Programme Specification

MSc Microelectronics Systems Design (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: Institution of Engineering and Technology (IET)

Final award: Master of Science (MSc)
Name of award: Microelectronics Systems Design
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: 4442
QAA Subject Benchmark or other external reference
Programme Lead: Koushik Maharatna (km1j06)

Programme Overview

Brief outline of the programme

In the world of electronics there is a need for well-educated and experienced engineers to design extremely complex and highly integrated electronics systems and integrated circuits. Systems such as mobile telephones, cars, aircraft, televisions, computers, and many mobile devices are shrinking size to the extent that the vast majority of the system design is required to be implemented as a single integrated circuit. A fundamental building block of such systems is Microelectronics (devices and circuits), leading to integrated circuits. These circuits are pervasive in Electronic systems, whether it is embedded processors, VLSI (Very Large Scale Integration), Microprocessors or Analogue and Mixed Signal Systems. The pace of change in the current electronics market is also driving the design cycle time (the time it takes to get from product inception to delivery to the market) to be ever shorter with an increasing pressure on designers to achieve the design right first time. The skills that are required to support this level of design are rapidly changing as are the software and hardware tools required for
engineers. This programme will provide the fundamental techniques and methods to enable students to implement Microelectronic Systems Designs.

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

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.

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 Microelectronics Systems Design 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. the scientific and technological principles underlying Microelectronics Systems and more generic applications of electronic engineering to Microelectronics Systems design.

A2. techniques used for the fabrication of Microelectronics electronic devices and components

A3. methods for characterisation and analysis of Microelectronics electronic devices and systems

A4. the design of electronic systems and devices, with a focus on Microelectronics

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

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

B1. Specify and design Microelectronics Systems

B2. Model and simulate the behaviour of parts of Microelectronics Systems 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

B4. Find, read, understand and explain scientific publications related to Microelectronics Systems

B5. Undertake research Microelectronics Systems 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 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 and Digital IC 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 different aspects of research skills.

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 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

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

D1. Digital IC design from schematic to layout, with detailed modeling in SystemVerilog
D2. Be able to create IC layouts from mask level to design kits
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 practicals 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

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

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. Five compulsory modules cover core material for Microelectronics Systems Design. Another compulsory module prepares you for your individual research project. Two optional modules can be selected to tailor the programme to your interests.
The core subjects are related to Microelectronics Systems Design, covering device structure, circuit operation and implementation methods. There is a range of optional modules covering cryptography, communications and networks, bio-related nanotechnology, microelectronic design, design automation, embedded systems, and microelectromechanical systems (MEMS). You will also be able to develop a project within a relevant research area of the department, which will allow further exploration of a specialist area of microelectronics systems design.

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.

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 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:

\[ \text{====} \]
\[ \text{SEMESTER 1} \]
\[ \text{ELEC3221 - compulsory} \]
\[ \text{ELEC6230 - compulsory} \]
\[ \text{ELEC6236 - compulsory} \]
\[ \text{ELEC62xx - compulsory} \]
\[ \text{----} \]
\[ \text{SEMESTER 2 - select two optional modules} \]
\[ \text{ELEC6211 - compulsory} \]
\[ \text{ELEC6231 - compulsory} \]
\[ \text{ELEC6214 - optional} \]
\[ \text{ELEC6227 - optional} \]
\[ \text{ELEC6232 - optional} \]
\[ \text{ELEC6233 - optional} \]
\[ \text{ELEC6234 - optional} \]
\[ \text{ELEC6242 - optional} \]
\[ \text{----} \]
\[ \text{SUMMER} \]
\[ \text{COMP6200 - core} \]
\[ \text{====} \]

**Part I Compulsory**
<table>
<thead>
<tr>
<th>Code</th>
<th>Module Title</th>
<th>ECTS</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELEC3221</td>
<td>Digital IC and Systems Design</td>
<td>7.5</td>
<td>Compulsory</td>
</tr>
<tr>
<td>ELEC6236</td>
<td>Digital System Design</td>
<td>7.5</td>
<td>Compulsory</td>
</tr>
<tr>
<td>ELEC6256</td>
<td>Nanoelectronic Devices (MSc)</td>
<td>7.5</td>
<td>Compulsory</td>
</tr>
<tr>
<td>ELEC6211</td>
<td>Project Preparation</td>
<td>7.5</td>
<td>Compulsory</td>
</tr>
<tr>
<td>ELEC6231</td>
<td>VLSI Design Project</td>
<td>7.5</td>
<td>Compulsory</td>
</tr>
<tr>
<td>ELEC6230</td>
<td>VLSI Systems Design</td>
<td>7.5</td>
<td>Compulsory</td>
</tr>
</tbody>
</table>

**Part I Core**

<table>
<thead>
<tr>
<th>Code</th>
<th>Module Title</th>
<th>ECTS</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMP6200</td>
<td>MSc Project</td>
<td>30</td>
<td>Core</td>
</tr>
</tbody>
</table>

**Part I Optional**

Select two semester 2 modules (15 ECTS/30 CATS) from the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Module Title</th>
<th>ECTS</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELEC6214</td>
<td>Advanced Wireless Communications Networks and Systems</td>
<td>7.5</td>
<td>Optional</td>
</tr>
<tr>
<td>ELEC6232</td>
<td>Analogue and Mixed Signal CMOS Design</td>
<td>7.5</td>
<td>Optional</td>
</tr>
<tr>
<td>ELEC6242</td>
<td>Cryptography</td>
<td>7.5</td>
<td>Optional</td>
</tr>
<tr>
<td>ELEC6233</td>
<td>Digital Systems Synthesis</td>
<td>7.5</td>
<td>Optional</td>
</tr>
<tr>
<td>ELEC6234</td>
<td>Embedded Processors</td>
<td>7.5</td>
<td>Optional</td>
</tr>
<tr>
<td>ELEC6227</td>
<td>Medical Electrical and Electronic Technologies</td>
<td>7.5</td>
<td>Optional</td>
</tr>
</tbody>
</table>

**Progression Requirements**

The programme follows the University's regulations for *Progression, Determination and Classification of Results : Undergraduate and Integrated Masters Programmes* and *Progression, Determination*. 
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
• Professional body accreditation/inspection
• 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

External Examiner(s) for the programme

Name: Professor Scott Roy - 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 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

<table>
<thead>
<tr>
<th>Type</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stationery</td>
<td>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.</td>
</tr>
<tr>
<td>Textbooks</td>
<td>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.</td>
</tr>
<tr>
<td>Approved Calculators</td>
<td>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.</td>
</tr>
<tr>
<td>Printing and Photocopying Costs</td>
<td>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.</td>
</tr>
</tbody>
</table>

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.