electronics and Computer Science University of Southampton Highfield Campus
Mode of Study	Full Time
Duration in Years	1 Year
Accreditation details	N/A
Final award	Joint Masters Degree (Erasmus Mundus)
Name of award	European Masters in Embedded Computing Systems
Interim Exit awards	Postgraduate Diploma Postgraduate Certificate
FHEQ level of final award	Level 7
UCAS code	n/a
QAA Subject Benchmark or other external reference	Framework for Higher Education Qualifications
Programme Leader	Basel Halak
Date specification was written	26/03/2014
Date Specification last Updated	14/12/2017

Programme Overview

Brief outline of the programme

The Erasmus Mundus European Masters in Embedded Computing Systems (EMECS) is a two-years master's program. The degree is a joint programme between three Universities (Southampton – UK, Kaiserslautern – Germany and Trondheim – Norway) where the students spend their two years in two of these universities, one year at each. A total of 120 ECTS (European Credit Transfer and Accumulations System) credit points must be acquired. The curriculum consists of a core program, an elective program and a Master's Thesis. The core program covers the fundamentals of Embedded Computing Systems and offers an equivalent education in all three institutions. The elective program reflects the specific profiles of the participating partner universities and their associated research institutes.

The core program (60 ECTS) consists of three study areas:

- Embedded System Hardware Architectures
- System Software
- System-on-Chip (SoC) Design Methodology

The three partner universities have agreed on the contents of these core study areas. All teaching modules of the core program are mandatory to all students and need to be finished within the first year of study at one of the partner universities. The core program guarantees that all students can achieve an equivalent educational level regarding the basic principles of embedded system design and architecture. After completion of the core program, no matter at which partner institution, students will be able to take full profit of the elective program and project activities offered throughout the consortium.

The elective program (60 ECTS) consists of four study areas:

- Advanced Topics in Embedded Systems
- Communication & Signal Processing
- Automation & Control
- Microsystems

In addition to the taught elements worth 120 ECTS there is an individual Masters Thesis project worth 30 ECTS.

These areas are offered by all partner universities. Each partner university contributes a number of teaching modules to each elective study area. The teaching modules within an elective study area are varying between universities and reflect specific local strengths, special application areas, design methodologies and architectures of embedded systems. Typically, a student will complete 60 ECTS in one partner institution and 60 ECTS at a second partner institution.

There are no mandatory teaching modules in the elective program. Every student is assigned a supervisor at each of the two partner universities that he or she attends. Based on the elective program an individual study plan is elaborated and mutually agreed on between the student and the supervisors.

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.

Learning and teaching

Modules consist of a combination of lectures, small group teaching, practical work, directed reading and coursework assignments. Most of the modules contain a laboratory or practical component which is delivered via hands-on practical sessions. One third of the course is an individual project within a research group or in industry, delivered by one-to-one supervision.

Assessment

Assessment is by a combination of written examinations and coursework. The proportion of examinations to coursework varies between modules. Depending on the choice of modules, about 50% of the marks will be derived from coursework, with the individual project assessed by dissertation. Coursework takes the form of problem solving exercises, laboratory reports with literature review components, design exercises, and individual and small-group projects. Experimental, research and design skills are also assessed through the Project Preparation module and the Individual Research Project by means of written exercises, presentation and the project dissertation.

Educational Aims of the Programme

The School of Electronics and Computer Science has a leading international reputation for its research. Each MSc programme offers a postgraduate education in one of the research specialisations of the School.
The programme aims to:

- Provide you with advanced knowledge in this particular discipline within the field of electronic engineering
- Develop your research skills applicable to a career in manufacturing, development or research
- Stimulate your interest in the subject using a variety of learning environments

Programme Learning Outcomes

Knowledge and Understanding

Having successfully completed this programme you will be able to demonstrate knowledge and understanding of:

A1. the scientific and technological principles underlying systems on chip (SOC) and more generic applications of electronic engineering to SOC design.
A2. techniques used for the fabrication of SOC electronic devices and components
A3. methods for characterisation and analysis of SOC electronic devices and systems
A4. the design of electronic systems and devices, with a focus on SOC

Teaching and Learning Methods

A1, A2, A3, A4. Most modules consist of a combination of lectures, small group teaching, practical work, directed reading and coursework assignments. At the end of the taught part of the course you will undertake an individual project within a research group or in industry. The MSc dissertation and several courseworks contain a literature review component. Small group teaching, including all practical work, and the individual project accommodate different learning styles. One-on-one tutorials can support full-class lectures, when required.

Assessment methods

A1, A2, A3, A4. 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. Depending on your choice of modules, about 50% of your marks will be derived from coursework, with the individual project assessed by dissertation. Assessment is through a combination of unseen written examinations and assessed coursework in the form of problem solving exercises, laboratory reports with literature review components, design exercises, and individual and small-group projects.

Subject Specific Intellectual and Research Skills

Having successfully completed this programme you will be able to:

B1. Specify and design Systems on Chip (SOC)
B2. Model and simulate the behaviour of parts of SOC elements and complete circuits at the appropriate level of detail using analogue or digital models where appropriate
B3. Verify a device design using advanced simulation and modelling tools and implement using IC layout techniques and FPGA based practical work
B4. Find, read, understand and explain scientific publications related to system on chip
B5. Undertake research into system on chip designs and applications

Teaching and Learning Methods

B1, B2, B3: Design skills are developed through individual practical work and the individual project. Modelling, simulation and verification are taught in various modules and applied through coursework components. The practical work includes modelling, design and IC layout laboratories and hands-on FPGA design, directed reading and coursework assignments, which can contain a literature review.
B4, B5: The Project Preparation module and the Individual Project itself concern the formulation of a research project. Small group teaching, including all practical work, and the individual project accommodate different learning styles. One-on-one tutorials can support full-class lectures, when required.

Assessment methods

B1, B2, B3, B4, B5. 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 documented designs (Analogue IC, Digital IC and FPGA based designs).
B4. The Project Preparation module and the dissertation from the MSc Project include a significant literature survey and have assessment criteria to reflect this specifically.
B5. The Project dissertation is centrally focussed on assessing the difference aspects of research skills.

Transferable and Generic Skills

As an existing engineering graduate, you will already be expected to have a general proficiency with IT, to be numerate and to be proficient in English. Your choice of modules will determine how and where these general skills are further developed, but having successfully completed this programme you will be able to:

Having successfully completed 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 in a pair or in a small group on a given task, managing your own contribution and the overall 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 individual project includes independent research, project management and report writing.

C1-C3: Most modules include small group teaching, practical work with one or more lab partners, directed reading and coursework assignments with a literature review component. The Project Preparation module includes project management and the delivery of a project plan via a presentation. Small group teaching, including all practical work, and the individual project accommodate different learning styles.
C4: The individual project includes independent research and report writing.

Assessment methods

Coursework is generally assessed through written reports. The individual project is assessed by a dissertation of up to 15,000 words. The Project Preparation module is assessed via a literature review, as well as written and presentation versions of the project plan.

Subject Specific Practical Skills

The exact subject specific practical skills developed by the programme depend upon the optional modules that you choose. Having successfully completed this programme you will be able to:

D1. Complete Analogue and Digital IC design from schematic to layout
D2. Be able to program FPGAs and use them in solving practical design problems
D3. Use Industry standard design packages to analyse and simulate designs
D4. Be able to implement and synthesize digital designs in a hardware description language

Teaching and Learning methods:

D1, D2, D3, D4: These skills will be developed through coursework and project work. Most modules include practical work, ranging from electronic lab activities, hands-on practical to simulation laboratories. The individual project will involve one or more subject specific practical skills, with one-to-one training delivered by the supervisory team or technical staff.

Assessment methods:

Assessment is based on coursework in the form of laboratory reports and the MSc dissertation.

Programme Structure

Structure of the joint degree programme

The programme overall consist of 4 semesters, of which two will be at one of the partner Universities. If a student comes to Southampton for their first year they will do two taught semesters, based on the MSc System on Chip programme, however they do have the flexibility to select electives across the entire MSc programme offered within the faculty if it is appropriate to Embedded Computing Systems in consultation with the Programme Leader at Southampton. For example, a student may have an interest in software or web science and these would be available as options as long as the relevant pre-requisites had been satisfied. The second year

students have four optional taught modules in the first semester, they will then undertake an individual project in the second semester.

Typical course content

The first year programme consists of eight taught modules, each worth 7.5 ECTS credit points, and the second year programme consists of four taught modules, each worth 7.5 ECTS credit points, and an individual project worth 30 ECTS credit points. The core subjects are related to Embedded Computing Systems, covering device structure, circuit operation and fabrication methods.

There are a range of optional courses covering cryptography, communications and networks, bio-related nanotechnology, microelectronic design, design automation, embedded systems, photonics and microelectromechanical systems (MEMS) allowing you to tailor the structure to suit your interests. You will also be able to choose and develop a project within several research areas in the department, which will allow further exploration of a specialist area of system on chip design.

Special Features of the programme

This programme will allow you to engage in highly specialised activities revolving around the production of system on chip design on both integrated circuit and advanced FPGA platforms. You will also be exposed to a wide range of industry standard equipment and simulation/modelling tools.

Programme details

There are a number of compulsory and optional modules. Most of these modules are shared with Master of Engineering programmes in Electronics.

Examinations are held at the end of Semester 1 (January) and at the end of Semester 2 (May/June). Students who have successfully completed 30 or 60 ECTS worth of taught material may exit with a Postgraduate Certificate or Postgraduate Diploma respectively.

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.

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

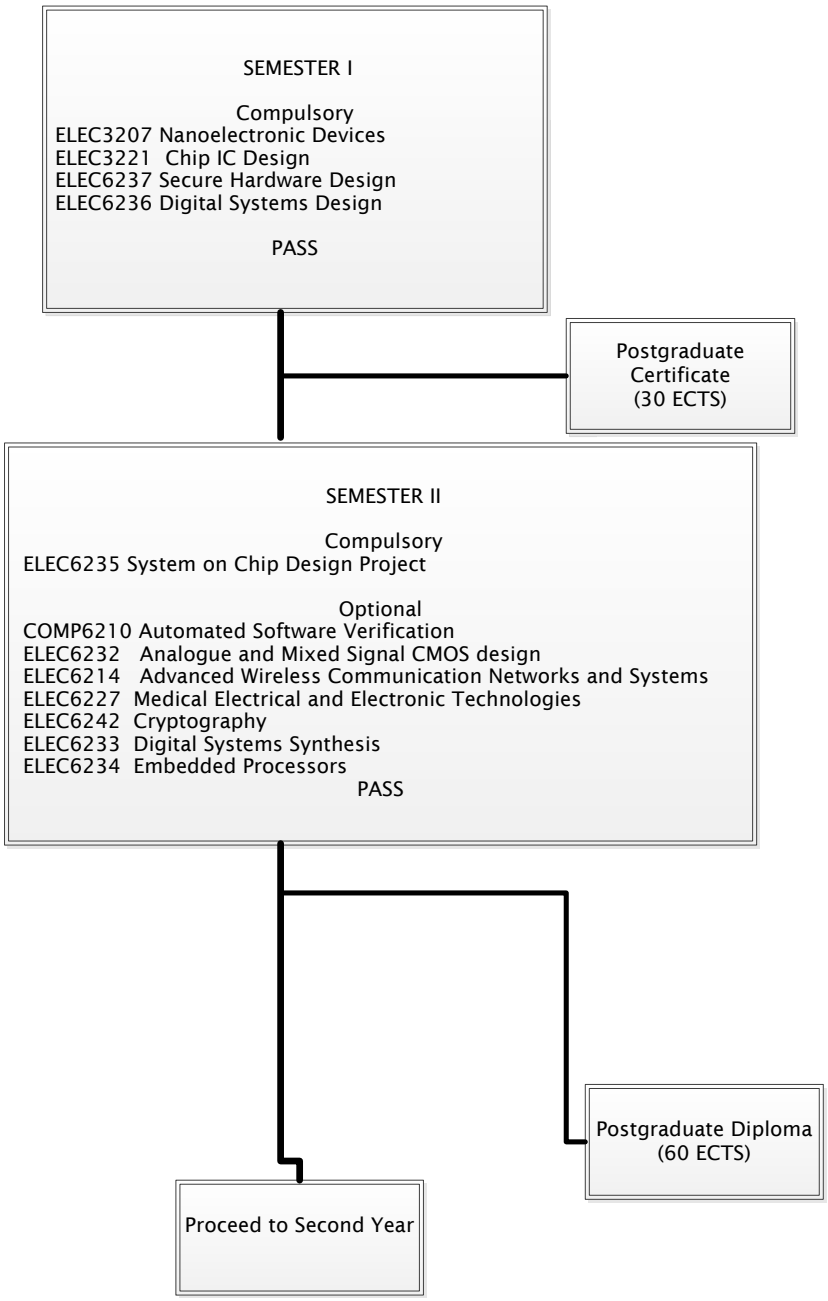
Semester 1 (first and second year students):
Four modules, including those specified as compulsory for the MSc programme. Examinations are held in January.

Semester 2 (first year students):
Four modules; including those specified as compulsory for the MSc programme. Examinations are held in May.

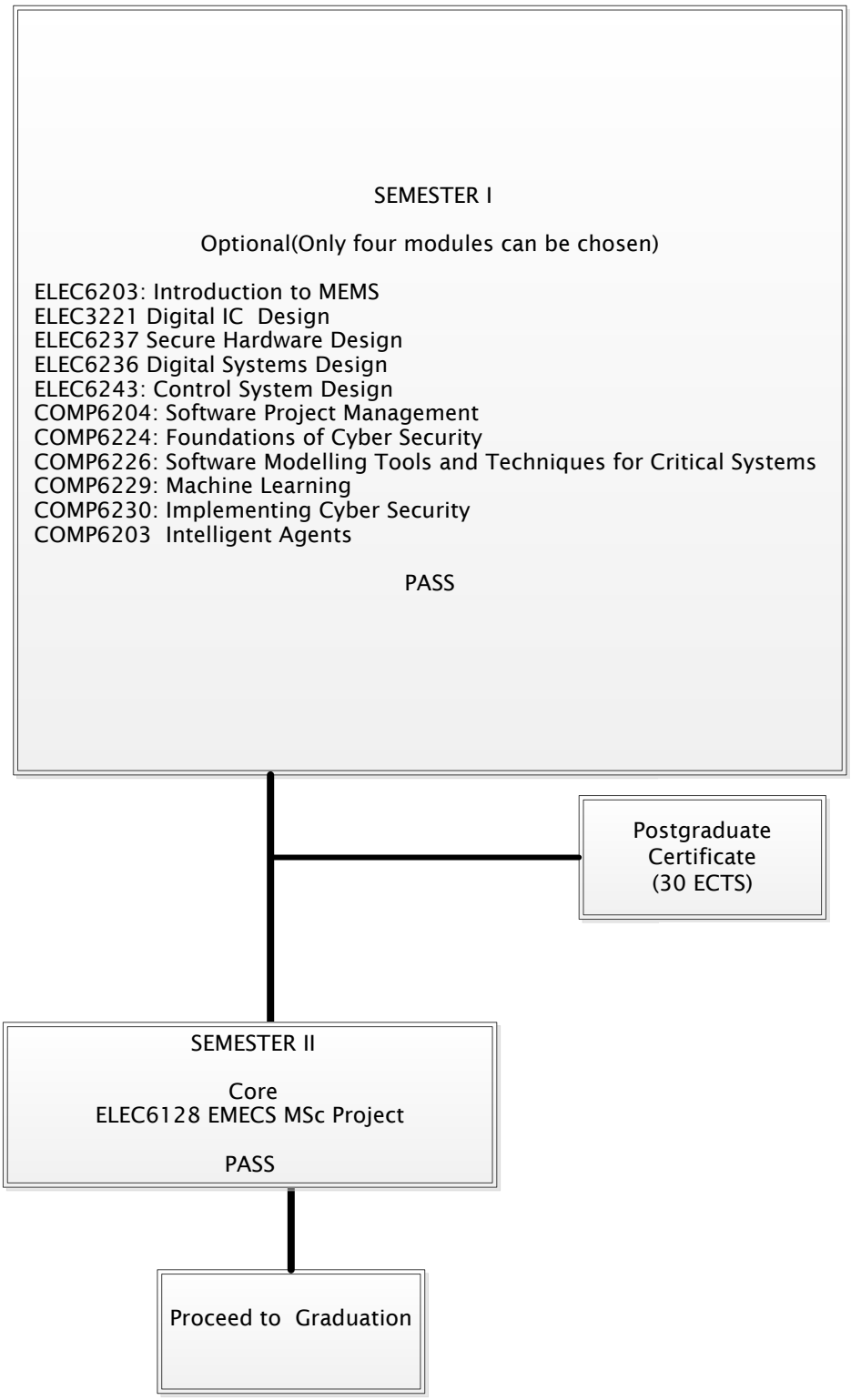
Semester 2 (second year students):
Individual project

The diagram below shows the overall structure and exit points.

First Year European Masters in Embedded Computing Systems



Second Year European Masters in Embedded Computing Systems



Additional Costs

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. Costs that students registered for this programme typically also have to pay for are included in Appendix 2.

Progression Requirements

The programme follows the University's regulations for Standalone Masters as set out in the University Calendar.

Intermediate exit points (where available)

You will be eligible for an interim exit award if you complete part of the programme but not all of it, as follows:

Qualification	Minimum overall credit in ECTS credits	Minimum ECTS credits required at level of award
Postgraduate Diploma	at least 60	45
Postgraduate Certificate	at least 30	20

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 Student Services Centre
- Enabling Services offering assessment and support (including specialist IT support) facilities if you have a disability, dyslexia, mental health issue or specific learning difficulties
- 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 Destinations, 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
- a range of personal support services : mentoring, counselling, residence support service, chaplaincy, health service
- 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:

- 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

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 feedback 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
- Professional body accreditation/inspection
- A national Research Evaluation exercise (our research activity contributes directly to the quality of your learning experience)
- Institutional Review by the Quality Assurance Agency

Criteria for admission

The University's Admissions Policy applies equally to all programmes of study. The following are the typical entry criteria to be used for selecting candidates for admission. The University's approved equivalencies for the requirements listed below will also be acceptable.

Undergraduate programmes

Qualification	Grades	Subjects required	Subjects not accepted	EPQ Alternative offer (if applicable)	Contextual Alternative offer (if applicable)
GCE A level					
GCSE					
BTEC					
International Baccalaureate					

European Baccalaureate					

Postgraduate programmes

Qualification	Grade/GPA	Subjects requirements	Specific requirements
Bachelor's degree	**2;1 Honours**		
Master's degree			

Mature applicants
Applications from mature students (over 21 years in the October of the year of entry) are welcome. Applications will be considered on an individual basis.

English Language Proficiency

Overall	Reading	Writing	Speaking	Listening
6.5	**6.0**	**6.0**	**6.0**	**6.0**

Career Opportunities

This programme provides an excellent platform for further research in either industry or academia.

Graduates from our MSc programme are employed worldwide in leading companies at the forefront of technology. ECS runs a dedicated careers hub which is affiliated with over 100 renowned companies like IBM, ARM, Microsoft Research, Imagination Technologies, Nvidia, Samsung and Google to name a few.

External Examiners(s) for the programme

Name Professor Scott Roy
Institution University of Glasgow

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 tutor in the first instance.

With this programme being international, there are different local practices, with each programme being accredited by their own national bodies. The external examiner for Southampton is able to visit the other institutions on request, if required.

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 Faculty student handbook: http://www.fpse.soton.ac.uk/student_handbook

Appendix: 1

Learning outcomes and Assessment Mapping document template

The numbers A1 A2 B1 B2 etc refer back to the learning outcomes listed under Knowledge and Understanding, Subject Specific Intellectual and Research Skills, Transferable and Generic Skills and Subject Specific Practical Skills in the Programme Learning Outcomes section of this programme specification template.

		Knowledge and Understanding				**Subject Specific Intellectual Skills**					**Transferable/ Key Skills**				**Subject Specific Practical Skills**			
Module Code	Module Title	A1	A2	A3	A4	B1	B2	B3	B4	B5	C1	C2	C3	C4	D1	D2	D3	D4
Semester 1 – Compulsory (First year Students)																		
ELEC6237	Secure Hardware Design	X	X	X	X	X	X	X	X	X	X	X	X		X		X	X
ELEC6203	Introduction to MEMS	X	X	X	X	X	X				X	X					X	
ELEC6236	Digital Systems Design	X	X	X	X	X	X					X	X			X		
ELEC3221	Digital IC Design Techniques	X			X	X												
Semester 2 – Compulsory (First year Students)																		
ELEC6235	System on Chip Design project		X	X			X				X	X	X				X	X
Semester 2 – CORE (Second year Students)																		
COMP6200	MSC Project	X	X	X	X	X	*	*	X	X	X	X		X	*	*	*	X
Semester 2 – Optional																		
COMP6210	Automated Software Verification	X				X						X	X				X	
ELEC6232	Analogue and Mixed Signal CMOS design	X	X	X	X		X	X	X		X	X	X				X	
ELEC6214	Advanced Wireless Communication Networks and Systems	X			X	X		X				X	X				X	
ELEC6227	Medical Electrical and Electronic Technologies		X		X			X				X	X				X	
ELEC6242	Cryptography		X		X	X		X		X	X	X	X			X		X
ELEC6234	Embedded Processors	X	X	X	X	X	X			X		X	X	X			X	X
ELEC6233	Digital Systems Synthesis	X	X	X		X		X	X		X	X	X				X	X

* depends on the details of the selected project

Details of assessment are shown below.

Module Code	Module Title	Coursework 1	Coursework 2	Exam
ELEC6237	Secure Hardware Design	SoC Design 65%	Hardware Security 25%	**0%**
ELEC6203	Introduction to MEMS	Lab Report **30 %**		**70%**
ELEC6236	Digital Systems Design	10%		**90%**
ELEC6241	System on Chip Design Techniques			**100%**
ELEC6235	System on Chip Design project	FPGA Group Report 100%		**0%**
ELEC6232	Analogue and Mixed Signal CMOS design	Analogue CMOS design 30%		**70%**
ELEC6214	Advanced Wireless Communication Networks and Systems			**100%**
ELEC3207	Nanoelectronic Devices	Fabrication Report **30 %**		**70%**
ELEC6227	Medical Electrical and Electronic Technologies			**100%**
ELEC6242	Cryptography	20%		**80%**
ELEC6234	Embedded Processors	50% Design Exercise		**50%**
ELEC6233	Digital Systems Synthesis	10%	40% Design Exercise	**50%**
ELEC6211	Project Preparation	100%		**0%**
ELEC6243	Control System Design	**10%**	10%	**80%**
COMP6204:	Software Project Management	25%		**75%**
COMP6224:	Foundations of Cyber Security	30%		**70%**
COMP6226:	Software Modelling Tools and Techniques for Critical Systems	15%	15%	**70%**
COMP6229	Machine Learning	30%	20%	**50%**
COMP6230:	Implementing Cyber Security	30%	20%	**50%**
COMP6203	Intelligent Agents	40%		**60%**
COMP6200	MSc Project	Dissertation **100%**		**0%**

Appendix 2:

Additional Costs

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 typically also have to pay for the items listed in the table below.

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.

Main Item	Sub-section	PROGRAMME SPECIFIC COSTS
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.
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.
Equipment and Materials Equipment	Art Equipment and Materials: Drawing paper; painting materials; sketchbooks	
	Art Equipment and Materials: Fabric, Thread, Wool	
	Design equipment and materials:	
	Excavation equipment and materials:	
	Field Equipment and Materials:	
	Laboratory Equipment and Materials:	

Main Item	Sub-section	PROGRAMME SPECIFIC COSTS
	Medical Equipment and Materials: Fobwatch; stethoscopes;	
	Music Equipment and Materials	
	Photography:	
	Recording Equipment:	
IT	Computer Discs	
	Software Licenses	
	Hardware	
Clothing	Lab Coats	
	Protective Clothing: Hard hat; safety boots; hi-viz vest/jackets;	
	Fieldcourse clothing:	
	Wet Suits?	
	Uniforms?	
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.
Fieldwork: logistical costs	Accommodation:	
	Insurance	
	Travel costs	
	Immunisation/vaccination costs	
	Other:	
Placements (including Study Abroad Programmes)	Accommodation	
	Insurance	
	Medical Insurance	
	Travel costs	
	Immunisation/vaccination costs	
	Disclosure and Barring Certificates or Clearance	
	Translation of birth certificates	
	Other	
Conference expenses	Accommodation	
	Travel	
Optional Visits (e.g. museums, galleries)		
Professional Exams		
Parking Costs		
Anything else not covered elsewhere		

Revision History

1. Update to Programme Overview (CMA Changes) – 14 September 2015
2. 2016-17 FPC Approval – 24 February 2016
3. Separated Year 1 and Year 2, Added in options for Year 2.

4. ELEC6237 renamed and ELEC6241 replaced with ELEC3221 – 27 February 2017
5. FPC approval for 17/18 – 08 March 2017
6. FPC approved optional module size caveat – CQA Team 14 December 2017